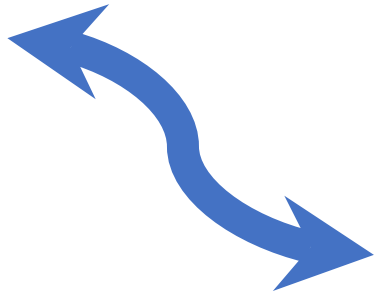
A Multi-Wavelength Photometer for Small Satellite Heliophysics

We Sort Light



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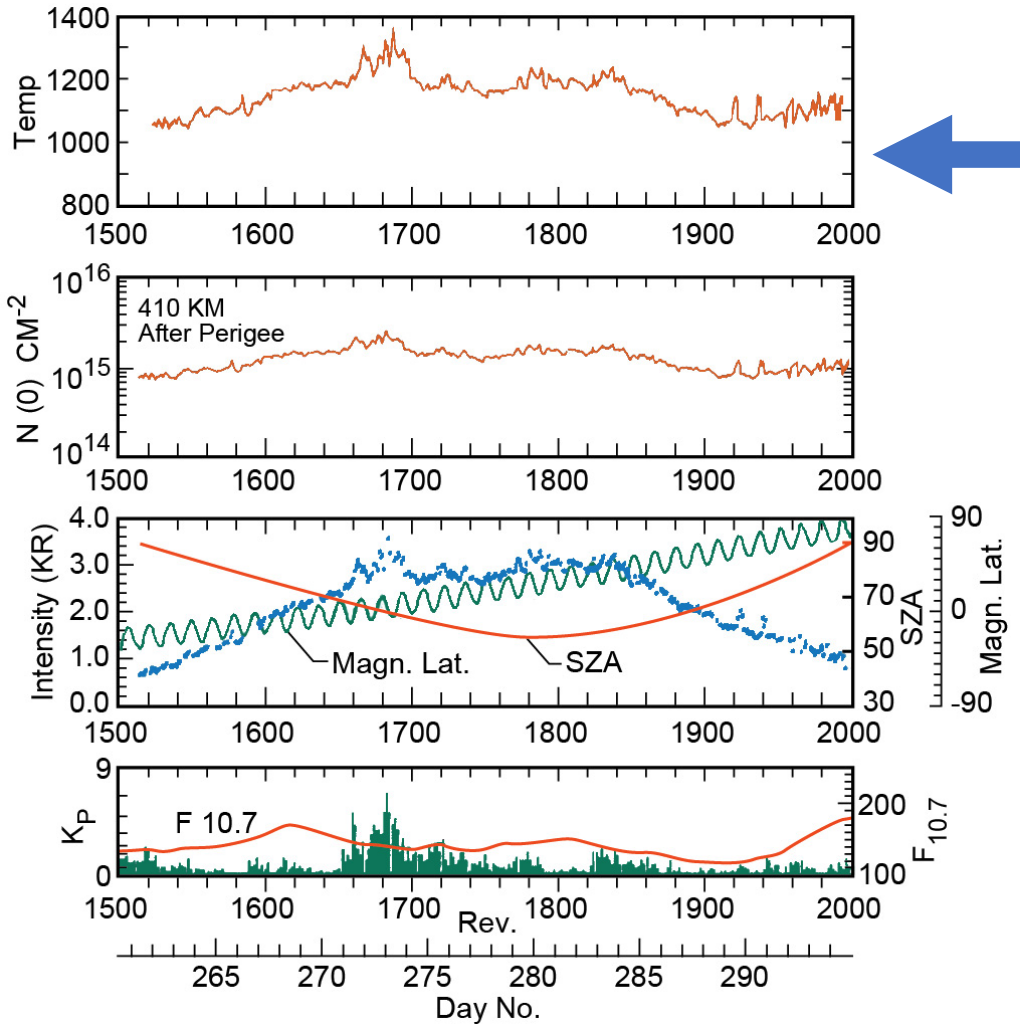
Motivation

Small-Sat VUV sensor to compliment GUVI, SUSI, GOLD & other larger missions.



OGO-6 (1976) zenith OI 130.4 nm photometer data and derived products N(O) and Texo

Strickland and Thomas 1976

Motivation

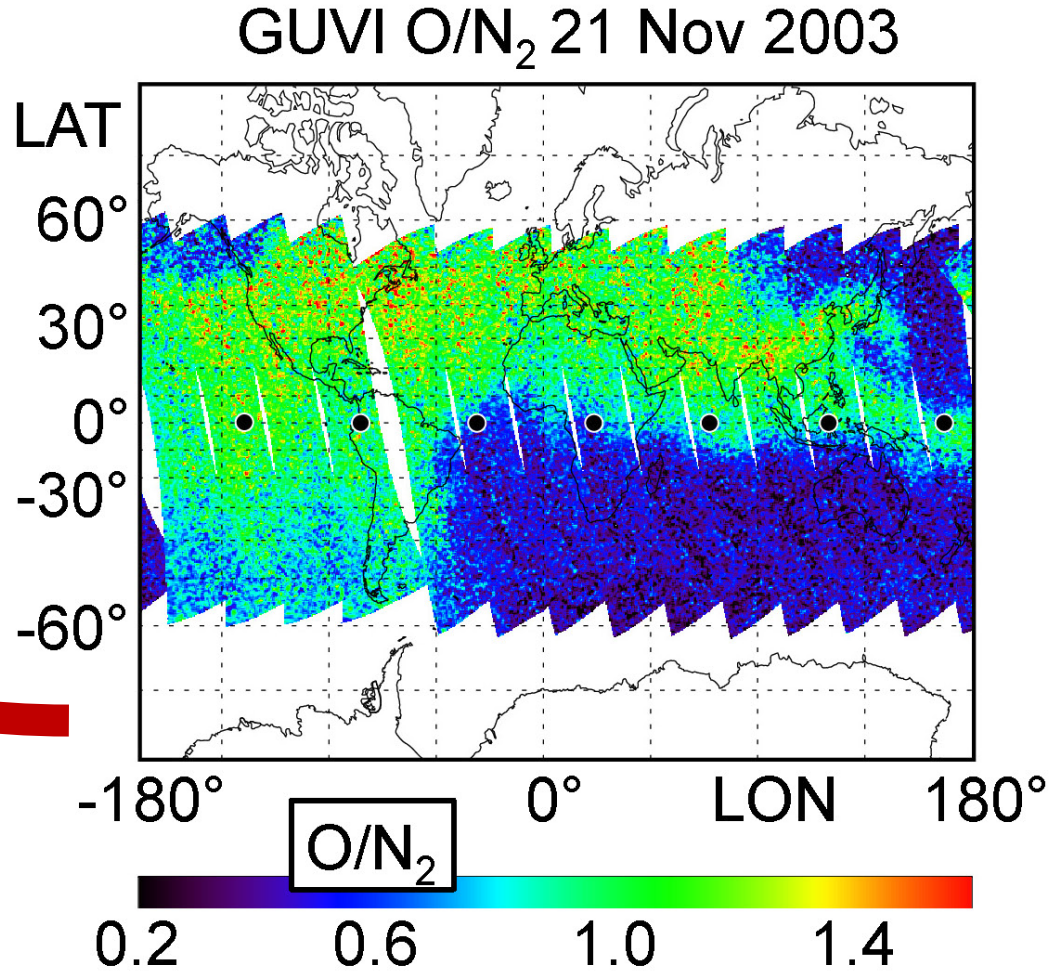
Characterize thermospheric variability

Proportionality of $O/N_2 \propto 135.6/LBH$

O/N2 variability between quiet and disturbed conditions.

Strickland et al. [1995]
Evans et al. [1995]
Strickland et al. [1999b; 2001]
Daniell and Strickland [2001]
Meier et al. [2005]
Crowley et al. [2006]

Storm time O/N2



Designed for Targeted Observations

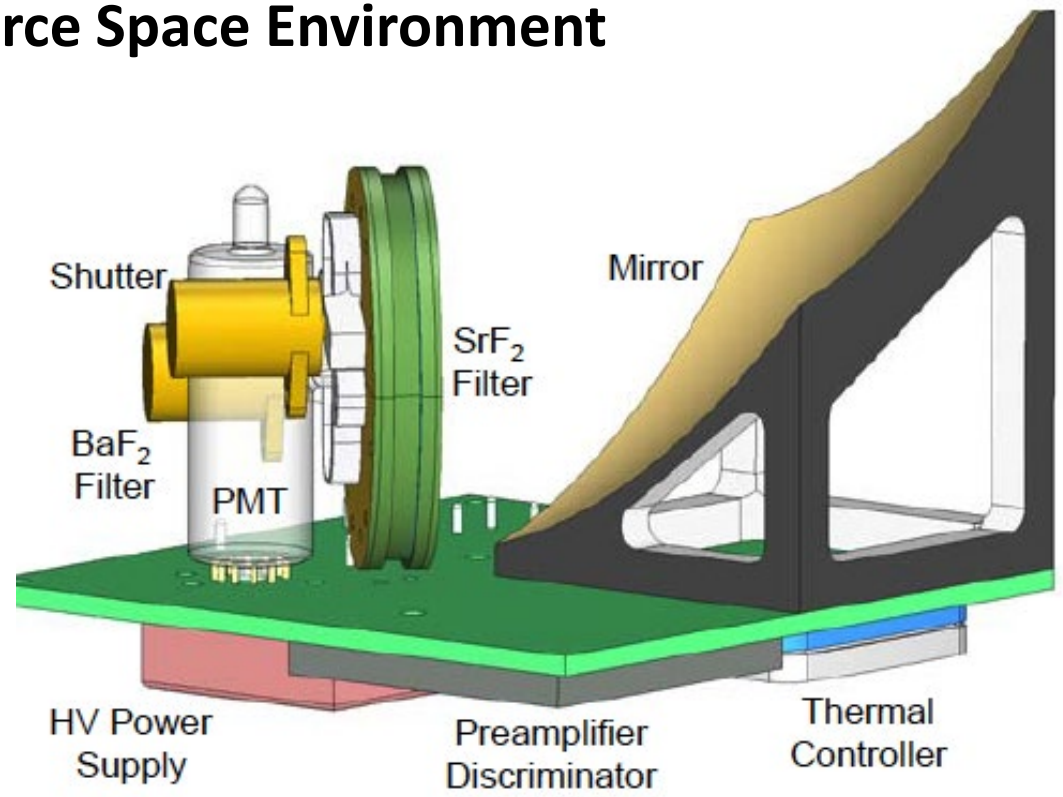
	SCIENCE TARGET			
Wavelength	**Dayside O/N_2**	**Auroral Energetics**		**Nightside F-Region**
OI 130.4 nm				X
OI 135.6 nm	X	X		X
LBHS 150 nm			X	
LBHL 170 nm	X	X	X	

ALSO

Lyman Alpha at 121.6

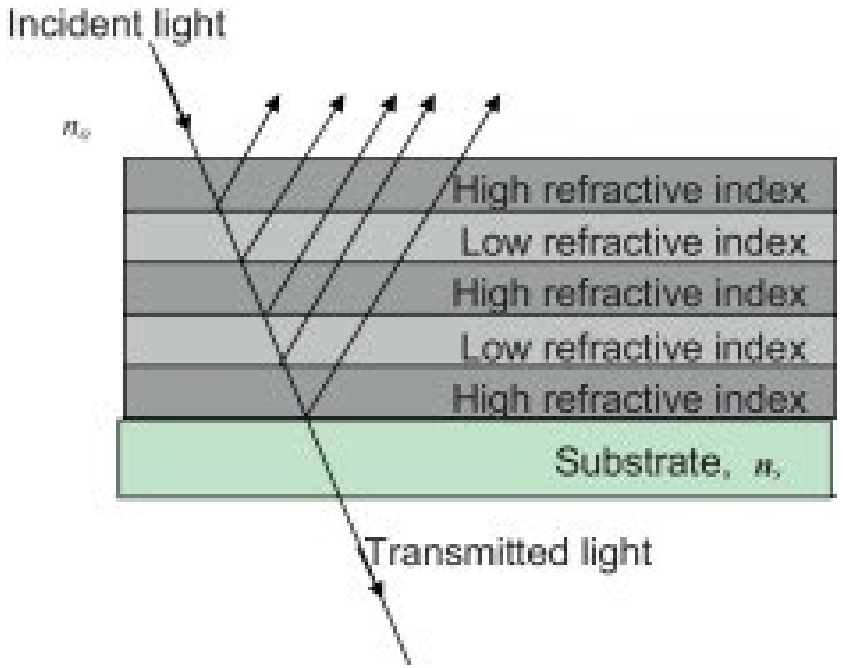
CubeSat Tiny Ionospheric Photometer (CTIP)

- **O+ density by 135.6-nm photoemission (nighttime)**
- **Similar to Tiny Ionospheric Photometer on COSMIC**
- **Launched November 2013 on the US Air Force Space Environment Nano-Satellite Experiment (SENSE) mission**



Reflective filters for the VUV

Pioneered by Torr and Zukic for Polar UVI



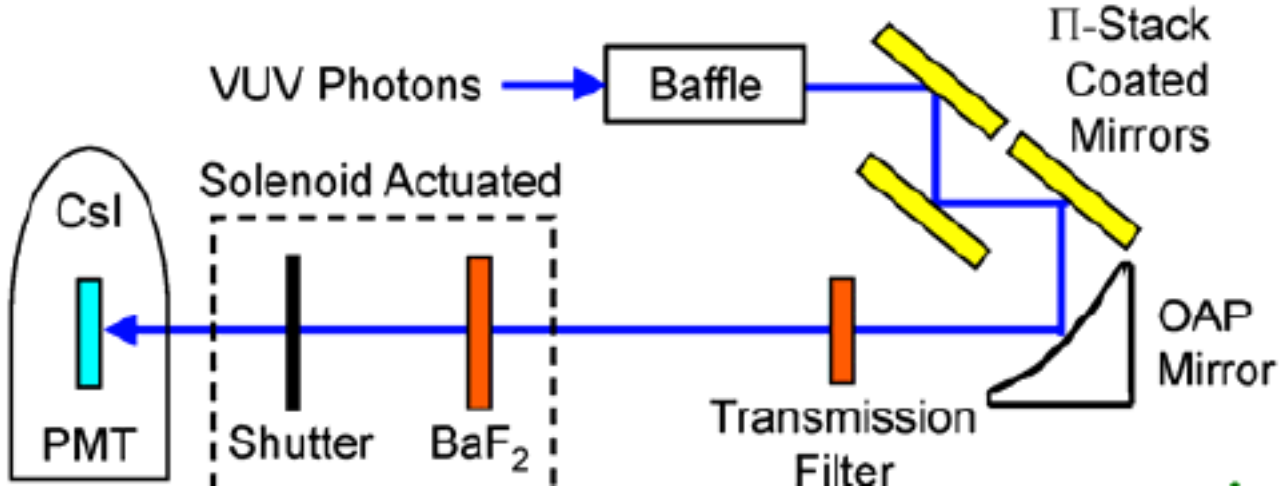
H+L=0.5λ

Π phase shift

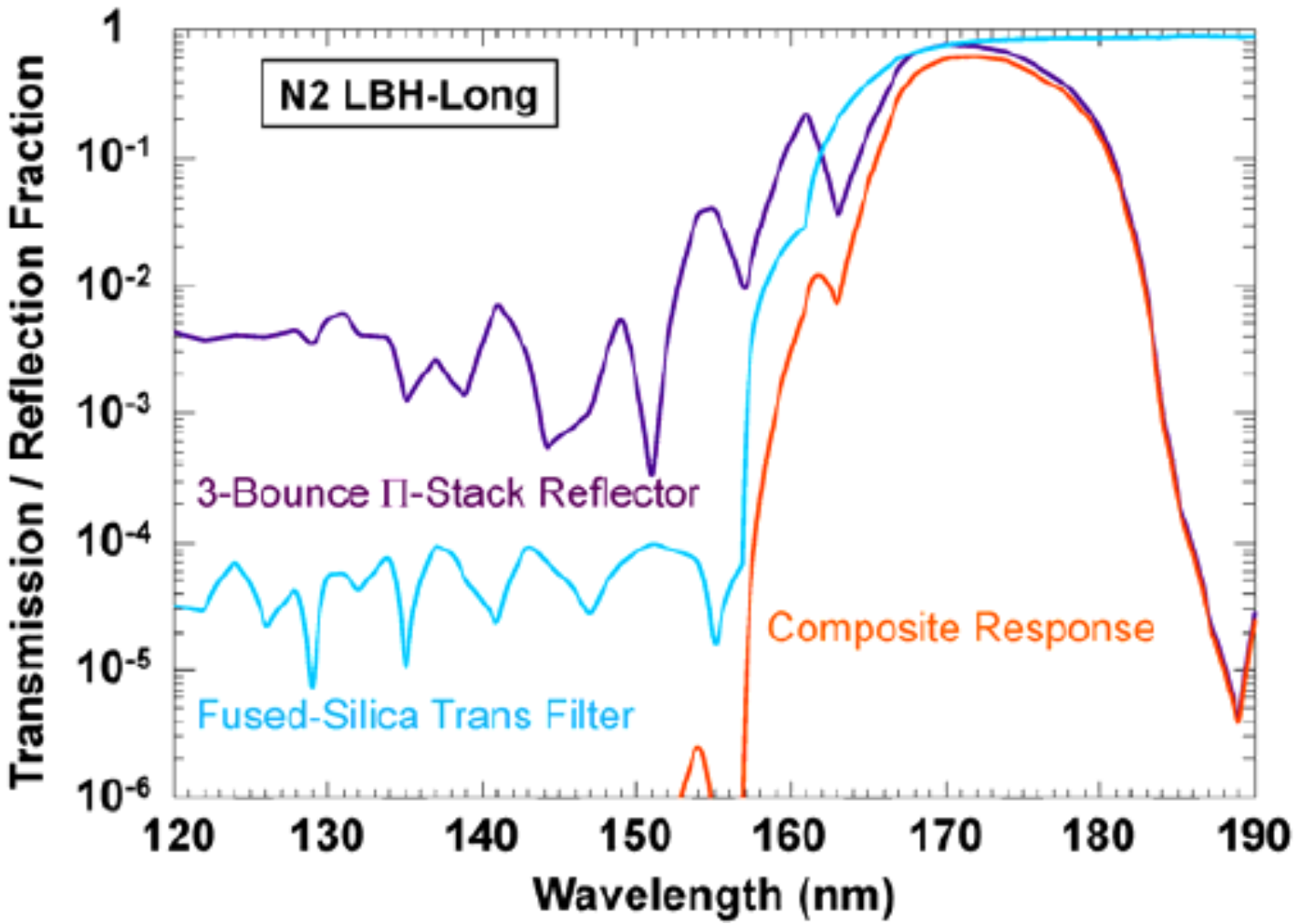
One mirror not sufficient; need multiple bounces for background rejection.

Π multilayer stacks, alternating layers of high and low index material

~30 layers



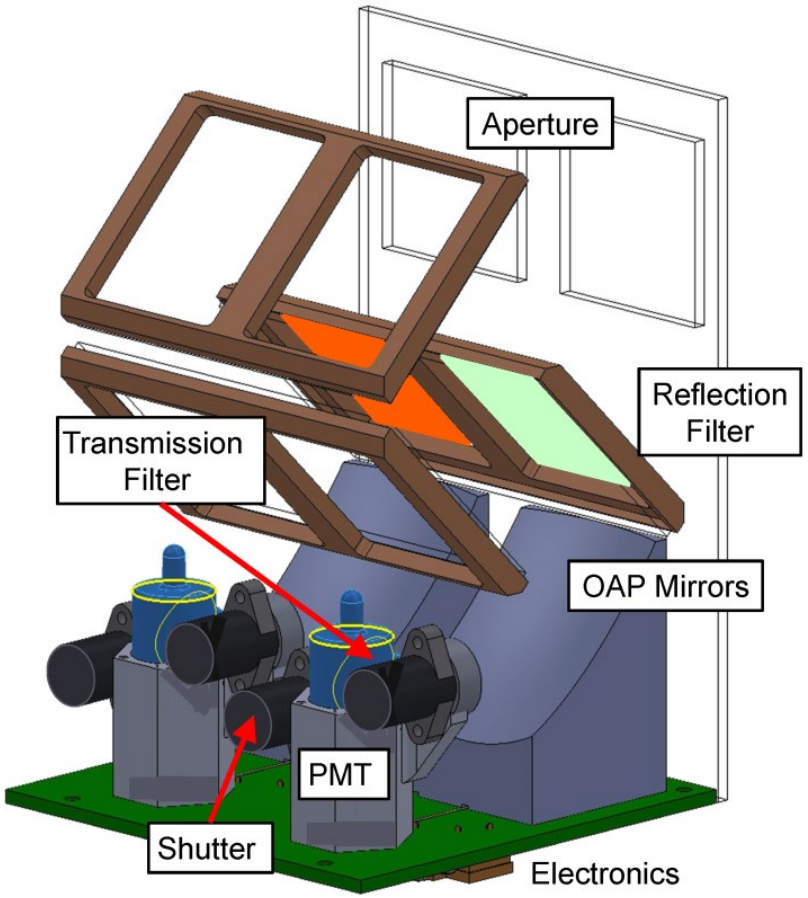
Reflective filters for the VUV

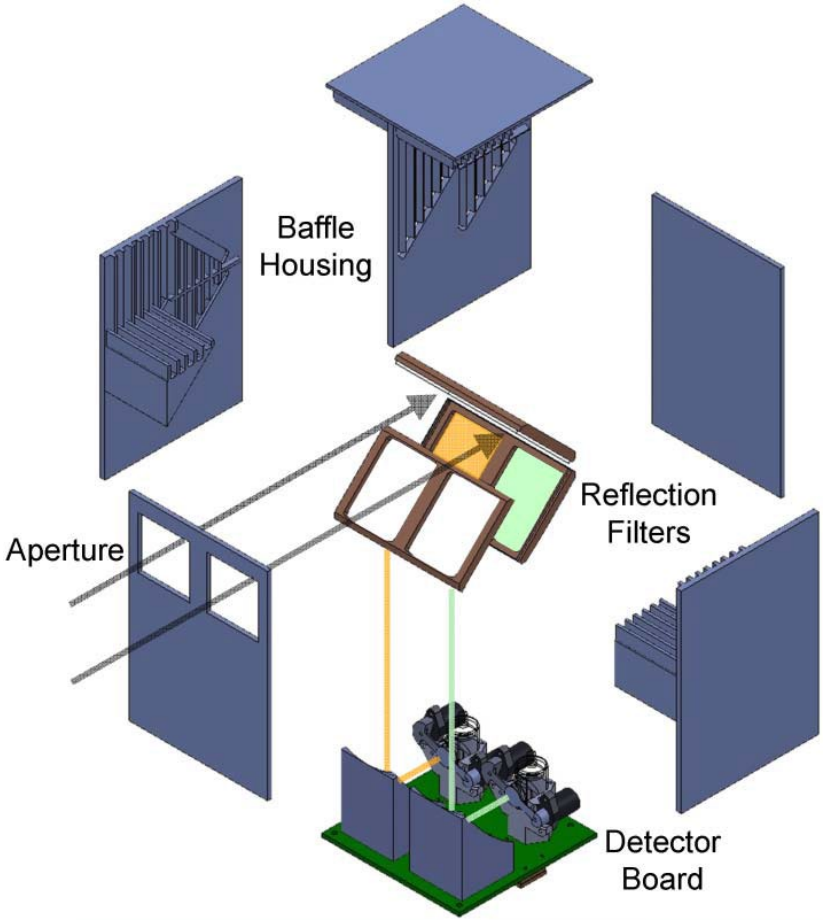


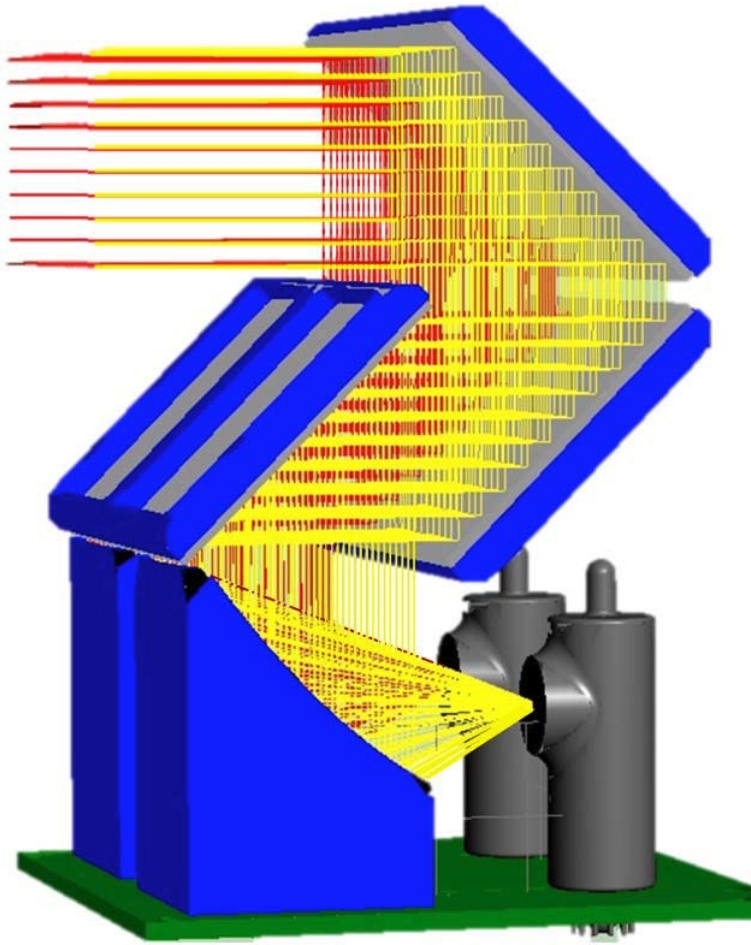
Zukic et al., 1990a
Zukic et al., 1990b
Torr et al., 1993

Expected LBH-Long composite filter response

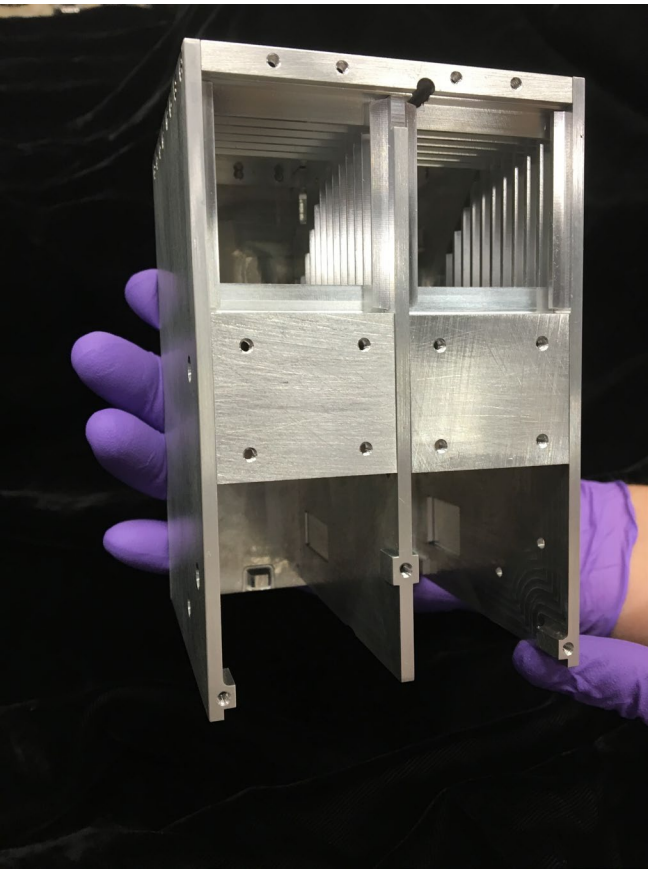
Two Wavelength Photometer
The Design

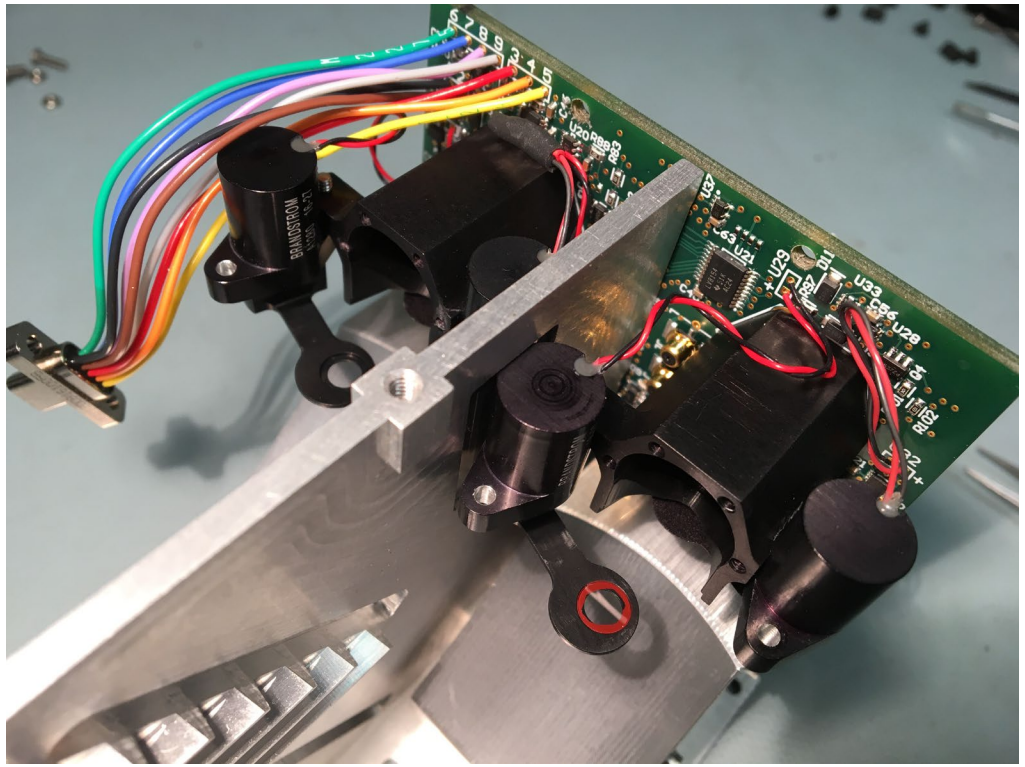


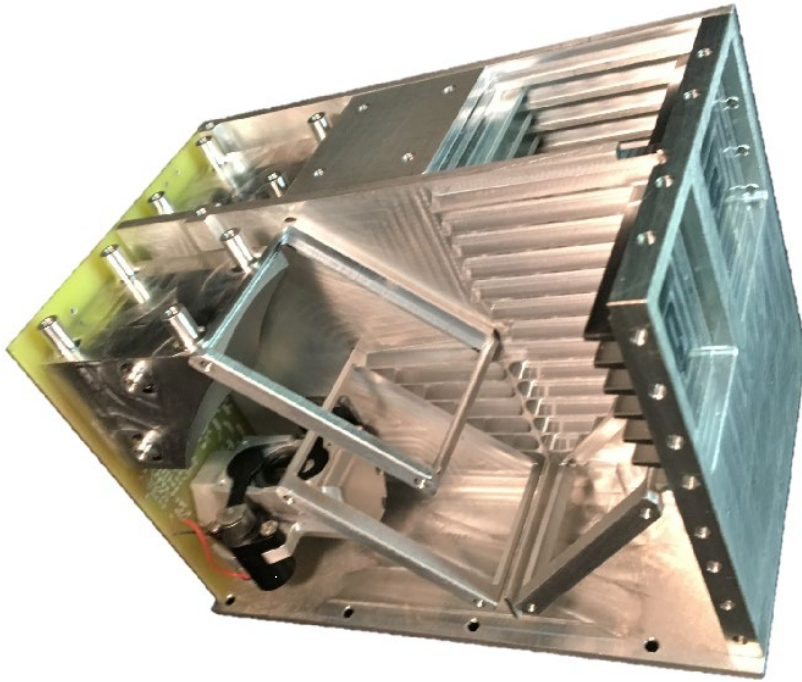




Two Wavelength Photometer: The Build

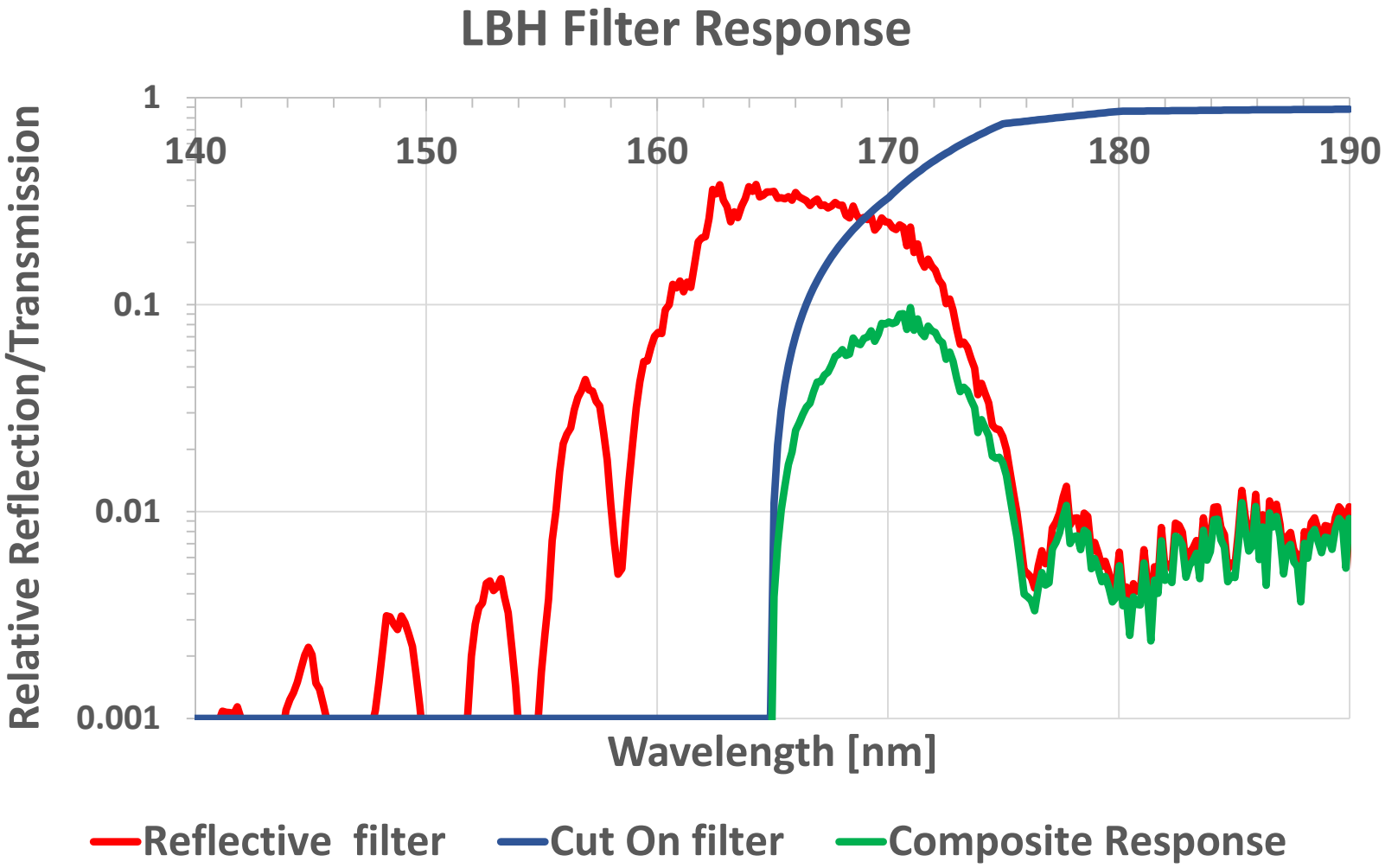






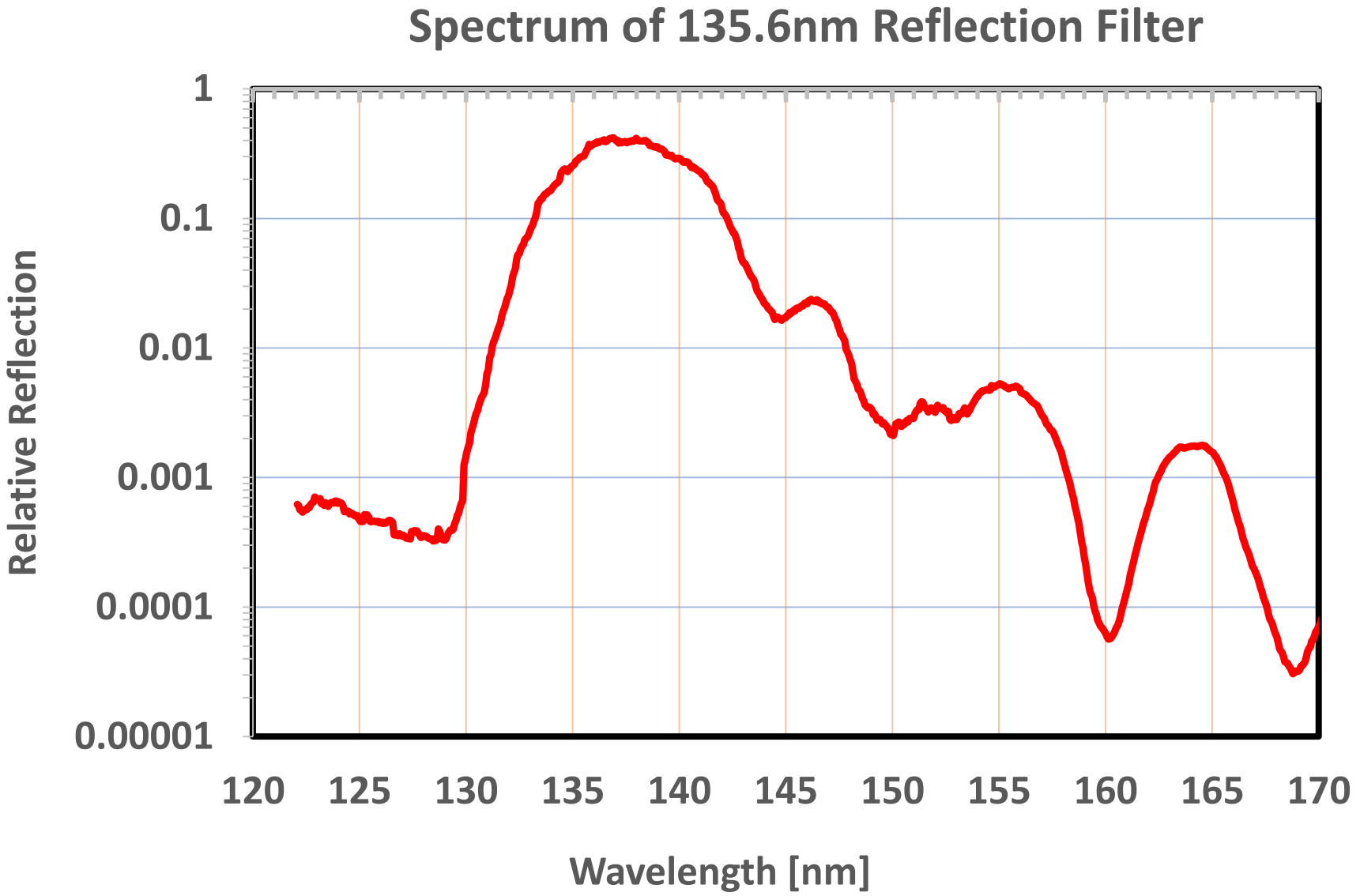
Results

- ✓ **FWHM ~ 9nm**
- ✓ **Max T of 10%**



Results

- ✓ **Max T of 55%**
- ✓ **FWHM ~ 8nm**



Parameter	OI Channel	N_2 Channel
Center Wavelength	135.6 nm	170.0 nm
Bandwidth	5.0 nm	9.0 nm
Baseline Responsivity[1]	146 counts/R-s	340 counts/R-s
Detector Noise	< 10 counts/R-s	
Min Signal (Night / Day)[2]	2.7 R / 1590 R	NA / 680 R
Max Signal (Night / Day)[2]	213 kR / 5100 kR	NA / 2550 kR
Field of View	6.5° X 6.5°	
Nightside Resolution[3]	34 km X 34 km	NA
Auroral Resolution[3]	56 km X 56 km	56 km X 56 km
Orbit Averaged Power[4]	1 W	
Survival Temperature	-24° to +61°C	
Operating Temperature	-13° to +55°C	
Mass (Margin)	800 g (80 g)	
Volume	1400 cm^3	
Form Factor	9.5 cm X 9.5 cm X 12 cm	
Power & Communication	5 ± 0.2 V_{DC}, RS422 Serial	
CTIP Software Reuse	85%	

The End

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