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Genesis

Scientists have recently produced matter from nothing. For decades this has been purely the area of science fiction, and even earlier, it was the realm of myth and fantasy. We’ve known that matter and energy are related and even that there was some equivalency given by Albert Einstein’s famous equation, E=mc2. The possibility of colliding photons to produce matter was even predicted in 1934 by Gregory Breit and John A. Wheeler, who saw it as something that was impossible to do.

At the Relativistic Heavy Ion Collider located in Upton, New York, scientists have created electron-positron pairs by accelerating gold ions to near the speed of light and sending them hurtling past each other in opposite directions. These ions are gold atoms that have been stripped of their electrons, giving them a very strong positive charge. When ions are moving near the speed of light, there is a circular magnetic field that is generated around the atom. A photon is an electric and magnetic field of equal strength which are perpendicular. If the ion has a high enough speed, the strength of the magnetic field generated can reach the strength of the ion’s perpendicular electric field, creating photons. These photons move with the ions in a sort of cloud around it, and when they pass close by each other, the photons collide, creating electron-positron pairs. There is another version of the Breit-Wheeler process which involves single photons decaying into electron-positron pairs. For this to occur the photon must be propagating through a very strong electromagnetic field.

One of the greatest feats performed by magic in stories told throughout history and in modern times is *creatio ex nihilo*, the creation of something from nothing. Technology is advancing at a rapid pace, and we are seeing more and more of our myths and fantasies become reality. As Arthur C. Clarke once said, “any sufficiently advanced technology is indistinguishable from magic”, and while we do not yet have the ability to conjure our greatest desires from thin air, this is a leap in that direction.

In Star Trek, replicators, devices that can create requested items out of pure energy, are commonplace. In such a world, scarcity is all but eliminated and, as long as energy is freely available, all people should have the things they need. However, having enough energy to make this a reality is an enormous challenge. If, in the future, the technology to do this was 100% efficient, meaning all of the energy was used to create the matter, then creating a single glass of water from energy would require almost as much energy as a small country currently uses in a year. Obviously, that is untenable with our current energy infrastructure, but there are theoretical methods of generating energy that could produce at the required rate, none of which would contribute to global warming.

One such method is known as a Dyson sphere. Named after the American theoretical physicist, Freeman Dyson, a Dyson sphere is a theoretical sphere of solar panels built around a star to capture as much energy as thermodynamically possible. If one were built around our sun with solar panels of maximum efficiency, it would produce watts, which is far more than required. With such a high power output, humanity could create more than 15 billion glasses of water per second using perfectly efficient energy-matter conversion.

It's fun to speculate about what we will be able to use this technology for in the far future, but actually using it is very far off indeed. A Dyson sphere would be a prohibitive logistic and financial undertaking in the modern world, and we are also nowhere near the technology required to create replicators in the style of Star Trek. It does, however, seem fitting that these two technologies may require a similar amount of time to become viable.