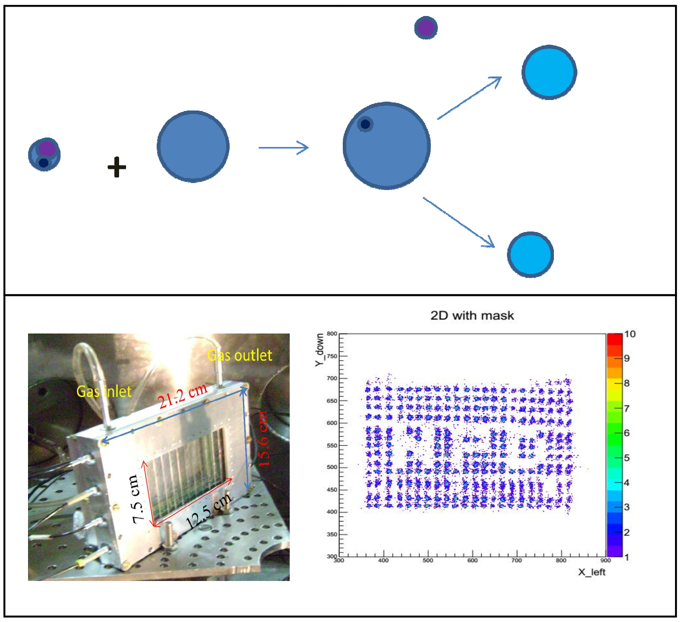
Title: **Study of fission reactions involving weakly bound projectiles**

For the synthesis of super heavy elements, it is proposed to fuse neutron rich radioactive ion beam (RIB) with heavy targets. It is now well known that the reaction mechanisms using RIB having small particle separation energy can be simulated by using weakly bound stable projectiles having low breakup threshold. In case of weakly bound stable projectiles, the study of fission process following compound nucleus formation becomes complicated as it gets mixed up with various breakup or transfer induced fission channels. Effect of the breakup or transfer induced fission channels on different fission observables have already been postulated in literature. In the present study quantitative assessment of the above effect has been aimed at. It is now well established that such kind of reactions can be utilized to determine neutron induced cross-sections useful for Generation-IV reactors in an indirect way called surrogate technique.

With this aim, breakup or transfer induced fission events were identified in reactions involving weakly bound projectiles and actinide targets, by detecting fission fragments in coincidence with the non-captured breakup fragments. It is found that transfer induced fission events may not be a responsible factor for the enhancement of FF angular anisotropy as compared to statistical model predictions. It is also found that the same events are indeed responsible for enhancing the ratio of asymmetric to symmetric yields in inclusive fission as compared to complete fusion fission. We found that breakup or transfer induced fission reactions is a powerful tool to study fission mechanism for neutron rich exotic nuclei which cannot be populated by stable target and stable beam. Shell effect for symmetric fragments has also been found to play an important role in describing the FF mass distributions of the above nuclei. We emphasized the advantages of the above coincidence technique between FF and projectile like fragments, over other available techniques, while determining incomplete fusion cross-sections.



(Top) Schematics representation of breakup or transfer induced fission mechanism (Bottom) Image of one MWPC detector and a 2D spectrum obtained from the detector.

Now applying the same technique, cross-sections for ^{238}Pu(n,f) and ^{236}Np(n,f) reactions have been determined for certain equivalent energy ranges using surrogate ratio method.
The thesis also contains work on development of two multi-wire proportional counter (MWPC) detectors having active area of 12.5cm X 7.5cm, for measuring position and time-of-flight of the fission fragments. These detectors have been used in one of the measurements included in the thesis.

References: (1). “Determination of ^{238}Pu(n, f) and ^{236}Np(n, f) cross sections using surrogate reactions”- Phys. Rev. C 91, 054618 (2015). (2) “Projectile-breakup-induced fission-fragment angular distributions in the ^{6}Li + ^{232}Th reaction”- Phys. Rev. C **96**, 024603 (2017)**.** (3)“Mass distributions of fission fragments from nuclei populated by multinucleon transfer or incomplete fusion channels in ^{6,7}Li+^{238}U reactions”- Phys. Rev. C **98**, 031601(R) (2018)**.** (4) Measurements of ICF cross-sections in ^{6,7}Li+^{238}U reactions”- Phys. Rev. C **99**, 024620(2019)**.** (5) Measurement of mass and total kinetic energy distribution of fission fr agments using newly developed compact MWPC detectors”- J. Inst. **15**, P02008 (2020)

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