Quarks, leptons, photons, gluons – the world of physics features a bewildering diversity of particles – a veritable "particle zoo". What's more, some of these minuscule building blocks of matter occur in several different forms. One of the most abundant particles in the universe, the neutrino, exists in three types that are constantly transforming into one another in a phenomenon known as oscillation. This has wide-ranging consequences. For a long time, it was assumed that neutrinos had no mass – in other words, that they weighed nothing at all. But with absolutely no mass, oscillation between the three types of neutrino would quite simply be impossible.

Now, in order to measure the tiny mass of a neutrino, scientists have developed the most precise weighing scale in the world. Dubbed KATRIN, this scale is located at the Karlsruhe Institute of Technology (KIT) and consists of a high-precision spectrometer and an extremely strong tritium source. When this heavy variant of hydrogen undergoes radioactive decay, one electron and one neutrino are emitted. The energy released in this process is divided between the two particles – and the neutrino carries off at least as much energy as corresponds to its mass. Accordingly, the spectrometer data allows the scientists to draw conclusions about the "weight" of the neutrino.

The team led by Susanne Mertens from the Max Planck Institute for Physics is part of this international experiment. In 2019, the researchers calculated the mass of a neutrino for the very first time. The result: its mass is less than an electron volt. This is the world's most accurate value so far, but the KATRIN scientists are certain that far greater precision can be achieved.

THE MOST ACCURATE WEIGHING SCALE IN THE WORLD: THE KATRIN EXPERIMENT IN KARLSRUHE.

ON LOCATION

7

PHOTO: MARKUS BREIG/KIT