Testing Reflectivity Measurement Components at UV Wavelengths

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In the near future, JLab will be constructing several ring-imaging Cherenkov (RICH) detectors for the EIC and SoLID projects. Each detector has arrays of mirrors that focus the Cherenkov light to the detector electronics array. These mirrors must adhere to strict manufacturing specification, particularly for their reflectivity. To ensure the mirrors meet the required reflectivity specifications for light in the deep UV wavelength spectrum (~200 nm), they will be tested in DSG's reflectivity test station (DSG Note ????-??). Before the existing test station can be used for 200-nm light, the compact CCD spectrometers (CCSs) had to be tested to ensure they are able to work correctly for the desired wavelengths.

DSG's current reflectivity test station uses two Thorlabs CCSs to measure the power of light before and after reflecting off of a mirror. The range of wavelengths that the CCSs are specified for are 200 – 1000 nm. To ensure that the CCSs are able to measure light power at the lower wavelengths, a simple proof-of-concept test was performed . In the test, the test station's quartz-tungsten halogen lamp was initially used. For this first test, the CCS was connected to the lamp using only a Thorlabs RP26 fiber-optic reflection probe's reference leg. Then, the CCS was used to take a snapshot of the light intensity from ~200 nm – 300 nm (Fig. 1). With this set up, a 40-ms CCS exposure time had to be used and resulted in a relatively flat wavelength vs. intensity curve.

Next, to see how a CCS operated with a lamp specifically rated to output UV light, the QTH lamp was replaced with an old deuterium lamp DSG had on hand, and the test repeated. Fig. 2 is the snapshot of the wavelength vs. measured light intensity when the deuterium. In this test, 900-ms CCS exposure times had to be used the wavelength vs. intensity curve has a well defined peak centered at about 230 nm.

From these tests, it was determined that the CCSs can indeed be used for lower wavelength light down to ~200 nm. Additionally, the tests provided insight into what type of light source should be used.

The immediate next steps for this project are to investigate new UV lamps, how the fiber-optic cable bundle can be coupled to the lamp, and the best probe set up for measuring mirror samples.

- **Several RICH detectors will be built that all have mirror arrays to focus Cherenkov light in the UV range to the detectors' electronics**
  - **The mirrors should be tested to ensure they meet necessary reflectivity specifications**
- **DSG has a mirror reflectivity test station, but its components are not clearly specified to work for UV wavelengths**
- **Before committing to the existing test station equipment or to buying new equipment, a test was performed to determine on-hand components' capabilities at measuring UV reflectivity**
- **Results:**
  - **Test station's Compact CCD spectrometers are able to measure down to ~200 nm**
  - **A new, UV lamp should be investigated to ensure there is enough light at the desired wavelengths for the tests**

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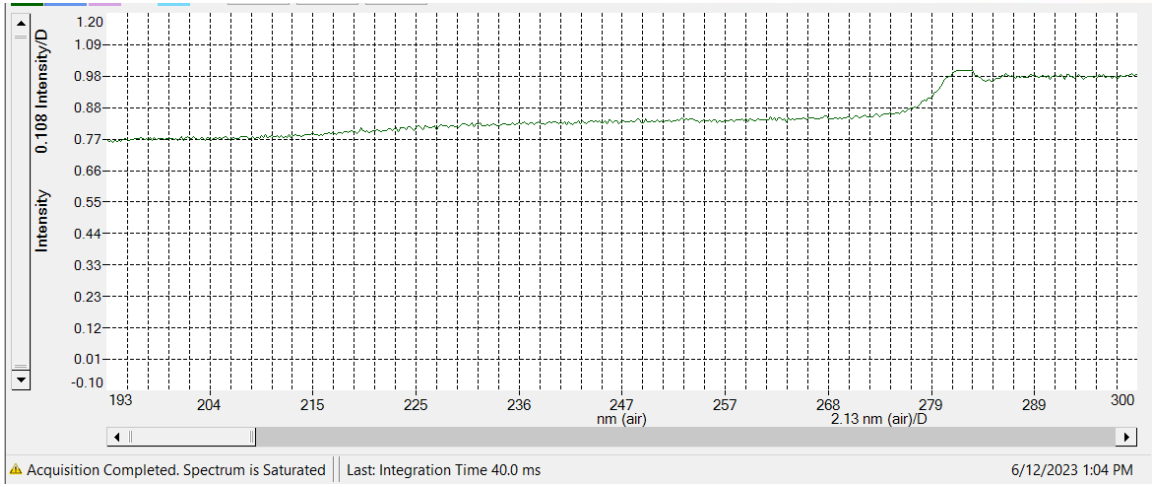

Fig. 1: Screenshot of CCS measurement spectrum using a QTH lamp. For tests, 40-ms CCS exposure time was used.

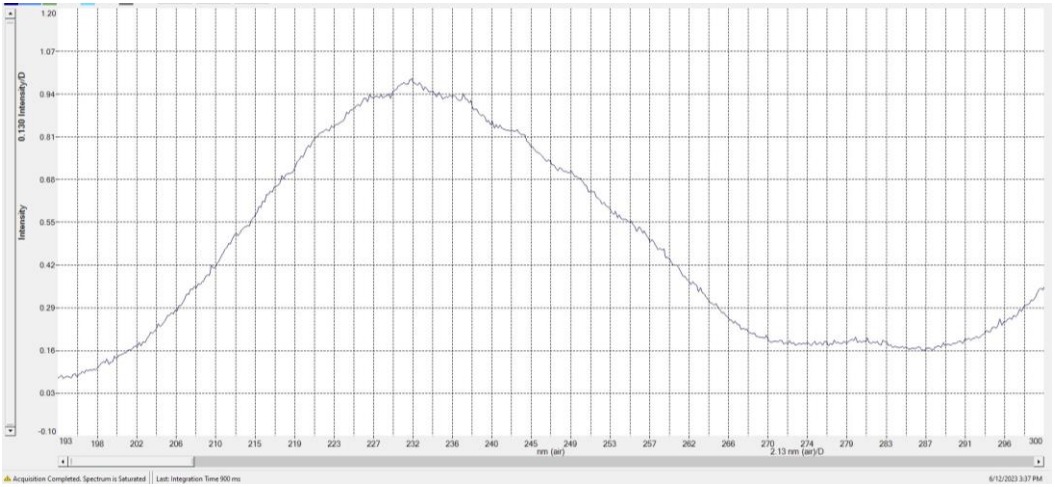

Fig. 2: Screenshot of CCS measurement spectrum using a Deuterium lamp. For tests, 900-ms CCS exposure time was used.