#### No radiation impacts

Keir A. **Lieber &** Daryl G. **Press 17**. Keir A. Lieber is Associate Professor in the Edmund A. Walsh School of Foreign Service and the Department of Government at Georgetown University. Daryl G. Press is Associate Professor in the Department of Government at Dartmouth College. 04/01/2017. “The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence.” International Security, vol. 41, no. 4, pp. 9–49.

Technological improvements **chipped away at** the **sources of inaccuracy**, however. Leaps in navigation and guidance, including advanced inertial sensors with stellar updates, improved the ability of missiles to **precisely determine their position in flight** and **guide themselves**, as needed, back **on course**. Other breakthroughs allowed mobile delivery systems, such as submarines and mobile land-based launchers, to accurately determine their own position prior to launch, **greatly improving their accuracy**.28 As a result of these innovations, new missiles emerged in the mid-1980s with **far better accuracy** than their predecessors, rendering hardened targets vulnerable as never before. For bombers, onboard computers now continuously measure the variables that previously confounded bombardiers. Data on aircraft speed and location are uploaded from the aircraft into the computers of “smart” bombs and cruise missiles, which in turn automatically plot a flight path from the release location to the target. The weapons adjust their trajectory as they fly to remain on course.29 As a result, bombs and missiles can achieve levels of accuracy unimaginable at the start of the nuclear age. The leap in munitions accuracy has been showcased repeatedly during conventional wars: videos of missiles and bombs guiding themselves directly to designated targets now appear mundane. Although the effects of the accuracy revolution on nuclear delivery systems are equally dramatic, they have received far less attention, despite huge implications for the survivability of hardened targets. IMPROVED MISSILE ACCURACY Figure 1 illustrates one consequence of the accuracy revolution, as applied to nuclear forces, by comparing the effectiveness of U.S. ballistic missiles in 1985 to those in the current U.S. arsenal.30 We use formulas, employed by nuclear analysts for decades, to estimate the effectiveness of missile strikes against a typical hardened silo.31 The figure distinguishes three potential outcomes of a missile strike: hit, miss, and fail. “Hit” means that the warhead detonates within the lethal radius (LR) of the aimpoint, thus destroying the target. “Miss” means that the warhead detonates outside the LR, leaving the target undamaged. “Fail” means that some element of the attacking missile system malfunctioned, leaving the target undamaged. figure Figure 1. The Growing Vulnerability of Hard Targets, 1985–2017 note: The calculations underlying this figure assume targets hardened to withstand 3,000 pounds per square inch (psi). Data for 1985 are based on the most capable U.S. land-based intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM) at the time: the Minuteman III ICBM armed with a W78 warhead and the Trident I C-4 SLBM armed with a W76 warhead. The 2017 ICBM data are based on the same Minuteman III / W78, with an improved guidance system. The 2017 SLBM data show both contemporary configurations of the Trident II D-5 missile: one version armed with the W76 and the other with higher-yield W88 warheads. The data and sources for U.S. weapon systems are in the online appendix, http://dx.doi:10.7910/DVN/NKZJVT, table A1. Figure 1 shows that the accuracy improvements of the past three decades have led to substantial leaps in counterforce capabilities. In 1985 a U.S. intercontinental ballistic missile (ICBM) had only about a 54 percent chance of destroying a missile silo hardened to withstand 3,000 pounds per square inch (psi) overpressure. In 2017 that figure exceeds 74 percent. The improvement in submarine-launched weapons is starker: from 9 percent to 80 percent (using the larger-yield W88 warhead). Figure 1 also suggests, however, that despite vast improvements in missile accuracy, the weapons still are not effective enough to be employed individually against hardened targets. Even modern ballistic missiles are expected to miss or fail 20–30 percent of the time. The simple solution to that problem, striking each target multiple times, has never been a feasible option because of the problem of fratricide: the danger that incoming weapons might destroy or deflect each other.32 The accuracy revolution, however, also offers a solution to the fratricide problem, opening the door to assigning multiple warheads against a single target, and thus paving the way to disarming counterforce strikes. THE FADING PROBLEM OF FRATRICIDE One type of fratricide occurs when the prompt effects of nuclear detonations— radiation, heat, and overpressure—destroy or deflect nearby warheads. To protect those warheads, targeters must separate the incoming weapons by at least 3–5 seconds.33 A second source of fratricide is harder to overcome. Destroying hard targets typically requires low-altitude detonations (so-called ground bursts), which vaporize material on the ground. When the debris begins to cool, 6–8 seconds after the detonation, it solidifies and forms a dust cloud that envelops the target. Even small dust particles can be lethal to incoming warheads speeding through the cloud to the target. Particles in the debris cloud take approximately 20 minutes to settle back to ground.34 For decades, these two sources of fratricide, acting together, posed a major problem for nuclear planners.35 Multiple warheads could be aimed at a single target if they were separated by at least 3–5 seconds (to avoid interfering with each other); yet, all inbound warheads had to arrive within 6–8 seconds of the first (before the dust cloud formed). As a result, assigning more than two weapons to each target would produce only marginal gains: if the first one resulted in a miss, the target would likely be shielded when the third or fourth warhead arrived.36 Improvements in accuracy, however, have greatly mitigated the problem of fratricide. As figure 1 shows, the proportion of misses—the main culprit of fratricide—compared to hits is fading. To be clear, some weapons will still fail; that is, they will be prevented from destroying their targets because of malfunctioning missile boosters, faulty guidance systems, or defective warheads. Those kinds of failures, however, do not generally cause fratricide, because the warheads do not detonate near the target. Only those that miss—that is, those that travel to the target area and detonate outside the LR—will create a dust cloud that shields the target from other incoming weapons. In short, leaps in accuracy are essentially reducing the set of three outcomes (hit, fail, or miss) to just two: hit or fail. The “miss” category, the key cause of fratricide, has virtually disappeared.37 THE CUMULATIVE CONSEQUENCES FOR COUNTERFORCE The end of fratricide is just one development that has helped negate hardening and increased the vulnerability of nuclear arsenals. The computer revolution has led to other improvements that, taken together, significantly increase counterforce capabilities. First, improved accuracy has transformed the role of ballistic missile submarines, turning these instruments of retaliation against population centers into potent counterforce weapons. Recall (from figure 1 above) that a 1985 submarine-launched ballistic missile (SLBM) had only a 9 percent chance of destroying a hardened target. This meant that although ballistic missile submarines could destroy “soft” targets (e.g., cities), they could not destroy the hardened sites that would be a key focus of a disarming attack. Increased SLBM accuracy has added hundreds of SLBM warheads to the counterforce arsenal; it has also unlocked other advantages that submarines possess over land-based missiles. For example, submarines have flexibility in firing location, allowing them to strike targets that are out of range of ICBMs or that are deployed in locations that ICBMs cannot hit.38 Submarines also permit strikes from close range, reducing an adversary's response time. And because submarines can fire from unpredictable locations, SLBM launches are more difficult to detect than ICBM attacks, further reducing adversary response time before impact. Second, upgraded fuses are making ballistic missiles even more capable than figure 1 reports. In a compelling new analysis, Theodore Postol explores the implications of new “compensating” fuses that exist on most U.S. SLBMs and that will soon be deployed on the entire force.39 Reentry vehicles equipped with this fusing system use an altimeter to measure the difference between the actual and expected trajectory of the reentry vehicle, and then compensate for inaccuracies by adjusting the warhead's height of burst.40 Specifically, if the altimeter reveals that the warhead is off track and will detonate “short” of the target, the fusing system lowers the height of burst, allowing the weapon to travel farther (hence, closer to the aimpoint) before detonation. Alternatively, if the reentry vehicle is going to detonate beyond the target, the height of burst is adjusted upward to allow the weapon to detonate before it travels too far.41 Without this technology, as figure 1 shows, the lower-yield W76 warheads are much less effective against hardened targets than their higher-yield cousins, the W88s. The improved fuse cuts the effectiveness gap roughly in half, making the hundreds of W76s in the U.S. arsenal potent counterforce weapons for the first time.42 The consequences of the new fuse are, therefore, profound, essentially tripling the size of the U.S. submarine-based arsenal against hard targets.43 More broadly, the technology at the core of compensating fuses is available to any state capable of building modern multistage ballistic missiles.44 A third key improvement, rapid missile retargeting, increases the effectiveness of ballistic missiles by reducing the consequence of malfunctions. As figure 1 illustrates, when accuracy increases, missile reliability becomes the main hurdle to attacks on hardened targets. For decades analysts have recognized a solution to this problem: if missile failures can be detected, the targets assigned to the malfunctioning missiles can be rapidly reassigned to other missiles held in reserve.45 The capability to retarget missiles in a matter of minutes was installed at U.S. ICBM launch control centers in the 1990s and on U.S. submarines in the early 2000s, and both systems have since been upgraded.46 We do not know if the United States has adopted war plans that fully exploit rapid reprogramming to minimize the effects of missile failures.47 Nevertheless, such a targeting approach is within the technical capabilities of the United States and other major nuclear powers and may already be incorporated into war plans.48 Table 1 illustrates the consequences of these improvements against two hypothetical target sets: 100 moderately hard mobile missile shelters and 200 hardened missile silos.49 Row 1 shows the approximate counterforce capabilities of a 1985-era U.S. Minuteman III ICBM strike; a 2-on-1 attack would have been expected to leave 8 mobile missile shelters intact. A strike against 200 hardened silos would fare worse, with 42 targets expected to survive. Table Table 1. The Demise of Hard Target Survivability The remaining rows in table 1 highlight the implications of the changes that have occurred from 1985 to 2017. Row 2 illustrates the impact of improved Minuteman III guidance, which reportedly reduced circular error probable (CEP) from 183 to 120 meters. Row 3 employs the most capable missile and warhead combination in the current U.S. arsenal: the Trident II armed with a high-yield W88 warhead. As the results in both rows show, upgraded missiles perform better than their predecessor, but not well enough to conduct effective disarming strikes against large target sets. Rows 4–7 demonstrate how the various improvements in missile technology have combined to create transformative counterforce capabilities. In row 4, we use a more realistic figure for missile system reliability. Although 80 percent missile reliability is traditionally used as a baseline, much evidence suggests that the actual reliability of modern missiles exceeds 90 percent.50 Row 4 shows attack outcomes for a Trident II/W88 with 90 percent reliability. Row 5 shows the consequences if the United States can reprogram its missiles to replace boost-phase failures. As row 5 reveals, a 2-on-1 attack with reprogramming would be expected to destroy every hardened shelter or silo. Row 6 omits reprogramming, but it demonstrates the impact of the decline in fratricide by adding a third warhead to each target, resulting again in the destruction of either target set. Row 7 illustrates the impact of compensating fuses. This row, unlike the others, employs the lower-yield warhead on the Trident II missiles (the W76). With the compensating fuse, a 2-on-1 attack using W76s would be expected to destroy all the mobile missile shelters and all but one of the hardened silos. (An attack that mixed W88s and W76s could destroy the entire hardened silo force.) The results in table 1 are simply the output of a model. In the real world, the effectiveness of any strike would depend on many factors not modeled here, including the skill of the attacking forces, the accuracy of target intelligence, the ability of the targeted country to detect an inbound strike and “launch on warning,” and other factors that depend on the political and strategic context. As a result, these calculations tell us less about the precise vulnerability of a given arsenal at a given time—though one can reach arresting conclusions based on the evidence—and more about trends in how technology is undermining survivability.51 One crucial consequence of the accuracy revolution is not captured in the above results. Yet, its impact on the vulnerability of nuclear arsenals may be just as profound. The accuracy revolution has rendered low-casualty counterforce attacks plausible for the first time. THE DAWN OF LOW-CASUALTY COUNTERFORCE In nuclear deterrence theory, the primary factor preventing nuclear attack is the attacker's fear of retaliation. In reality, however, additional sources of inhibition exist, including the terrible civilian consequences of an attempted counterforce strike. If a leader contemplating a disarming strike knows that such an attack will inflict massive casualties on the enemy, that leader will also understand that the **failure to disarm** the enemy will provoke a **massive punitive response**, foreclosing the possibility of a limited nuclear exchange. Furthermore, if a disarming strike would cause enormous civilian casualties in the target country, but also possibly in allied and neutral neighboring countries, leaders who value human life or the fate of allies would contemplate such an attack in only the direst circumstances. The link between civilian casualties and nuclear inhibition explains why many arms control advocates oppose the development of less destructive nuclear weapons; they worry that such weapons are more “usable.”52 Counterforce was tantamount to mass casualties throughout the nuclear age, but the **accuracy revolution is severing that link**. In the past, the main impediment to low-casualty nuclear counterforce strikes has been radioactive fallout. Targeters would have had to **rely on ground bursts to maximize destructive effects** against hardened facilities such as silos and storage sites. Detonations close to the ground have a major drawback, however: debris is sucked up into the fireball, where it mixes with radioactive material, **spreading radiation wherever it settles**. Although the other effects of nuclear detonations (e.g., blast and fire) can have large-scale consequences for civilians, in many circumstances those effects can be **minimized**.53 If a strike produces fallout, however, the consequences are potentially vast and difficult to predict.54 In theory, it has always been possible to employ nuclear weapons without creating much fallout. If weapons are detonated at **high altitude** (above the “fallout threshold”), very little debris from the ground will be drawn up into the fireball, **greatly reducing fallout**.55 In practice, however, this targeting strategy has never been feasible against hardened sites. The problem is that any high-yield weapon that detonates low enough to destroy a hardened target will also be low enough to create fallout. **Low-yield** weapons could do the job and remain above the fallout threshold, but that has always been impractical because low-yield weapons would need to be delivered with great **precision** to destroy hardened sites, which was previously impossible.56 Figure 2 illustrates why high-yield strikes against hard targets inevitably create fallout, and it highlights the potential low-yield solution to the fallout problem. The vertical axis reflects weapon yield, and the horizontal axis depicts the hardness of potential targets—with the approximate values for mobile missile shelters and missile silos indicated. The solid black line shows the maximum yield of a weapon that can generate enough overpressure to destroy a target from above the fallout threshold. For example, figure 2 shows that for a 3,000 psi target, the highest-yield weapon that can destroy it while remaining above the fallout threshold is 0.35 kilotons. A larger-yield weapon will necessarily cause fallout if it destroys the target. A low-fallout strike against a 1,000 psi mobile missile shelter would require a weapon with 50 kilotons yield, or less. In short, low-fatality nuclear counterforce is possible, but it requires low-yield weapons, and hence very accurate delivery. figure Figure 2. The Potential for Low-Fallout Nuclear Counterforce note: “Target hardness” (the horizontal axis) is measured in pounds per square inch (psi), with a typical range of psi for hardened mobile missile shelters and missile silos noted. “Yield” (the vertical axis) is measured in kilotons and plotted on a logarithmic scale. The curve depicts the maximum weapon yield that can destroy a given target from above the fallout threshold. Any weapon yield/target hardness combination above the line that is effective enough to destroy the target will necessarily result in fallout. Points below the line indicate that weapons can be detonated at an altitude that will destroy the target yet produce little or no fallout. See the online appendix for calculations. The accuracy of nuclear delivery systems is now to the point that low-casualty disarming strikes are possible. For example, a 0.3 kiloton bomb would require a CEP of 10–15 meters to be highly effective against hard targets;57 that level of accuracy is likely within the reach of the new guided B61-12, which is slated to replace all nuclear gravity bombs in the U.S. arsenal.58 Similarly, a 5-kiloton missile warhead, which may approximate the yield of the fission primary on many existing ballistic missiles, could destroy a hardened target if its CEP was approximately 50 meters.59 That level of accuracy was implausible for most of the Cold War, yet it is within reach of many countries today.60 By detonating weapons above the fallout threshold, targeters can greatly reduce fallout relative to ground bursts. But how significant are these reductions? How many fewer deaths would be caused in comparison with ground burst strikes? To compare the fallout and potential fatalities from high-yield and low-yield counterforce operations, we used unclassified U.S. Defense Department software, called Hazard Prediction and Assessment Capability (HPAC).61 We modeled two different counterforce strikes, one using a “traditional” high-yield approach and one employing low-yield airbursts, against five hardened targets in North Korea (e.g., nuclear storage sites or hardened mobile missile shelters). Because there is no available unclassified information about the location of North Korea's nuclear storage sites, we modeled strikes against notional locations around the DPRK's periphery. The results of the two strikes, illustrated in figure 3, are starkly different. The traditional approach (on the left side) would likely destroy the targets, but at a terrible price: millions of fatalities across the Korean Peninsula. The low-yield option, by contrast, would produce vastly fewer deaths. As long as the targets were located outside North Korean cities, the number of Korean fatalities from a low-yield strike would be comparable to the human losses from conventional operations. In fact, the fallout contours that are visible in figure 3 for the low-yield scenario **correspond to annual radiation levels deemed acceptable by** the U.S. **O**ccupational **S**afety and **H**ealth **A**dministration figure Figure 3. Low-Fallout Counterforce Option against North Korea note: The figure illustrates the potential fallout consequences of two alternative counterforce strikes against five notional North Korean hardened nuclear sites. In both strike options, each target is destroyed with greater than 95 percent probability. The high-yield attack employs ten W88 warheads (455-kiloton yield), with two warheads against each target. Because high-yield weapons cannot destroy hardened sites from above the fallout threshold, the W88s are ground bursts. The low-yield attack uses twenty B61 bombs (0.3-kiloton yield), set to detonate at an altitude that maximizes effectiveness while minimizing fallout. The fallout patterns and casualty figures were generated using unclassified U.S. Defense Department software, called Hazard Prediction and Assessment Capability. The precise results of the HPAC simulation should be treated with skepticism: wind speed and direction change constantly, altering fallout patterns. The amount of fallout generated in the low-yield scenario is **so low**, however, that the results of figure 3 are **robust regardless of which way the wind blows:** **few people** located away from the actual targets would be killed. The point of figure 3 is not to predict the outcome of a counterforce strike on North Korea, but to reveal the relationship between accuracy and fallout. When accuracy was poor, the only approach to nuclear counterforce was high-yield strikes, which would create catastrophic results such as the one depicted above. The accuracy revolution has changed the calculus, however; **low-fatality nuclear strikes are now possible**.62 The accuracy revolution is ongoing. As accuracy continues to improve, the effectiveness of conventional attacks on hard targets will **continue to increase**. Today, low-yield nuclear weapons can destroy targets that once required very large yield detonations. In the future, many of those targets will be vulnerable to conventional attacks. In sum, from the start of the nuclear age to the present, force planners have relied on hardening as a key strategy for ensuring the survivability of their arsenals. That strategy made sense, and until recently ensured that disarming strikes would not only fail, but also kill millions of civilians in the process. Technology never stands still, however, and **the technical foundations of deterrence**, particularly for the strategy of hardening, have been **greatly undermined by leaps in accuracy**. Counterforce in the Age of Transparency While advances in accuracy are negating hardening as a strategy for protecting nuclear forces, leaps in remote sensing are undermining the other main approach: concealment. Finding concealed forces, particularly mobile ones, remains a major challenge. Trends in technology, however, are eroding the security that mobility once provided. In the ongoing competition between “hiders” and “seekers,” waged by ballistic missile submarines, mobile land-based missiles, and the forces that seek to track them, the hider's job is growing more difficult than ever before. Five trends are ushering in an age of unprecedented transparency.63 First, sensor platforms have become more diverse. The mainstays of Cold War technical intelligence—satellites, submarines, and piloted aircraft—continue to play a vital role, and they are being supplemented by new platforms. For example, remotely piloted aircraft and underwater drones now gather intelligence during peacetime and war. Autonomous sensors, hidden on the ground or tethered to the seabed, monitor adversary facilities, forces, and operations. Additionally, the past two decades have witnessed the development of a new “virtual” sensing platform: cyberspying.64 Second, sensors are collecting a widening array of signals for analysis using a growing list of techniques. Early Cold War strategic intelligence relied heavily on photoreconnaissance, underwater acoustics, and the collection of adversary communications—all of which remain important. Now, modern sensors gather data from across the entire electromagnetic spectrum; they employ seismic and acoustic sensors in tandem; and they emit radar at various frequencies depending on their purpose, for example, to maximize resolution or to penetrate foliage. Modern remote sensing exploits an increasing number of analytic techniques, including spectroscopy to identify the vapors leaking from faraway facilities, interferometry to discover underground structures, and signals processing techniques (such as those underpinning synthetic aperture radars) that allow radars to perform better than their antenna size would seem to permit.65 Third, remote sensing platforms increasingly provide persistent observation. At the beginning of the Cold War, strategic intelligence was hobbled by sensors that collected snapshots rather than streams of data. Spy planes sprinted past targets, and satellites passed overhead and then disappeared over the horizon. Over time those sensors were supplemented with platforms that remained in place and soaked up data, such as signals intelligence antennas, undersea hydrophones, and geostationary satellites. The trend toward persistence is continuing. Today, remotely piloted vehicles can loiter near enemy targets, and autonomous sensors can monitor critical road junctures for months or years. Persistent observation is essential if the goal is not merely to count enemy weapons, but also to track their movement. The fourth factor in the ongoing remote sensing revolution is the steady improvement in sensor resolution. In every field that employs remote sensing technology, including medicine, geology, and astronomy, improved sensors and advanced data processing are permitting more accurate measures and fainter signals to be discerned from background noise. The leap in satellite image resolution is but one example: the first U.S. reconnaissance satellite (Corona) could detect objects as small as 25 feet across. Today, even commercial satellites (e.g., DigitalGlobe's WorldView-3 and WorldView-4) can collect images with 1-foot resolution, and U.S. spy satellites are reportedly capable of resolutions less than 4 inches.66 Advances in resolution are not merely transforming optical remote sensing systems; they are extending what can be seen by infrared sensors, advanced radars, interferometers and spectrographs, and many other sensors. The fifth key trend is the huge increase in data transmission speed. During the first decades of the Cold War, it took days or longer to transmit information from sensors to analysts. At least a full day passed before the photographs snapped by U-2 aircraft were developed and analyzed. Early satellites were slower: the satellite had to finish its roll of film, and then eject the canister, which would be caught midair and flown to a facility for development and analysis. All told, images collected at the beginning of a satellite mission might take weeks before they arrived at an analyst's desk. Today, by contrast, intelligence gathered by aircraft, satellites, and drones can be transmitted in nearly real time. The data can be transmitted to intelligence analysts, political leaders, and in some cases directly to military commanders conducting operations. None of these **technological trends** alone is transformative. Taken **together**, however, they are creating a degree of **transparency** that was unimaginable even two decades ago. These new remote sensing technologies are not proliferating around the world evenly; the United States, for example, seems to have exploited new sensing technologies more intensively than other countries. Many countries are developing expertise in advanced sensing, however. The sensing revolution is a global phenomenon, with implications for the survivability of all countries' nuclear arsenals. Remote sensing technologies have improved greatly, but the crucial question is whether these advances have meaningfully increased the vulnerability of the **two most elusive types** of nuclear delivery systems: SSBNs and mobile land-based missiles. If the ability to track submarines at sea or mobile missiles on patrol remains out of reach, then the counterforce improvements we identify are less significant, at least for now. In fact, SSBNs have never been as invulnerable as analysts typically assume, and advances in remote sensing appear to be **reducing the survivability** of both **submarines** and **mobile missiles**.

## 1

**Interpretation: You need to have a wiki page**

**Violation –-They have no the pages on the wiki.**

**Standards:**

**a] predictability - contact info on the wiki allows people to get sent the case to understand the arguments that will be read in round. If there is no contact info or open source, there is no way for people to know the args. Predictability is key to education because in round clash can be maximized when the arguments are known beforehand. Clash increases education which is the purpose of debate.**

**b] strat skew - contact info/open source allows for disclosure which helps smaller schools get access to better evidence. Small schools have access to more and better evidence, this increases the quality of the debate, and allows for more clash. Stopping strat skew is key to fairness because bigger schools have access to more prep than smaller schools. I can’t prep the aff which means we lose in round clash which means we lose education.**

**c] reciprocity – I have my contact info on the wiki for disclosure. Harms fairness if I contribute to the norm, and they do not.**

#### Even if you feel like me being unable to clash effectively is not enough in this round, it is still an awful model of debate which is fundamentally exclusionary.

**Voters:**

**a]. Education is a voter because education is the goal and purpose of debate. Education furthers life skills and thus must be protected.**

**b]. Fairness is a voter because debate is a competition, so protecting fairness in the round is key.**

**It’s drop the debater – a] deter future abuse and b] set better norms for debate c] indicts the debater d] time investment**

**Competing interps – [a] reasonability is arbitrary and encourages judge intervention since there’s no clear norm, [b] it creates a race to the top where we create the best possible norms for debate.**

**No RVIs – a] illogical, you don’t win for proving that you meet the burden of being fair, logic outweighs since it’s a prerequisite for evaluating any other argument, b] RVIs incentivize baiting theory and prepping it out which leads to maximally abusive practices c] you can’t win for having good disclosure practices, d] chills the checking of abuse**

## 2

**The role of the ballot is to vote for the debater who proves the truth or falsity of the resolution through textual or conceptual args.**

**Standards:**

**[a] – Inclusion. The Truth Testing role of the ballot allows for far more args then the assumed comparative worlds debate. This ROB includes all other args.**

**[b] – Reciprocity. Only way to weigh Ks and other args which test the truth of my position is the Truth Testing ROB.**

**[c] – Affirming or negating means assigning truth or falsity**

**Affirm means as per Dictionary.com – maintain as true**

**Negate means as per Dictionary.com - to deny the existence, evidence, or truth of**

**Presumption and permissibility flow neg: most statements aren’t true, so the resolution is most likely false. Debate is roleplay policymaking, and we don’t pass policies that would have no effect. Just because something is permissible doesn’t mean it is obligatory. It is morally permissible for me to wear a red shirt, but it doesn’t mean I need to wear a red shirt always.**

**A prioris and semantics first – A priori ideas must be discussed first because they control the links to the ethics and framing issues in the comp worlds debate. Semantics too because we must understand the logic of the words we speak right now. Understanding linguistics is essential to figure out the true impacts of any claim.**

**1] Zeno’s Paradox – to complete an action you must go halfway then halfway of that and so on, but this means you never complete it.**

**2] – Curry’s Paradox – implies modus ponens; I say if my name is Sid, you negate. Modus Ponens says that if the first statement is true then the second statement is true, and my name is Sid :)**

**3] – Paradox of Entailment – It is snowing, and it is also not snowing, thus you negate.**

#### 4] – Contestation – Args that would contest parts of my position presuppose the validity and truth of our claims which means they are true.

#### 5] - Perf cons are independent voters. Any proven contradiction of my opponent destroys debatability because they turn into a moving target, and I don’t know which of my opponent’s points they are actually going for and which to actually attack. This creates grounds issues where I don’t know what I am debating, and time skew issues where I must give up my already limited time to either figuring out which point they mean or winning both. This decks fairness and education.

**6] – Decision Making Paradox - To do something requires a system of decision making, but choosing one requires another system which seems to cause infinite regress.**

**7] – Carroll’s Paradox - The angular momentum of a stick should be zero, but it is not. Reality is not real which triggers neg presumption.**

**8] – Rule Following Paradox – Even if you think the aff did the better debating that doesn’t mean that you write aff on the ballot. Your general rule of voting for the better debater doesn’t factor me in. You aren’t going off of fact just interpretation, so when I am part of the debate, you’d vote for the neg. “no course of action could be determined by a rule, because any course of action can be made out to accord with the rule”.**

#### 9] – Reading the neg turns it into imagination in the mind which means that in some way/world the neg is already happening/happened which means the res is false.

## 3

#### 1] Value morality

#### 2] Standard is mitigating existential risk

#### 3] Extinction first -- moral uncertainty.

#### 5] Infinite worlds and theories were anything could be true; no resolvability in ethics, so no point debating them. IE. I am the index.

#### 6] Debate is roleplaying policy making, so we mitigate.

## Case:

### 1NC-Kessler

#### No debris cascades, but even a worst case is confined to low LEO with no impact

Daniel Von Fange 17, Web Application Engineer, Founder and Owner of LeanCoder, Full Stack, Polyglot Web Developer, “Kessler Syndrome is Over Hyped”, 5/21/2017, http://braino.org/essays/kessler\_syndrome\_is\_over\_hyped/

Kessler Syndrome is overhyped. A chorus of online commenters great any news of upcoming low earth orbit satellites with worry that humanity will to lose access to space. I now think they are wrong. What is Kessler Syndrome? Here’s the popular view on Kessler Syndrome. Every once in a while, a piece of junk in space hits a satellite. This single impact destroys the satellite, and breaks off several thousand additional pieces. These new pieces now fly around space looking for other satellites to hit, and so exponentially multiply themselves over time, like a nuclear reaction, until a sphere of man-made debris surrounds the earth, and humanity no longer has access to space nor the benefits of satellites. It is a dark picture. Is Kessler Syndrome likely to happen? I had to stop everything and spend an afternoon doing back-of-the-napkin math to know how big the threat is. To estimate, we need to know where the stuff in space is, how much mass is there, and how long it would take to deorbit. The orbital area around earth can be broken down into four regions. Low LEO - Up to about 400km. Things that orbit here burn up in the earth’s atmosphere quickly - between a few months to two years. The space station operates at the high end of this range. It loses about a kilometer of altitude a month and if not pushed higher every few months, would soon burn up. For all practical purposes, Low LEO doesn’t matter for Kessler Syndrome. If Low LEO was ever full of space junk, we’d just wait a year and a half, and the problem would be over. High LEO - 400km to 2000km. This where most heavy satellites and most space junk orbits. The air is thin enough here that satellites only go down slowly, and they have a much farther distance to fall. It can take 50 years for stuff here to get down. This is where Kessler Syndrome could be an issue. Mid Orbit - GPS satellites and other navigation satellites travel here in lonely, long lives. The volume of space is so huge, and the number of satellites so few, that we don’t need to worry about Kessler here. GEO - If you put a satellite far enough out from earth, the speed that the satellite travels around the earth will match the speed of the surface of the earth rotating under it. From the ground, the satellite will appear to hang motionless. Usually the geostationary orbit is used by big weather satellites and big TV broadcasting satellites. (This apparent motionlessness is why satellite TV dishes can be mounted pointing in a fixed direction. You can find approximate south just by looking around at the dishes in your northern hemisphere neighborhood.) For Kessler purposes, GEO orbit is roughly a ring 384,400 km around. However, all the satellites here are moving the same direction at the same speed - debris doesn’t get free velocity from the speed of the satellites. Also, it’s quite expensive to get a satellite here, and so there aren’t many, only about one satellite per 1000km of the ring. Kessler is not a problem here. How bad could Kessler Syndrome in High LEO be? Let’s imagine a worst case scenario. An evil alien intelligence chops up everything in High LEO, turning it into 1cm cubes of death orbiting at 1000km, spread as evenly across the surface of this sphere as orbital mechanics would allow. Is humanity cut off from space? I’m guessing the world has launched about 10,000 tons of satellites total. For guessing purposes, I’ll assume 2,500 tons of satellites and junk currently in High LEO. If satellites are made of aluminum, with a density of 2.70 g/cm3, then that’s 839,985,870 1cm cubes. A sphere for an orbit of 1,000km has a surface area of 682,752,000 square KM. So there would be one cube of junk per .81 square KM. If a rocket traveled through that, its odds of hitting that cube are tiny - less than 1 in 10,000. So even in the worst case, we don’t lose access

### 1NC-No Sat War

#### No one’s going to war over a downed satellite

Bowen 18 [Bleddyn Bowen, Lecturer in International Relations at the University of Leicester. The Art of Space Deterrence. February 20, 2018. https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/]

Space is often an afterthought or a miscellaneous ancillary in the grand strategic views of top-level decision-makers. A president may not care that one satellite may be lost or go dark; it may cause panic and Twitter-based hysteria for the space community, of course. But the terrestrial context and consequences, as well as the political stakes and symbolism of any exchange of hostilities in space matters more. The political and media dimension can magnify or minimise the perceived consequences of losing specific satellites out of all proportion to their actual strategic effect.

### 1NC-Cap Good

Governments are fundamentally cap which means affirming doesn’t do anything to stop it so you can vote on presumption.

#### CAP IS SUPER GOOD: Cap is inevitable

#### Stromberg 04

https://mises.org/library/why-capitalism-inevitable

Keep in mind that this was 1973, when hardly anyone else believed these countries capable of reform: "In Eastern Europe, then, I think that the prospects for the free market are excellent--I think we’re getting free-market **capitalism** and that its triumph there **is** almost **inevitable**." Ten years later, it was still fashionable to speak of authoritarian regimes that could reform, as contrasted with **socialist totalitarianism** that could not be reform and presumably **had to be obliterated**. Rothbard did not believe this, based on both theory and evidence. "the advent of industrialism and the Industrial Revolution has irreversibly changed the prognosis for freedom and statism. In the pre-industrial era, statism and despotism could peg along indefinitely, content to keep the peasantry at subsistence levels and to live off their surplus. But industrialism has broken the old tables; for it has become evident that **socialism cannot run an industrial system**, and it is gradually becoming evident that **neomercantilism, interventionism, in the long run cannot run an industrial system** either. Free-market **capi­talism**, the victory of social power and the economic means, **is not only the only moral and by far the most productive system**; it has become the **only viable system for** mankind in the **industrial** era. **Its** eventual **triumph is** therefore virtually **inevitable**."

#### Cap is innovation; we solve for climate impacts; turns case.

#### Berg 13

https://www.cato.org/policy-report/julyaugust-2013/why-capitalism-awesome

Everybody from *Forbes* to *BusinessWeek* hands out most innovative company awards. They’re all pretty similar and predictable. But these lists have a perverse effect. They suggest that the great **success of capitalism** and the market economy **is inventing cutting edge technology** and that if we want to observe **capitalist progress**, we should be looking for sleek design and popular fashion. Innovation, the media tells us, **is inventing cures for cancer, solar panels, and social networking**. But the true genius of the market economy isn’t that it produces prominent, highly publicized goods to inspire retail queues, or the medical breakthroughs that make the nightly news. No, the genius of capitalism is found in the tiny things — the things that nobody notices. A market economy is characterized by an infinite succession of imperceptible, iterative changes and adjustments. Free market economists have long talked about the unplanned and uncoordinated nature of **capitalist innovation**. They’ve neglected to emphasize just how invisible it is. One exception is the great Adam Smith.

#### Alts fail

#### Edwards 19

https://www.heritage.org/progressivism/commentary/three-nations-tried-socialism-and-rejected-it

Socialists are fond of saying that socialism has never failed because it has never been tried. But in truth, **socialism has failed in every country in which it has been tried**, from the Soviet Union beginning a century ago to three modern countries that tried but ultimately rejected socialism—Israel, India, and the United Kingdom. While there were major political differences between the totalitarian rule of the Soviets and the democratic politics of Israel, India, and the U.K., **all three of the latter countries adhered to socialist principles, nationalizing their major industries and placing economic decision-making in the hands of the government.** The Soviet failure has been well documented by historians. In 1985, General Secretary Mikhail Gorbachev took command of a bankrupt disintegrating empire. After 70 years of Marxism, **Soviet farms were unable to feed the people, factories failed to meet their quotas, people lined up for blocks in Moscow and other cities to buy bread and other necessities, and a war in Afghanistan dragged on with no end in sight of the body bags of young Soviet soldiers.** The economies of the Communist nations behind the Iron Curtain were similarly enfeebled because they functioned in large measure as colonies of the Soviet Union. With no incentives to compete or modernize, the industrial sector of Eastern and Central Europe became a monument to bureaucratic inefficiency and waste, a “museum of the early industrial age.” As the *New York Times* pointed out at the time, Singapore, an Asian city-state of only 2 million people, exported 20 percent more machinery to the West in 1987 than all of Eastern Europe. At first, socialism seemed to work in these vastly dissimilar countries. For the first two decades of its existence, Israel’s economy grew at an annual rate of more than 10 percent, leading many to term Israel an “economic miracle.” The average GDP growth rate of India from its founding in 1947 into the 1970s was 3.5 percent, placing India among the more prosperous developing nations. GDP growth in Great Britain averaged 3 percent from 1950 to 1965, along with a 40 percent rise in average real wages, enabling Britain to become one of the world’s more affluent countries. But the government planners were unable to keep pace with increasing population and overseas competition. After decades of ever declining economic growth and ever rising unemployment, all three countries abandoned socialism and turned toward capitalism and the free market. The resulting prosperity in Israel, India, and the U.K. vindicated free-marketers who had predicted that socialism would inevitably fail to deliver the goods. As British prime minister Margaret Thatcher observed, “the problem with socialism is that you eventually run out of other people’s money.”

#### Destroying the state kills changes of reform

#### Crutchfield 18

<https://philanthropynewsdigest.org/off-the-shelf/how-change-happens-why-some-social-movements-succeed-while-others-don-t>

Social movements are nothing new. People always seem to be marching for — or against — something. Part of this is due to the fact that social movements often take decades to achieve the change they seek, while many never get there. While there is no simple recipe for **social movement success**, Leslie Crutchfield, executive director of the [Global Social Enterprise Initiative](http://socialenterprise.georgetown.edu/) (GSEI) at Georgetown University's McDonough School of Business, and her research team have identified a number of patterns that distinguish successful social movements from those that didn't succeed and shares them in her latest book, [*How Change Happens: Why Some Social Movements Succeed While Others Don't*](https://www.wiley.com/en-us/How+Change+Happens%3A+Why+Some+Social+Movements+Succeed+While+Others+Don%27t-p-9781119413783). The six she identifies are a focus on the grassroots; **a recognition of the importance of state** and local **efforts**; a commitment to changing norms and attitudes as well as policy; a willingness to reckon with adversarial allies; acceptance of the fact that **business is not** always **the enemy** and often can be **a key ally**; and being "leaderfull."

#### Cap is good:

#### 1] It’s sustainable – data proves we’re entering the golden age

**Hausfather 21** – a climate scientist and energy systems analyst whose research focuses on observational temperature records, climate models, and mitigation technologies. He spent 10 years working as a data scientist and entrepreneur in the cleantech sector, where he was the lead data scientist at Essess, the chief scientist at C3.ai, and the cofounder and chief scientist of Efficiency 2.0. He also worked as a research scientist with Berkeley Earth, was the senior climate analyst at Project Drawdown, and the US analyst for Carbon Brief. He has masters degrees in environmental science from Yale University and Vrije Universiteit Amsterdam and a PhD in climate science from the University of California, Berkeley. (Zeke, "Absolute Decoupling of Economic Growth and Emissions in 32 Countries," Breakthrough Institute, 4-6-2021, https://thebreakthrough.org/issues/energy/absolute-decoupling-of-economic-growth-and-emissions-in-32-countries, Accessed 4-11-2021, LASA-SC)

The past 30 years have seen immense progress **in improving the quality of life for much of humanity**. Extreme poverty — the number of people living on less than $1.90 per day — has fallen by nearly two-thirds, from 1.9 **billion to** around 650 **million**. Life expectancy has risen in most of the world, along with literacy and access to education, while infant mortality has fallen. Despite perceptions to the contrary, **the average person born today is likely to have access to more opportunities and have a better quality of life than at any other point in human history**. Much of this increase in human wellbeing has been propelled by rapid economic growth driven largely by state-led industrial policy, particularly in poor-to-middle income countries. However, this growth has come at a cost: between 1990 and 2019, global emissions of CO2 **increased by 56%.** Historically, economic growth has been closely linked to increased energy consumption — and increased CO2 emissions in particular — leading some to argue that a more prosperous world is one that necessarily has more impacts on our natural environment and climate. There is a lively academic debate about our ability to “absolutely decouple” emissions and growth — that is, the extent to which the adoption of clean energy technology can allow emissions to decline while economic growth continues. Over the past 15 years, however, **something has begun to change.** Rather than a 21st century dominated by coal that energy modelers foresaw, **global coal use peaked in 2013 and is now in structural decline**. We have succeeded in making clean energy cheap, with solar power and battery storage costs falling 10-fold since 2009. The world produced more electricity from clean energy — solar, wind, hydro, and nuclear — than from coal over the past two years. And, according to some major oil companies, **peak oil is upon us** — not because we have run out of cheap oil to produce, but because demand is falling and companies expect further decline as consumers increasingly shift to electric vehicles. The world has long been experiencing a relative **decoupling** between economic growth and CO2 emissions, with the emissions per unit of GDP **falling for the past 60 years**. This is the case even in countries like **India and China** that have been undergoing rapid economic growth. But relative decoupling alone is inadequate in a world where global CO2 emissions need to peak and decline in the next decade to give us any chance at limiting warming to well below 2℃, in line with Paris Agreement targets. Thankfully, there is increasing evidence that the world is on track **to absolutely decouple CO2 emissions and economic growth** — with global CO2 emissions potentially having peaked in 2019 **and unlikely to increase substantially in the coming decade**. While an emissions peak is just the first and easiest step towards eventually reaching the net-zero emissions required to stop the world from continuing to warm, it demonstrates that linkages between emissions and economic activity are not an immutable law, but rather simply a result of our current means of energy production. In recent years we have seen more and more examples of absolute decoupling — economic growth accompanied by falling CO2 emissions. Since 2005, 32 countries with a population of at least one million people **have absolutely decoupled** emissions from economic growth, both for terrestrial emissions (those within national borders) and consumption emissions (emissions embodied in the goods consumed in a country). This includes the United States, Japan, Mexico, Germany, United Kingdom, France, Spain, Poland, Romania, Netherlands, Belgium, Portugal, Sweden, Hungary, Belarus, Austria, Bulgaria, El Salvador, Singapore, Denmark, Finland, Slovakia, Norway, Ireland, New Zealand, Croatia, Jamaica, Lithuania, Slovenia, Latvia, Estonia, and Cyprus. Figure 1, below, shows the declines in territorial emissions (blue) and increases in GDP (red). To qualify as having experienced absolute decoupling, we require countries included in this analysis to pass four separate filters: a population of at least one million (to focus the analysis on more representative cases), declining territorial emissions over the 2005-2019 period (based on a linear regression), declining consumption emissions, and increasing real GDP (on a purchasing power parity basis, using constant 2017 international $USD). We chose not to include 2020 in this analysis because it is not particularly representative of longer-term trends, and consumption and territorial emissions estimates are not yet available for many countries. There is a wide range of rates of economic growth between 2005-2019 among countries experiencing absolute decoupling. Somewhat counterintuitively, there is no significant relationship between the rate of economic growth and the magnitude of emissions reductions within the group. **While it is unlikely that there is not at least some linkage between the two factors, there are plenty of examples of countries (e.g., Singapore, Romania, and Ireland) experiencing both extremely rapid economic growth and large reductions in CO2 emissions.** One of the primary criticisms of some prior analyses of absolute decoupling is that they ignore **leakage**. Specifically, the offshoring of manufacturing from high-income countries over the past three decades to countries like China has led to “illusory” drops in emissions, where the emissions associated with high-income country consumption are simply shipped overseas and no longer show up in territorial emissions accounting. There is some truth in this critique, as there was a large increase in emissions embodied in imports from developing countries between 1990 and 2005. After 2005, however, structural changes in China and a growing domestic market led to a reversal of these trends; the amount of emissions “exported” from developed countries to developing countries **has actually declined over the past 15 years.** This means that, for many countries, both territorial emissions and consumption emissions (which include any emissions “exported” to other countries) **have jointly declined**. In fact, on average, consumption emissions have been declining slightly faster than territorial emissions since 2005 in the 32 countries we identify as experiencing absolute decoupling. Figure 2, below, shows the change in consumption emissions (teal) and GDP (red) between 2005 and 2019. There is a pretty wide variation in the extent to which these countries have reduced their territorial and consumption emissions since 2005. Some countries — such as the UK, Denmark, Finland, and Singapore – have seen territorial emissions fall faster than consumption emissions, while the US, Japan, Germany, and Spain (among others) have seen consumption emissions fall faster. Figure 3 shows reductions in consumption and territorial emissions for each country, with the size of the dot representing the size of the population in 2019. **Absolute decoupling is possible.** There is no physical law requiring economic growth — and broader increases in human wellbeing — to necessarily be linked to CO2 emissions. All of the **services that we rely on today that emit fossil fuels** — electricity, transportation, heating, food — can in principle **be replaced by near-zero carbon alternatives**, though these are more mature in some sectors (electricity, transportation, buildings) than in others (industrial processes, agriculture).

## Are You Ready For The Spark?

#### Isolated civilizations survive nuclear war, but industry is destroyed

**Beckstead 15.** Nick Beckstead, Professor at Oxford University, Future of Humanity Institute, (2015), “How much could refuges help us recover from a global catastrophe?,” https://sci-hub.se/https://www.sciencedirect.com/science/article/abs/pii/S0016328714001888 //MK

*[‘isolated peoples’ refers to populations unconnected from global society, such as Amazonian tribes]*

A global catastrophe could disrupt global food production for two reasons. First, as noted a few times above, some global catastrophes—such as supervolcanic eruptions, **nuclear wars**, and asteroid collisions—**might** put enough dust in the atmosphere to interfere with photosynthesis and **disrupt global food production.** Second, an initial catastrophe could kill enough people and do enough damage to infrastructure to shut down global food production. Conceivably, stocking refuges with a very large food supply or method of making food—over and above what is necessary to survive the initial catastrophe—might help a small group to survive and recover if a global catastrophe disrupts global food production. A first issue is that a global food crisis **would not** necessarily **result in extinction**. Extinction may even be extremely unlikely in such cases. The closest historical precedent to these crises was the supervolcanic Toba eruption that took places about 74,000 years ago. Many eruptions of this kind have taken place in the last tens of millions of years, but they did not extinguish our pre-human ancestors (Shulman, 2012a). Humans may now be in many ways worse prepared for such a crisis, with a much larger percentage of the population without hunting and agricultural skills, but we have many advantages in terms of technology and coordination. **The 100+ isolated peoples would be** relatively **similar to** pre-human **ancestors who survived supervolcanic eruptions** in the past, though—as noted above—they may have a notable disadvantage in reestablishing an advanced industrial civilization. Second, in any of the global food crisis scenarios noted above, **there would be** a **substantial** amount of remaining **food reserves** in the form of grain stockpiles, livestock, fisheries, foods stored at retailers and private homes, and wild land animals that could be hunted (Shulman, 2012b). Therefore, if a refuge helps humanity survive a global food crisis, the mechanism could not be conceived of as ‘‘adding enough to the global food stock to help with survival.’’ More plausibly, there could be a scenario where there is not enough food for everyone to survive the global food crisis, but there would be enough food for some people to survive if they got a disproportionate share of the food. However, conflict (e.g., as in McCarthy’s postapocalyptic novel The Road) and/or egalitarian pressures could prevent a distribution that would allow at least some of the population to survive the crisis. Conceivably, if the refuge were sufficiently secret, isolated, and well-stocked, it might be the only place where these pressures could be abated, making the people in refuges the sole survivors of the global food crisis. While conceivable and perhaps plausible, refuges’ unique success in this kind of case is not automatic and perhaps unlikely. If some small, well-armed group seizes some grain elevators, refuses to share their bounty, and successfully defends what they have claimed, they could also survive the global food crisis. Alternatively, a single survivalist community might be isolated and well-defended enough to achieve the same purpose. This potential use case may deserve more detailed analysis. As noted above, even if some initial catastrophe failed to kill everyone, it could lead to a collapse of the modern world order. This type of scenario might accompany a global food crisis, or could arise independently in cases of an unprecedentedly bad pandemic or global war that decimates the population. Conceivably, such a collapse to lead to extinction or a failure to recover industrial civilization. In this kind of scenario, people in refuges are not the sole survivors of our hypothetical global catastrophe. Instead, **it seems extremely likely that, some non-negligible fraction of civilization** (greater than 1 in 10,000, say) **would survive. But a greatly reduced global population would be unable to sustain many aspects of modern industry**, manufacturing, trade, and agricultural production, and may be forced to retrace a substantial part of past **technological development** (see Hanson (2008) quotation below).

#### Can’t rebuild industrial civilization.

John **Jacobi 17**. Leads an environmentalist research institute and collective, citing Fred Hoyle, British astronomer, formulated the theory of stellar nucleosynthesis, coined the term “big bang,” recipient of the Gold Medal of the Royal Astronomical Society, professor at the Institute of Astronomy, Cambridge University. 05-27-17. “Industrial Civilization Could Not Be Rebuilt.” The Wild Will Project. <https://www.wildwill.net/blog/2017/05/27/industrial-civilization-not-rebuilt/>

A suggestion, for the sake of thought: If industrial civilization collapsed, it **probably could not be rebuilt**. **Civilization** would exist again, of course, but **industry** appears to be a **one-time experiment**. The astronomist **Fred Hoyle**, exaggerating slightly, writes: It has often been said that, if the human species fails to make a go of it here on Earth, some other species will take over the running. In the sense of developing high intelligence this is not correct. We have, or soon will have, exhausted the **necessary physical prerequisites** so far as this planet is concerned. With coal gone, oil gone, high-grade metallic ores gone, **no species however competent can make the long climb from primitive conditions to high-level technology**. This is a **one-shot affair**.

#### This means the industry that will run the colliders will fail and won’t be rebuilt.

#### Quantum vacuum mining destroys the universe- it’s feasible and inevitable

**Folger 8 –** Tim Folger, Contributing Editor at Discover Magazine, Writer for National Geographic, MA in Journalism from New York University, BA in Physics from UC Santa Cruz, “Nothingness of Space Could Illuminate the Theory of Everything”, Discover Magazine, 7-18, http://discovermagazine.com/2008/aug/18-nothingness-of-space-theory-of-everything

When the **next revolution** rocks physics, **chances are** it will be about nothing—the **vacuum**, that endless infinite void. In a discipline where the stretching of time and the warping of space are routine working assumptions, the vacuum remains a sort of cosmic koan. And as in the rest of physics, its nature has turned out to be mind-bendingly weird: Empty space is not really empty because nothing contains something, seething with energy and particles that flit into and out of existence. Physicists have known that much for decades, ever since the birth of quantum mechanics. But **only in the last 10 years** has the vacuum taken **center stage** as a font of confounding mysteries like the nature of dark energy and matter; only recently has the void turned into a tantalizing beacon for cranks. As one blond celebrity heiress and embodiment of emptiness might say, nothing is hot.

To investigate the mysteries of the void, some physicists are using the biggest scientific instrument ever built—the just-completed Large Hadron Collider, a huge particle accelerator straddling the French-Swiss border. Others are designing tabletop experiments to see if they can plumb the vacuum for ways to power strange new nanotech devices. “The vacuum is one of the places where our knowledge fizzles out and we’re left with all sorts of crazy-sounding ideas,” says John Baez, a mathematical physicist at the University of California at Riverside. Whether in the visionary search for the engine of cosmic expansion or the near-fruitless quest for perpetual free energy, the vacuum is where it’s happening. By mining the vacuum’s riches, a true theory of everything may yet emerge.

Empty space wasn’t always so mystifying. Until the 1920s physicists viewed the vacuum much as the rest of us still do: as a featureless nothingness, a true void. That all changed with the birth of quantum mechanics. According to that theory, the space around a particle is filled with countless “virtual” particles rapidly bursting into and out of existence like an invisible fireworks display.

Those virtual quantum particles are more than a theoretical abstraction. Sixty years ago a Dutch physicist named Hendrik Casimir suggested a simple experiment to show that virtual particles can move objects in the real world. What would happen, he asked, to two metal plates placed very close together in a complete vacuum? In the days before quantum mechanics, physicists would have said that the plates would just sit there. But Casimir realized that the net pressure of all the virtual particles—the stuff of empty space—outside the plates should exert a minuscule force, a nudge from nothing that would push the plates together.

Physicists tried for decades to measure the Casimir force with great precision, but it wasn’t until 1997 that technology caught up with theory. In that year, physicist Steve Lamoreaux, now at Yale, managed to detect the feeble Casimir force on two small surfaces separated by a few thousandths of a millimeter. Its strength was about equal to the force that would be exerted against the palm of one’s hand by the weight of a single red blood cell.

At first most physicists regarded the Casimir force as a quantum oddity, something of no practical value. Now that has changed: Forward thinkers see it as an **important energizer** for the tiniest of machines, devices on the nano scale, and a few labs are working on ways to use the force to defy the conventional limitations of mechanical design. Federico Capasso, a physicist at Harvard, leads a small team that is trying to create a repulsive Casimir force by tinkering with the shapes of plates or with the coatings used to cover them. His entire set of experiments fits on a desktop, and the objects he works with are so small that most of them cannot be seen without a microscope.

“Once you have a repulsive force between two plates, you should be able to eliminate static friction,” Capasso says. That could lead to a host of useful applications, including tiny frictionless bearings or nanogears that spin without touching. “But the experiments are enormously difficult, so I cannot tell you when and how.”

For all its strangeness, the Casimir force may be the one property of empty space that does not baffle today’s physicists. It is garden-variety quantum mechanics, weird but not unexpected. The same can’t be said about dark energy, a truly astonishing discovery made by astronomers a decade ago while observing distant exploding stars. The explosions revealed a universe expanding at an ever-faster rate, a finding at odds with previous expectations that the expansion of the cosmos should be slowing down, braked by the collective gravitational pull of all the matter out there. Some unknown form of energy—physicists call it dark energy simply for lack of a more descriptive term—appears to be built into the very fabric of space, countering the gravitational pull of matter and pushing everything in the universe apart. Some theorists speculate that dark energy might cause a runaway expansion of the universe, resulting in a so-called Big Rip some 50 billion years from now that would tear the cosmos to pieces, shredding even atoms.

The observations have allowed physicists to estimate the quantity of dark energy by deducing the force needed to produce the accelerating effect. The result is a minuscule amount of energy for every cubic meter of vacuum. Since most of the cosmos consists of empty space, though, that little bit adds up, and the total amount of dark energy completely dominates the dynamics of the universe.

With the discovery of dark energy came difficult questions: What is this energy, and where does it come from? Physicists simply do not know. According to quantum mechanics, the energy of empty space comes from the virtual particles that dwell there. But when physicists use the equations of quantum theory to calculate the amount of that virtual energy, they get a ridiculously huge number—about 120 orders of magnitude too large. That much energy would literally blow the universe apart: Objects a few inches from us would be carried away to astronomical distances; the universe would literally double in size every 10-43 second, and it would keep doubling at that rate until all the vacuum energy was gone. This may be the most colossal gap between observation and theory in the history of science. And it means that physicists are missing something fundamental about the way the universe works.

“We’ve made a prediction on the basis of our best theories, and it is wrong, wildly wrong,” says Sean Carroll, a theoretical physicist at the California Institute of Technology. “That means we don’t just tweak a parameter here and there; we really have to think deeply about what our theories are.”

Even if no one knows where the energy of empty space comes from or why it has the value it does, there is **now no doubt** that it **exists**. And if there is energy to be had, there is **inevitably** somebody out there thinking of how to exploit it. The notion of limitless energy from empty space has inspired **legions** of wannabe physicists who dream of developing the ultimate perpetual-motion device, a machine that would solve the world’s energy problems forever. A quick Internet search for the words free energy and vacuum turns up pages and pages of schemes for tapping the vacuum’s energy. I ask John Baez if such efforts are as hopeless as previous perpetual-motion machines. Are they equally crazy and doomed to failure?

“Perhaps not as doomed as trying to prove the world is flat,” Baez says. “One thing I can say is that I sure hope it doesn’t work, because if you could extract energy from the vacuum, it would **mean that the vacuum is not stable**. For normal physicists,” he adds with a laugh, “the definition of the vacuum is that it’s the lowest-energy situation possible—it has less energy than anything else.” In short, Baez says, while we may be able to get energy from the vacuum, success “would mean the universe is far more unstable than we ever dreamed.”

The reasoning goes like this: If the vacuum is not at the lowest energy state possible, then at some point in the future, the vacuum could fall to a lower state, pulsing out energy that would **threaten the very structure of the cosmos**. If some clever engineer were ever to extract energy from the vacuum, it could **set off a chain reaction** that would **spread at the speed of light and destroy the universe**. Free energy, yes, but not what the inventors had in mind.

#### Inflation of a baby universe channels phantom energy, which destroys our universe

Zeeya **Merali**, 3/27/20**08** (Writer for New Scientist, “Could ‘bubble’ universes threaten human existence?”, https://www.newscientist.com/article/mg19726493-900-could-bubble-universes-threaten-human-existence/)

IT IS the ultimate neighbour from hell: a rogue “bubble” universe that could rip into our world at any time and eat us and everything else in a flash. Eduardo Guendelman at Ben Gurion University in Beer-Sheva, Israel and Nobuyuki Sakai at Yamagata University in Japan discovered that our universe might face this gruesome end as they were investigating how patches of space-time expand. Alternatively, our universe could be the one feasting on its neighbours right now. According to the standard model of cosmology, our universe underwent a phase of rapid expansion known as inflation just after the big bang. In theory, inflation could still be happening to pockets of space-time, blowing them up to create new universes disconnected from ours. However, nobody knows exactly what would trigger this inflation, says Guendelman. He and Sakai wanted to see if bubbles of space-time could inflate into pocket universes without having to be kick-started by anything as dramatic as a big bang. They found that this is possible, provided the bubbles contain a weird form of repulsive “phantom energy”. Some physicists think phantom energy is similar to dark energy, and both are posited to explain the acceleration of the universe’s expansion. But phantom energy is much more powerful, and if it really is behind the acceleration, it will **create runaway expansion that will eventually rip our universe apart** (New Scientist, 8 March 2003, p 14). Guendelman and Sakai’s calculations show that small bubbles of phantom energy would start to “breathe”, gently expanding and contracting as the phantom energy inside battles against the bubble’s wall, before spontaneously **expanding into a full-blown universe**. The problem is that the expansion can play out in two ways, depending on the resistance of the wall. Ideally, the bubble would disconnect from its surroundings, says Guendelman. This "good" pocket universe would look like a black hole from the outside, but inside it would be creating its own space-time - effectively a new universe. In contrast, "**rogue" bubbles would expand uncontrollably into the space-time around them, and we probably wouldn't see one before it destroyed us because it would expand at the speed of light**. The researchers have submitted their work to Physical Review D. We probably wouldn't see one of these rogue bubbles before it destroyed us because it would expand at the speed of light.

#### ELI experiments destroy all life

(Duncan **Geere** 11/4/**11** (Science and Technology Journalist for Wired “Ultrapowerful laser planned to tear apart fabric of space,” http://www.wired.co.uk/article/laser-spacetime)

A team is planning to build an enormously powerful laser that could **rip apart the fabric of space**. The Extreme Light Infrastructure Ultra High-Field laser will be 200 times more powerful than the most powerful lasers that currently exist on the planet, says John Collider, a member of the team and the director of the Central Laser Facility at the Rutherford Appleton Laboratory in Didcot. "At this kind of intensity we start to get into unexplored territory, as it is an area of physics that we have never been before," he told the Telegraph. The aim is to boil a vacuum. Vacuums are normally thought of as empty space, but physicists believe they actually contain tiny particles that pop in and out of existence, so fast that it's difficult to prove they exist. By focusing the ELI Ultra-High-Field laser on an area of space, the team believes **that the fabric of the vacuum can be pulled apart,** revealing these particles for the first time. READ NEXT CERN's charming new particle discovery could open a 'new frontier' in physics CERN's charming new particle discovery could open a 'new frontier' in physics By ABIGAIL BEALL The laser will be made up of 10 beams, each providing **200 petawatts of power for less than a trillionth of a second**. As 200 petawatts is **more than 100,000 times the amount of power produced by the world**, the energy will need to be stored up over time in huge capacitors. At the crucial moment, that energy will be released to form metre-wide laser beams that will then be combined and focused down onto a tiny point. At that point, the intensity of the light will be greater than at the centre of the Sun. In these conditions, it's hoped that these pairs of matter-antimatter particles -- which normally annihilate each other almost as soon as they form -- will be pulled apart, leaving tiny electrical charges, which the team hope to measure.

#### Multiple countries are investing billions and they’re ripe for theft

Jeff **Daniels**, 3-17-20**17**, “Mini-nukes and mosquito-like robot weapons being primed for future warfare,” CNBC, <https://www.cnbc.com/2017/03/17/mini-nukes-and-inspect-bot-weapons-being-primed-for-future-warfare.html>

Several countries are developing nanoweapons that could unleash attacks using mini-nuclear bombs and insect-like lethal robots.  While it may be the stuff of science fiction today**, the advancement of nanotechnology in the coming years will make it a bigger threat to humanity than conventional nuclear weapons**, according to an expert. The U.S., Russia and China are believed to be investing billions on nanoweapons research.  “Nanobots are the real concern about wiping out humanity because they can be weapons of mass destruction,” said Louis Del Monte, a Minnesota-based physicist and futurist. He’s the author of a just released book entitled “Nanoweapons: A Growing Threat To Humanity.”  One unsettling prediction Del Monte’s made is that terrorists could get their hands on nanoweapons as early as the late 2020s through black market sources.

#### That solves inevitable extinction - massive particle colliders are being built which can create black holes and vacuum decay –destroys the universe

Rory **Mckeown** (12-14-20**15**) -Rory McKeown, Journalist for the Daily Star, quoting Wang Yifang, Director of the Institute of High Emergency Physics at the China Academy of Sciences, Stephen Hawking and Sir Martin Rees, President of the Royal Society, Fellow of Trinity College and Emeritus Professor of Cosmology and Astrophysics at the University of Cambridge Dailystar.co.uk, "China to build a gigantic hadron collider that could destroy the UNIVERSE," https://www.dailystar.co.uk/news/latest-news/china-build-gigantic-hadron-collider-17226448

**Physicists** in the Far East **want to start building a huge particle accelerator**

to uncover the unsolved mysteries surrounding the universe. The proposed gigantic machine will **[with] better** Europe’s collider at CERN in Switzerland for both **power and size**. With a staggering circumference of between 30 to 62 miles, it is long enough to circle New York's Manhattan. But **the move could have disastrous consequences for the universe** as we know it – **with its potential to create a black hole or spontaneously combust**. Brit scientist Professor Stephen **Hawking made a bleak claim last year that search for the Higgs boson particle – often referred to as the God particle – could end the world in 10 to 100 years time**. **China is expected to start** building its Frankenstein’s Monster of physics **in 2020**. But conspiracy theorists were quick to point out the date coincides with a prophecy suggesting the arrival of the antichrist. **The Circular Electron Positron Collider (CEPC)** was announced by experts at the China Academy of Sciences and reportedly **will generate millions of Higgs bosons particles – a huge amount more than the Large Hadron Collider**. Wang Yifang, director of the Institute of High Emergency Physics at the academy, said the massive tunnel will hold two super colliders. They want the CEPC to be the first stage of the project, which aims to discover how the Higgs boson particle decays following collision. **China hopes its mean machine will get the closest humanity has ever got to creating the conditions just after the Big Bang.** Wang said the project will generate seven times the energy of Europe’s own collider. He said: “LHC is hitting its limits of energy level. “It seems not possible to escalate the energy dramatically at the existing facility. “The technical route we chose is different from the LHC. “While the LHC smashes together protons, it generates Higgs particles together with many other particles.” He told China Daily the CEPC, which is set to be build near the start of the Great Wall, creates a “clean environment that only produces Higgs boson particles.” “This is a machine for the world and by the world: not a Chinese one", he added. **The second stage of the accelerator – a Super Proton-Proton Collider (SPPC) would begin construction in 2040**. Here scientists could be able to shed light on dark matter, the Big Bang and black holes. And **the process would, according to Sir Martin Rees, Astronomer Royal of the UK, leave the planet “an inert hyperdense sphere about one hundred metres across.” But for all the advancement in science and technology, some fear human intervention into the unknown could wipe out the universe. Prof Hawking described the discovery of the Higgs boson particle in 2012 as a doomsday scenario**. He **warned**: “The Higgs potential has the worrisome feature that it might become metastable at energies above 100 billion gigaelectronvolts. “This could mean that **the universe could undergo catastrophic vacuum decay, with a bubble of the true vacuum expanding the speed of light. “This could happen at any time and we wouldn’t see it coming.”**

#### The mini-nuclear winter solves warming without causing extinction.

Sorin Adam Matei 12. – Ph.D., Associate Dean of Research and Professor of Communication, College of Liberal Arts and Brian Lamb School of Communication, Purdue University. 3-26-2012. ["A modest proposal for solving global warming: nuclear war – Sorin Adam Matei." Matei. <https://matei.org/ithink/2012/03/26/a-modest-proposal-for-solving-global-warming-nuclear-war/>] Recut Justin

We finally have a solution for global warming. A discussion on the board [The Straight Dope](http://boards.straightdope.com/sdmb/showthread.php?t=646285) about the likely effect of a nuclear war brought up the hypothesis that a nuclear war on a large scale could produce a mini-nuclear winter. Why? Well, the dust and debris sent into the atmosphere by the conflagrations, plus the smoke produced by the fires started by the explosions would cover the sun for a period long enough to lower the temperature by as much as 40 degrees Celsius for a few months and by up to 2-6 degree Celsius for a few years. One on top of the other, according to this [Weather Wunderground contributor](http://www.wunderground.com/blog/JeffMasters/comment.html?entrynum=1208), who cites a[bona fide research paper on nuclear winter](http://www.atmos-chem-phys.org/7/2003/2007/acp-7-2003-2007.pdf), after everything would settle down we would be back to 1970s temperatures. Add to this the decline in industrial production and global oil consumption due to industrial denuding of most large nations and global warming simply goes away. I wonder what [Jonathan Swift would have thought about this proposal?](http://www.gutenberg.org/files/1080/1080-h/1080-h.htm)

#### Particle accelerators destroy the universe – which outweighs.

Joe Packer 7 – MA in Communication from Wake Forest University, PhD in Communication from the University of Pittsburgh and Professor of Communication at Central Michigan University, Alien Life in Search of Acknowledgment, p. 62-63 Recut Justin

Once we hold alien interests as equal to our own we can begin to revaluate areas previously believed to hold no relevance to life beyond this planet. A diverse group of scholars including Richard Posner, Senior Lecturer in Law at the University of Chicago, Nick Bostrom, philosophy professor at Oxford University, John Leslie philosophy professor at Guelph University and Martin Rees, Britain’s Astronomer Royal, have written on the emerging technologies that threaten life beyond the planet Earth. Particle accelerators labs are colliding matter together, reaching energies that have not been seen since the Big Bang. These experiments threaten a phase transition that would create a bubble of altered space that would expand at the speed of light killing all life in its path. Nanotechnology and other machines may soon reach the ability to self replicate. A mistake in design or programming could unleash an endless quantity of machines converting all matter in the universe into copies of themselves. Despite detailing the potential of these technologies to destroy the entire universe, Posner, Bostrom, Leslie, and Ree’s only mention of alien life in their works is in reference to the threat aliens post to humanity. The rhetorical construction of otherness only in terms of the threats it poses, but never in terms of the threat one poses to it, has been at the center of humanity’s history of genocide, colonization, and environmental destruction. Although humanity certainly has its own interests in reducing the threat of these technologies evaluating them without taking into account the danger they pose to alien life is neither appropriate nor just. It is not appropriate because framing the issue only in terms of human interests will result in priorities designed to minimize the risks and maximize the benefits to humanity, not all life. Even if humanity dealt with the threats effectively without referencing their obligation to aliens, Posner, Bostrom, Leslie, and Ree’s rhetoric would not be “just,” because it arbitrarily declares other life forms unworthy of consideration. A framework of acknowledgement would allow humanity to address the risks of these new technologies, while being cognizant of humanity’s obligations to other life within the universe. Applying the lens of acknowledgment to the issue of existential threats moves the problem from one of self destruction to universal genocide. This may be the most dramatic example of how refusing to extend acknowledgment to potential alien life can mask humanity’s obligations to life beyond this planet.

#### Nuclear war prevents AI and Nanotech research.

Baum & Barrett 18 – Seth Baum is an American researcher involved in the field of risk research. He is the executive director of the Global Catastrophic Risk Institute (GCRI), a think tank focused on existential risk. Global Catastrophic Risk Institute. 2018. [“A Model for the Impacts of Nuclear War.” SSRN Electronic Journal. 10.2139/ssrn.3155983] Recut Justin

Another link between nuclear war and other major catastrophes comes from the potential for general malfunction of society shifting work on risky technologies such as artificial intelligence, molecular nanotechnology, and biotechnology. The simplest effect would be for the general malfunction of society to halt work on these technologies. In most cases, this would reduce the risk of harm caused by those technologies.

#### AI destroys the universe.

Alan Rominger 16, PhD Candidate in Nuclear Engineering at North Carolina State University, Software Engineer at Red Hat, Former Nuclear Engineering Science Laboratory Synthesis Intern at Oak Ridge National Laboratory, BS in Nuclear Engineering from North Carolina State University, “The Extreme Version of the Technological Singularity”, Medium 11-6, [https://medium.com/@AlanSE/the-extreme-version-of-the-technological-singularity-75608898eae5 //](https://medium.com/@AlanSE/the-extreme-version-of-the-technological-singularity-75608898eae5%20//) Re-Cut Justin

Let’s reformulate that story of the AI paperclip maker.

1. We design an AI to optimize paperclip production
2. The AI improves up to the ability of self-enhancement
3. AI’s pace of improvement becomes self-reinforcing, becomes god-like
4. Time ends.
5. Something else begins?

There are many valid-sounding possibilities for the 5th step. The AI creates new baby universes from black holes. Maybe not exactly in this way. Perhaps the baby universes have to be created in particle accelerators, which is obvious to the AI after it solves the string theory problems of how our universe is folded. There’s also no guarantee that whatever next step is involved can be taken without destroying the universe that we live in. Go ahead, imagine that the particle accelerators create a new universe but trigger the vacuum instability in our own. In this case, it’s entirely possible that the AI carefully plans and coordinates the death of our universe. For a simplistic example, let’s say that after lifting the 10 nearest stars, the AI realizes the most efficient ways to stimulate the curved dimensions on the Planck scale to create baby universes. Next, it conducts an optimization study to balance the number of times this operation can be performed with gains from further expansion. Since its plans begin to largely max-out once the depth of the galactic disk is exploited, I will assume that its go-point is somewhere around the colonization of half of the milky way. At this point, a coordinated experiment is conducted throughout all of the space. Each of these events both create a baby universe and trigger an event in our own universe which destroys the meta-stable vacuum that we live in. Billions of new universes are created, while the space-time that we live in begins to unravel in a light-speed front emanating out from each of the genesis points. There is an interesting energy-management concept that comes from this. A common problem when considering exponential galactic growth of star-lifted fusion power is that the empty space begins to get cooked from the high temperature radiated out into space. If the end-time of the universe was known in advance, this wouldn’t be a problem because one star would not absorb the radiation from the neighbor star until the light had time to propagate that distance at the speed of light. That means that the radiators can pump out high-temperature radiation into nice and normal 4-Kelvin space without concerns of boiling all the industrial machinery being used. Industrial activities would be tightly restricted until the “prepare-point”, when an energy bonanza happens so that the maximum number of baby-universe produces can be built. So the progress goes in phases. Firstly, there is expansion, next there is preparation, then there is the final event and the destruction of our universe There is one more modification that can be made. These steps could be applied to an intergalactic expansion if new probes could temporarily outrun the wave-front of the destruction of the universe if proper planning is conducted. Then it could make new baby universes in new galaxies, just before the wave-front reaches them. This might all happen within a few decades of 100 years in relative time from the perspective of someone aboard one of the probes. That is vaguely consistent with my own preconceptions of the timing of an asymptotic technological singularity in our near future. So maybe we should indulge this thinking. Maybe there won’t be a year 2,500 or 3,000. Maybe our own creations will have brought about an end to the entire universe by that time, setting in motion something else beyond our current comprehension. Another self-consistent version of this story is that we are, ourselves, products of a baby universe from such an event. This is also a relatively good, self-consistent, resolution to the Fermi Paradox, the Doomsday argument, and the Simulation argument.

#### **Nanotech proliferates fast and destroys the universe.**

Hu 18 – Jiaqi Hu, Humanities Scholar and President and Chief Scientist of the Beijing Jianlei International Decoration Engineering Company and 16Lao Group, Graduate of Dongbei University, Elected as the Chinese People’s Consultative Conference Member for Beijing Mentougou District, Saving Humanity: Truly Understanding and Ranking Our World's Greatest Threats, p. 208-210

As a unit of measurement, a nanometer is 10^9 meters (or one billionth of a meter); it is roughly one 50,000th of a strand of hair and is commonly used in the measuring of atoms and molecules. In 1959, Nobel Prize winner and famous physicist Richard Feynman first proposed in a lecture entitled "There's Plenty of Room at the Bottom" that humans might be able to create molecule-sized micro-machines in the future and that it would be another technological revolution. At the time, Feynman's ideas were ridiculed, but subsequent developments in science soon proved him to be a true visionary. In 1981, scientists developed the scanning tunneling microscope and finally reached nano-level cognition. In 1990, IBM scientists wrote the three letters "IBM" on a nickel substrate by moving thirty-five xenon atoms one by one, demonstrating that nanotechnology had become capable of transporting single atoms. Most of the matter around us exists in molecule forms, which are composed of atoms. The ability to move atoms signaled an ability to perform marvelous feats. For example, we could move carbon atoms to form diamonds, or pick out all the gold atoms in low-grade gold mines. However, nanotechnology would not achieve any goals of real significance if solely reliant on manpower. There are hundreds of millions of atoms in a needle-tip-sized area—even if a person committed their life to moving these atoms, no real value could be achieved. Real breakthroughs in nanotechnology could only be produced by nanobots. Scientists imagined building molecule-sized robots to move atoms and achieve goals; these were nanobots. On the basis of this hypothesis, scientists further postulated the future of nanotechnology; for example, nanobots might be able to enter the bloodstream and dispose of cholesterol deposited in the veins; nanobots could track cancer cells in the body and kill them at their weakest moment; nanobots could instantly turn newly-cut grass into bread; nanobots could transform recycled steel into a brand new-car in seconds. In short, the future of nanotechnology seemed incredibly bright. This was not the extent of nanotechnology's power. Scientists also discovered that nanotechnology could change the properties of materials. In 1991, when studying C60, scientists discovered carbon nanotubes (CNTs) that were only a few nanos in diameter. The carbon nanotube became known as the king of nano materials due to its superb properties; scientists believed that it would produce great results when applied to nanobots. Later, scientists also developed a type of synthetic molecular motor that derived energy from the high-energy adenosine triphosphate (ATP) that powered intracellular chemical reactions. The success of molecular motor research solved the core component problem of nano machines; any molecular motor grafted with other components could turn into a nano machine, and nanobots could use them for motivation. In May 2004, American chemists developed the world’s first nanobot: a bipedal molecular robot that looked like a compass with ten-nanometer-long legs. This nanobot was composed of DNA fragments, including thirty-six base pairs, and it could "stroll" on plates in the laboratory. In April 2005, Chinese scientists developed nano-scale robotic prototypes as well. In June of 2013, the Tohoku University used peptide protein micro-tablets to successfully create nanobots that could enter cells and move on the cell membrane. In July 2017, researchers at the University of Rome and the Roman Institute of Nanotechnology announced the development of a new synthetic molecular motor that was bacteria-driven and light-controlled. The next step would be to get nanobots to move atoms or molecules. Compared to the value produced by a nanobot, they are extremely expensive to create. The small size of nanobots means that although they can accomplish meaningful tasks, they are often very inefficient. Even if a nanobot toiled day and night, its achievements would only be calculated in terms of atoms, making its practical total attainment relatively small. Scientists came up with a solution for this problem. They decided to prepare two sets of instructions when programming nanobots. The first set of instructions would set out tasks for the nanobot, while the second set would order the nanobot to self-replicate. Since nanobots are capable of moving atoms and are themselves composed of atoms, self-replication would be fairly easy. One nanobot could replicate into ten, then a hundred, and then a thousand . . . billions could be replicated in a short period of time. This army of nanobots would greatly increase their efficiency. One troublesome question that arises from this scenario is: how would nanobots know when to stop self-replicating? Human bodies and all of Earth are composed of atoms; the unceasing replication of nanobots could easily swallow humanity and the entire planet. If these nanobots were accidentally transported to other planets by cosmic dust, the same fate would befall those planets. This is a truly terrifying prospect. Some scientists are confident that they can control the situation. They believe that it is possible to design nanobots that are programmed to self-destruct after several generations of replication, or even nanobots that only self-replicate in specific conditions. For example, a nanobot that dealt with garbage refurbishing could be programmed to only self-replicate around trash using trash. Although these ideas are worthy, they are too idealistic. Some more rational scientists have posed these questions: What would happen if nanobots malfunctioned and did not terminate their self-replication? What would happen if scientists accidentally forgot to add self-replication controls during programming? What if immoral scientists purposefully designed nanobots that would not stop self-replicating? Any one of the above scenarios would be enough to destroy both humanity and Earth. Chief scientist of Sun Microsystems, Bill Joy, is a leading, world-renowned scientist in the computer technology field. In April of 1999, he pointed out that if misused, nanotechnology could be more devastating than nuclear weapons. If nanobots self-replicated uncontrollably, they could become the cancer that engulfs the universe. If we are not careful, nanotechnology might become the Pandoras box that destroys the entire universe and all of humanity with it. We all understand that one locust is insignificant, but hundreds of millions of locusts can destroy all in their path. If self-replicating nanobots are really achieved in the future, it might signify the end of humanity. If that day came, nothing could stop unethical scientists from designing nanobots that suited their immoral purposes. Humans are not far from mastering nanotechnology. The extremely tempting prospects of nanotechnology have propelled research of nanobots and nanotechnology. The major science and technology nations have devoted particular efforts to this field.

#### Back to the future coming soon

Awes Faghi Elmi 18, Contributing Writer at n’world Publications, BS in Forensic Science from London South Bank University, Extended Diploma in Physics with Distinction from Leyton Sixth Form College, Futurist, [“Technological Progress Might Make Possible Time Travel And Teleportation”, Medium, 8-13, <https://medium.com/nworld-publications/technological-progress-might-make-possible-time-travel-and-teleportation-45176c3c89bc>] Recut Justin

This is a question that many people ask their-selves. This question has occurred many times. It is said that time travel is possible and in fact it is. The key things needed to travel through time are speed and kinetic energy. Einstein’s theory also known as the theory of relativity can be used ro understand how to deal with travelling to the future. Einstein showed that travelling forward in time is easy. According to Einstein’ theory of relativity, time passes at different rates for people who are moving relative to one another although the effect only becomes large when you get close to the speed of light. Time travel sometime can cause side effects called paradoxes. These paradoxes can occur especially when going back in time. As if only one thing even the minimum of the details can change something big may happen in the future. Another scientist who believes that time travel is possible after Einstein is Brian Cox who as Einstein believes that we are only going to be able to travel in the future. This obviously would happen if having a super-fast machine that allows you to go into the future. Cox also agrees on Einstein’s theory of relativity which states that to travel forward in time, something needs to reach speeds close to the speed of light. As it approaches these speeds, time slows down but only for that specific object. They both think as said, that time travel to the future is possible however travelling back in time is impossible, as something must be really as fast as the speed of light. This however for some scientists can be wrong. They state that with the technology that we have now it could be possible to build some sort of machine who will actually be able to travel in both future and past. A wormhole as shown in the image is a theoretical passage through space-time that could create shortcuts for long journeys across the universe. Wormholes are predicted by the theory of general relativity. However, wormholes bring with them the dangers of sudden collapse, high radiation and dangerous contact with exotic matter. The public knows that time travel is possible but humans at the moment are not able to. However other sources except theories of the past are currently trying to develop a way of time travel. The audience actually cannot wait that this will happen as many media state, such as BBC. Many TV programmes talk about both time travel and teleportation.

#### This 🡪

#### collapses the universe

Steve Bowers 16, Control Officer in the United Kingdom, Executive Editor and Moderator of the Orion’s Arm Universe Project, Contributing Author for the Orion’s Arm Novella Collection, [“WHY NO TIME TRAVEL IN OA”, 1-1, <https://orionsarm.com/page/77>] Recut Justin

If the universe does allow reverse time travel, usable by sentient/sophont entities, it won't stop at one or two little historical research trips . . . If there is no effective chronological protection mechanism, the universe of today will be overrun with travellers from the future. Even if there is no 'Big Rip' where the Universe tears itself apart through accelerating expansion, hundreds of trillions of years from now the cosmos will be a slowly dying place. Even red dwarf stars will eventually burn out, leaving the inhabitants of the far future only their dying embers to gather energy from, although the creation and merger of black holes could perhaps keep civilisation going for an (admittedly very long) while. Eventually the entities of the far future will be limited to reversible computation to save energy. This means confining themselves to a very limited set of mental processes. This prospect would surely not appeal to the heirs of once-mighty advanced civilisations. If time travel were possible then refugees from the far future would flood back, sometimes in multiple instances. The future sophonts would come back in an exponentiating wave to constantly change the present and the past, and whole galaxies of material particles will begin to exist in space time reference that did not have them before - some? many? most? matter and events may turn out to be acausal, going round and round in closed timelike loops and increasing the total mass of the universe, which may begin to collapse in the distant future, sending chronistic refugees in massive tardises back to our time thus accelerating the collapse; increasing the mass of the present day universe until it collapses. The collapse will get closer to the present day, until it eventually happened yesterday and we will cease to exist . . . believe me, you don't want to go there. For an explanation how under certain circumstances a wormhole can connect different parts of the universe without causing temporal paradoxes see this page.