Systematic Study of Quasifission in ^{48}Ca-Induced Reactions

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Superheavy elements (SHEs) mark the upper boundary of the existence of atomic nuclei. The production of SHEs through the fusion of two heavy nuclei is severely hindered by the quasifission (QF) process, which results in the fragmentation of heavy systems before an equilibrated compound nucleus (CN) can be formed [1]. The QF process is the most significant limitation to SHE formation, and so a detailed understanding of this process is essential.

The heaviest elements have been synthesised using ^{48}Ca as the projectile nucleus [2, 3]. However, the use of ^{48}Ca in the formation of new SHEs has been exhausted, as the production of targets heavier than ^{249}Cf suitable for SHE production is currently not achievable. Thus, heavier projectile nuclei are required to produce new SHEs. To determine which heavier projectile should be used, an understanding of what has made ^{48}Ca so successful is crucial.

A systematic study of QF in ^{48}Ca-induced reactions with a variety of target nuclei at energies close to the Coulomb barrier is presented. Ten different target nuclei were used, ranging from the spherical ^{144}Sm, to strongly deformed nuclei, such as ^{170}Er and ^{186}W, through to the spherical ^{208}Pb. These targets allow the role of deformation in the subsequent reaction dynamics to be investigated. Moreover, the role of closed shells can also be investigated, due to the fact that the ^{48}Ca projectile and ^{208}Pb target both have full proton and neutron shells, whilst ^{144}Sm has a closed neutron shell.

To investigate the presence of QF, mass and mass-angle distributions (MADs) have been measured for all 10 reactions. The systematic changes of both the mass distributions and MADs shall be discussed in this talk, along with a novel method to investigate the probability of forming a CN through measurements of two different reactions that form the same CN.

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