PROBING QUASIFISSION IN REACTIONS FORMING Rn NUCLEUS

A. Shamlath[1], E. Prasad[1,†], P. V. Laveen[1], N. Madhavan[2], J. Gehlot[2], A. M. Vinodkumar[3], A. K. Nasirov[4], G. Giardina[5], G. Mandaglio[5], S. Nath[2], M. Shareef[1], Tathagata Banerjee[2], A. Jhingan[2], T. Varughese[2], DVGRKS Kumar[6], P. Sandya Devi[6], Khushboo[7], P. Jisha[3], Neeraj Kumar[7], M. M. Hosamani[8], and S. Kailas[9]

[1] Department of Physics, Central University of Kerala, Nileshwar, 671314, India
[†] Department of Nuclear Physics, Australian National University, Canberra ACT, Australia
[2] Inter University Accelerator Centre (IUAC), Aruna Asaf Ali Marg, New Delhi, 110067, India
[3] Department of Physics, University of Calicut, Calicut, 673635, India
[4] BLTP, Joint Institute for Nuclear Research, Joliot-Curie 6, Dubna, 141980, Russia
[5] Dipartimento di Fisica e di Scienze della Terra dell'Università di Messina, 98166, Italy
[6] Department of Nuclear Physics, Andhra University, 530003, India
[7] Department of Physics Astrophysics, University of Delhi, New Delhi, 110007, India
[8] Department of Physics, Karnatak University, Dharwad, 580003, India and
[9] UM-DAE Centre for Excellence in Basic Sciences, University of Mumbai, 400098, India

The mechanism of heavy-ion fusion becomes significantly different in the reactions involving heavy, more symmetric reaction partners compared with their asymmetric counter parts, with an increasing probability for the non-equilibrium processes severely hindering the formation of the compound nucleus (CN). The largest uncertainty in the predictions of superheavy element production rates is in the CN formation probability, owing to the complex nature of quasifission process which is not yet known completely. We studied the competition between fusion and quasifission by populating the CN ^{210}Rn through different entrance channels - ^{16}O+^{194}Pt and ^{30}Si+^{180}Hf, at energies around the Coulomb barrier. The larger widths of the fission fragment mass distributions (inset of Fig. 1(a)) in the ^{30}Si+^{180}Hf reaction which could not be explained by using transition state models indicated the onset of quasifission in this reaction. Further, the evaporation residues (ERs) produced in these reactions were measured using the gas-filled recoil separator HYRA at IUAC. The measurements showed a reduced ER cross section for the ^{30}Si+^{180}Hf when compared (Fig. 1(a)) with that of ^{16}O+^{194}Pt at similar excitation energies, confirming a clear presence of quasifission in the ^{30}Si+^{180}Hf reaction. The experimental results are analysed using the dinuclear system (DNS) model to understand the possible influence of potential energy surfaces (PES) and different entrance channel conditions in heavy-ion fusion reactions. The model analysis are in agreement with the experimental observations (Fig. 1(b)), confirming the presence of significant quasifission in Si+Hf reaction. Calculations have also been extended to more symmetric systems populating the same CN.

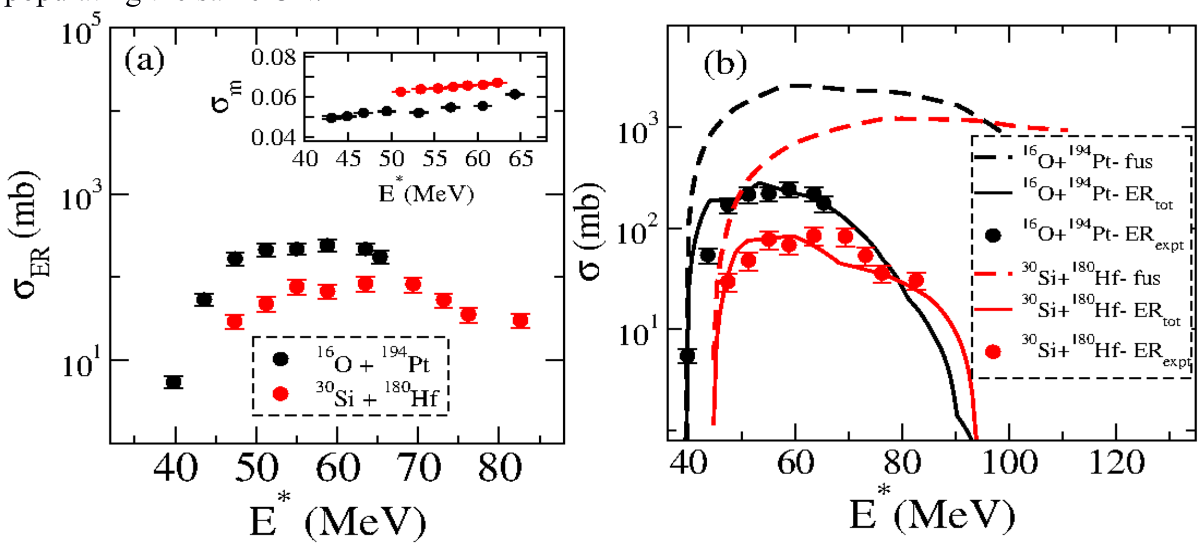

Fig. 1 (a) Experimental ER cross sections for the ^{16}O+^{194}Pt and ^{30}Si+^{180}Hf reactions. (b) DNS model predictions for fusion and ER excitation functions.