Developing a More Efficient Fusion Reactor through Computer Modeling

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Producing the conditions necessary for nuclear fusion in current reactor designs requires using more energy than the process of fusion releases. This is due to the level of energy required to overcome the electrostatic repulsion between nuclei when bringing them sufficiently close together to fuse. Overcoming this obstacle, thereby allowing power production through fusion, will provide humanity with a near-limitless source of clean energy. Fusion of the deuterium contained in one cup (8 oz) of heavy water releases enough energy to power a city for a day at a fuel cost of $300 per day (with current heavy water production methods). This would reduce our dependence on fossil fuels; the release of harmful chemicals into the environment and geopolitical instability. The project will develop and use software capable of accurately simulating the motion of charged particles under electromagnetic fields to test new and existing designs for fusion reactors and then improve those designs using a genetic algorithm. It will provide a guide for future research into fusion power and prototyped designs for efficient fusion reactors. Simulations will be programmed using a time-step model, calculating the new location of a particle based on a linear approximation of its motion during a very short period of time (whose duration is the change in time, Δt) assuming constant forces during that period. Because the motion of the particle is continuous and differentiable, this linear approximation will approach the actual motion of the particle for very small values of Δt.