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First in-beam test of SPICE

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A new ancillary detector, SPICE (SPectrometer for Internal Conversion Electrons) has been constructed and tested for the first time at the
ISAC-II facility of TRIUMF. SPICE is designed to be coupled with the TIGRESS HPGe array to enable simultaneous in-beam gamma-ray and
conversion-electron spectroscopy in both stable and radioactive ion beam experiments. The TIGRESS+SPICE setup will combine with other
downstream detectors/arrays to provide the possibility for a broad range of reaction mechanisms, such as Coulomb-excitation or fusion
evaporation, to be used to populate states of interest.

The main focus of the SPICE design is the reduction of background due to low-energy particles and beam scattering, a high detection efficiency for electrons and a large energy-acceptance range between ˜100 and 3500 keV. This is achieved using a magnetic lens formed of permanent NdFeB magnets positioned upstream of the target and surrounding a truncated-conical-shaped high-Z-material photon shield. The internal conversion electrons emitted from the target are guided around the photon shield and detected by a large-area annular lithium-drifted silicon detector which is segmented into 120 individual segments. Reactions induced by a stable 12C beam at 67 MeV impinging on a 3 mg/cm^2 ^{196}Pt target was studied with SPICE to demonstrate its capacity of detecting internal-conversion electrons in coincidence with gamma rays in TIGRESS.
The residual ^{12}C particles were detected with a double-sided annular silicon detector positioned at forward angles.
A selective recoil-electron-gamma-type triggering for enhancing the signal-to-noise ratio of measurements was made possible by integrating the SPICE detector signals into the TIGRESS data-acquisition system.
In the future, SPICE will be a powerful tool to measure conversion coefficients
and $E0$ transitions in atomic nuclei thus providing a useful probe to study shape coexistence and quantum state mixing.
An overview of the main features of the design and results from the test beam-time of SPICE will be presented as well as a look at future opportunities.

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