New particles get a mass boost

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A sophisticated, new analysis has revealed that the next frontier in particle physics is farther away than once thought. New forms of matter not predicted by the Standard Model of particle physics are most likely twice as massive as theorists had previously calculated, according to a just-published study.

The discovery is noteworthy because experimental improvements of this magnitude rarely occur more often than once in a decade.

To see the infinitely small bits of matter that make up our universe, physicists build ever more powerful accelerators, which are the microscopes they use to see matter. But while the trend is to more powerful accelerators, the precision achieved by some less powerful ones can pinpoint the best places to look for never-before-seen particles.

Scientists at the Department of Energy's Thomas Jefferson National Accelerator Facility combined data from experiments in which electrons were used to precisely probe the nucleus of the atom. The experiments were designed to study the weak nuclear force, one of the four forces of nature. The effects of the weak force on the building blocks of the proton, up and down quarks, were determined precisely from this data and were found to be in agreement with predictions.

But when this new analysis was combined with other measurements, it raised the predicted mass scale for the discovery of new particles to about one Tera-electron-volts (1 TeV) - more than a factor of two higher than previously thought, according to Jefferson Lab scientists who

published the result in *Physical Review Letters*.

Searches for new particles can take the form of direct production of new particles by high-energy interactions or by lower-energy, extremely precise measurements of experimental observables, which are sensitive to the existence of new particles beyond the ability of existing theories to predict.

Source: Jefferson Lab