A New Proposal to the High Intensity Gamma-Ray Source (HiγS) PAC-10

Fragment Anisotropy from Photofission of $^{238}$U

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May 14th, 2010
1. Experiment Summary

The large number of neutrons emitted during the fission process and their potential link to the fragment anisotropy make them a means to study the photofission reaction. However, any lack of understanding with respect to their production limits their usefulness to probe the transition states that dictate the fragment characteristics. It also limits the understanding of the neutron emission mechanisms leading to the neutron angular distributions.

The fission of a nucleus generally results in two high energy fragments moving in opposite directions and accompanying prompt neutrons. These neutrons can be emitted through multiple mechanisms whose relative contributions are not fully understood. One of these mechanisms is the evaporation of neutrons from fragments during the deexcitation following scission, the point at which the nucleus splits. The other processes include emission prior to and at the point of scission. If only the first mechanism were present, the emitted neutrons might reflect the angular distribution of the fragments, which is known in many cases to be anisotropic at energies near the fission barrier [1-2]. Therefore, it would be possible to reconstruct a neutron angular distribution from a measured fragment angular distribution using the assumption of neutron evaporation from the fragments. The difference between the resulting angular distribution and the measured distribution would be evidence for the presence of neutron emission mechanisms other than from fragments, such as might occur prior to and at scission.

The proposed experiment will be instrumental in understanding the connection between the fragment angular distribution and the already measured neutron anisotropy accompanying it. The existing neutron data, measured by a DHS-funded project led by M.S. Johnson, indicates that the neutron angular distribution is not in agreement with the strong E1 nature of the fragment distribution as measured in [6]. This is suggestive of a more complicated mechanism than neutron emission from fragments. The proposed measurement, with its increased sensitivities, can bring insight to this data and also to the structure of the fissioning nucleus at the saddle point.