INSTITUTE OF NUCLEAR & PARTICLE PHYSICS
INPP
@OHIO UNIVERSITY

Two-neutron halos and the neutron-neutron scattering length

Matthias Göbel
Technical University Darmstadt

Two-neutron halos are exotic nuclear systems with two neutrons well separated from a more tightly bound core. They offer interesting opportunities to study nuclear physics away from stability. These halos, which can be well described using halo effective field theory (halo EFT), are not only exciting systems on their own but also offer new possibilities to study the fundamental neutron-neutron interactions.

The s-wave neutron-neutron scattering length, the leading-order parameter of this interaction, is not yet well known. Precision experiments conducted in the late '90s and early '00s produced a range of values from -16.3(4) fm to -18.7(7) fm. I will talk about a new experiment proposal approved at RIKEN to measure the final neutron-neutron relative-energy distribution of the high-energy knockout reaction He-6(p, p' alpha)nn. The scattering length can then be deduced from this distribution by comparing it to theoretical predictions parameterized by the scattering length. I will focus on our theoretical efforts to calculate this distribution in a systematic manner with robust uncertainty estimates using halo effective field theory [Phys. Rev. C 104 (2021) 2, 024001]. Our work emphasized accurate description of the neutron-neutron final-state interaction and found that the distribution is quite sensitive to the variation of the scattering length: varying this parameter by 2 fm changes characteristic parts of the distribution by 10%.

In the last part of my talk I will show that the neutron-neutron relative-energy distribution also provides opportunities to learn about different s-wave two-neutron halo nuclei, such as Li-11, Be-14, B-17, B-19, and C-22. I will show that this distribution can be predicted by an approach that exploits the universality of two-neutron halos as Borromean three-body bound states beyond the classical regime.

Tuesday, November 1st, 2022

4:00 pm

Lindley Hall room 321