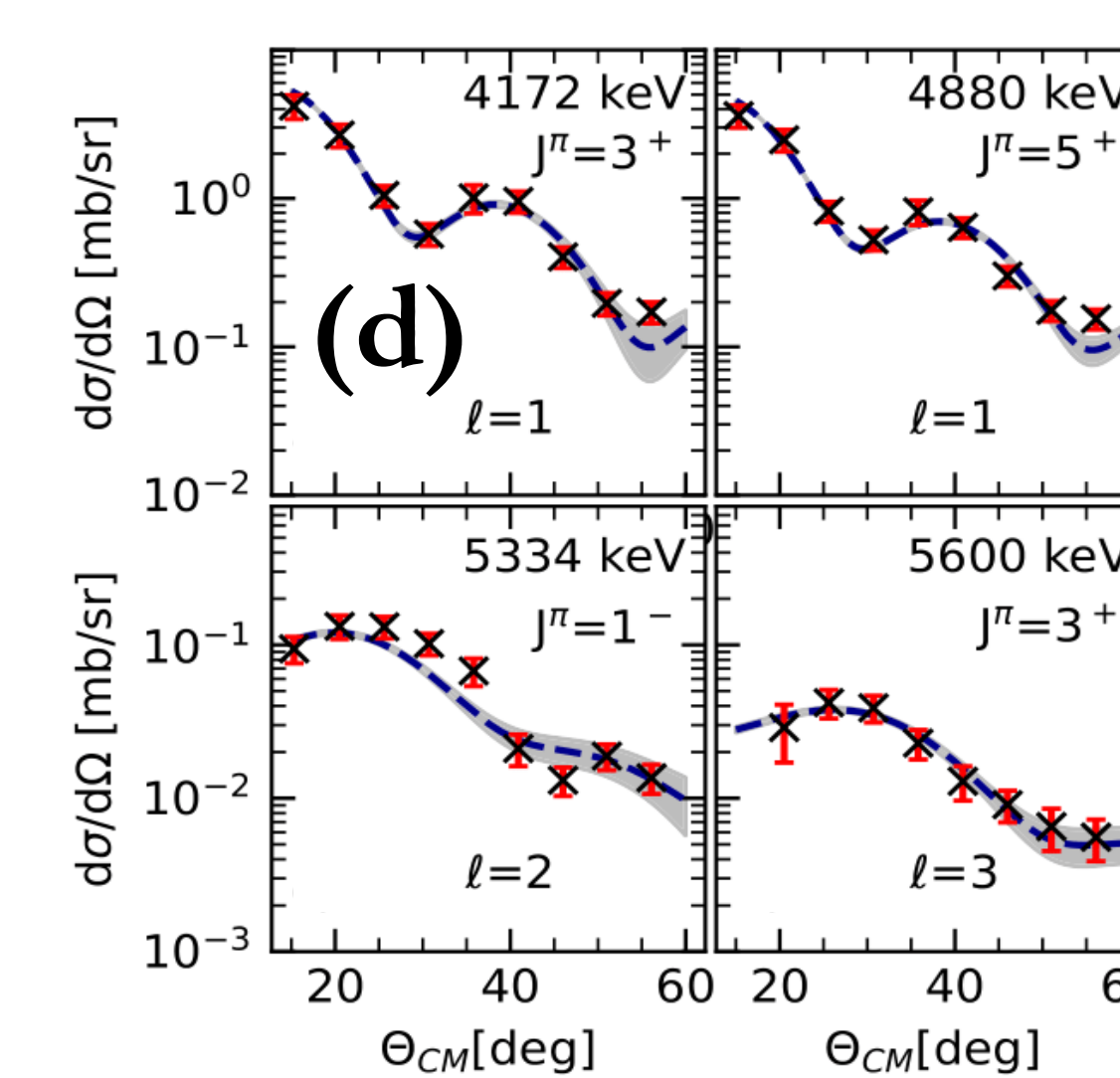
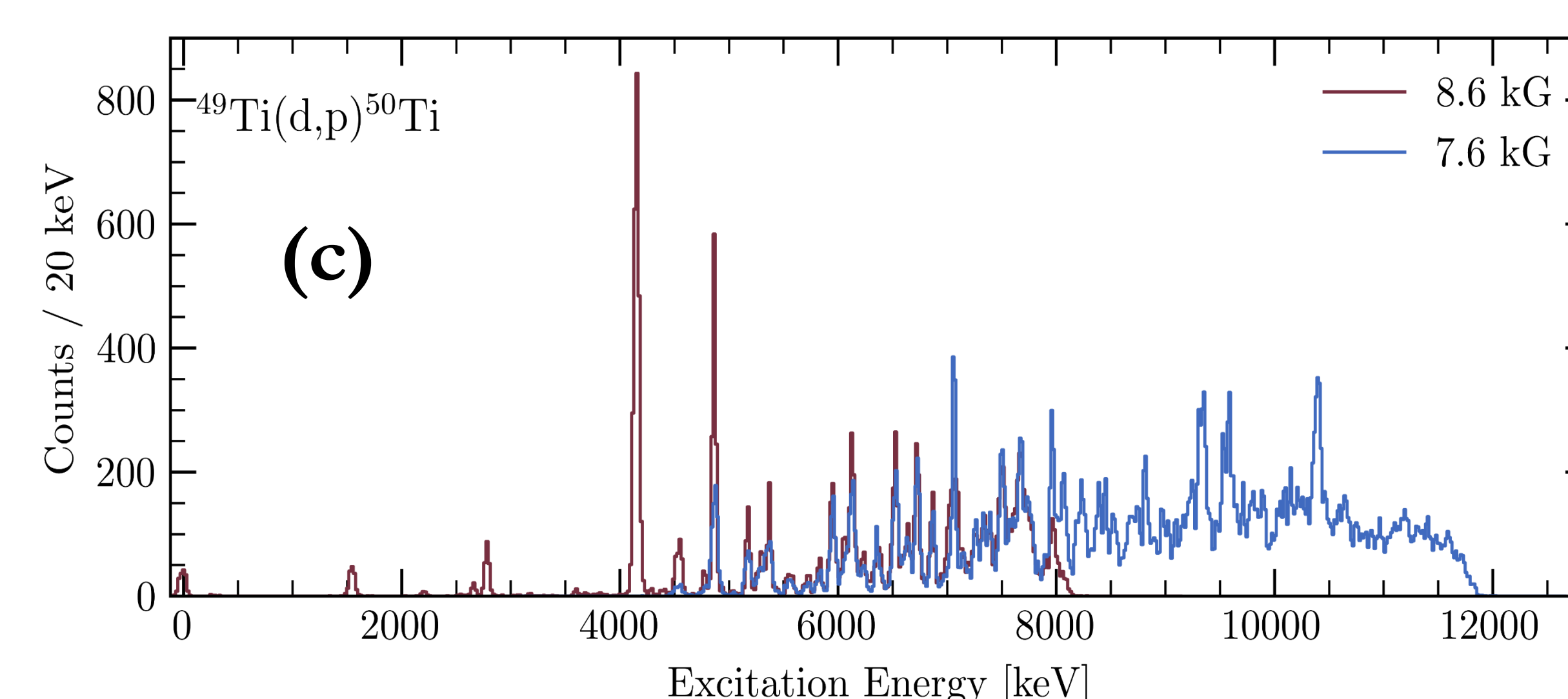
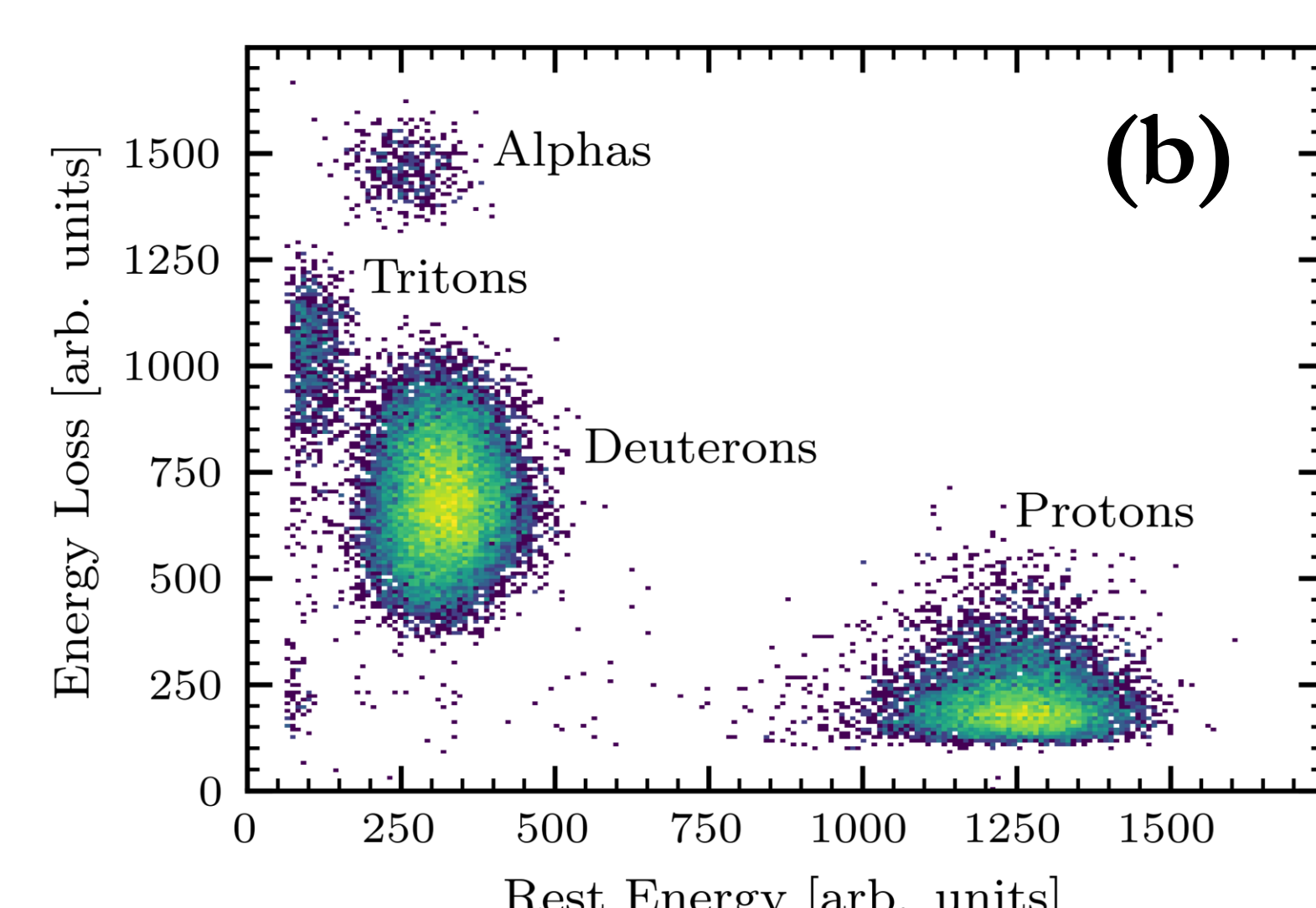


(left) Photo of the SE-SPS in target room 2 with the sliding seal scattering chamber installed. The beam comes from the left. (right) Schematic drawing of the SE-SPS with three particle trajectories corresponding to different particle energies.

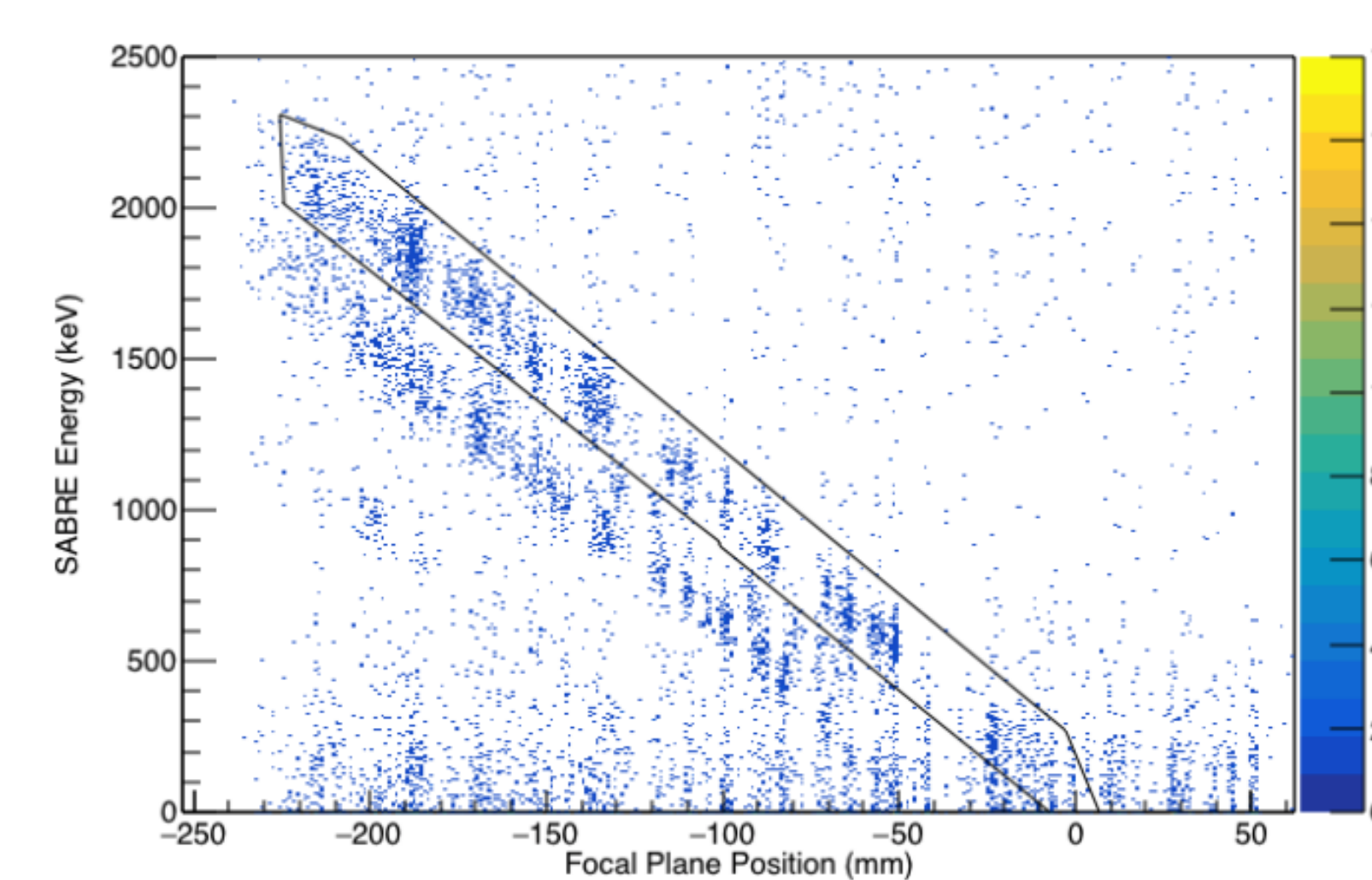
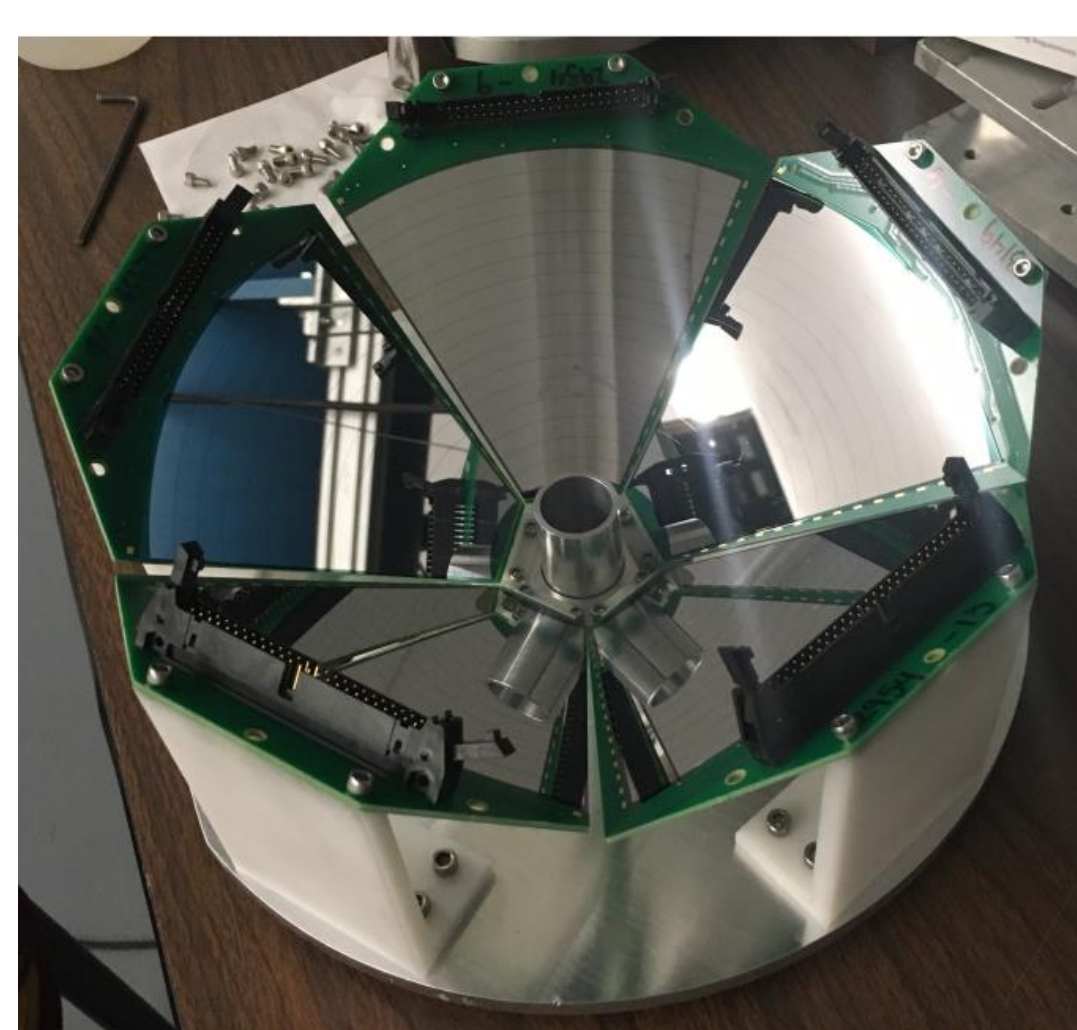
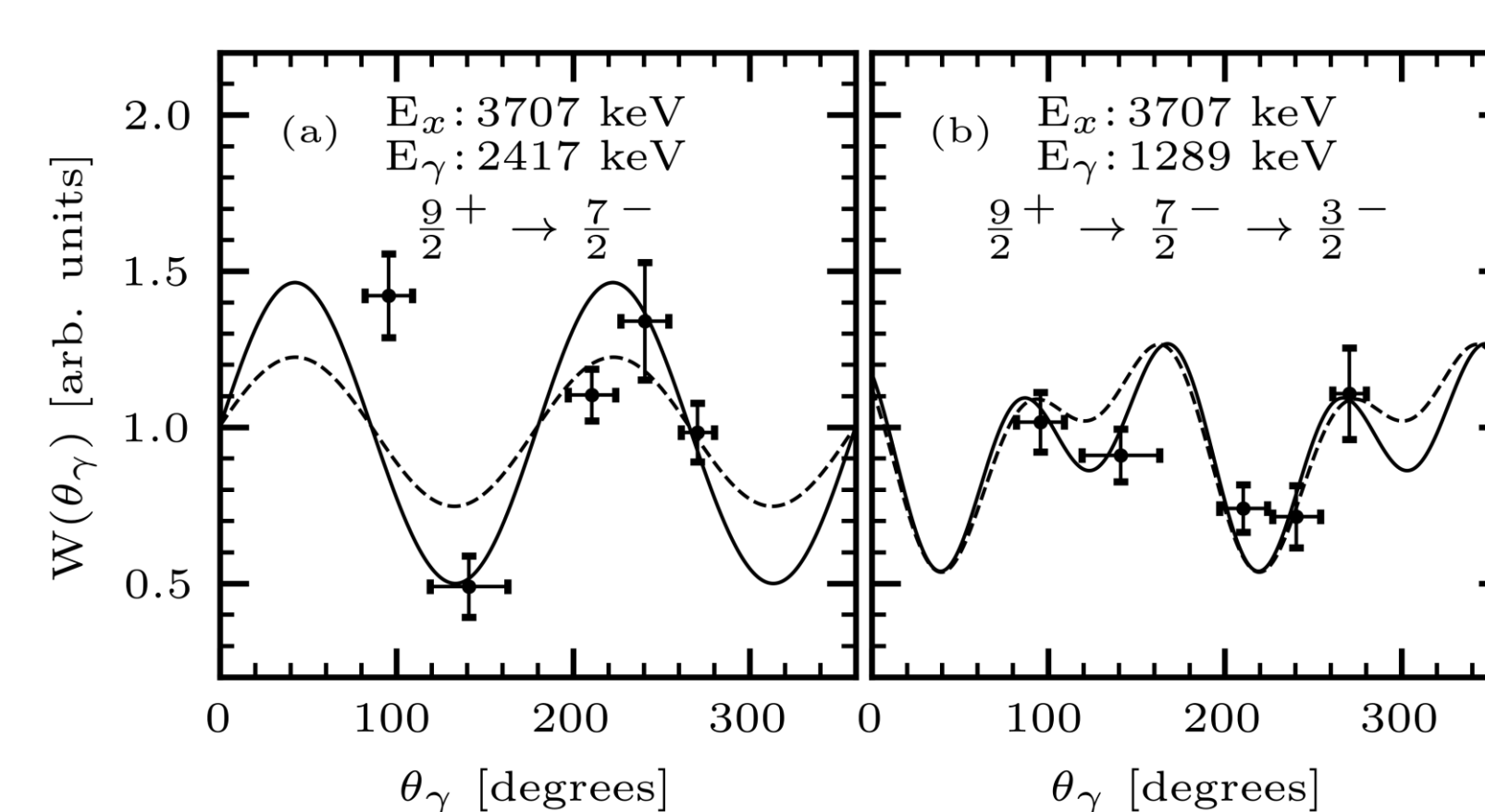
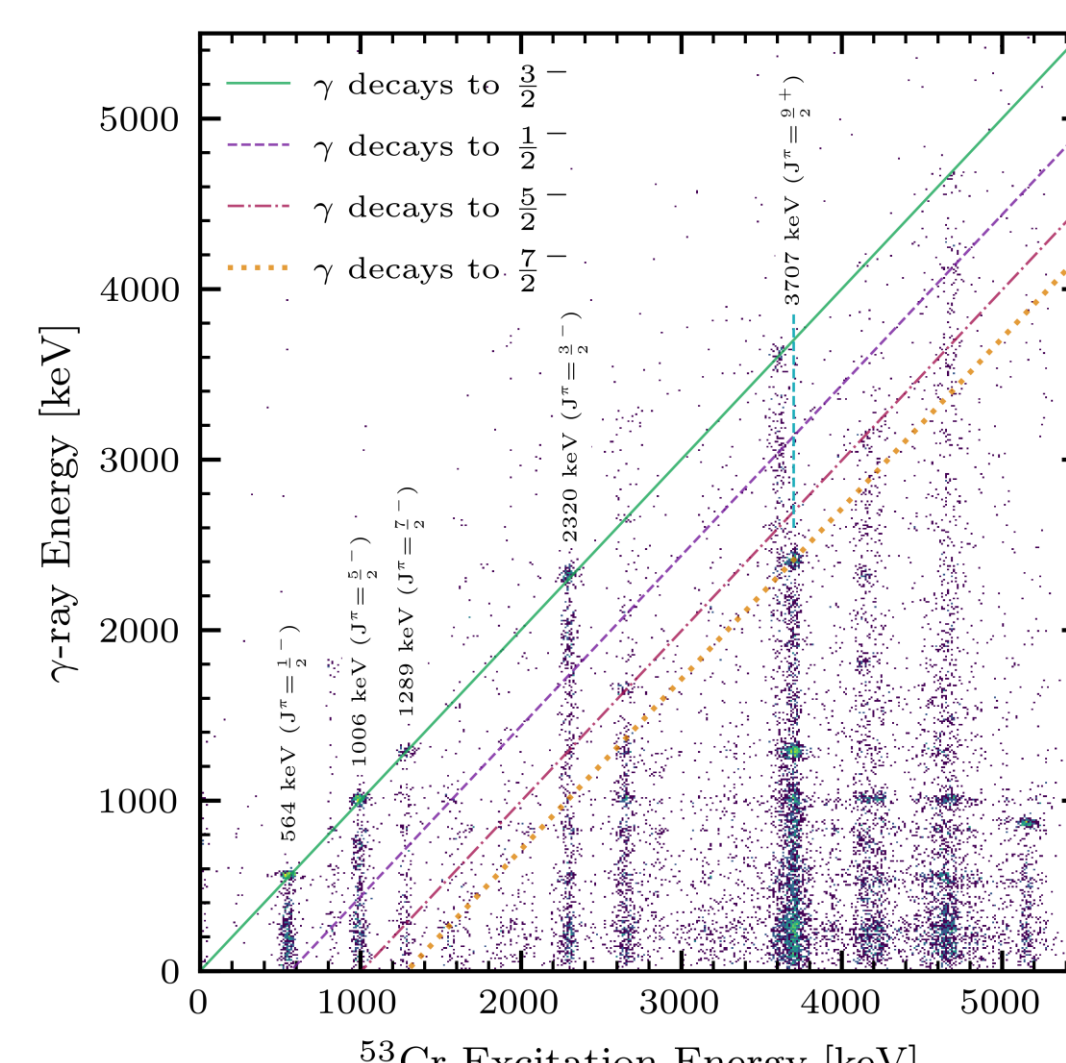
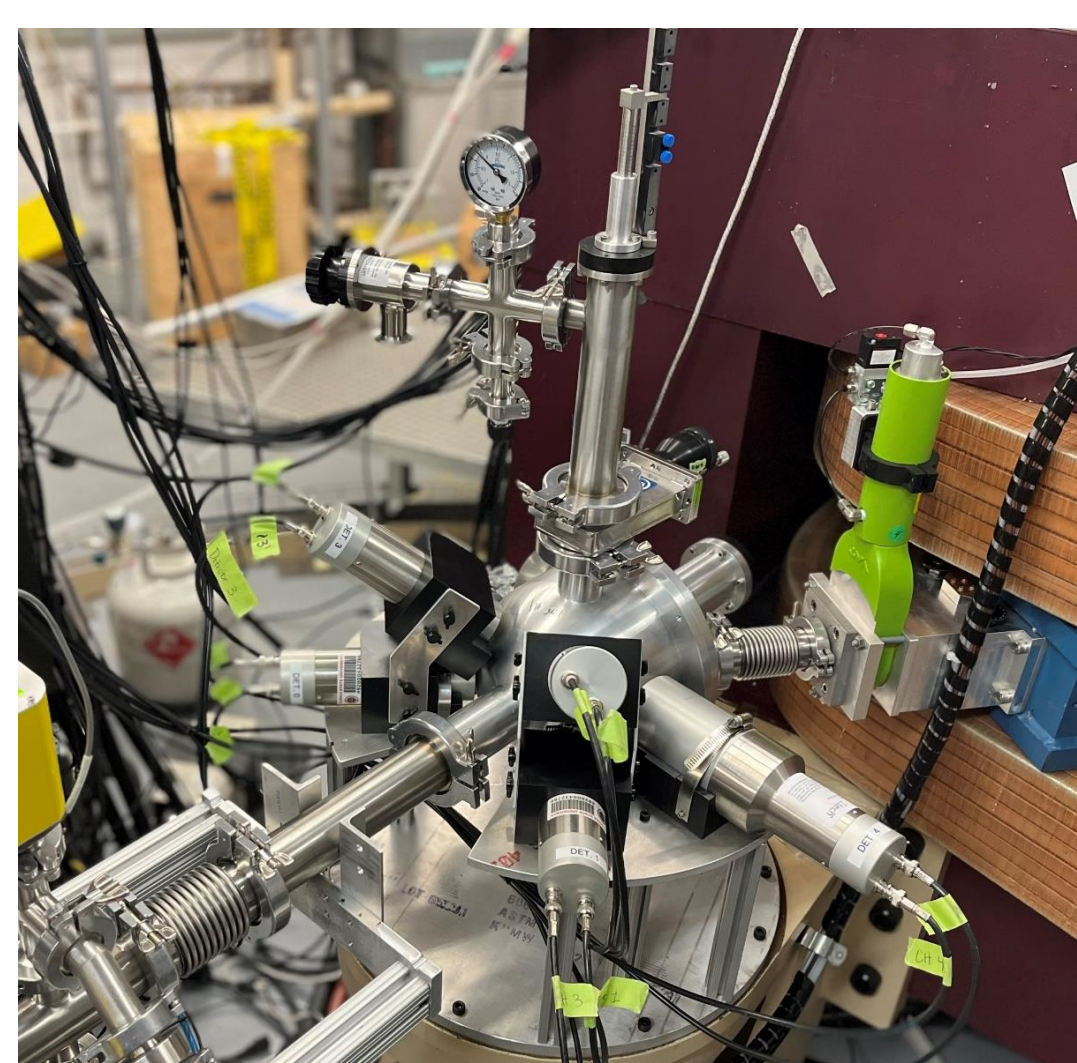
The Super-Enge Split-Pole Spectrograph (SE-SPS)

- The SE-SPS was commissioned in 2018 at FSU (formerly at Yale). It was funded through the NSF MRI Collaborative Program (PHY-1429019) and installed at the FSU John D. Fox Laboratory in collaboration with Louisiana State University.
- The spectrograph consists of **two pole sections used to momentum-analyze light-ion reaction products** and to focus them at the magnetic focal plane, which **enables the study of excited states in atomic nuclei after being populated in a nuclear reaction**.
- The design of the spectrograph allows to accomplish approximate transverse focusing as well as to maintain second-order corrections in polar and azimuthal angle over the entire horizontal range of the focal plane even for its large solid angle acceptance of 12.8 msr.



(a) Position sensitive light ion focal plane detector
(b) Particle (reaction) identification with focal-plane detector
(c) Exemplary excitation energy spectrum recorded with SE-SPS
(d) Angular distributions measured with SE-SPS

Ancillary Detectors – SABRE for Coincident Decay Particle Spectroscopy and CeBrA for Coincident γ -Ray Spectroscopy



(top and from left to right) CeBrA demonstrator in front of SE-SPS, proton- γ coincidence matrix for $^{52}\text{Cr}(d,p)^{53}\text{Cr}$, and proton- γ angular correlations for 3707-keV state in ^{53}Cr . (bottom and from left to right) Lampshade design of SABRE's silicon detectors, SABRE being mounted inside scattering chamber, and SABRE-SE-SPS coincidence matrix.

CeBr₃ Array (CeBrA)

- Five-detector demonstrator consisting of one 3x4 inches and four 2x2 inches CeBr₃ detectors commissioned.
- Fully digital data acquisition system based on CAEN V1725S digitizer and DPP-PSD firmware.
- Particle- γ coincidences enable selective study of γ decay of excited states.
- Accessible experimental observables: γ -decay intensities, particle- γ angular correlations, nuclear level lifetimes
- Plans exist to build full 14 detector array complementing the existing array with more 3x4 inches and 3x6 inches CeBr₃ detectors.
- Exemplary science cases: Study of γ -ray strength function relevant for isotope production in star explosions, importance of $g_{9/2}$ orbital beyond N=28, γ -neutron branching above neutron-emission threshold.

Reference: A.L. Conley *et al.*, Nuclear Instruments and Methods in Physics Research, A **1058**, 168827 (2024)

Silicon Array for Branching Ratio Experiments (SABRE)

- 5 Micron Semiconductor Ltd. MMM Silicon strip detectors with thin deadlayers in lampshade configuration.
- Fully digital data acquisition based on CAEN V1725 and V1730 digitizers and DPP-PHA firmware.
- Array primarily used for studying the decay of unbound particle resonances relevant for Nuclear Astrophysics.
- Decay-particle-particle angular correlations with SABRE and SE-SPS can be measured to test wave functions in great detail.
- Exemplary science cases: Synthesis of ^{26}Al , isotope production in classical novae, super-radiance in ^{13}C .

Reference: E.C. Good *et al.*, Nuclear Instruments and Methods in Physics Research, A **1003**, 165299 (2021)