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Challenges ahead in atomic, molecular, and nuclear few-body physics

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In ultracold atomic physics and in nuclear physics, the interactions are often very close to the regime of universality, with near-infinite scattering lengths. Using a variety of tools, such as correlated Gaussian basis set expansions, effective field theory, and Monte Carlo methods, significant progress has been achieved during the past decade to compute bound state properties and in some cases resonance positions and widths. But the description of collision processes, e.g. for systems with 5-10 atoms or nucleons, has lagged far behind and has far less quantitative capability. This is especially problematic for processes where the initial or final state of the system has 3 or more particles or composites in the continuum. I will discuss some such problems, and broaden out the discussion to discuss the collisional electronic structure problem as well, for electron collisions and photo-processes involving increasingly complex molecules and even heavy atoms.

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