Isospin physics with heavy-ion reactions

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The ultimate goal of studying isospin physics via heavy-ion reactions with neutron-rich, stable and/or radioactive nuclei is to explore the isospin dependence of in-medium nuclear effective interactions and the equation of state of neutron-rich nuclear matter, particularly the isospin-dependent term in the equation of state, i.e., the density dependence of the nuclear symmetry energy. Because of its great importance for understanding many phenomena in both nuclear physics and astrophysics, the study of the density dependence of the nuclear symmetry energy has been the main focus of the intermediate-energy heavy-ion physics community during the last decade, and significant progress has been achieved both experimentally and theoretically. In particular, a number of phenomena or observables have been identified as sensitive probes to the density dependence of the nuclear symmetry energy. Experimental studies have confirmed some of these interesting isospin-dependent effects and allowed us to constrain relatively stringently the symmetry energy at sub-saturation densities [1]. The impacts of this constrained density dependence of the symmetry energy on the properties of neutron stars have also been studied, and they were found to be very useful for the astrophysical community. With new opportunities provided by the various radioactive beam facilities being constructed around the world, the study of isospin physics is expected to remain one of the forefront research areas in nuclear physics. We have published an comprehensive review on the major progress achieved during the last decade in isospin physics with heavy ion reactions and discuss future challenges to the most important issues in this field [2].

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