

# SH12A-1160 Pre-Launch and On-Orbit Prism Transmission Calibrations for SIM on SORCE

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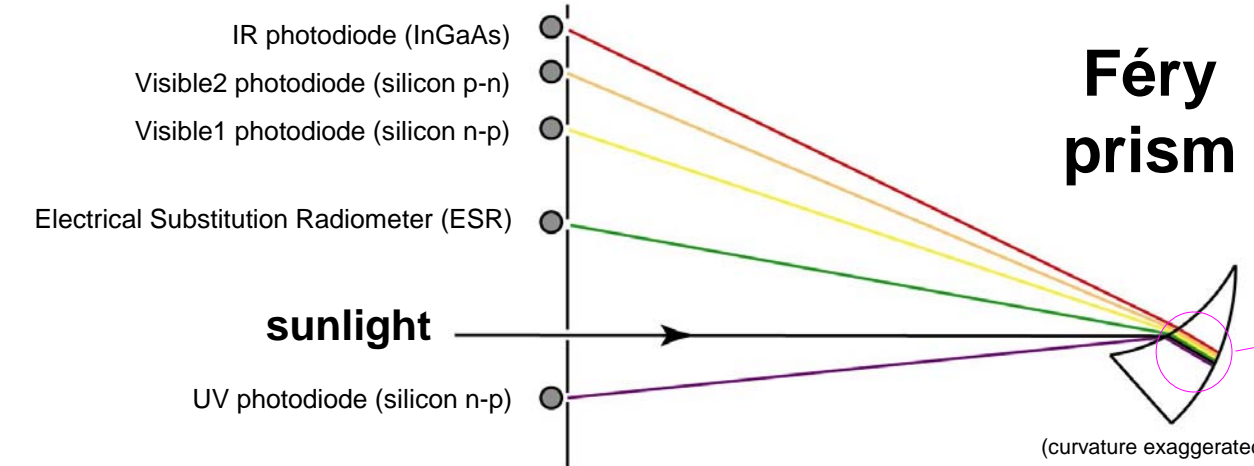
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## Motivation

A *Féry prism* made of Suprasil 300 disperses sunlight onto detectors in the focal plane of the SIM instrument.



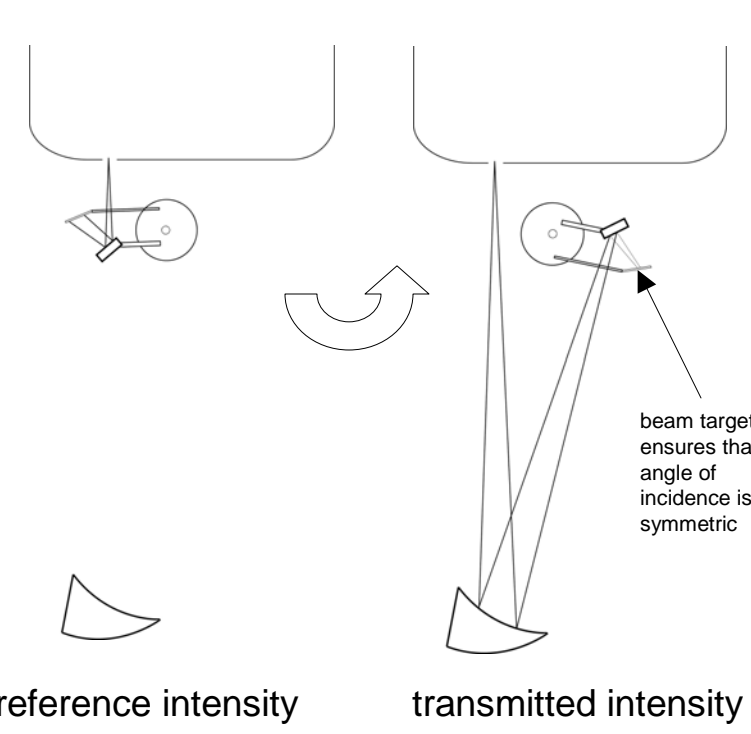
The measurement equation for spectral irradiance,  $\epsilon_\lambda$ , contains the prism transmission:

$$\epsilon_\lambda = \frac{1}{f \cdot L} \left[ \tau_{\text{prism}}(\lambda) \cdot \tau_{\text{HRT}}(\lambda) \cdot \Phi_{\text{Diff}}(\lambda) \cdot W(y(\lambda) - y_{\text{set}}) \cdot \alpha(\lambda) \right] \cdot \frac{V_7^2 \cdot R_H}{M \cdot (R_s + R_H)^2} \cdot \left( \frac{1+G}{G} \cdot \frac{Z_H}{Z_R} \right) \cdot \frac{p \cdot D}{A \cdot p \cdot Q}$$

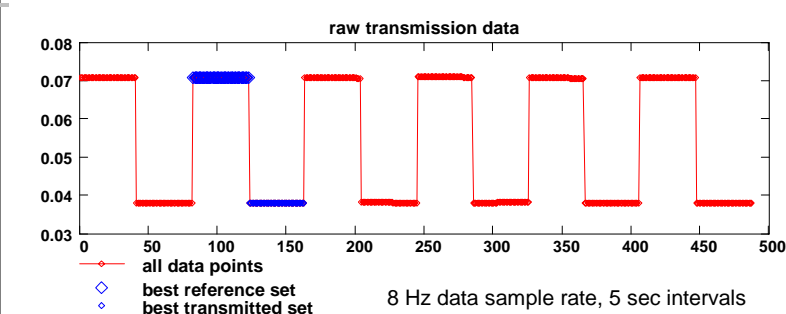
Thus, the prism transmission vs. wavelength must be known pre-launch and monitored on-orbit.

## The Prism Transmission Is Measured *Pre-Launch*

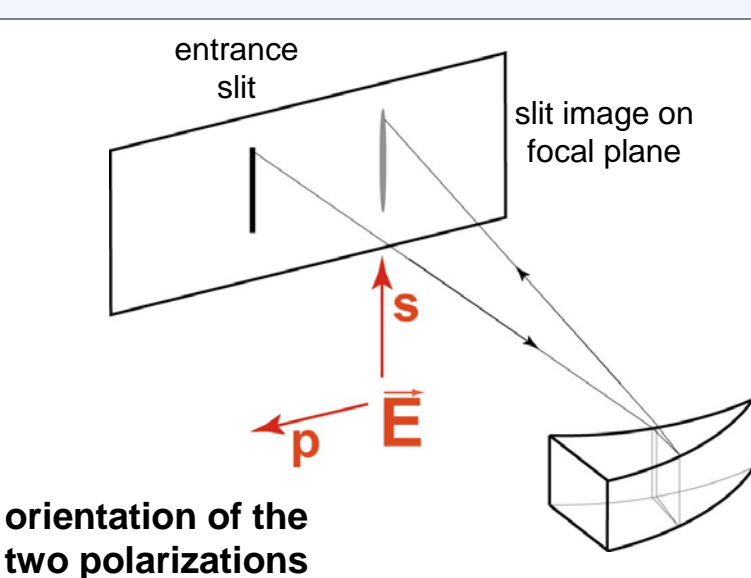
The detector turns to measure transmission



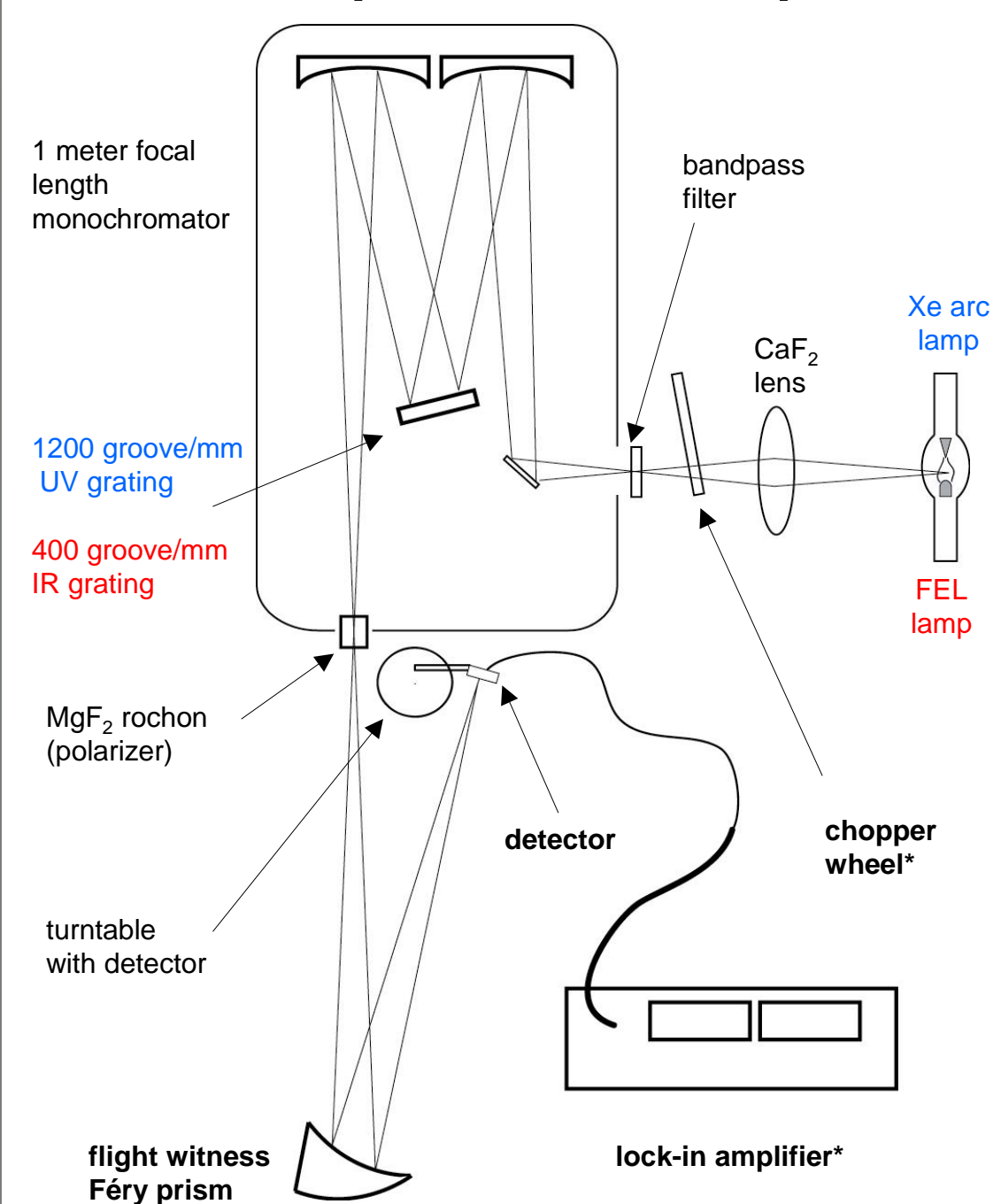
The transmission coefficient is transmitted/reference, measured repeatedly to check for stability.



The data set with the lowest noise is used.



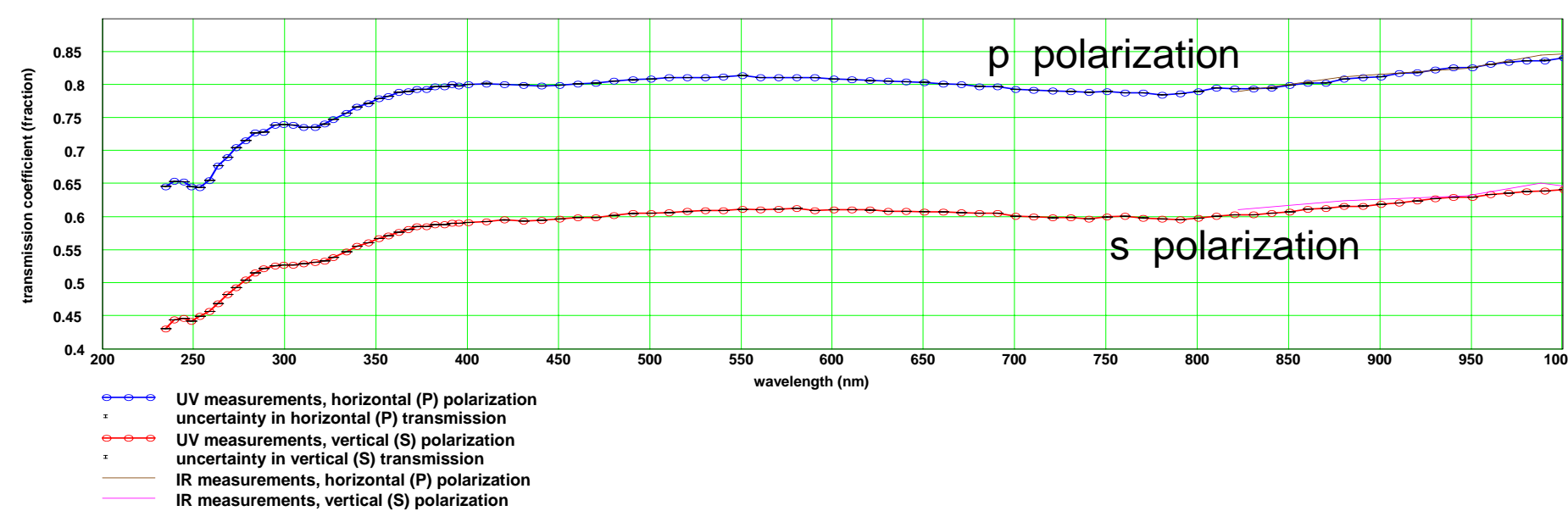
## Experimental Setup



\*Phase sensitive detection established a signal over 10<sup>3</sup> times the dark signal. Long time constants (~300 ms) help smooth the noise.

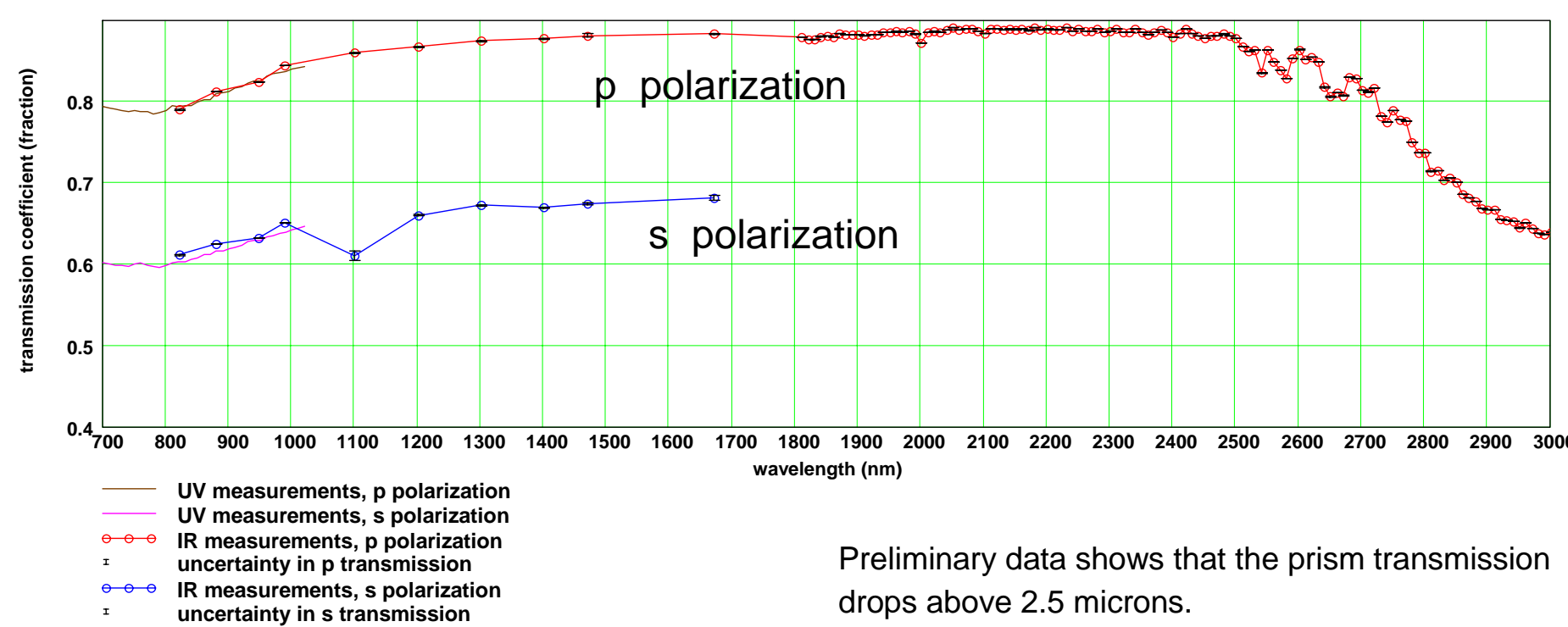
The detector for the UV measurements was a silicon photodiode. For the IR, it was a PbS photoconductor thermoelectrically cooled to -20°C.

## UV configuration was used from 200 to 1000 nm



Data was taken in 5 nm increments from 200 to 400 nm, then every 10 nm until 1000 nm. Uncertainties were less than 300 ppm (1σ), smaller than the plotting symbols above.

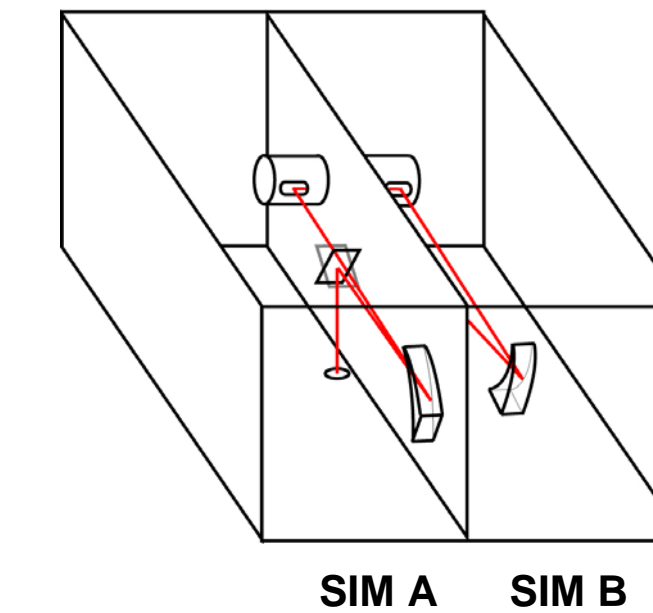
## IR configuration was used from 0.85 to 3.0 μm



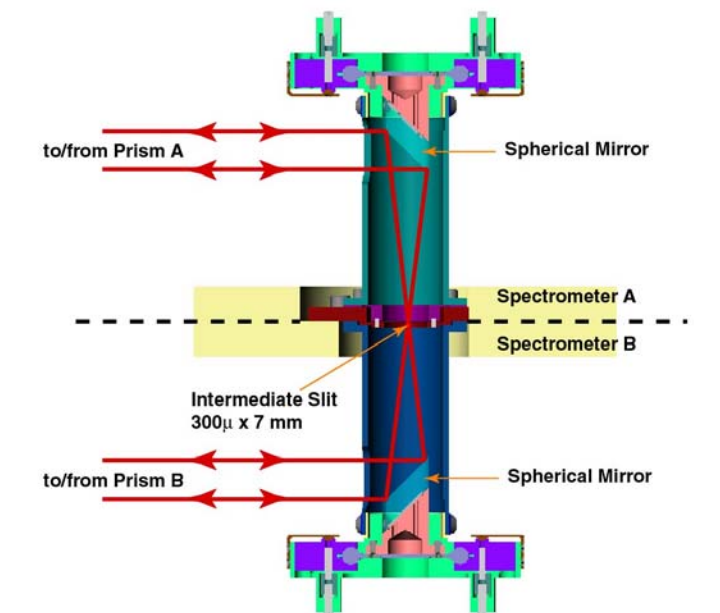
Preliminary data shows that the prism transmission drops above 2.5 microns.

## The Prism Transmission Is Monitored *On-Orbit*

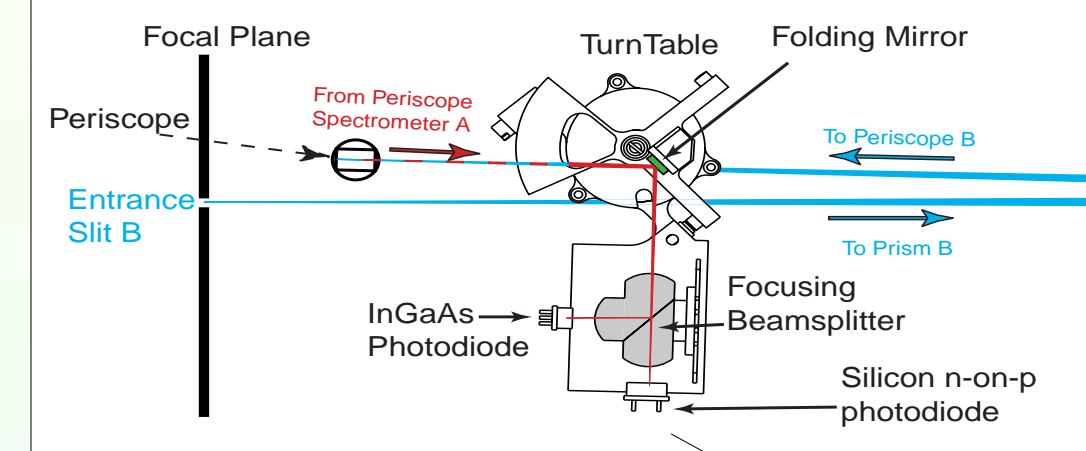
One SIM uses a periscope, mirror, and detector to monitor the prism transmission of the other SIM.



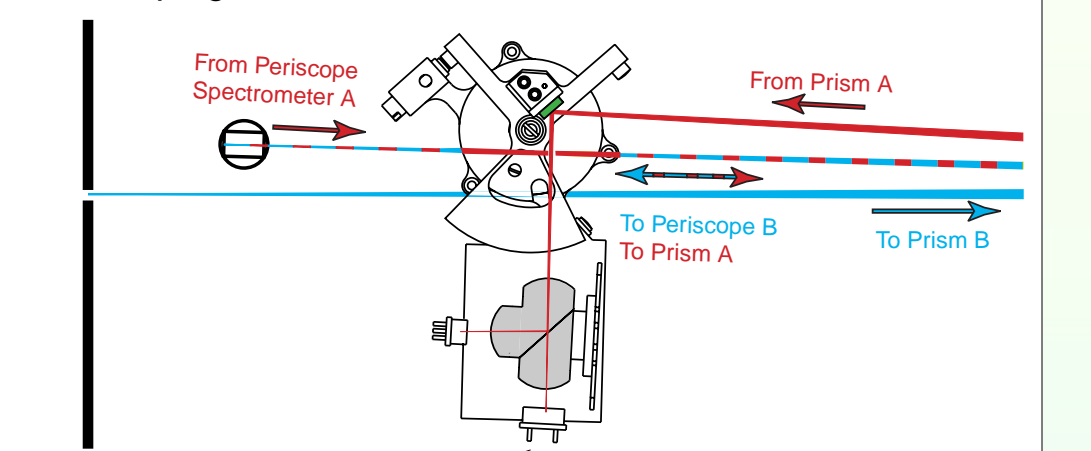
The first SIM acts as a monochromator, directing one wavelength into the periscope.



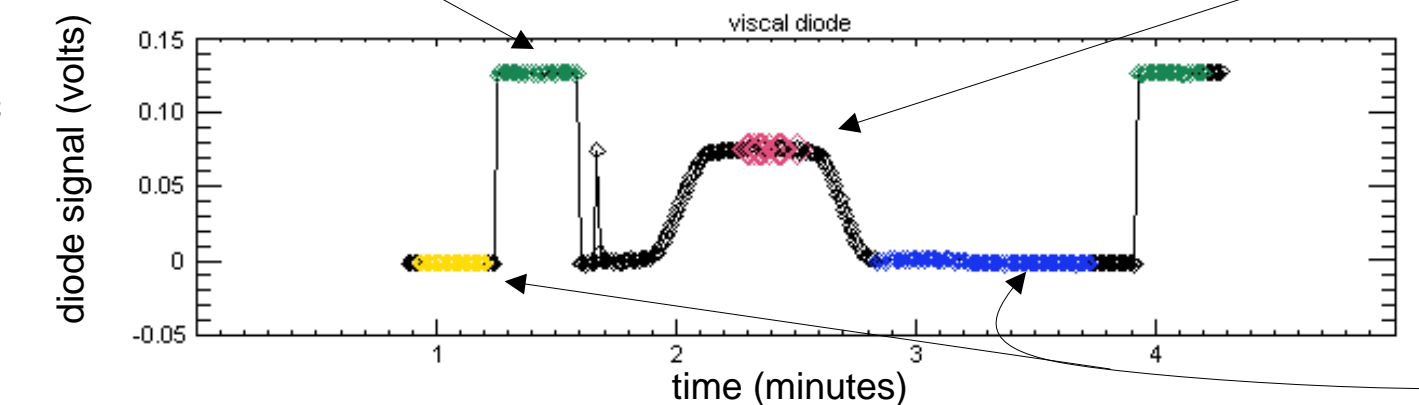
The reference intensity is measured when the mirror reflects light directly into the photodiodes. (red ray)



Next, the mirror rotates, intercepting the transmitted beam from the prism (red ray). Also, the prism under test turns, sweeping the transmitted beam across the mirror.



Sample of raw data:



Dark counts are also recorded.

Preliminary time series reveal *degradation*, or the fractional decrease of transmission over time.

