Tuesday

Aug. 22st

At 3:45pm

Systematic Studies of Proton-Induced Spallation Reaction

Abstract:

Spallation, namely the interaction of a high-energy proton or neutron with a heavy nucleus, has recently gained practical importance due to its numerous applications including a) innovative energy production schemes (e.g. accelerator driven systems) and the transmutation of nuclear waste b) spallation neutron facilities employing the neutrons as probes for material or biological studies c) the interaction of cosmic rays with interstellar bodies, the radiation damage of electronic devices and the radiation dosimetry of man in space and d) the production of medical radionuclides. A large amount of experimental data on spallation fragment properties has been collected by various groups. The theoretical description has been traditionally based on a two-step phenomenology: the dynamical intranuclear cascade stage followed by the deexcitation stage that includes nucleon evaporation, fission or multifragmentation. The primary goal of the present work is to describe the complete dynamics of the spallation process using the microscopic Constrained Molecular Dynamics (CoMD) model [1,2]. The code implements an effective interaction with a nuclear-matter compressibility of K=200 (soft EOS) with several forms of the density dependence of the nucleon symmetry potential. The CoMD code imposes a constraint in the phase space occupation for each nucleon restoring the Pauli principle at each time step. Proper choice of the surface parameter of the effective interaction has been made to describe the fission/residue competition. We compared the CoMD results with recent experimental data from the literature and with calculations we performed with a two-stage framework combining the INC code ISABEL and the deexcitation code SMM. We obtained mass yield curves, fission and residue cross sections and neutron multiplicities for the proton spallation of targets 238U, 208Pb, 181Ta and 197Au in the energy range 200-1000 MeV. The choice of these targets was motivated by the availability of experimental data and the importance of these materials in applications. Our calculations showed an overall satisfactory agreement with the experimental data and indicate further improvements in our models. Systematic calculations of the above reactions and extensive comparisons with experimental data are currently in progress. Our results to date indicates that the microscopic CoMD approach is able to describe the complicated N-body dynamics of the spallation/fission process. Further systematic calculations and improvements are in line. We hope these efforts may lead to advancements in the physics-based modeling of the spallation process.

[1] M. Papa, A. Bonasera et al , Phys. Rev. C 64, 024612 (2001).
[2] N. Vonta, G.A. Souliotis, M. Veselsky, A. Bonasera, Phys. Rev. C 92, 024616 (2015).
[3] A. Assimakopoulou, G.A. Souliotis, A. Bonasera et al. in preparation

TEXAS A&M UNIVERSITY

CYCLOTRON COLLOQUIUM

George A. Souliotis

Professor

Department of Chemistry

National and Kapodistrian University of Athens, Athens, Greece

CYLOTRON INSTITUTE

Room 228

Refreshments will be served at 3:30pm