PREFACE

The Third ANL/MSU/JINA/INT RIA Theory Meeting was held at Argonne National Laboratory from 4 – 7 April, 2006. It was one of a series of workshops that are hosted in a rotating fashion among the sponsoring institutions. The series was established to explore, explain and support the case for an advanced exotic-beam facility from a theoretical-physics perspective, and to encourage the theoretical work that will be needed to interpret experiments once such a facility is built.

An advanced exotic-beam facility has been a recognized priority of the US nuclear physics community since the 1996 Long-Range Plan formulated by the Nuclear Science Advisory Committee (NSAC). It is vital for the future of low-energy nuclear physics and will produce advances: in understanding the nature of nuclei and nuclear matter; in explaining the origins of the chemical elements and the workings of stars; and in testing the standard model of particle physics. During the period since the Long Range Plan the need for such a facility has been reiterated many times by NSAC, by the broader nuclear physics community, and by the Department of Energy (DOE). Moreover, although the Rare Isotope Accelerator (RIA) concept was materially modified shortly before this third meeting took place, both the community and DOE remain firmly committed to such a facility. Indeed, the charge letter requesting NSAC to prepare a new long range plan states that "... the projected funding for DOE is compatible with [...] commencing construction of the proposed Rare Isotope Accelerator early in the next decade."

The first two meetings in this series focused on specific areas of nuclear theory. The topic of the first, held at the Institute for Nuclear Theory (INT), was the astrophysical r-process. The second, held at Michigan State University (MSU), concentrated on the present state of nuclear reaction theory. Owing to the timing of this third meeting, we wanted the presentations, the discussions and, indeed, the proceedings volume to cover a broader range of topics in current nuclear theory. Sessions were organized on: dynamic symmetries in nuclei; fundamental symmetries; nuclear structure; and nuclear astrophysics. With broad consultation, including input from Francesco Iachello and Wick Haxton, we recruited a collection of speakers to give a thorough overview of topics at the leading edge of nuclear theory. In addition, we encouraged participation from the wider nuclear physics community, both experiment and theory. There were sixty-six registered participants, and we are grateful to all for their involvement and for making an effort to address the issue we identified; namely: "What questions does your research pose that only an exotic beam facility can answer?"

The picture which emerged from the presentations is that progress is being made in a broad range of distinct but overlapping areas within nuclear theory. This is captured in the contributions to this volume, which span a wide range of topics, from the lightest nuclei to some of the heaviest, from *ab initio* to phenomenological approaches, from "pure" nuclear physics to challenging astrophysical problems that require proper accounting for nuclear properties. An expansion of the range of measurable nuclear properties beyond present capabilities will present new constraints and new challenges for the theoretical approaches discussed in each of the chapters in this volume.

We set aside thirty minutes at the end of each session for discussion in an open forum; these discussions were often lively. Such discussion, with broad representation from across the nuclear physics community, is important to get theory launched on a trajectory that will both support and profit from experiments at the next generation of experimental facilities. It is our hope that the conversations begun at Argonne have continued over the subsequent months in university corridors and conference centers, and that the present volume of proceedings from the workshop will help that discussion evolve into fruitful action.

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