Implementation of Optical Target Temperature Measurements into ISAC Experiment Control and Data Acquisition Systems (MIDAS and EPICS)

Lucas Backes[1,6], Aurelia Laxdal[1,3], Friedhelm Ames[1,2], Bradley Cheal[3], Max Fatouros[1], Alexander Gottberg[1,5,7], Devon Joseph[1,4], Peter Kunz[1,3,4], Jens Lassen[1,2,3,4,7], Matthew Pearson[3], Andrzej Wolski[3]

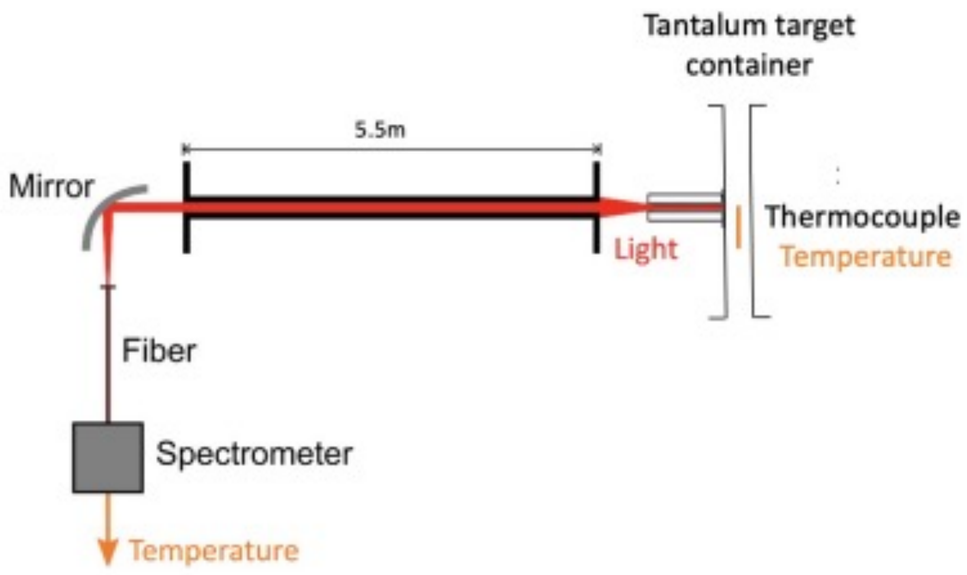
1. TRIUMF 2. University of Manitoba 3. University of Liverpool 4. Simon Fraser University 5. University of Victoria 6. McMaster University 7. UBC

Introduction

A new optical method for measuring the temperature of Isotope Separation On-Line (ISOL) targets at ISAC is being tested. The method relies on capturing the light emitted by the hot targets in the NIR range (850nm-1650nm). The temperature readings will be integrated into ISAC's data acquisition (DAQ) and experiment control systems to aid in optimal target operation.

Optical Setup

The light from the on-line hot target passes through the ionizer opening then gets captured by a parabolic mirror and focused into an optical fiber to be analyzed with a NIR spectrometer.



Blackbodies and Planck's Law

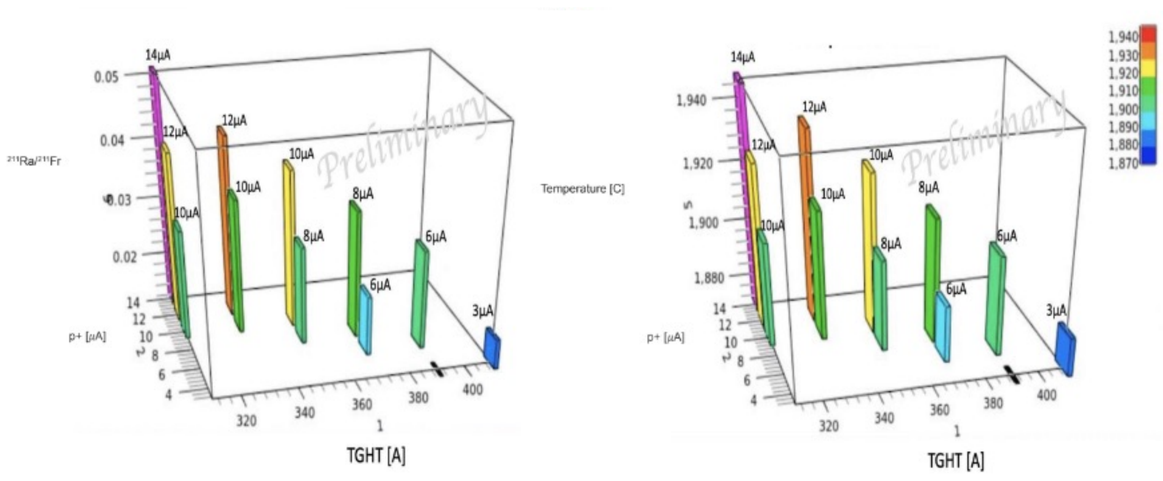
A **blackbody** is a perfect emitter and absorber of radiation. **Planck's Law** describes the spectral radiance (W m^{-2} nm^{-1}) of a blackbody:

$$\text{Spectral Radiance} = \frac{C_1}{\lambda^5}\frac{1}{e^{C_2/\lambda T}-1}$$

The algorithm used to determine the maximum target temperature is based on Planck's law (above).

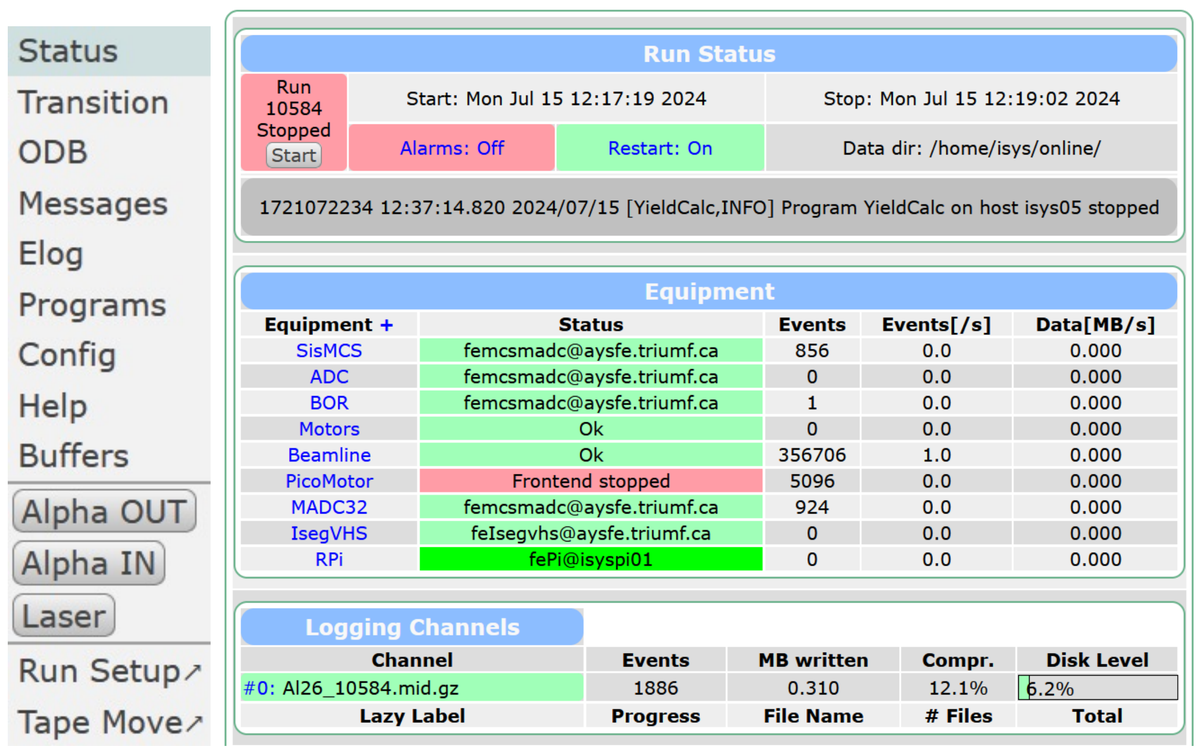
Temperature Measurements

Automated target temperature measurements would assist in optimizing desired isotope yields as well as provide a monitoring method for reliable target operation. The plots below show the strong correlation between yield and target temperature.



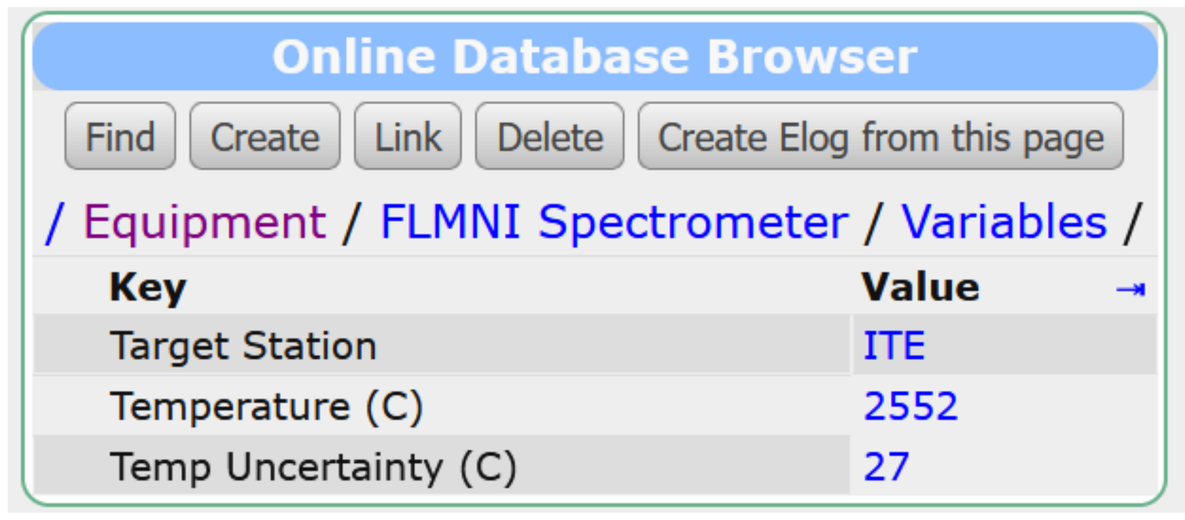
MIDAS for the ISAC Yield Station

MIDAS (Maximum Integrated Data Acquisition System) is a robust system for small to medium scale Physics experiments. The ISAC yield station uses MIDAS as its DAQ system to store data such as yield measurements, proton beam current and target heater current.



Temperature Implementation

To set-up for further analysis and optimize the extraction of desired isotopes at ISAC, the measured temperature will be integrated into ISAC's experiment control (EPICS) and DAQ systems (MIDAS). These measurements will be completely automated and further correlated with other target and beam settings and parameters.



Conclusion

A NIR spectrometer is used to collect the light from the ISAC targets and to calculate the maximum temperature using an algorithm based off Planck's Law. This temperature will be displayed on both MIDAS and EPICS to:

- optimize the yields of the isotopes of interest;
- validate, investigate and conduct further analysis of the targets and ion sources (R&D);
- automatically monitor the target temperature to ensure a reliable operation of the target ion source;
- monitor the aging of the target.

Discovery, accelerated