The Z-particle. Pure energy - no mass at all. It may well be the smallest building block in nature. Matter is nothing but trapped energy.

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SES 194

Energy in Everyday Life

Laser Fusion

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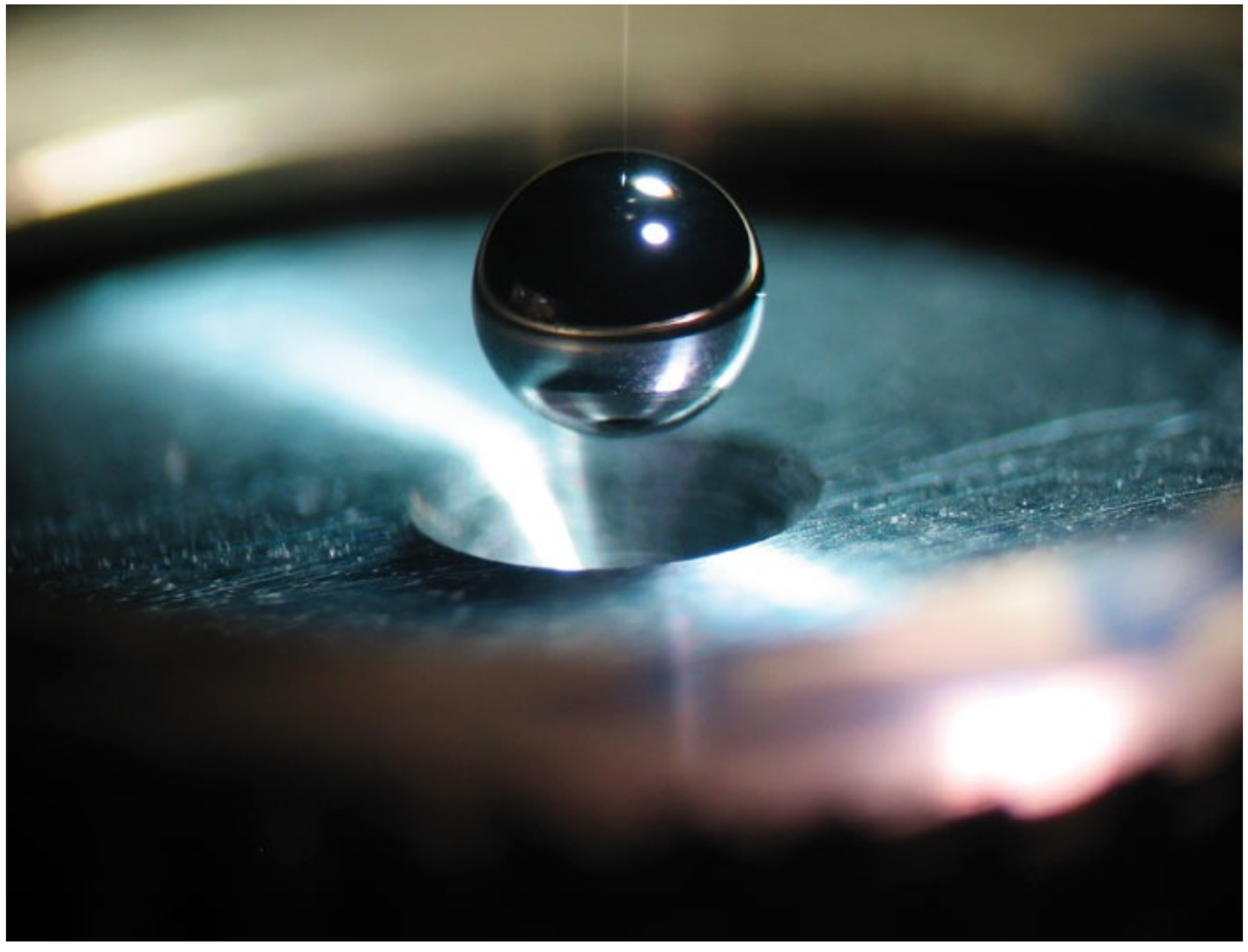
Laser fusion attempts fusion reactions by heating and compressing a fuel target, typically in the form of a pellet contains a mixture of deuterium and tritium.

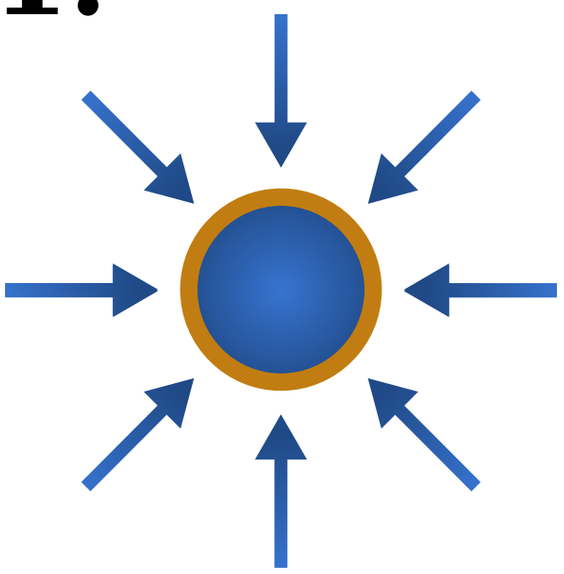
Typical fuel pellets are about the size of a pinhead and contain around 10 milligrams of fuel.



Only a small fraction of the fuel will undergo fusion, but if all this fuel were consumed it would release the energy equivalent to a barrel of oil.

To compress and heat the fuel, energy is delivered to the outer layer of the target using high-energy laser beams.

1.



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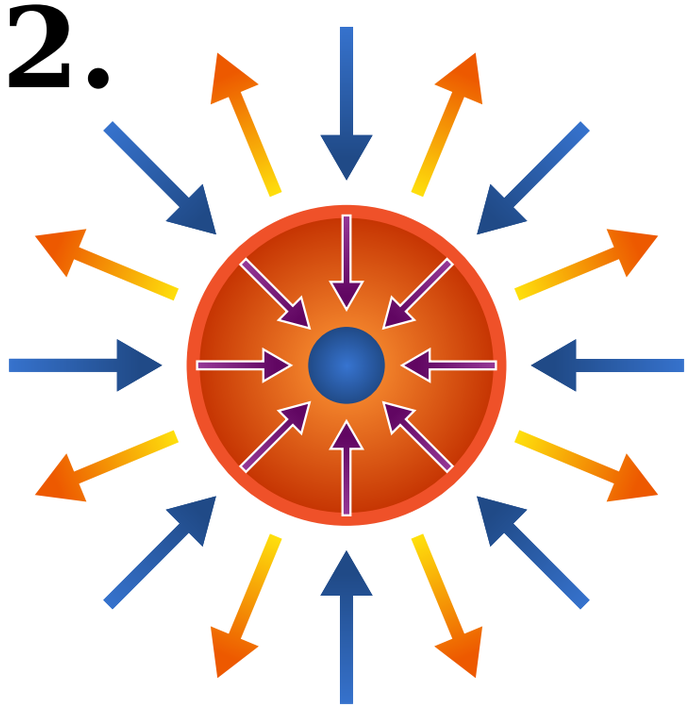

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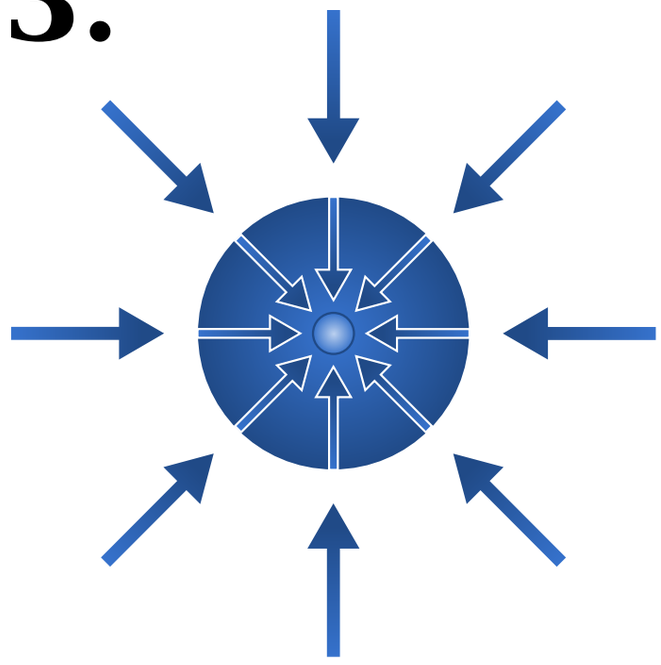

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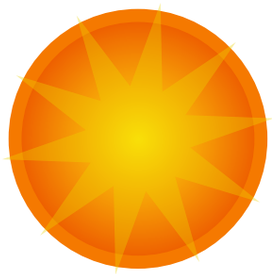
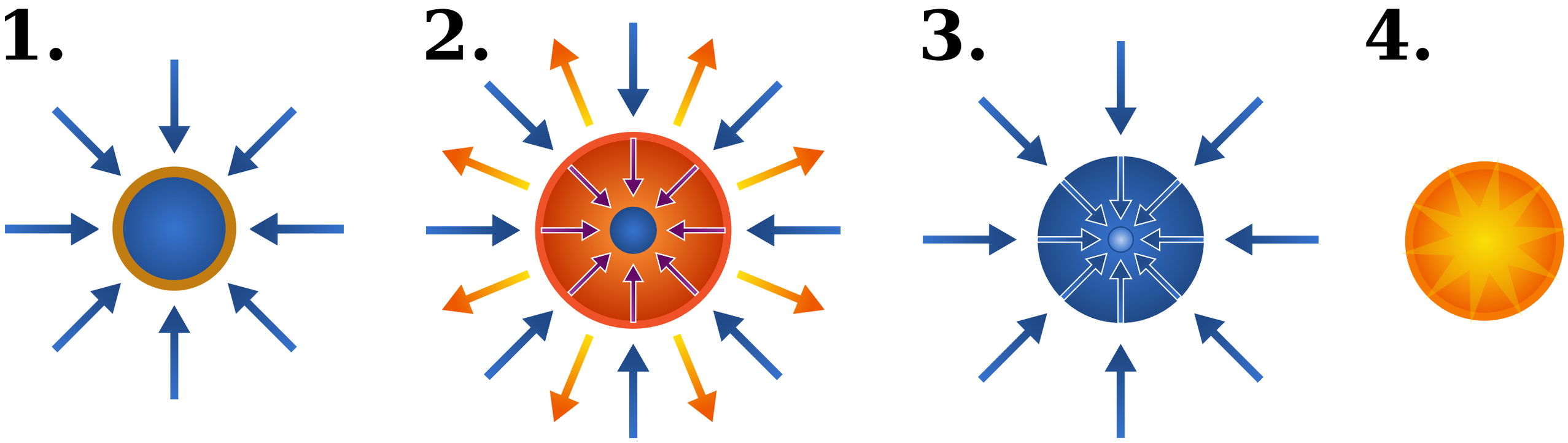


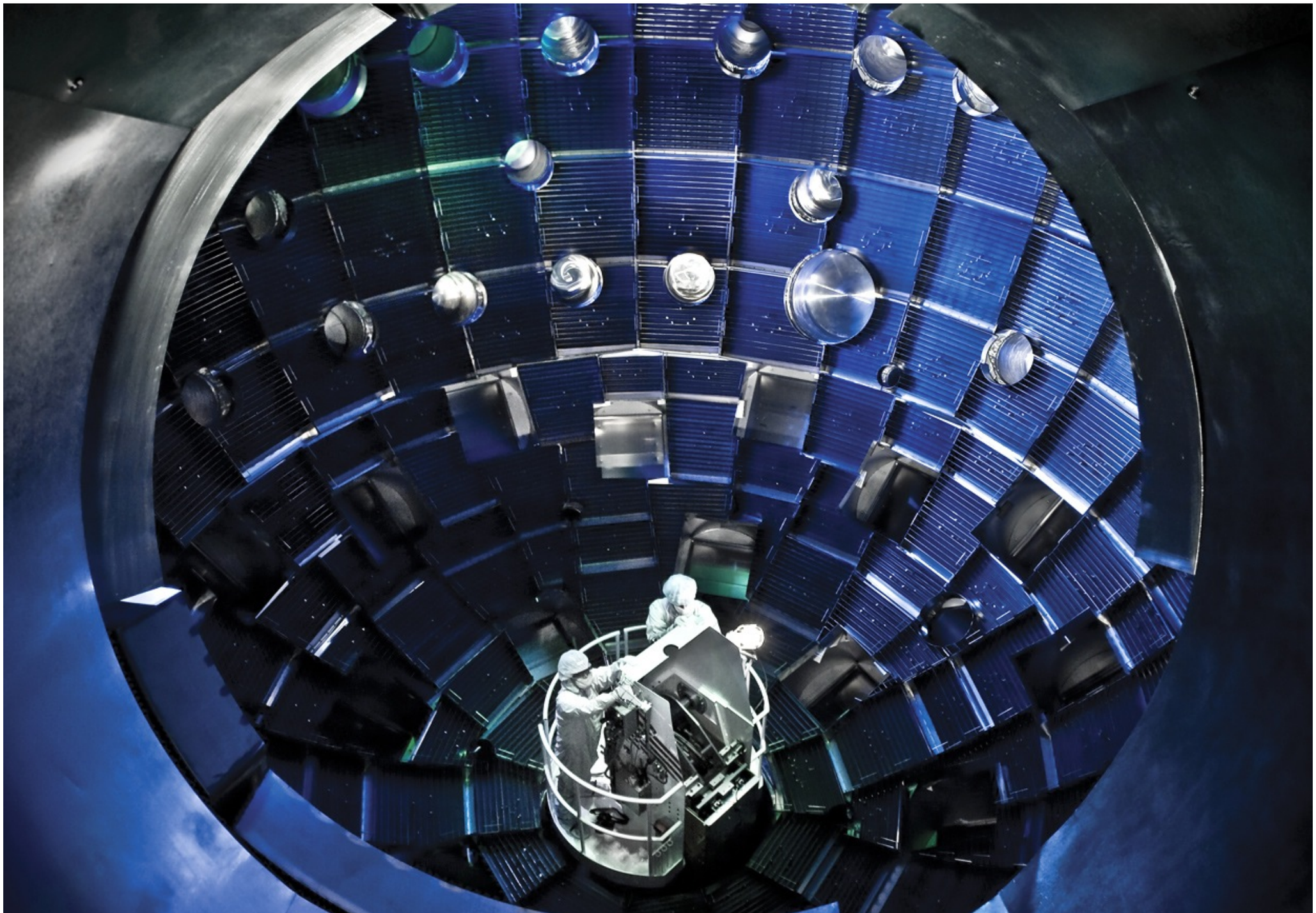
The heated outer layer explodes outward, producing a reaction force against the remainder of the target, accelerating it inwards, compressing the target.

The implosion creates shock waves that travel inward toward the center.

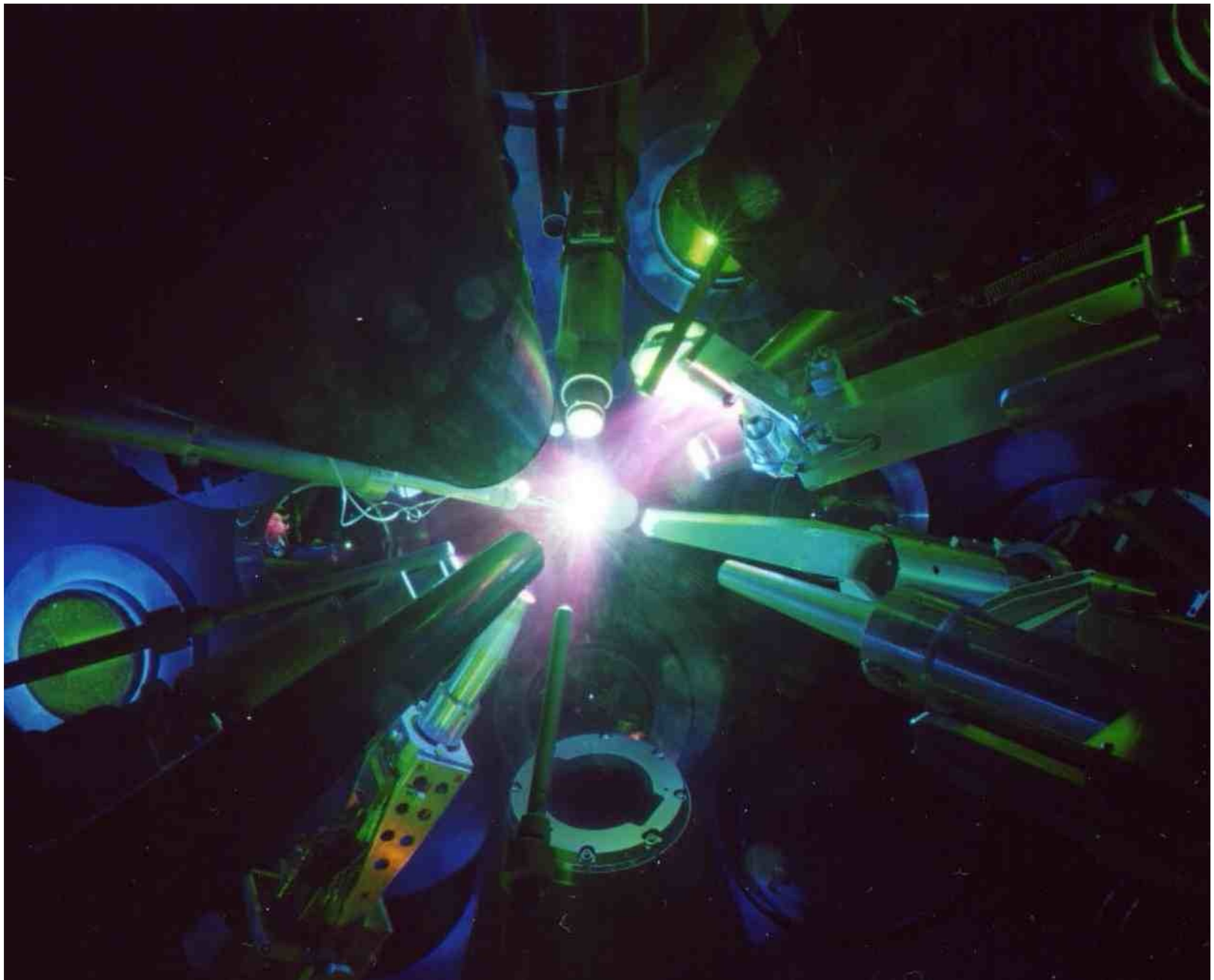


A sufficiently powerful set of shock waves can compress and heat the fuel at the center so much that fusion reactions can occur.

The largest laser fusion facility is the National Ignition Facility (NIF), designed using decades-long experience from earlier experiments.



In 2013, this facility achieved a milestone of having a fuel capsule give off more energy than was applied to it.



The main challenges with laser fusion are accurate energy delivery to the target, controlling symmetry of the implosion, premature heating of the fuel before maximum density is achieved, and premature mixing of hot and cool fuel.