Dynamical and Statistical Fragment Production In Heavy-ion Collisions

W. Gawlikowicz[1,2], J. Tõke[1], W.U. Schröder[1], R.J. Charity[3] and L.G. Sobotka[3]
[1] *University of Rochester, Rochester, NY 14627, USA*
[2] *Heavy-Ion Laboratory, Warsaw University, Warsaw, Poland*
[3] *Washington University, St.Louis , MO 63130, USA*

Mechanisms of particle production were studied in $^{136}Xe+^{209}Bi$ reactions at E/A = 28, 40, and 62 MeV, using two 4π set-ups for neutrons and charge particles detection. Correlations between the kinetic energy and the deflection angle of projectile-like fragments (Wilczyński plot) are seen to exhibit features characteristic of dissipative orbiting, commonly found at bombarding energies of a few MeV/nucleon above the interaction barrier, but also reported in the Fermi-energy domain. The reaction cross section is dominated by dissipative binary reactions of well-defined *projectile- and target-like fragments*. The reproduced excitation energy division between the projectile- and target-like fragments shows a clear transition from equal excitation energy division scenario, for low total excitation energies, to equal temperatures scenario for high total excitation energies. On the other hand, the Galilei-invariant velocity distributions of various charged reaction products, show presence of a third, *intermediate-velocity source* of emitted fragments . While the production of light-charged particles can be attributed mainly to evaporation from excited projectile- and target-like fragment, an intermediate-velocity source appears responsible for large amount of the observed intermediate-mass fragment yields for high excitation energies. Fragments emitted from the intermediate-velocity source appear to be produced *dynamically* in the overlap zone of the projectile and target nuclei. The experimental multidimensional joint distributions of neutrons and charged reaction products were found to exhibit several different types of prominent correlation patterns. It makes them a useful tool for probing reactions scenarios, different from the traditional approach of interpreting inclusive yields of individual reaction products.