

Polarization Modulator Proposal

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NCAR

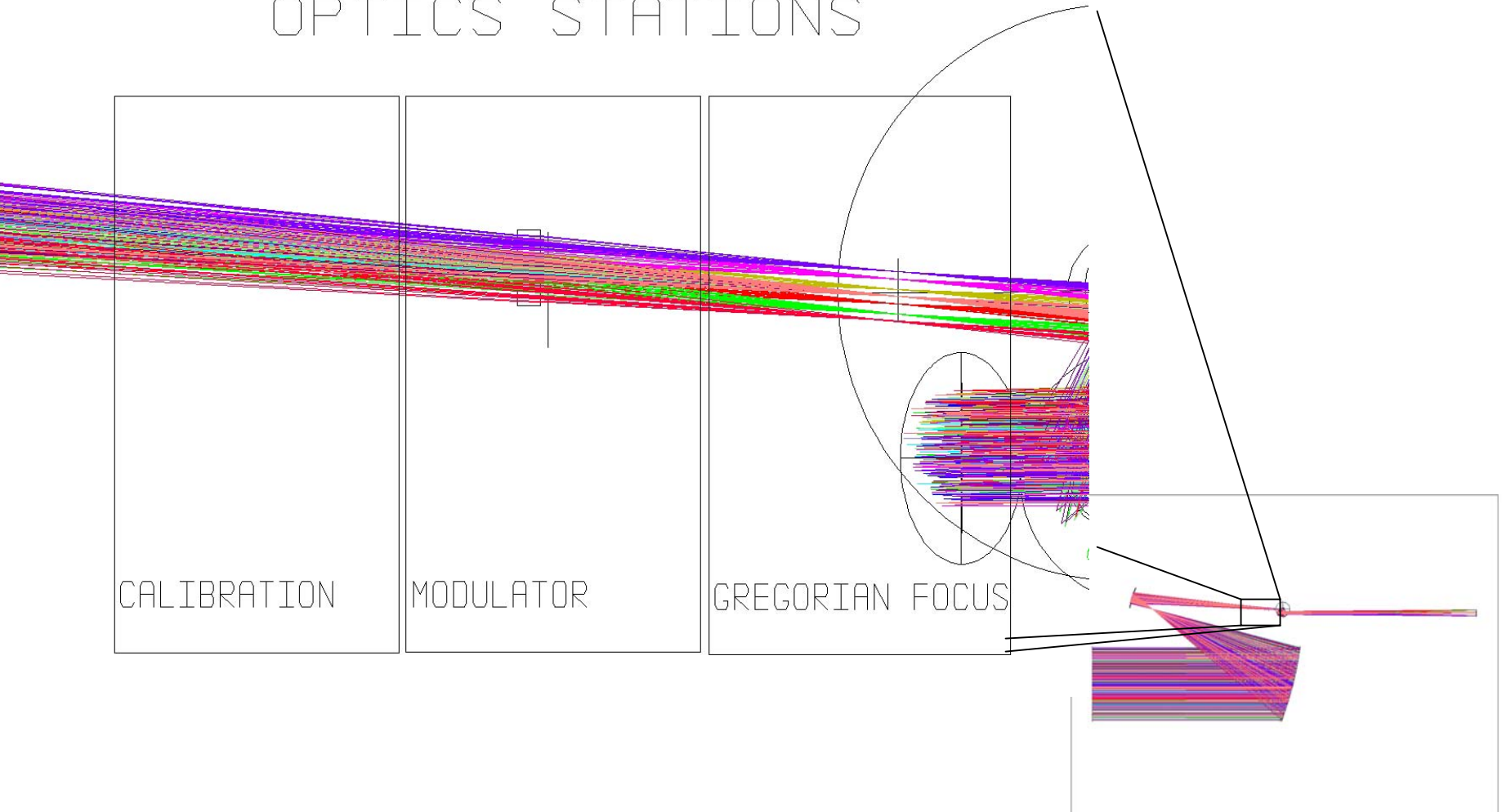
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Station Locations

OPTICS STATIONS



Turret at Gregorian Focus

- Why
 - ★ Various alignment masks are needed to set up post focus optics
 - ★ We don't know what other gregorian focus optics might be needed in the future
- Positions
 - ★ Clear
 - ★ Iris
 - ★ Resolution target
 - ★ Grid
 - ★ User 1
 - ★ User 2
 - ★ ... User N

Modulator turret before Gregorian Focus

- Why
 - ★ No single modulator meets all requirements
 - ★ We don't know what other polarization modulators might be needed in the future
- Positions
 - ★ Clear
 - ★ Rotating achromatic retarder
 - ★ Pockel's cell
 - ★ Interchangeable LCs
 - ★ IR mesh polarizers
 - ★ User 1
 - ★ User 2
 - ★ ... User N

Calibration station before modulator turret

- Why
 - ★ Polarimeter response matrix determination requires measurement of known input polarization.
- Positions
 - ★ Rotatable and retractable achromatic linear polarizer (Versalight)
 - ★ Rotatable and retractable retarder (achromatic crystal combination) following linear polarizer
 - ★ IR mesh polarizers
 - ★ User 1
 - ★ User 2
 - ★ ... User N

Modulator Options

- Rotating achromatic retarder
- Pockel's cells
- Ferroelectric liquid crystals
- Nematic liquid crystals

Rotating Achromatic Retarder

- Use
 - ★ Only identified modulator for all visible/NIR wavelengths
 - ★ Simultaneous observations at multiple wavelengths
- Features
 - ★ Multi-crystalline achromat, Panchratnam or both
 - ★ Rotation: DC to $\sim 1\text{kHz}/16$
 - ★ Retardance: $126^\circ \pm 15^\circ$ 300nm to 1600nm
 - ★ Balanced modulation not possible
 - ★ Mechanically complex
- Action items (if planned for first light)
 - ★ Model performance with realistic residual image motion and telescope polarization model
 - ★ Refine optical design

Pockel's Cell

- Use
 - ★ High modulation rate
 - ★ 300nm to 400nm candidate
- Features
 - ★ Balanced modulation at one wavelength at a time
 - ★ Hz to kHz modulation rate
 - ★ Shortest wavelength depends upon electrodes
 - ★ Longest wavelength depends upon voltage and number of cells used.
- Action items (if planned for first light)
 - ★ Research program to develop UV transmitting electrodes
 - ★ Explore availability of high purity KD*P

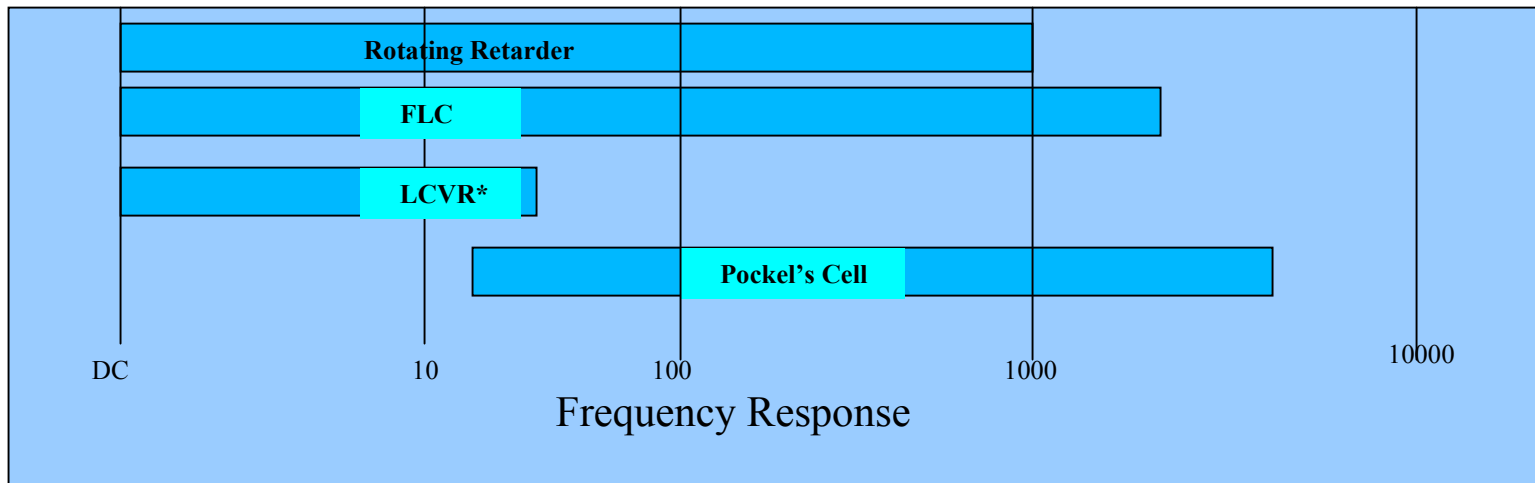
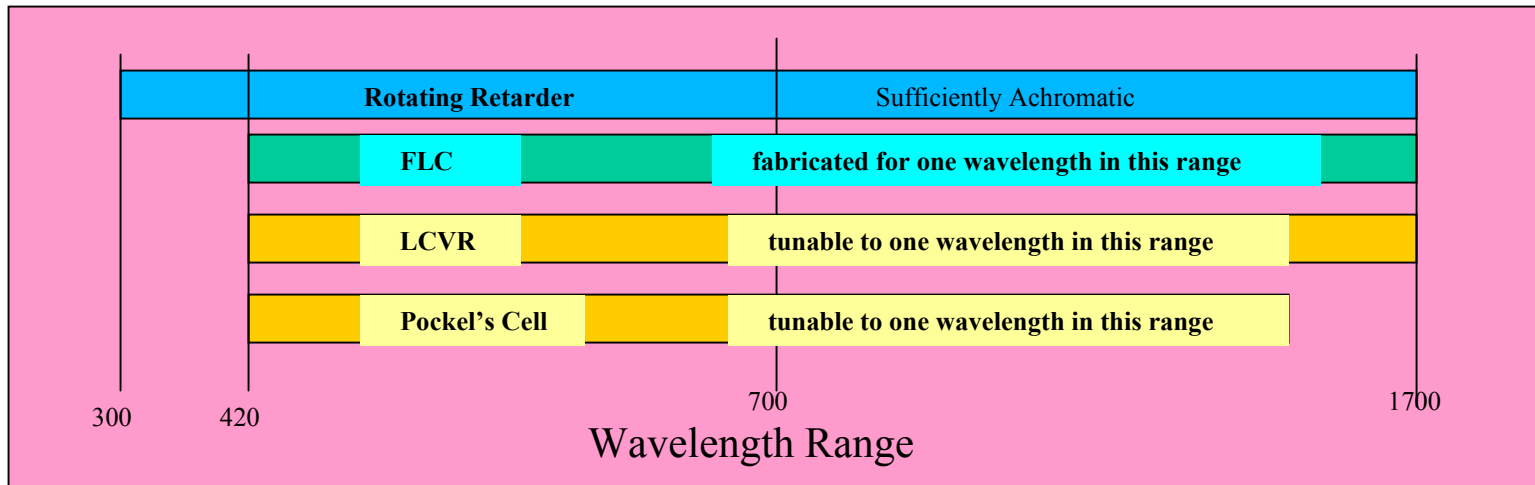
Ferroelectric Liquid Crystal

- Use
 - ★ Optimum modulation at design wavelength between 420nm to 1800nm
- Features
 - ★ Balanced modulation possible
 - ★ Optimum for fabrication wavelength only
 - ★ DC to kHz modulation rate
 - ★ Shortest wavelength depends upon electrodes, but LC is damaged <350nm.
 - ★ Longest wavelength depends upon LC thickness
 - ★ 'Achromatic' FLC has been demonstrated by Gandorfer
- Action Items (if planned for first light)
 - ★ Explore achromatic designs further

Nematic Liquid Crystal (LCVR)

- Use
 - ★ Quick tunability and optimum modulation 420nm to 1800nm.
- Features
 - ★ Balanced modulation possible
 - ★ Tunable to a range of wavelengths
 - ★ DC to 10s Hz modulation rate
 - ★ Shortest wavelength depends upon electrodes, but LC is damaged <350nm.
 - ★ Longest wavelength depends upon LC thickness
- Action items (if planned for first light)
 - ★ Explore electrodes for 350nm to 420nm
 - ★ Evaluate response vs. thickness and temperature

Modulator Comparison



*Could use FLC at polarization analyzer to increase effective rate

Modulator: Recommendation for First Light

- Modulator Turret
 - ★ *At least* 6 positions (rotating retarder, clear, LCvis, LCir, Far IR modulator, and user slot)
 - ★ Standard mechanical mounts with drive and status connections
- Rotating retarder modulator
 - ★ Most general polarization modulator
 - ★ Only modulator capable of full wavelength range
- LCVR modulators
 - ★ One optimized for visible
 - ★ One optimized for IR