

# China's top weapons scientist says nuclear fusion power is 6 years away

*Stephen Chen*

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The Z-pinch machine – which replicates the fusion reactions of a thermonuclear bomb through magnetic pressure created by an extremely strong electric pulse – is expected to be completed around 2025 in Chengdu the capital of the southwestern province of Sichuan.

The machine will produce 50 million amperes of electricity – about twice as much as the record-holding Z pulsed power facility, a similar device at the Sandia National Laboratory in the US, Peng said.

Nuclear powers like the US, Russia and China have built a number of Z-pinch machines over the past few decades – some of which have never been officially disclosed – to simulate the extreme conditions needed to develop atomic weapons.

These facilities can store a huge amount of electricity and release it in just a few nanoseconds. The electric pulse can create extreme pressure and enough radiation for two lightweight atoms to “fuse” into a heavier one, and give up some mass in the form of energy.

But building a machine that can produce more fusion power output than input is extremely difficult and so far, no country has been successful.

According to Peng's presentation, the Chinese researchers will try to create a nuclear fusion reaction by using the strong electric charge to ignite a small number of the hydrogen isotopes deuterium and tritium.

By carefully controlling the process, they hope to be able to cap the pulse energy released to a few hundred million joules – about as powerful as a 20kg (44lbs) bag of TNT.

And in a departure from previous designs, the fusion energy produced by the Chinese facility will not go to the power grid, but drive a swarm of superfast particles to hit uranium – the fuel which will power the facility's fission component.



A diagram of the overall structure of China's planned Z Fusion Fission Reactor. Photo: China Academy of Engineering Physics

In his conference presentation, Peng said this inclusion of fusion and fission reactors is responsible for the Chinese design's designation as Z-FFR.

The intention is for the walls of the fusion ignition chamber to be filled with uranium which will absorb the flying neutrons produced by the explosion, causing it to split into two lighter elements – the same process used in existing nuclear power facilities.

The uranium fission will increase the facility's total heat output by 10 to

20 times, significantly accelerating the application of fusion energy and making it ready for commercial power production by 2035, according to an estimate by Peng's team.

If China's machine is to succeed, it will need many high-performance capacitors to store the electricity and laser-powered switches that can operate instantly without causing a shortage.

Other challenges include special wires able to transmit the strongest electric currents on Earth, and a peanut-sized target device to efficiently convert electricity to an ignition charge.

Peng said many of these problems had been solved, thanks to new scientific discoveries and technical breakthroughs by Chinese nuclear scientists in recent years. And some of their approaches are fundamentally different from what has been tried in the West.

In its fusion experiments, the Sandia lab tried to start ignition from the centre of the target device. But the Chinese researchers say they have found ignition could more easily be achieved by first creating a thin line of fusion reactions that runs through the target's centre.

This linear approach reduces the complex, three-dimensional problem of squeezing the entire target – at equal pressure from many directions simultaneously – to a one-dimensional issue, Peng said.

The Chinese approach significantly simplifies the physical models for computer analysis while relaxing the demand for energy input, he said. "This is a big innovation."





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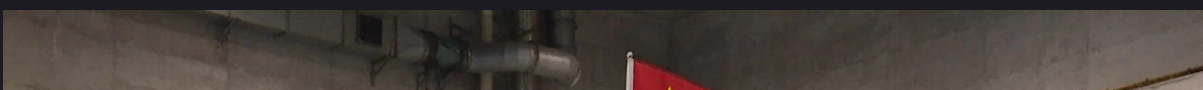
China sets new world record in development of ‘artificial sun’

The researchers said the future power plant could use natural uranium ore, the nuclear waste produced by today’s reactors, or thorium, which could meet energy demand for thousands – or even tens of thousands – of years while producing little radioactive waste.

And because the fusion explosion will happen only once every 10 seconds, it will be incapable of generating enough energy to start a chain reaction and cause a meltdown, making the design safe and suitable for most places on Earth, they said.

The Z machine is just one of a range of methods – including powerful lasers and hot plasma caged in a magnetic field – being tried and tested by China and other countries in the race to achieve fusion ignition.

A number of giant facilities are in development around the world, with most aiming for commercial power production by the middle of this century.





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Chinese scientists experiment with gaining limitless clean energy through fusion reactions

A Beijing-based nuclear physicist, who asked not to be named because of the issue's sensitivity, said that while the Z machine has some unique advantages, it also presents some difficult problems that may affect its mass application.

The electric power source, for instance, will need to generate and release charges at a high frequency every few seconds, putting an enormous strain on the capacitors and other components, the physicist said.

In addition, the target device will need to be replaced after each explosion,

while the reactor chamber will need to withstand thousands of explosive shocks per day.

But whether ignition can be achieved, one thing is certain, according to the physicist: the facility will be a “mega lab” for cutting edge research on everything from Big Bang physics to new weapons.