Project in nuclear astrophysics: "Development of a model of electron-induced dissociation of nuclei to infer reaction rates of astrophysical interest"

Since stars are nuclear powered, accurate stellar models require a good estimate of the cross sections for the nuclear reactions that take place in stars. Unfortunately, these reactions takes place at such a low energy, that they are usually impossible to measure directly in the laboratory. To obtain the correspond cross sections, astrophysicists rely on theoretical models and indirect measurements. At Mainz, we plan to develop a new indirect technique to measure the "holy grail" of nuclear astrophysics: the radiative capture 12C(alpha,gamma)16O. In that reaction a 12C nucleus absorbs an alpha particle to form 16O. This reaction is key to understand the production of 16O in the universe. The indirect method uses the time-reversed reaction, in which the dissociation of a 16O nucleus into an alpha particle and a 12C is induced by a high-intensity electron beam. To support the experimental effort, predict the reaction rates, and properly analyse the data, we need to develop a model of the reaction that properly takes into account the structure of 16O. This project of course has a strong theory part, but it also includes a significant collaboration with the experimental team.

Prerequisites are a good knowledge of non-relativistic quantum mechanics and basic notions of nuclear physics. Knowledge of quantum collision theory and astrophysics is a plus.