Gamma-ray spectroscopy of neutron-rich ^{148}Ce

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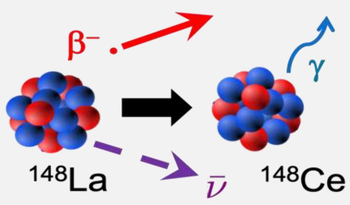
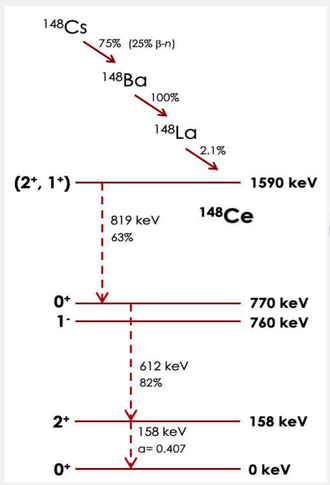
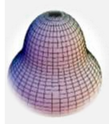
Introduction & Motivation

Ce isotopes with $146 \leq A \leq 152$ are transitional nuclei characterized by a few nucleons outside of the so-called closed shells. Isotopes in this region are predicted to possess octupole deformation.

Octupole correlations are the result of the long range octupole-octupole interaction between nucleons occupying pairs of orbitals which differ by 3 units in both orbital and total angular momentum, which gives rise to an asymmetric pear-shaped form [1,2,3].



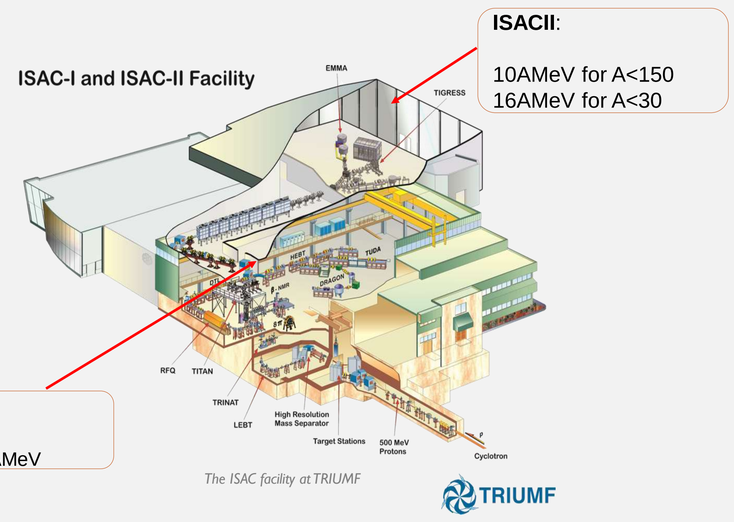




Experiment

A 500 MeV proton beam was impinged on a UC_x target. Extracted isotopes were mass separated and transported to GRIFFIN.

Data was collected over a 7 days period using the GRIFFIN detector array for spectroscopy studies of ^{148}Ce.
The beam intensity for ^{148}Cs was $4 \cdot 10^4\ pps\ (beta)$.



ISACII:

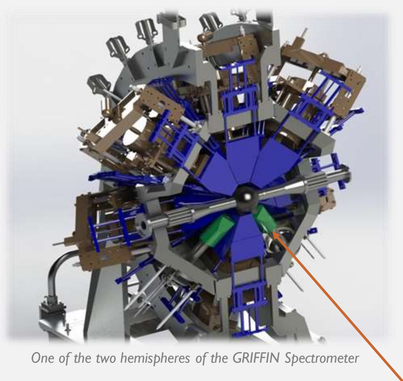
10AMeV for A<150
16AMeV for A<30

ISAC I:

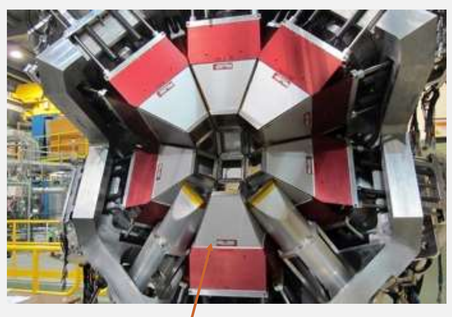
60 keV & 1.7 AMeV

The ISAC facility at TRIUMF

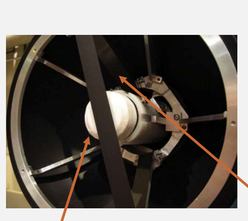
TRIUMF

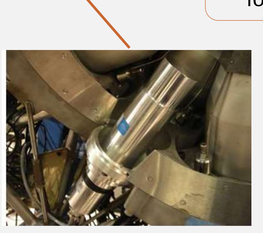


One of the two hemispheres of the GRIFFIN Spectrometer



16 HPGe clover detectors for gamma detection





8 LaBr3 detectors for fast-timing measurements of excited-state lifetimes

1 Zero Degree Scintillator for fast-timing measurements of ultra-fast gamma decays from daughter nuclei

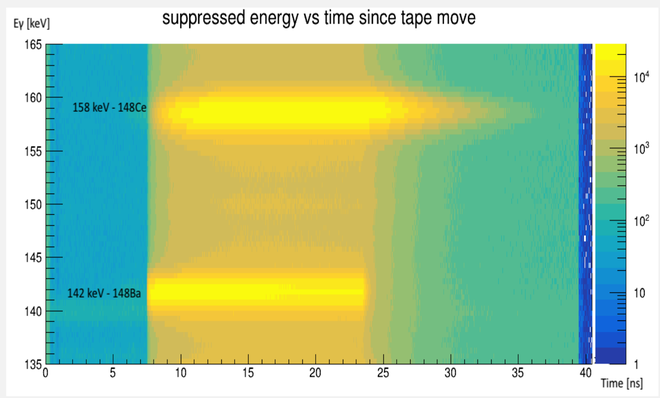
aluminised mylar moving tape collector placed at the centre of the GRIFFIN array

5 scintillators for conversion electron spectroscopy (PACES)

Ongoing Analysis

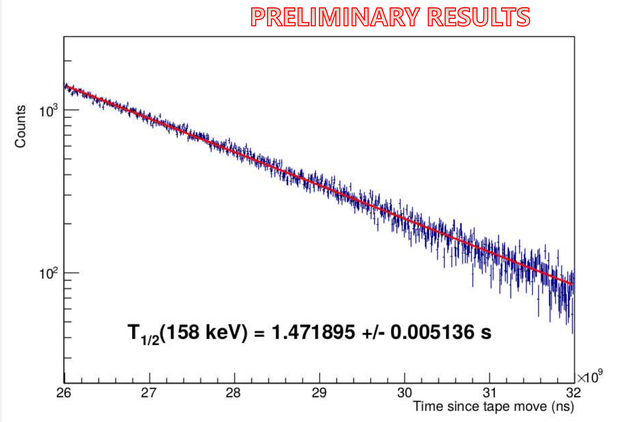
LIFETIME ANALYSIS

Based on the longest tape cycle it was possible to identify the isotope of interest and to measure the lifetime of ^{148}La, by gating on different γ-rays.



Energy vs time for the longest tape cycle for the ^{148}Cs data.

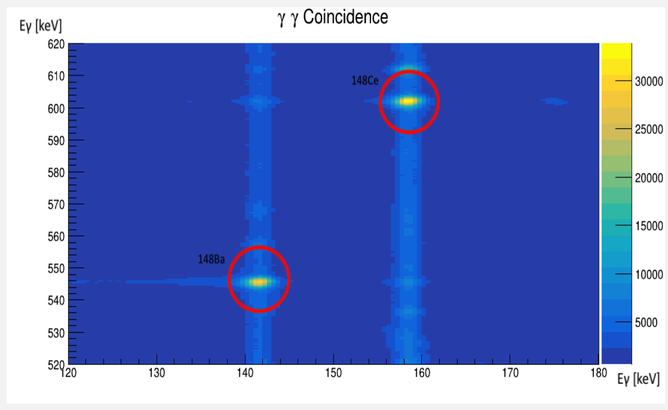
PRELIMINARY RESULTS



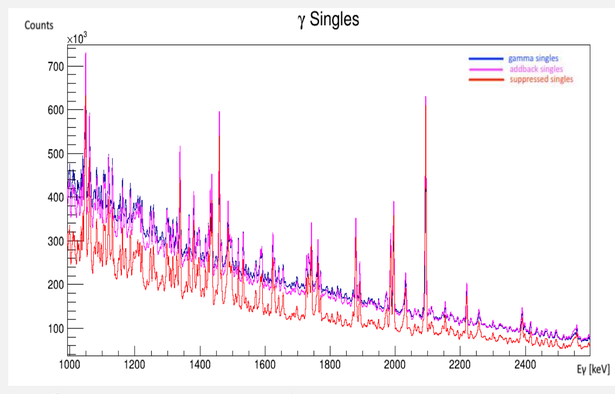
Measurement of the lifetime of ^{148}La by gating on the 158 keV γ-ray.

COINCIDENCE GAMMA-RAY SPECTROSCOPY ANALYSIS

Coincidence gamma-ray spectroscopy, application of addback and suppressed addback correction helps reduce the background radiation significantly. As a result, non-interesting peaks can be avoided and weaker peaks become more visible in the spectrum.

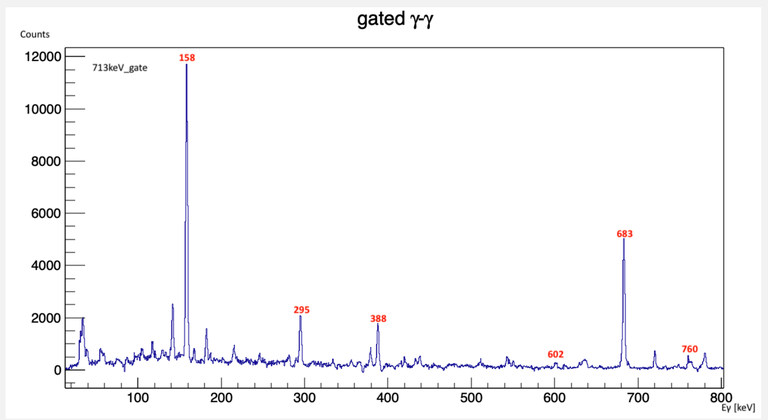


Gamma-gamma coincidence matrix of the ^{148}Cs data.

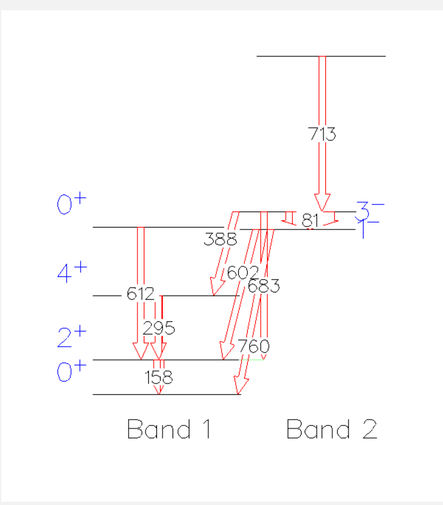


Gamma-ray energy spectrum of the singles, the addback singles and the suppressed addback singles combined

A combination of these methods and information can contribute to the building or extension of the decay scheme and give us an insight on the nuclear structure of the nucleus of interest.



Gated spectrum of ^{148}Ce at 713 keV..



Decay scheme of ^{148}Ce.

Conclusion & Future Directions

- Spectroscopy studies for the verification and extension of the decay scheme of ^{148}Ce is on-going.
- The investigation and measurement of the lifetime of the excited 3^- state in ^{150}Ce and the measurement of the characteristic B(E1)/B(E2) ratios are in progress.
- Complementary studies of ^{146}Ce will take place at HIE ISOLDE in 2023.

References

[1] K. Nomura, R. Rodríguez-Guzmán, and L.M. Robledo, Phys. Rev. C 104, 054320 (2021).
[2] P.A. Butler, J. Phys. G Nucl. Part. Phys. 43, 073002 (2016).
[3] P.A. Butler and W. Nazarewicz, Rev. Mod. Phys. 68, 349 (1996).
[4] R.L. Gill, et al., Phys. Rev. C 27, 1732 (1983).