From raw materials to fission studies

Nuclear fission is a vital area of study for reasons of energy generation and national security. Production of rare isotopes in nuclear reactors and from natural sources enables new physical phenomena to be examined. The production of targets suitable for heavy ion spectroscopy, such as is appropriate with fission fragments, remains a challenge. Understanding the influence of target chemistry is important for proper interpretation of fission physics results due to the large influence of target composition on stopping power.

While thermal-spectrum fission energy release is well understood, the influence of neutrons faster than ~ 20 MeV remains uncertain, and unexpected observations are still being made. In particular, the influence of fast neutron energy on total kinetic energy (TKE) release remains somewhat less than quantitative in description, even with commonly-studied isotopes such as ^{233}U, ^{237}Np, and ^{239}Pu. This is important, as fission fragment TKE is over 80% of the energy released in fission. Recent experiments measuring the TKE release in (n, f) reactions have determined an unexpected plateau for the region of (30 MeV $< E_n <$ 70 MeV). Additional information regarding the configuration of the fissioning nucleus can be obtained by comparison of nuclear distortion at the scission point as a function both of mass and incident neutron energy. Discussion of results from just above the fission barrier to 100 MeV will be presented.

Oregon State University has recently obtained an upgraded digital data acquisition system (DDAS) for use in fission studies. The use of MVME software and MDPP-16 data modules (both produced by Mesytec) are tested with simultaneous alpha particle and fission fragment detection at the Oregon State TRIGA Reactor. The flexibility and stability of this system is demonstrated with after-the-fact searches for ternary fission fragments perpendicular to the path of principal fission fragments. Time, energy, and mass relationships between putative ternary particles and principal fission fragments are examined and used to benchmark the MDPP-16 module time and energy resolutions. Insights into the influence of effective target and backing thickness are presented from these data, including the use of alpha decay energy loss as an internal calibration for these variables.