Five in Five

Lucas Platter wins the department's fifth NSF CAREER grant five years

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Lucas Platter is taking nuclear theory into territory where experiment can't go, devising methods to more accurately describe important nuclear processes—like how energy is generated in the sun. The research has won a five-year Faculty Early Career Development (CAREER) grant from the National Science Foundation, making it the fifth CAREER grant for the department in as many years and the second in 2016 alone.

Assistant Professor Lucas Platter has won an NSF CAREER grant to more accurately describe important nuclear processes. His is the fifth CAREER grant for UT Physics in five years.

Platter, an Assistant Professor, will study "Uncertainty Estimates in Low-Energy Nuclear Physics." Working with students and postdocs, he uses numerical methods to calculate nuclear reactions and quantify uncertainties that can't be measured with existing tools—how two protons fuse to form a deuteron in the sun, for example. His approach uses effective field theory (EFT), which he defined as "describing the physical process with a minimal set of assumptions to obtain a desired accuracy."

The project will focus on using EFT to explain electroweak processes, which combine electromagnetism and the weak interaction, two of the fundamental interactions in physics.

"Certain aspects of electromagnetic processes are related to weak processes," Platter said. "It's called electroweak because essentially they're two sides of the same coin."

In this case those processes fall into two categories of EFT studies: "pionfull" and "pionless." A pion comprises a quark and an antiquark. Much like a Knoxvillian is also a Tennessean, a pion is also a meson —a subatomic particle that helps bind the components (or nucleons) of an atomic nucleus.

"If you scatter two nucleons at very high or medium energies, in order to describe that scattering appropriately, you need to include the fact that pions are exchanged between the two of them and the pion mediates the interaction," Platter explained. "But if you go to very, very low energies you don't see the pion anymore, so the nucleons simply look like atoms or like particles that scatter somehow."

In the pionless EFT approach, he will study the decay half-life of tritium, an isotope of hydrogen that decays into Helium-3.

"That particular process fixes a parameter that is really relevant for proton-proton fusion, which is something that happens in the sun all the time," Platter said. "It's the starting point of the energy generation in the sun."

While this has been studied previously using different methods to pin down theoretical uncertainties, Platter's research will investigate the process within a single theoretical approach.

The grant's second aspect involves studying the intrinsic error in Hamiltonians—functions that describe a system's energy based on momentum and positional coordinates—and the associated electroweak currents generated in "pionfull" EFT. Those results will help Platter and his collaborators improve calculation accuracy in decay rates or half-life times that physicists already observe and measure. The research contributes to the way nuclear theory is constructed.

Joining Platter in the NSF research are graduate students Sam Emmons and Daniel O'Dell. He also has funding for undergraduate Jose Bonilla, who has been working with him since May through the department's summer fellowship program.

In the past five years, UT's physicists have won five CAREER grants from the National Science Foundation to study complex systems (Norman Mannella), frustrated materials (Haidong Zhou), bacterial organization (Jaan Mannik), and neutron stars (Andrew Steiner). Steiner's award began July 1, 2016, the same day as Platter's. The latter is a $430,00 grant that runs through June 2021.

The Faculty Early Career Development (CAREER) Program offers the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations.

More information online:

- **Lucas Platter's NSF CAREER Grant (http://www.nsf.gov/awardsearch/showAward?AWD_ID=1555030)**
- **Lucas Platter's Website (http://web.utk.edu/~lplatter/Site/Welcome.html)**