How to calculate the ideal ingredients for nuclear fusion with the most energy

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Nuclear fusion is regarded as the energy of the future. It does not emit CO_2, it is safe and it provides a lot of energy that can easily supply large cities with electricity. Nuclear fusion is very interesting in theory, but not yet in practice. Scientists have already succeeded in making nuclear fusion happen, but to make it profitable a lot of research still needs to take place in the coming years. TU/e researcher Michele Marin takes his part with his research on nuclear fusion plasma.

Nuclear fusion is a significantly different energy source than the energy that is currently generated using coal-fired power plants. Or solar energy or wind power. Nuclear fusion is not dangerous. Unlike nuclear power is does not create radioactive waste. It's a bit like a sun in a box. Hydrogen nuclei collide hard, fuse together and provide a lot of energy. Just like a sun. But trapping a sun in a box is a different matter.

Artificial Sun

Yet that is what scientists are trying to do with special reactors, the tokamaks. In these reactors hydrogen nuclei collide with great force and are trapped by magnets. It produces plasma full of energy. But how do you get the ideal ingredients for plasma with as much energy as possible? TU/e researcher Michele Marin used a model to find out. He discovered that the hydrogen elements deuterium and tritium mix with each other faster than previously thought.

His model also calculated the influence of impurities in the hydrogen mixture. Impurities in the mixture can dilute the fuel, which is a disadvantage. But it can also help fusion. This is because the walls of the tokamak face extreme heat and forces during nuclear fusion. Thanks to radiation, they are less affected by heat waves from the plasma that is created to enable nuclear fusion, which makes the material more stable.

Furthermore, adding the substance neon to the mixture can have a positive effect by creating a higher temperature in the core itself. Marin's simulation models will be used in the coming years in the experiments of JET, one of the European tokamaks. It brings the energy of the future a little closer.

Michele Marin will receive his doctorate September 1 on his thesis titled: "Integrated modeling of multiple ions discharges: validation and extrapolation."

Provided by Eindhoven University of Technology

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