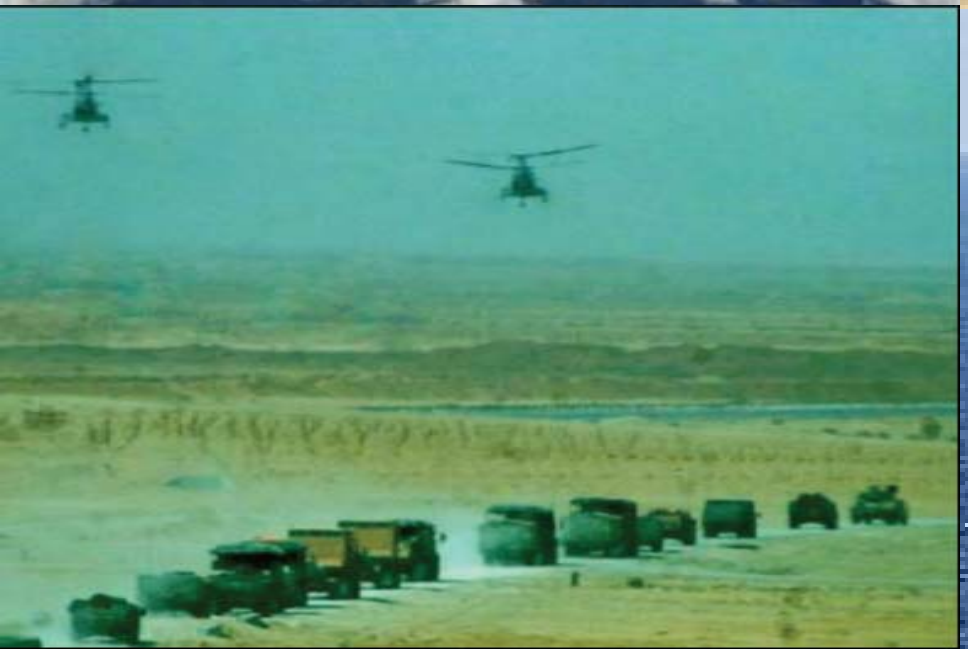
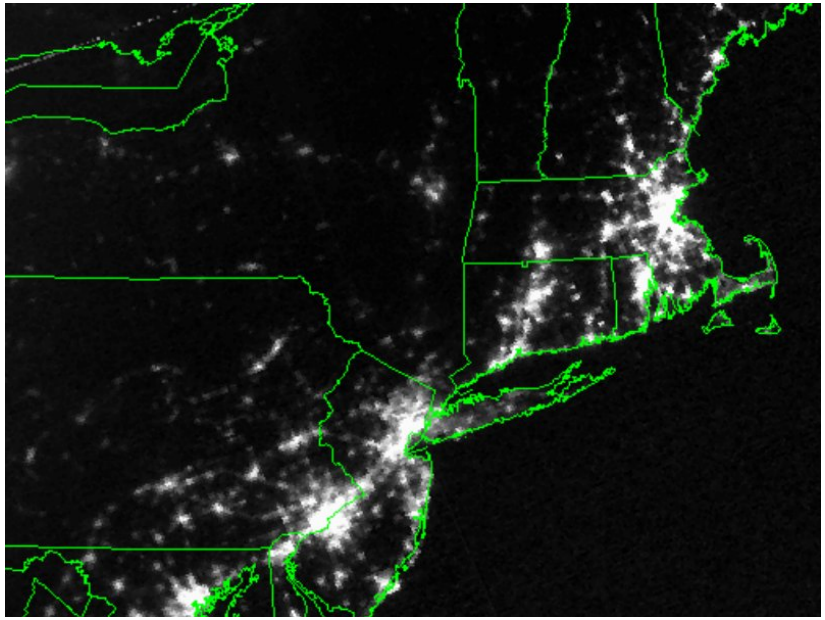
Energy & National Security

An Exploration of Threats,
Solutions and Alternative Futures

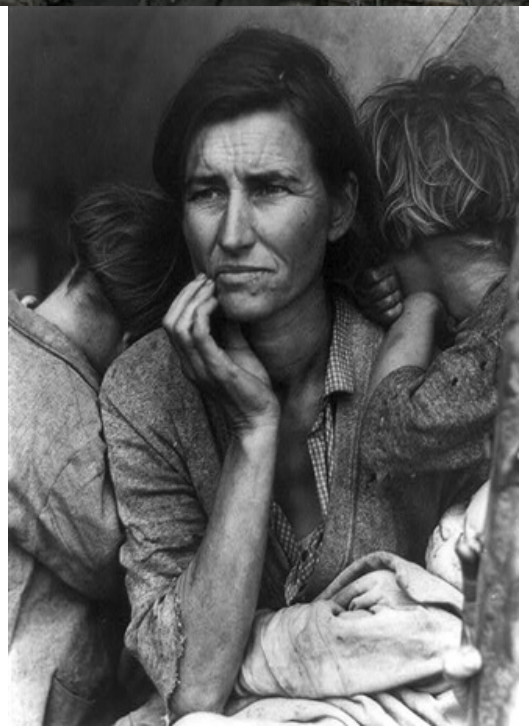
DoD Fuel Use Strategy



Infrastructure Vulnerability



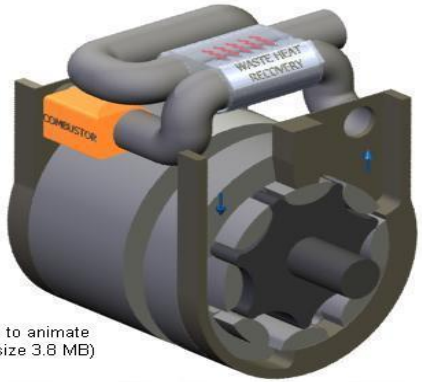
Economic Energy Security



Climate and Implications

Fuel Efficient Platform Design

Engine Efficiency



Click to animate
(file size 3.8 MB)

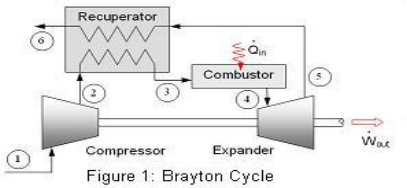
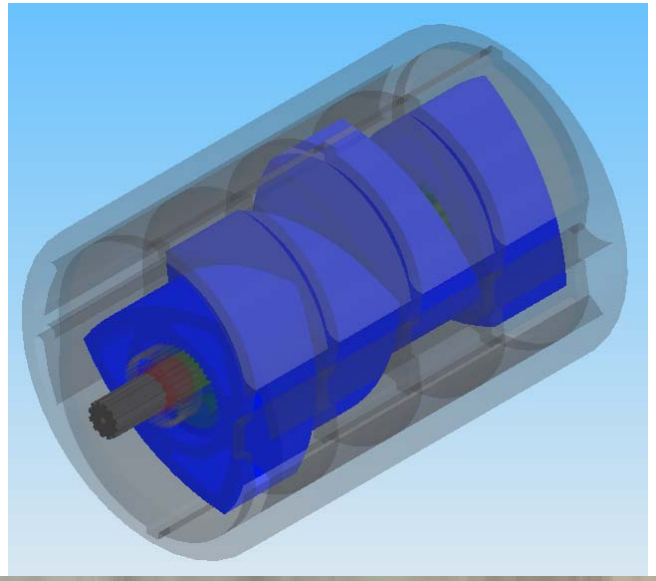
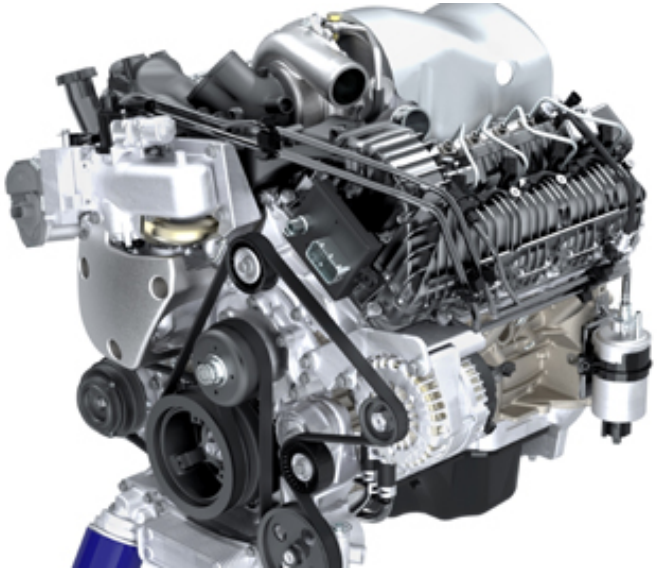
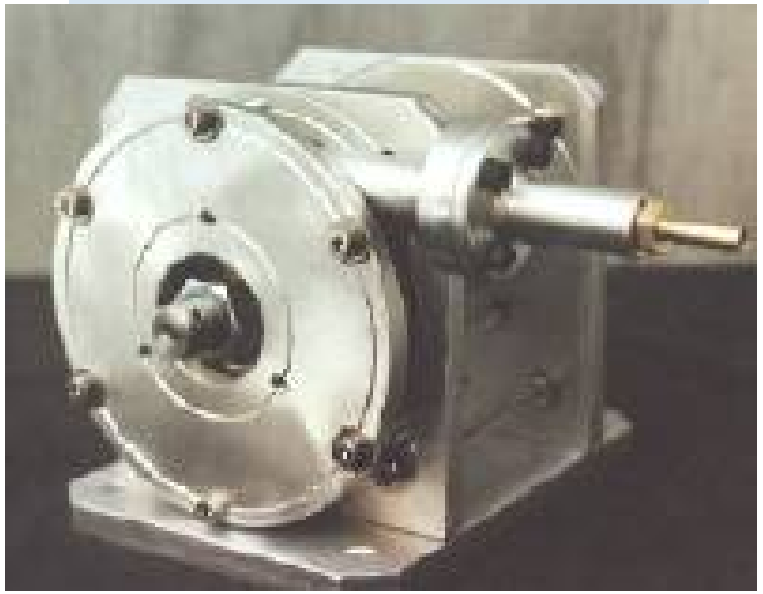


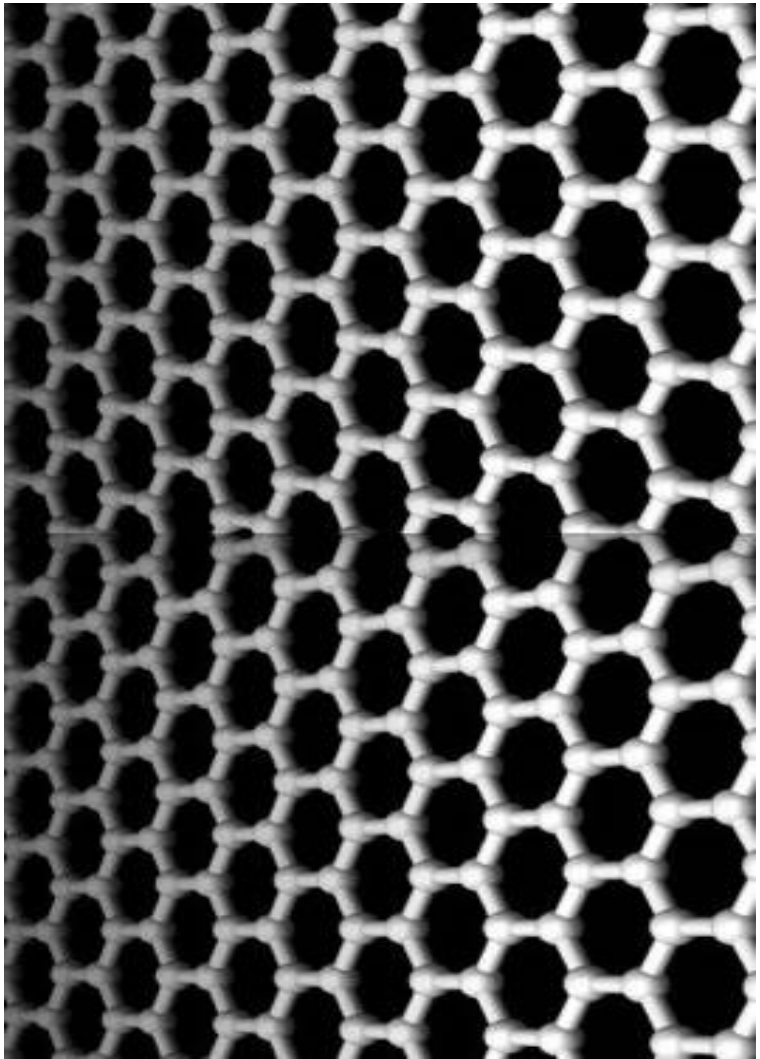
Figure 1: Brayton Cycle



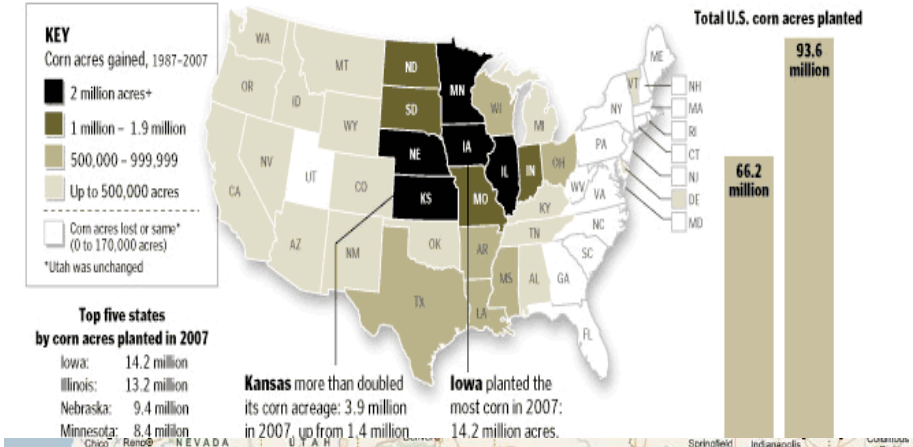


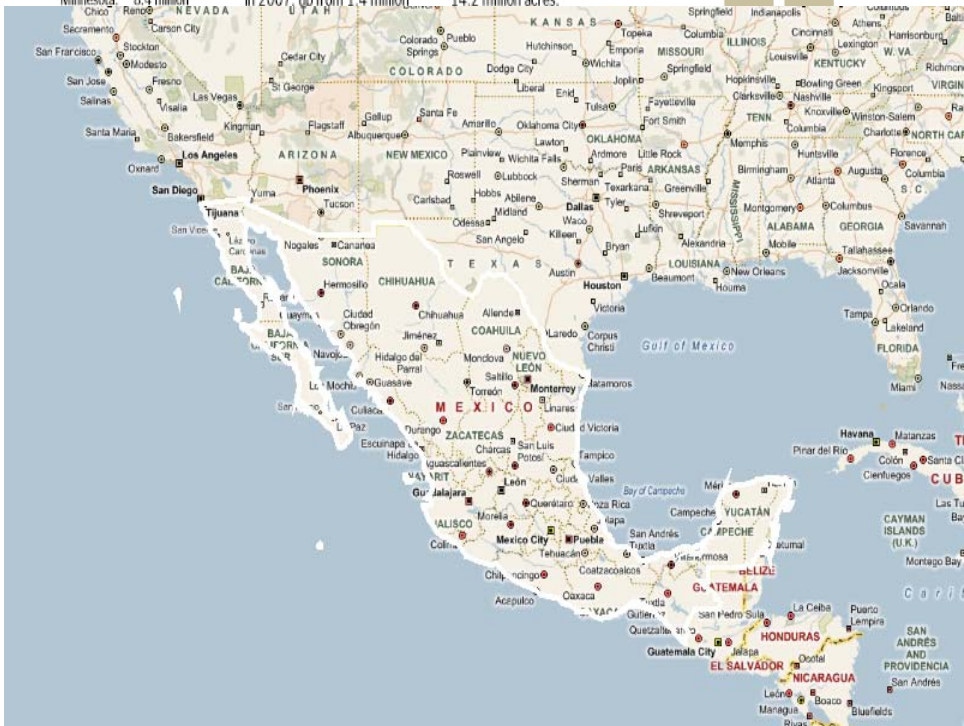


Electric Vehicle Technology



Renewable Synthetic Fuels





Alternative Power and Distribution

DefenseNews March 5, 2007

Fighting for Fusion

Why the U.S. Isn't Funding A Promising Energy T

by WILLIAM MATTHEWS

On Nov. 11, 2005, the day his small fusion reactor exploded in a shower of sparks and metal fragments, even physicist Robert Bussard didn't know what he had achieved.

For 11 years, the U.S. Navy quietly funded Bussard's research. It was a small project with a very large goal: deriving usable energy from controlled nuclear fusion.

Funding ran out at the end of 2005 and Bussard was supposed to spend the tail end of the year shutting down his lab. He kept postponing that in an effort to finish a final set of experiments.

He completed low-power tests in September and October and began high-power testing of the reactor in November.

After four tests Nov. 9 and 10, an electromagnetic coil short-circuited as electricity surged through it, "vaporizing" part of his reactor, Bussard said, and bringing his tests to an end.

"The following Monday, we started to tear the lab down. Nobody had time to reduce the data that was stored on the computer. It wasn't until early December that we reduced the data and looked at it and realized what we had done," he said.

Bussard said he and his small team of scientists had proven that nuclear fusion can be harnessed as a usable source of cheap, clean energy.

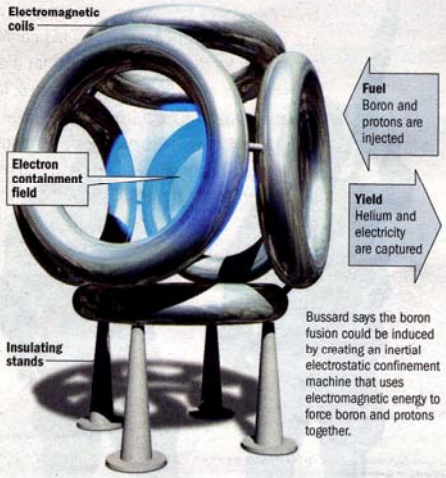
But for more than a year now, Bussard has been unable to move to the next step in his research. At 78, he is in ill health and his scientific allies fear that the long-sought breakthrough he appears to have achieved may fade into obscurity before it can be fully developed.

No small part of the problem is that the U.S. Energy Department has a competing project, and has spent five decades and $18 billion in an as-yet-unsuccessful effort to solve the fusion puzzle.

"Who would believe that a tiny company based on one person could solve the riddle that has es-

BORON FUSION

U.S. physicist Robert Bussard believes that a novel form of atomic fusion based on boron could be harnessed to create electricity cheaply and cleanly, without hydrogen fusion's superhot temperatures, dangerous radiation, and enormous reactors.

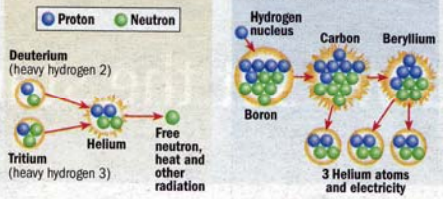


Bussard says the boron fusion could be induced by creating an inertial electrostatic confinement machine that uses electromagnetic energy to force boron and protons together.

FUSION REACTIONS

HYDROGEN: Hot and dirty
- Powers the sun and thermonuclear bombs.
- Yields heat and neutron radiation.

BORON: Non-radioactive
- Could be tested in new kind of machine.
- Yields helium and electricity.



SOURCE: *The Advent of Clean Nuclear Fusion*, Robert W. Bussard, Ph.D., Oct. 2006

DEFENSE NEWS GRAPHIC BY JOHN BRETSCHNEIDER

"Who would believe that a tiny company based on one person could solve the riddle that has escaped literally thousands of researchers?"

Don Gay
Former U.S. Navy engineer

His idea was the basis for the

with deuterium, not boron — in November 2005 proved that the boron process will work.

The boron reactor would be similar to, but more powerful than, the reactor that blew up in 2005.

Bussard's reactor design is built upon six shiny metal rings joined to form a cube — one ring per side. Each ring, about a yard in diameter, contain copper wires wound into an electromagnet.

The reactor operates inside a vacuum chamber.

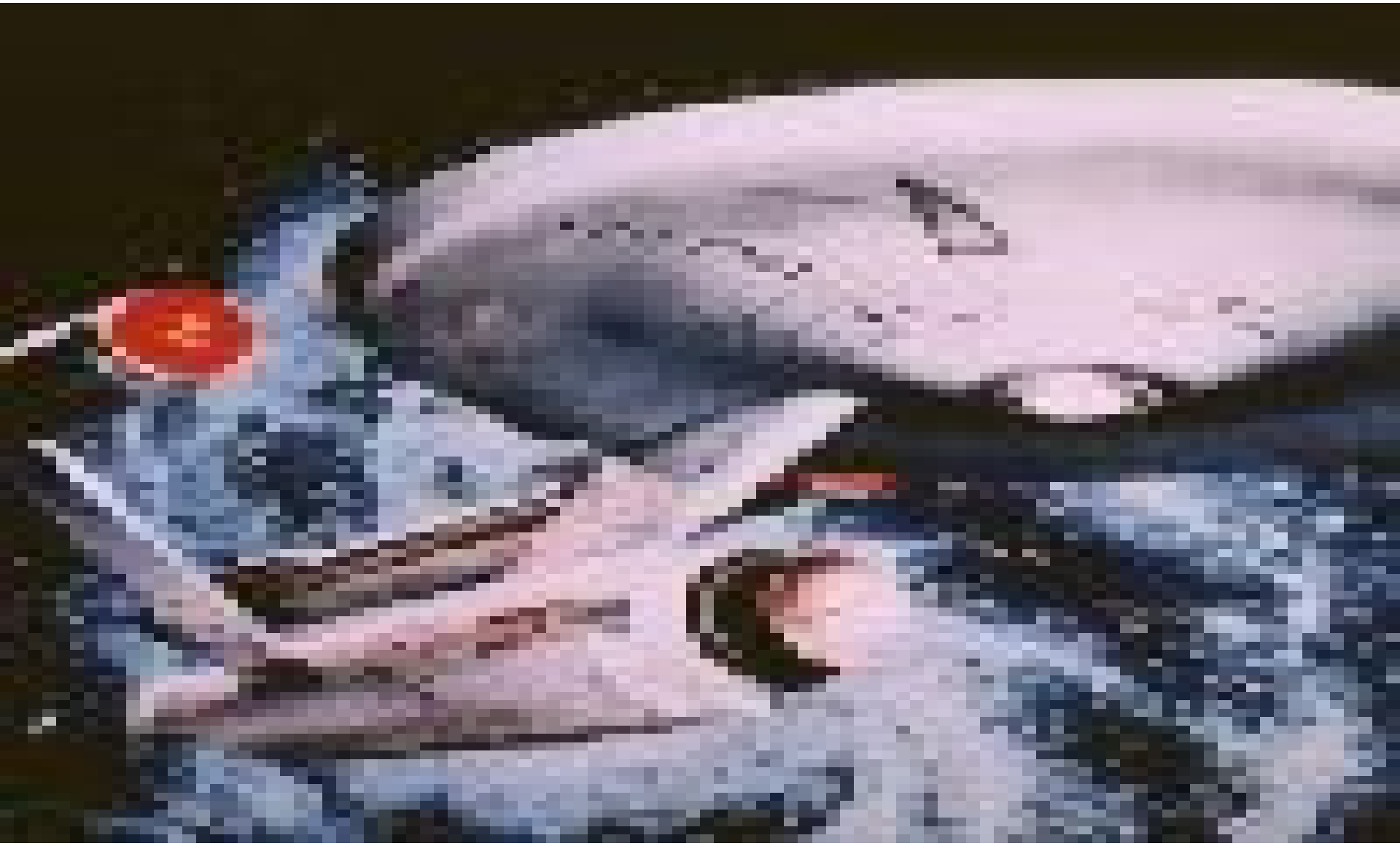
When energized, the cube of electromagnets creates a magnetic sphere into which electrons are injected. The magnetic field squeezes the electrons into a dense ball at the reactor's core, creating a highly negatively charged area.

To begin the reaction, boron-11 nuclei and protons are injected into the cube. Because of their positive charge, they accelerate to the center of the electron ball. Most of them sail through the center of the core and on toward the opposite side of the reactor. But the negative charge of the electron ball pulls them back to the center. The process repeats, perhaps thousands of times, until the boron nucleus and a proton collide with enough force to fuse.

That fusion turns boron-11 into highly energetic carbon-12, which promptly splits into a helium nucleus and a beryllium nucleus.

process does not produce ra-

Quo Vadimus?



BACKUP SLIDES