Solar-Similar NIR-Supressed “Blue” Calibration Source

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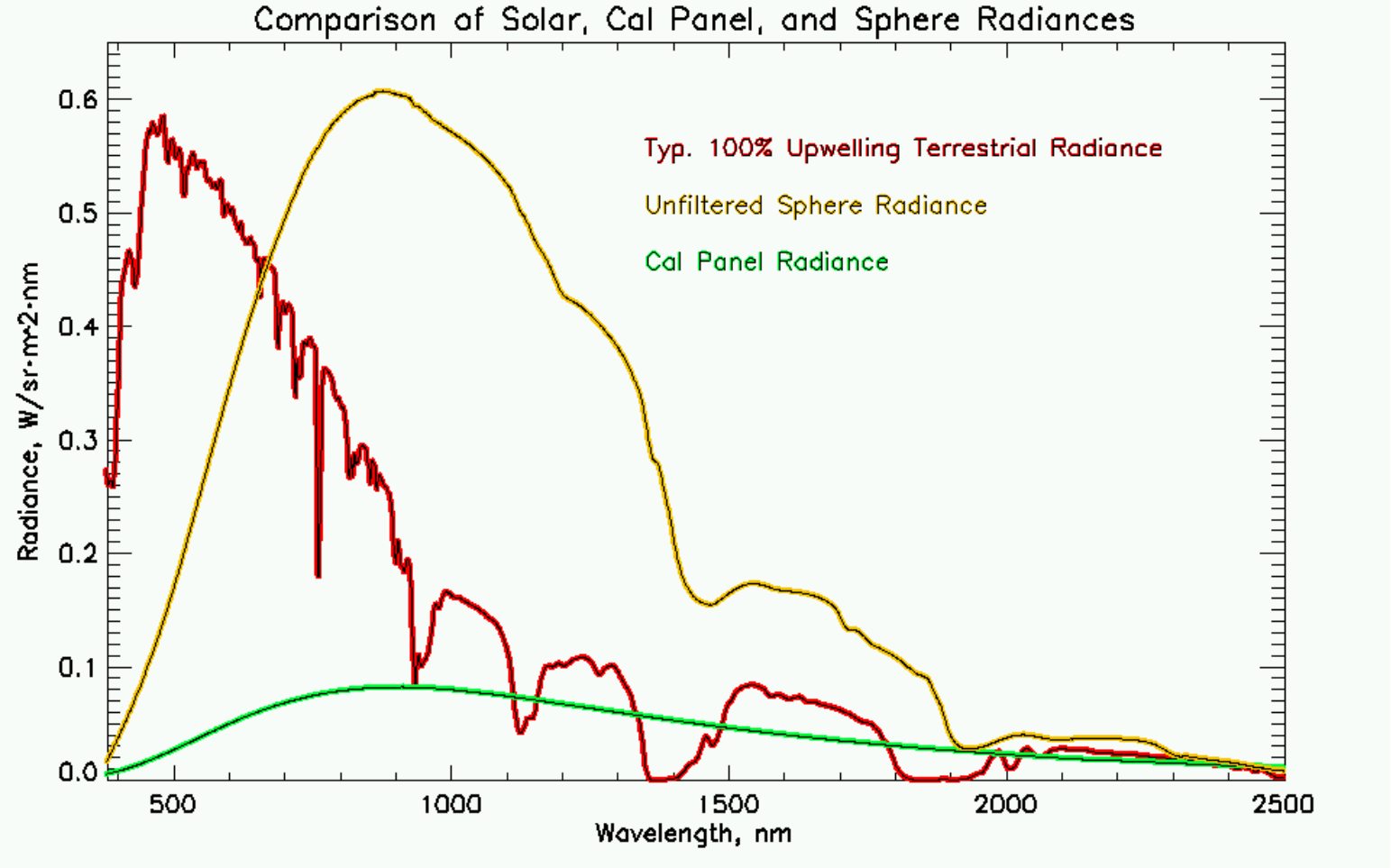
Laboratory calibration and characterization methods using incandescent sources have been weak at short wavelengths.



Spectral radiance of a typical industry-standard integrating sphere and a typical mid-latitude upwelling terrestrial radiance of a spectrally-flat white target.

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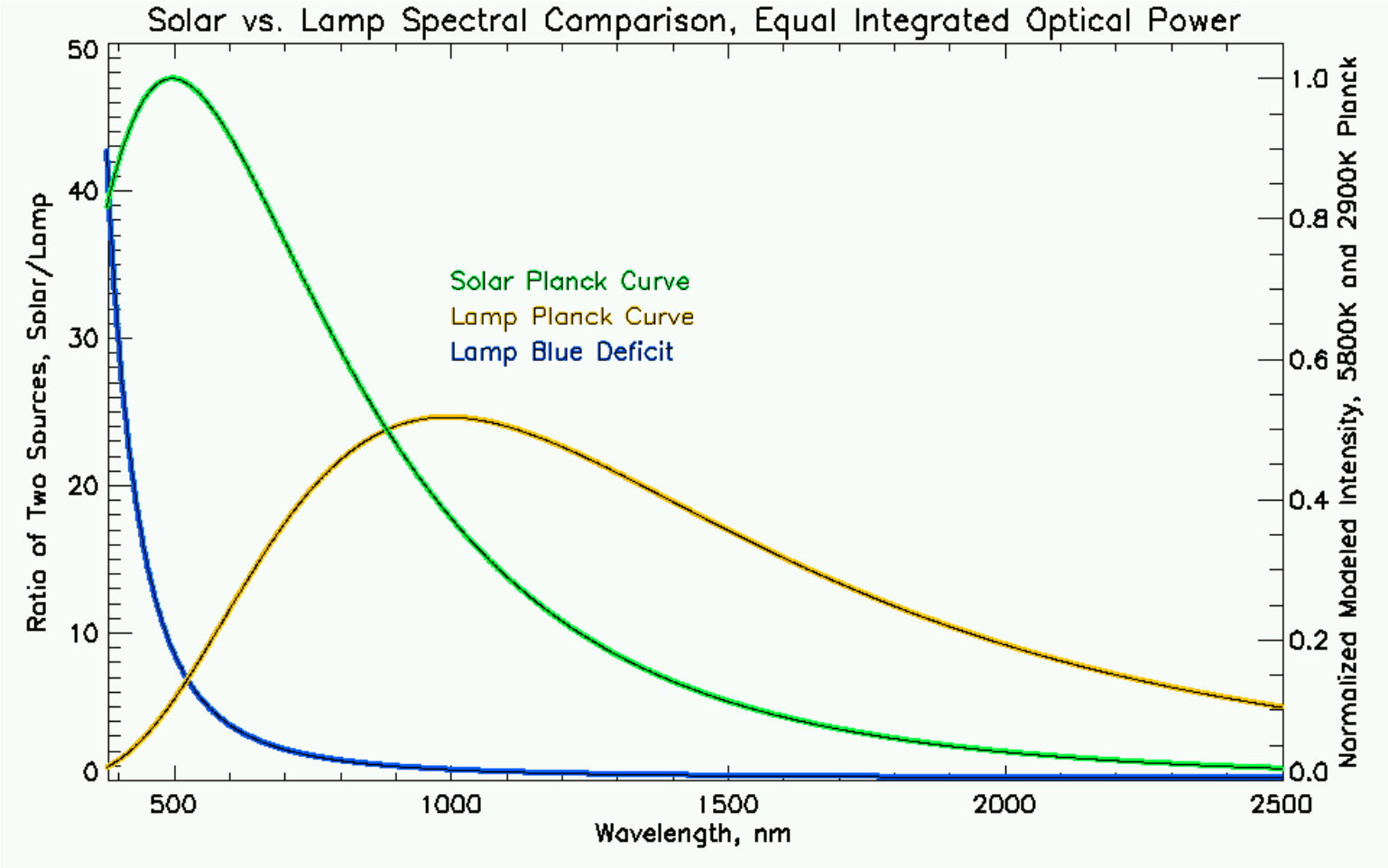
The magnitude of the "Blue" problem: Amping it up would produce orders of magnitude more NIR light than is required or desired.



The output of a 2900K source and a 5800K source, both at the same integrated power (right axis). Also displayed is the ratio of the two (left axis).

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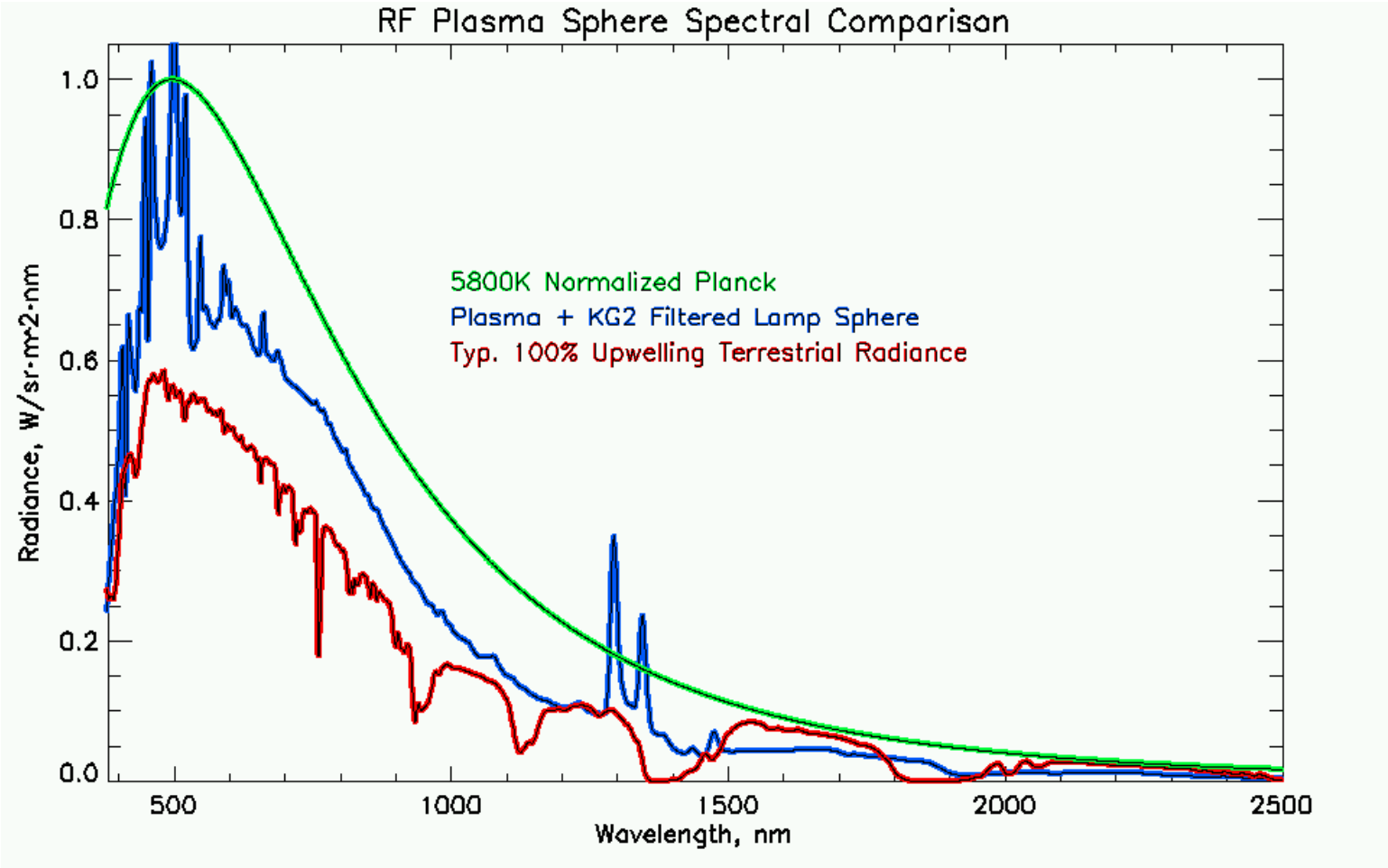
Attempts have been made to address this issue, such as infilling with a plasma-based source; complicating radiometric accounting.



RF-stimulated composite plasma source augmenting a QTH lamp. Resulting spectrum unavoidably includes sharp spectral features

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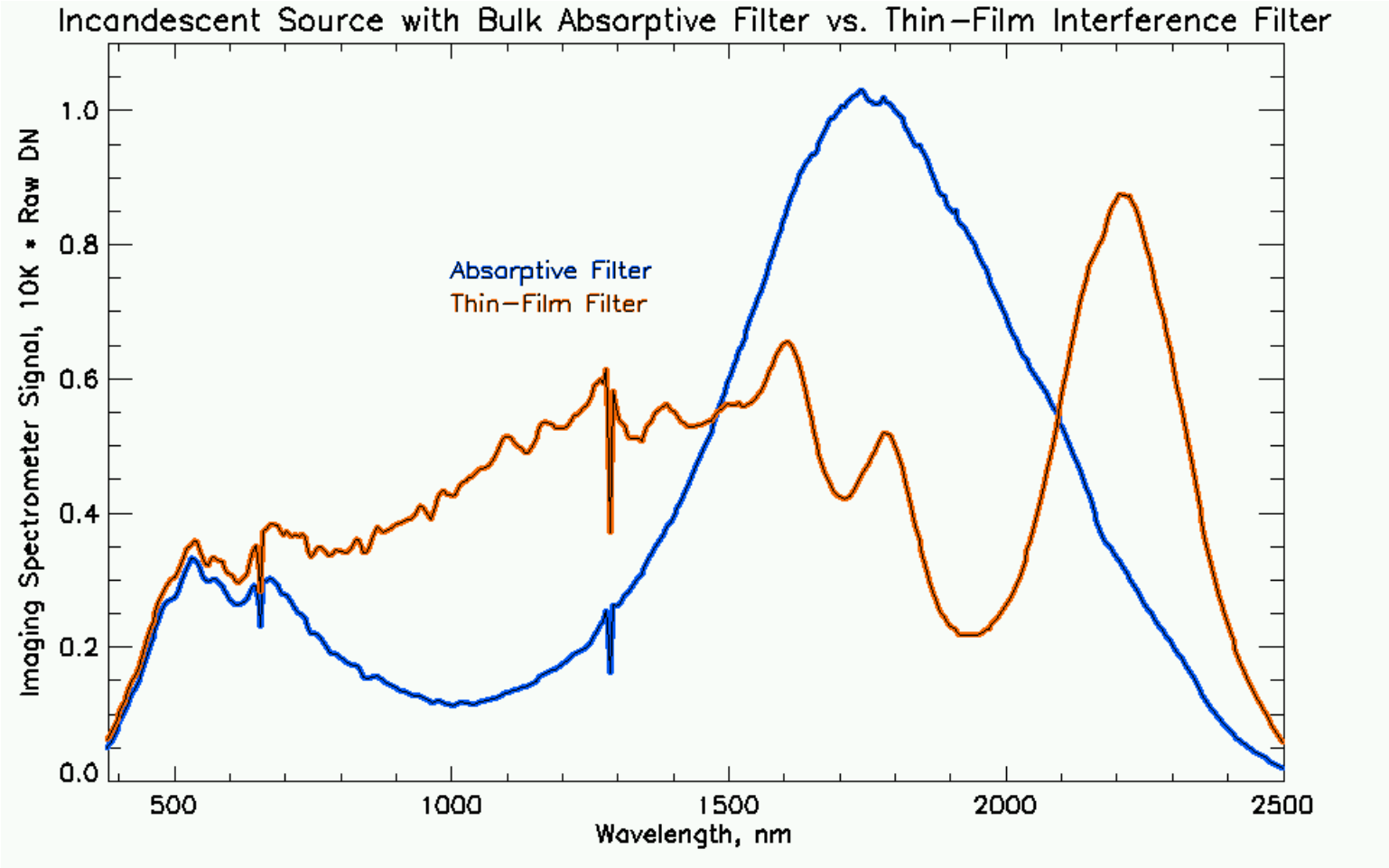
Filtering out the excessive NIR of an incandescent source is an available path. Two approaches have been tried: reflective and absorptive.



Absorptive filters overheat. Reflective filters do not, however the technology is based on thin film materials, which introduce their own peculiar spectral contributions.

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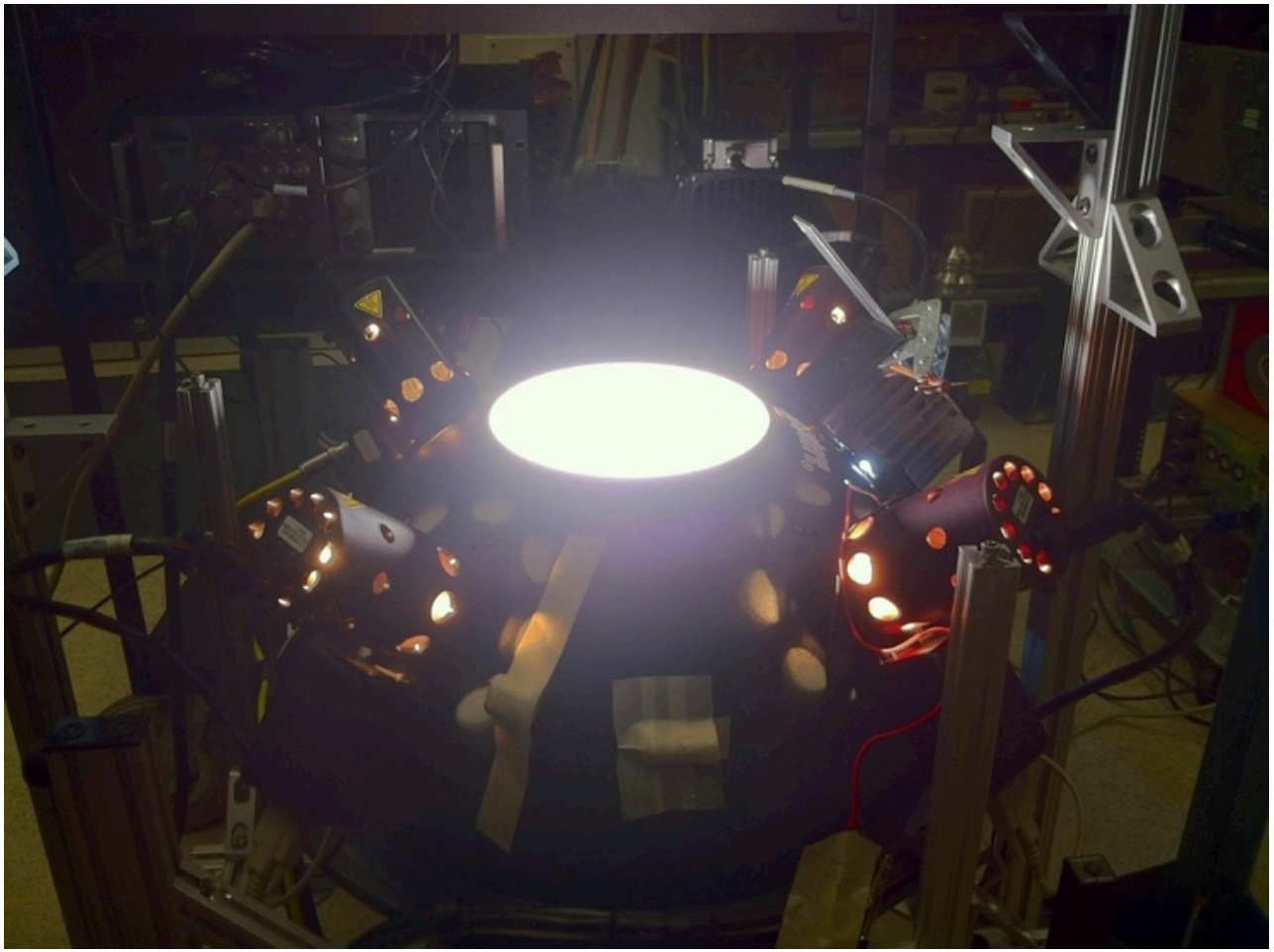
An initial cost-effective solution to producing a spatially uniform source with more solar-like spectral characteristics.



An existing 8” aperture integrating sphere was modified. This model has four light projectors with rhodium coated concentrators and variable attenuators with 1” ports.

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Leveraging a mechanical coincidence for proof-of-concept: The ports at the end of the projectors allowed the use of 1” round filters.

A test was conducted, outside of the sphere. Upon illumination, the filter immediately shattered, but into just a few pieces. A screen did the trick.

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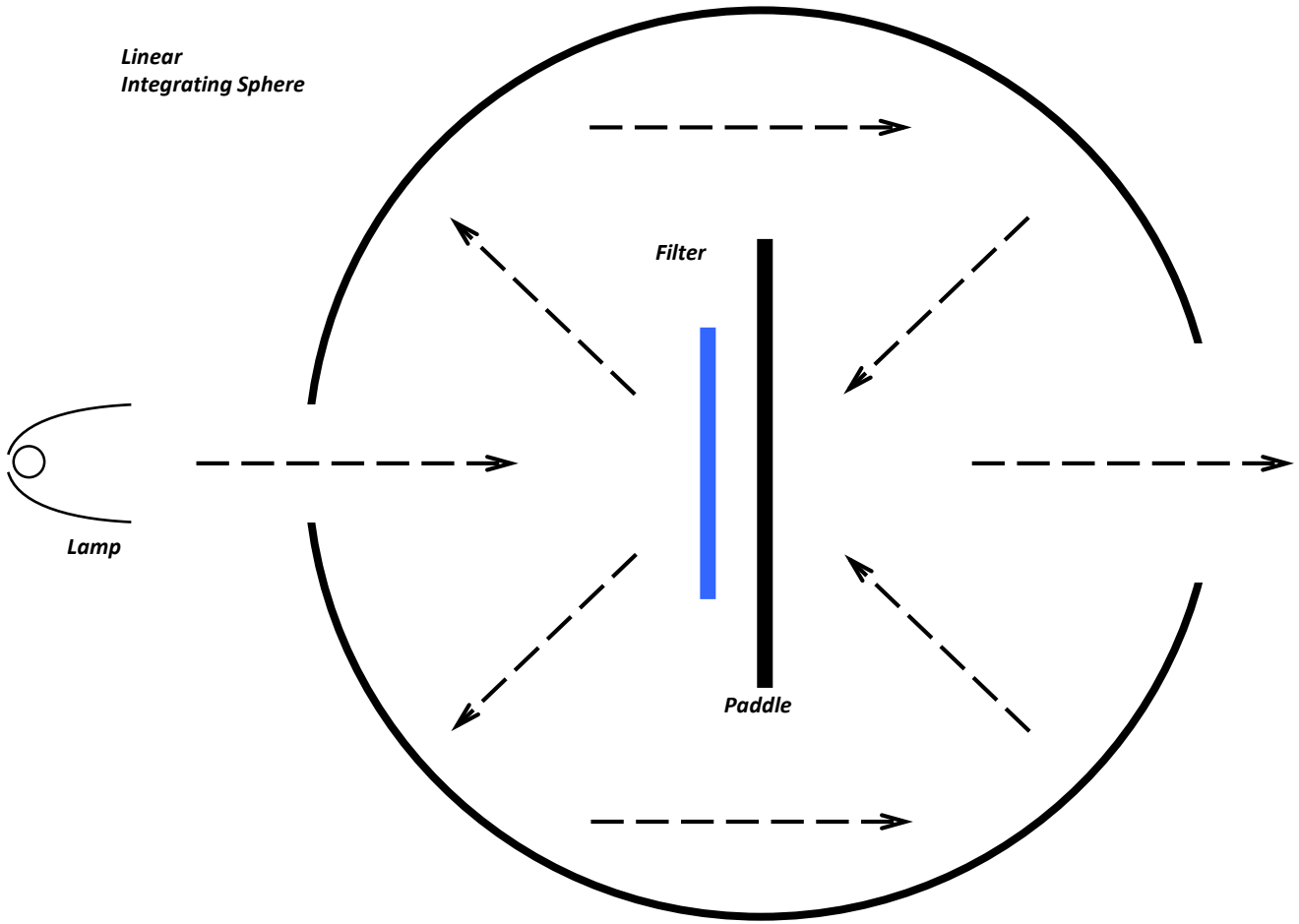
More cost-effective leveraging: Modifying an existing two-inch aperture, pressed-Halon interior, linear integrating sphere.



An advantageous feature of this style of integrating sphere selected is a circular, Lambertian, (on both sides) paddle suspended in the middle.

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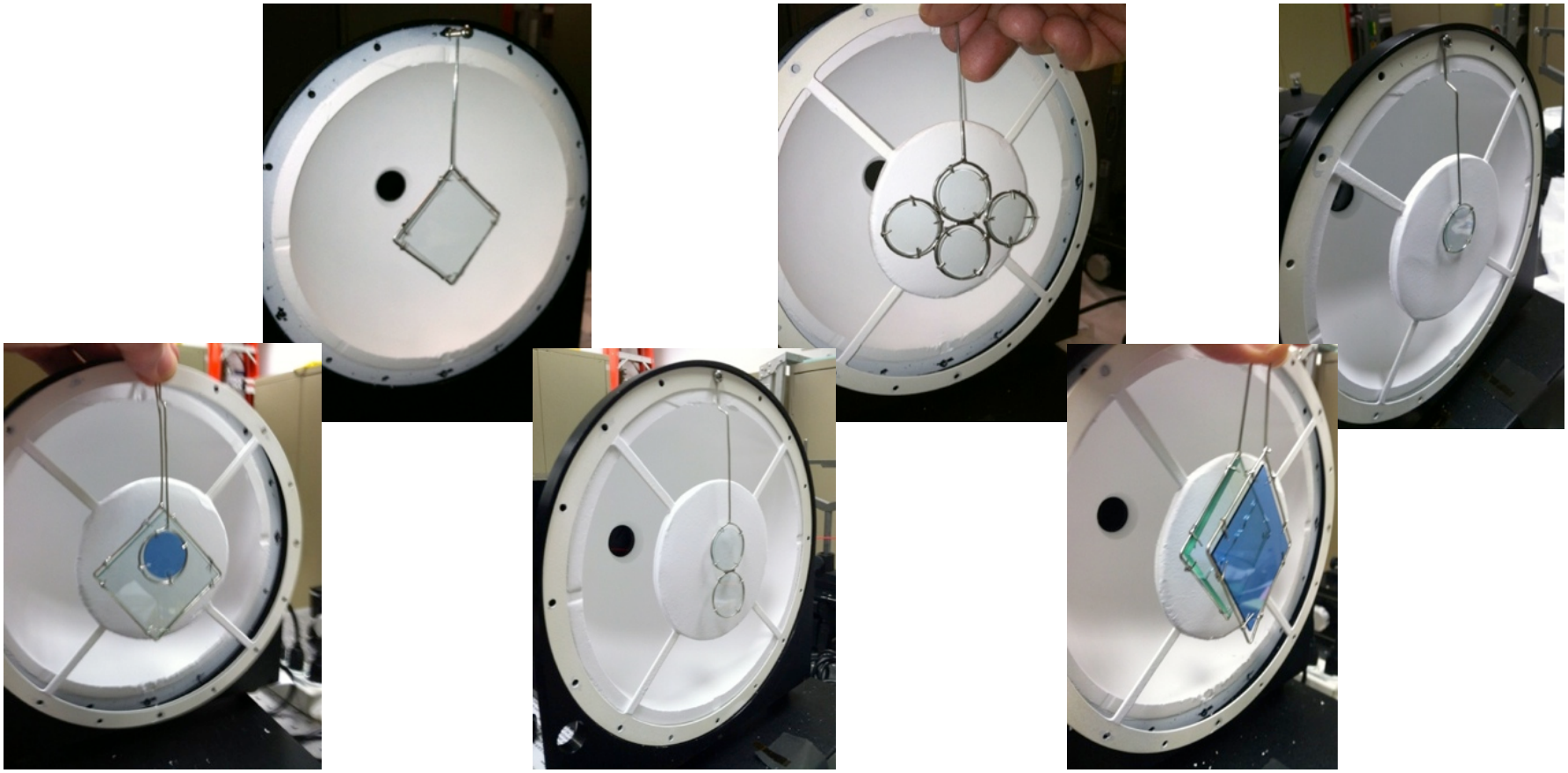
An empirical investigation of several variables: Total area, optical thickness, spectral bandpass, and thermal robustness.



Taking apart this type of sphere is not for the faint of heart. The pressed Halon is about as robust as Christmas tree flocking. Hence, the “Ornament experiment.”

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The current filter, cracked in battle and super-glued back together. Two-inch square 3mm thick Schott KG-2.

First use, the holder solder melted and the filter cracked. A no-solder holder made of one wire strand and slower warm-up procedures now ensure reliable operation.

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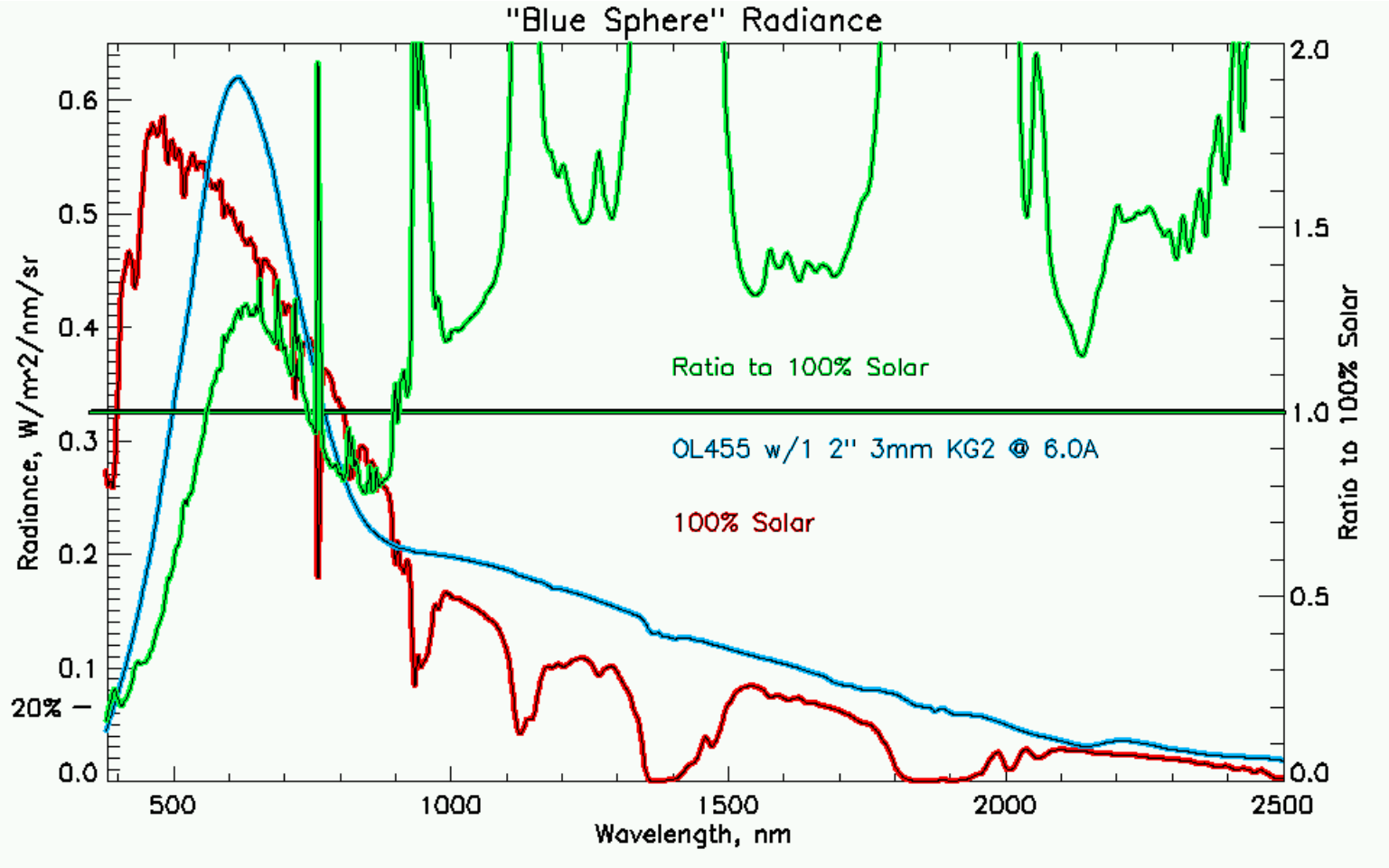
2-inch linear "Blue" sphere output. A dramatic improvement over industry-standard QTH sources, and, spectrally smooth.



Lamp current is over-driven slightly to produce as much blue/UV as practical without burning out the lamp. OL-455 variable attenuator is used to avoid saturation.

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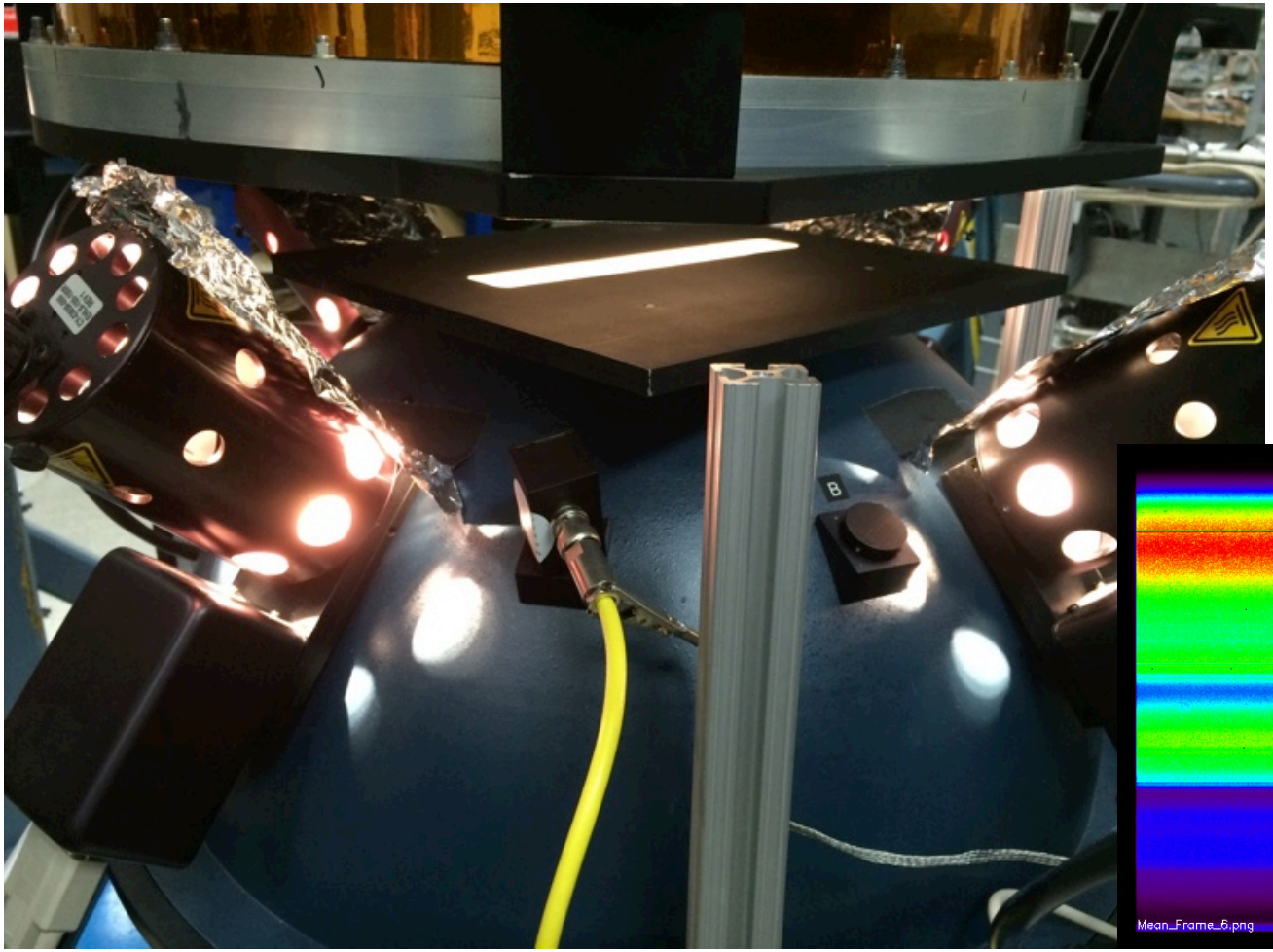
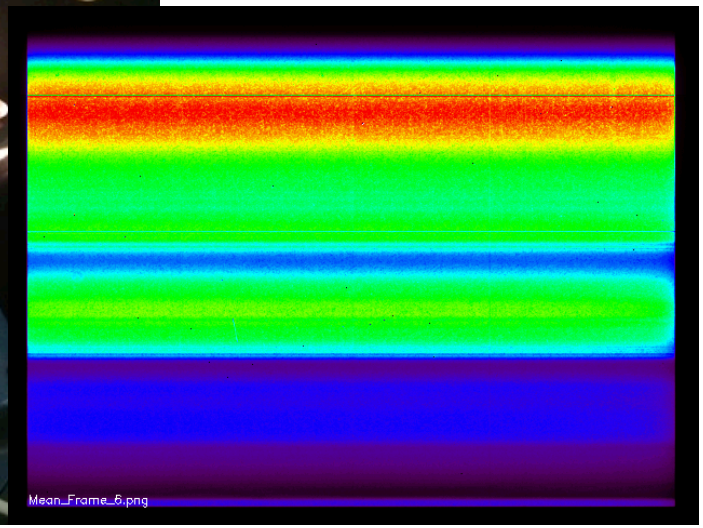
An experiment using the 8-inch aperture integrating sphere to investigate the benefits of using an NIR-filtered spectrum.



AVIRIS Next Generation Imaging Spectrometer

640x480 pixel FPA raw DN frame of integrating sphere with "blue" filters



Note the added custom sintered PTFE aperture tile. It is white on the bottom, and spray painted flat black on top. It has a slit cut into it, which enhances output and uniformity.

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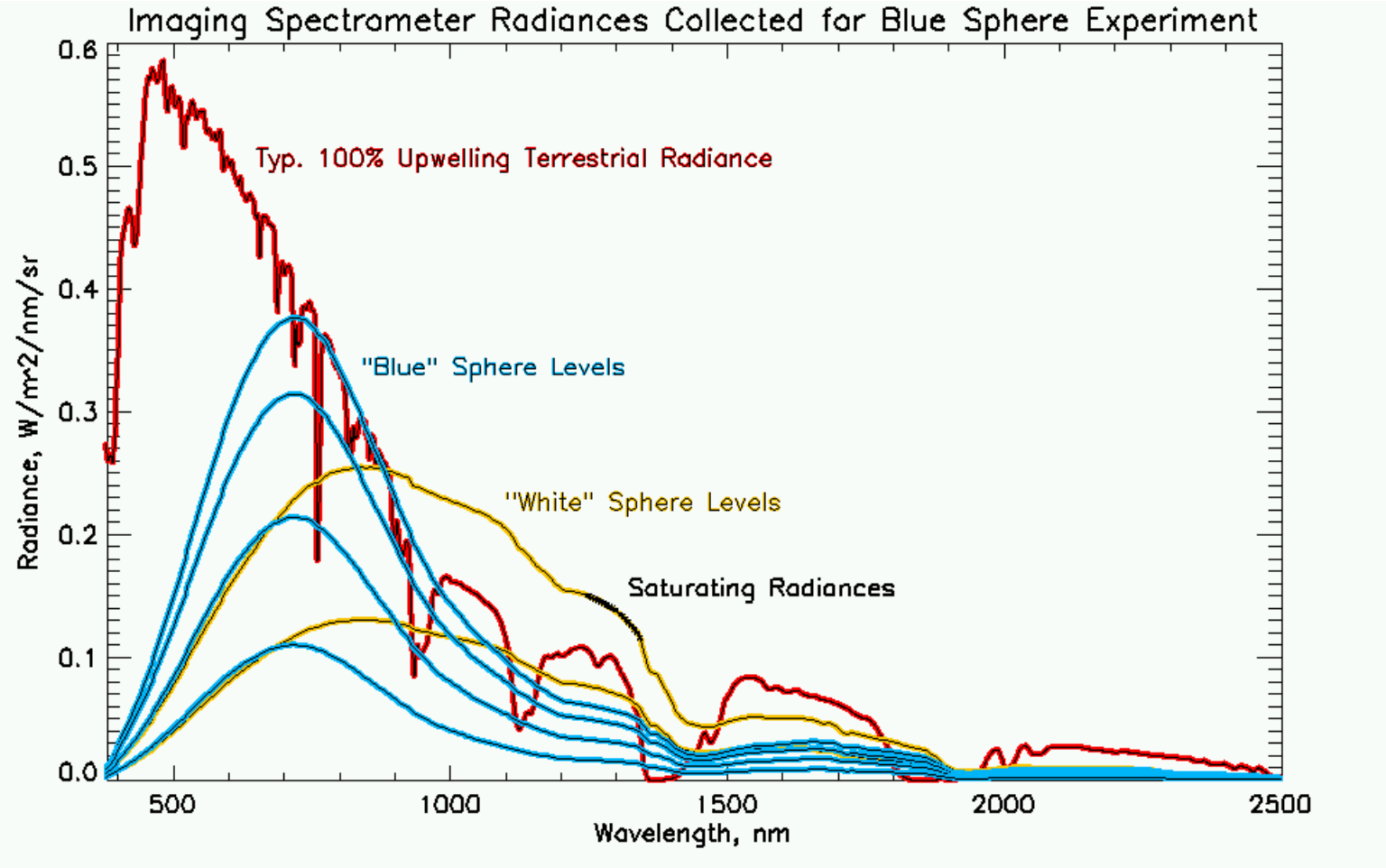
8-inch sphere output as compared to Solar Radiance. “Blue” and “White” modes for comparison of imaging spectrometer performance.



Two “blue” sphere radiances roughly coincide in overall visible intensity with the two “white” sphere levels. These four radiances are key to later analysis and discussion.

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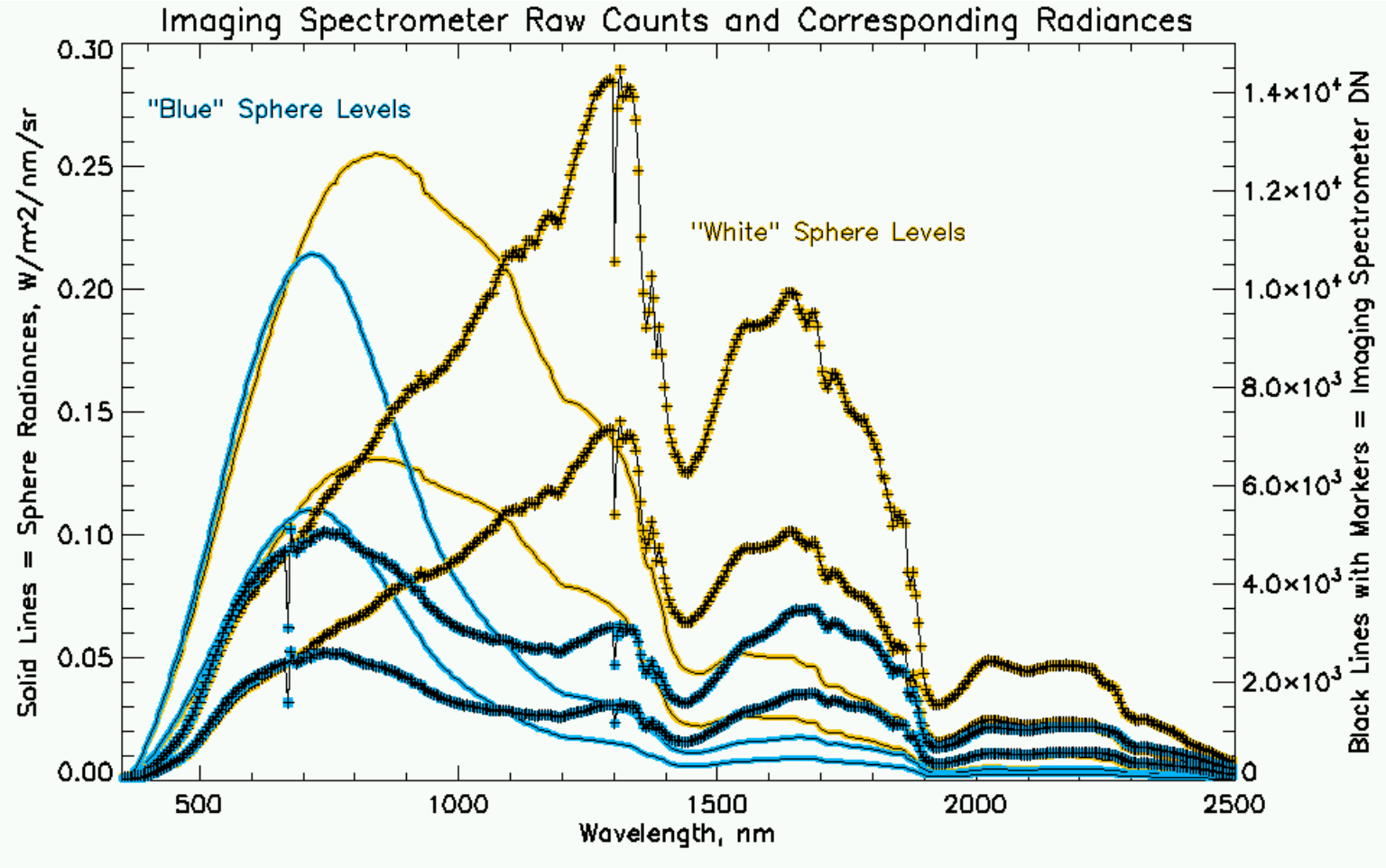
Dark-subtracted imaging spectrometer raw counts and corresponding radiances for the two lowest pairs of “Blue” & “White” sphere levels.



Also plotted is source radiance as measured via transfer from a NIST lamp & panel. Accuracy of the spectral radiometer used for the transfer is trusted to the first order.

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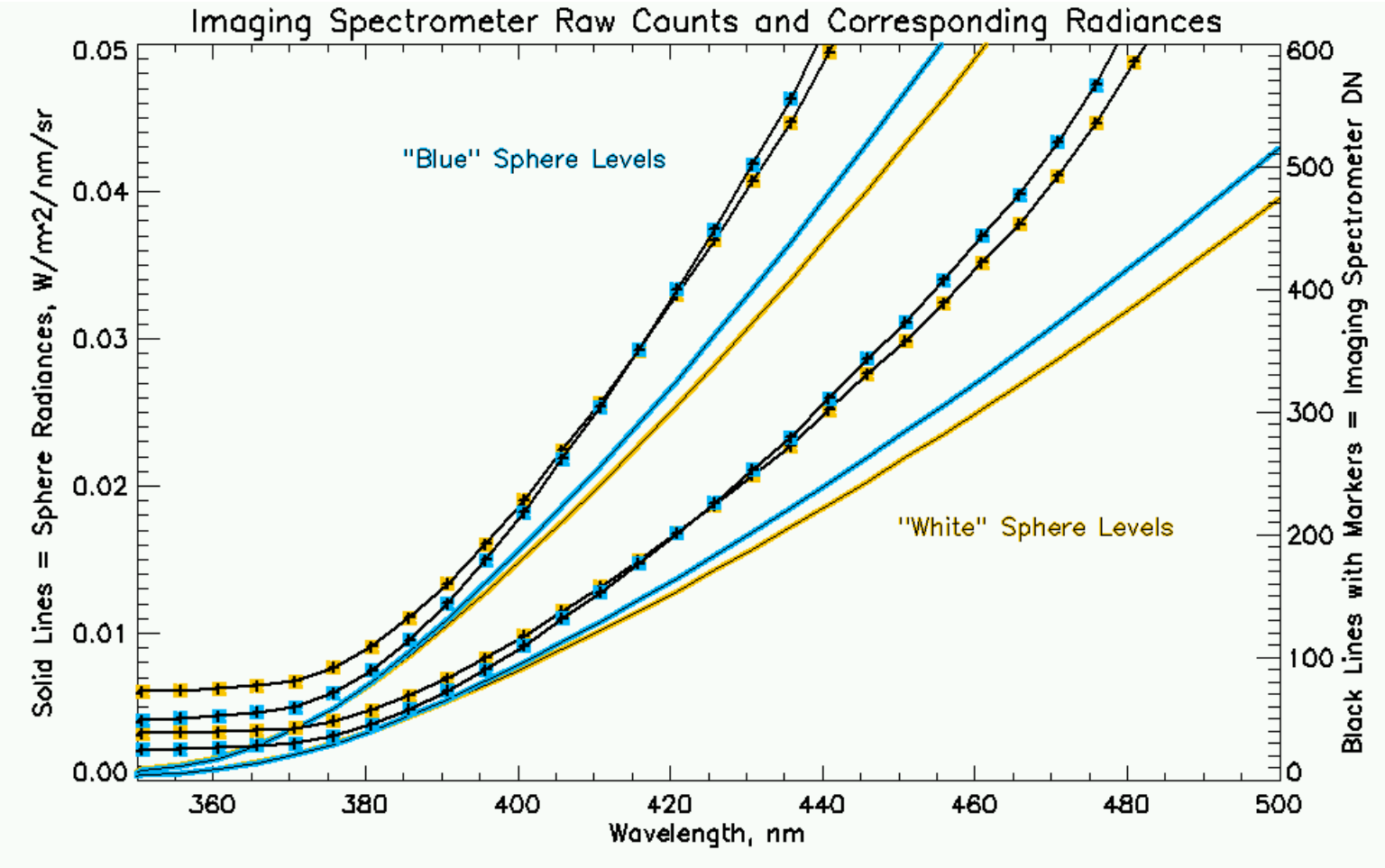
Dark-subtracted instrument response and input radiance of “Blue” and “White” sphere levels providing a window into calibration fidelity.



Note the crossover in raw counts at about 420 nm, while radiances never cross. Also, extra photons have passed through the OD 6 at 350 nm order-sorting cut-off filter.

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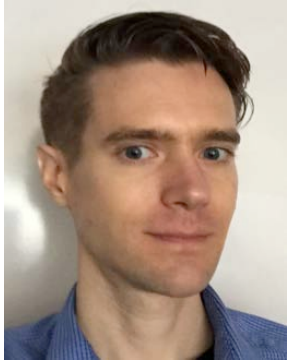
Thank you to my co-authors:

Calibrate like you fly, fly like you calibrate.

Michael Eastwood

Robert Green



David R. Thompson

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