# Experimental report

20/08/2021

**Proposal:** 3-17-49 **Council:** 4/2020

**Title:** Prolate-oblate phase transition inthe transitional nucleus 193Os

**Research area:** Nuclear and Particle Physics

**This proposal is a resubmission of 3-17-44**


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**Samples:** 192Os

| Instrument | Requested days | Allocated days | From | To |
|---|---|---|---|---|
| FIPPS | 15 | 15 | 12/08/2020 | 26/08/2020 |


**Abstract:**

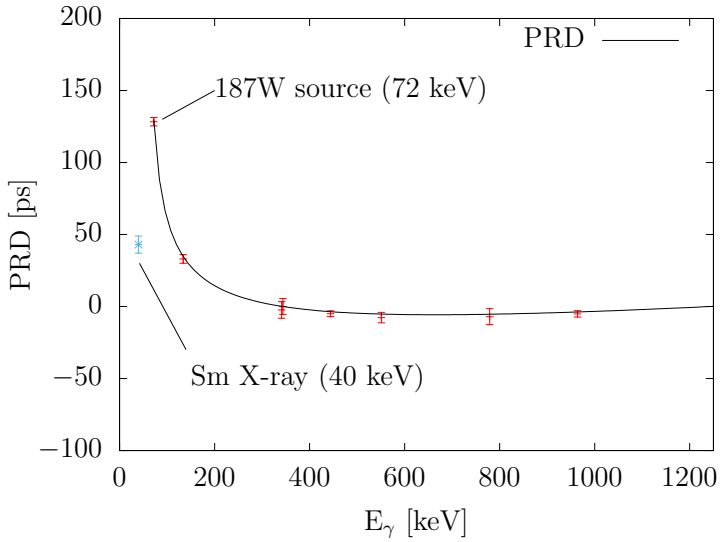
The nucleus 193Os is located in the area of gradual phase transition exhibited in the Osmium isotopes. Calculated energy surfaces based on the Gogny-D1M EDF suggest a transition from a triaxial shape at 192Os to an oblate-soft one at 194Os. Additionally, the low-lying level structure in the odd-A isotopes changes significantly between 191Os and 193Os including a change in ground state's spin. It is of particular interest to investigate the low-lying structure arising from the interplay between single-particle and collective degrees of freedom in the region of shape transition. The aim of this experiment is the precise measurement of the lifetimes of the 1/2-, 3/2- and 5/2- states and to firmly assign the spin of the low-lying states.

# Experimental Report 3-17-49: Prolate-oblate phase transition in the transitional nucleus $^{193}$Os

The experiment for proposal 3-17-49 with the title 'Prolate-oblate phase transition in the transitional nucleus $^{193}$Os' was performed successfully on the FIPPS instrument in August 2020. For this experiment, the FIPPS spectrometer was used in the fast-timing configuration, consisting of eight HPGe Clover detectors (BGOs disabled) in a 90° ring around the target position as well as sixteen $LaBr_3$(Ce) detectors, eight each mounted at forward and backward direction.

Picture of the $^{192}$Os powder target contained in a plastic bag.

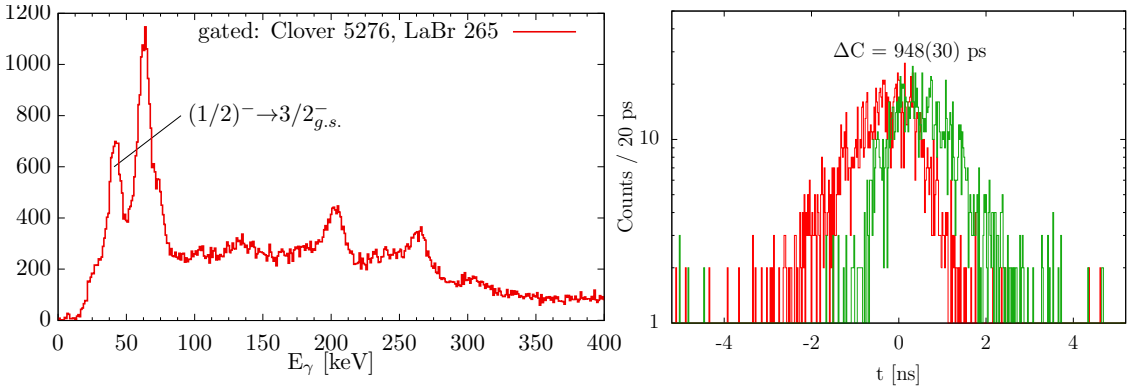
The target consisted of 240mg $^{192}$Os powder (99% enriched) and was irradiated for 9 days. Besides the $^{192}$Os(n,$\gamma$)$^{193}$Os reaction, traces of $^{189}$Os(n,$\gamma$)$^{190}$Os and $^{190}$(n,$\gamma$)$^{191}$Os, as well as the $\beta$-decay to $^{193}$Ir were observed. Well known mixing ratios in $^{193}$Ir will be used to cross-check the angular correlation analysis.




PRD curve of the FIPPS fast-timing setup in the low energy regime.

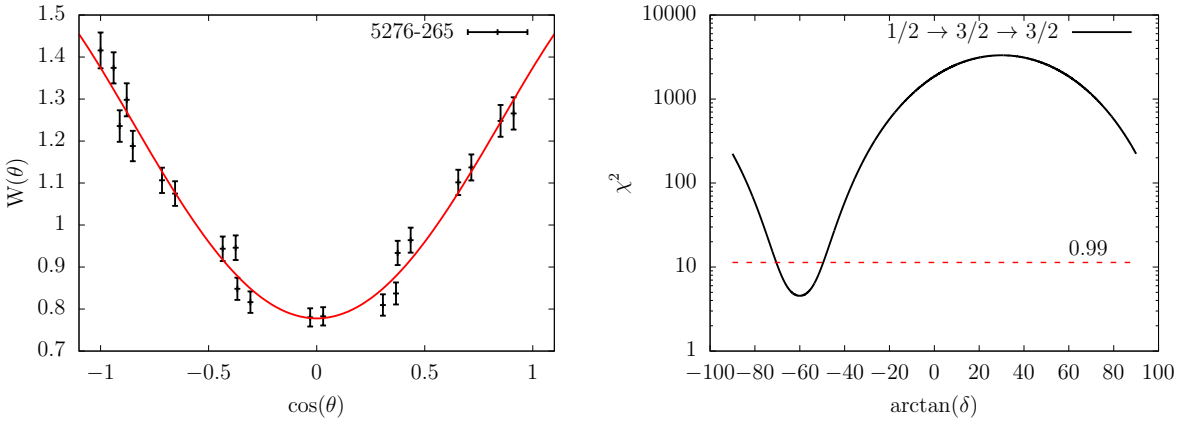
Calibration measurements were performed using the 48Ti(n,$\gamma$)$^{49}$Ti reaction and with the $^{152}$Eu and $^{187}$W sources. With these measurements the time-walk and efficiency of the setup were calibrated for low energies and up to 6 MeV. Most notably the $^{152}$Sm

X-Ray at 40 keV and the 72 keV transition in the decay of $^{187}$W directly correspond to the energies of important transitions in $^{193}$Os and yield precise calibration points for the critical low energy region (states at 41.5 keV, 73 keV and 103 keV). The resulting PRD curve of the setup shows minimal time-walk in the 300-1000 keV range. One of the




**(Left)** Spectrum gated on the 5276 keV primary transition and the feeding 265 keV feeding transition of the 41.5 keV state. **(right)** The corresponding centroid difference.

main goals of this experiment was the lifetime measurement of the low-energy states in $^{193}$Os. The statistics gathered in this experiment is sufficient to measure the lifetime of the state at 41.5 keV. In threefold coincidence, with a clover gate on the 5276 keV primary $\gamma$ - ray transition and $LaBr_3$ timing gates on the the 265 keV feeding transition and 41.5 keV decaying transition, the resulting time spectra contain $\approx$ 1500 counts in accordance with our beam-time estimate. The analysis of the lifetime measurements of several states is ongoing. For a theoretical description of the underlying nuclear struc-




**(Left)** Distribution of the 5276-265 cascade. **(right)** Determination of the mixing ratio.

ture, spins of nuclear states and mixing ratios of several transitions will be measured. The data was sorted into 23 angular groups, but the two in-detector groups (20° and 28°) will be excluded in the analysis, due to scattering effects. The FIPPS central clover ring worked exceptionally well and the spin assignment and measurement of mixing ratios are looking promising. At the moment the analysis of the angular correlations is in progress with some optimization still required. Also, GEANT4 simulations are planned to take into account the effect of finite detector sizes.