Towards a Polarimetry Observing Mode for Gemini North

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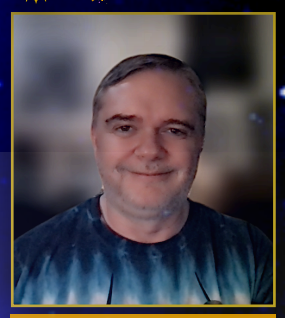


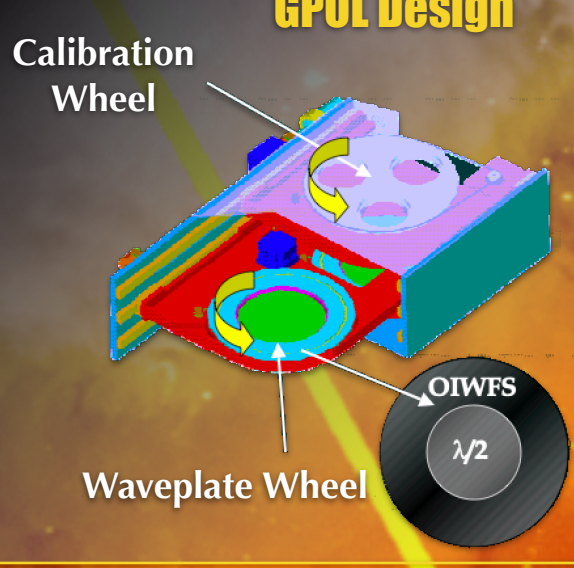
Abstract

Polarimetric observations can provide important information on many astrophysical phenomena beyond that available via conventional imaging and spectroscopy alone. As a first step toward providing Gemini North facility instrument support for polarimetry observations, an instrument upgrade program is currently under way to bring one of the GPOL facility polarization modulator units (GPOL-N) into operation in concert with NIRI at Gemini North (GN). Featuring removable, rotatable polarizing waveplates, GPOL is designed to facilitate polarimetric observations over the optical-infrared wavelength range of 0.3 - 5 microns. When installed, GPOL is physically situated inside the telescope Acquisition and Guidance (A&G) unit, and is designed to work in concert with bottom port instruments containing an on-instrument Wollaston prism, such as NIRI. We present here an overview of the functional characteristics of GPOL, its scientific potential and the current status of the GPOL/NIRI commissioning project. The possibility of using GPOL for targeted NIR follow-up of large-scale polarimetry programs at other wavelengths (e.g. JCMT's BISTRO Large Programs) is also discussed.

Overall Design

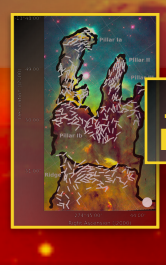
- Installs in telescope Acquisition & Guidance (A&G) Unit
- Only works with instruments on up-looking port
- Waveplate trays fully retractable, to pass unvignetted beam to up-looking port
- Waveplates rotatable to change orientation with respect to sky
- Two λ/2 (linear) waveplates covering (i) 0.3-2.5 μm & (ii) L-band currently available
- Transparent annuli surround waveplates to transmit peripheral telescope field to on-instrument WaveFront Sensor (OIWFS)
- ~1′ field compatible with **NIRI**, GNIRS, GMOS

GPOL Design



Possible NIRI + GPOL Science

- Multi-wavelength studies (e.g. targeted JCMT's BISTRO survey follow-up)
- Dust grain studies (scattering; alignment)
- Compact HII region morphology
- Separating spatial components
- Star formation; YSOs; filaments
- Active Galaxies (synchrotron)
- Circumstellar environments



JCMT BISTRO; Pattle+ (2018)

Current GPOL + NIRI Commissioning Project

- **Aim:** Refurbish GPOL-N unit & commission with NIRI (Gemini North's Near-IR Imager)
- Initial modes envisioned:
  - Linear polarimetry
  - Multiple NIRI filters
  - Point-source / compact targets only
- Replacement control board already working with GPOL-N
- Software migration to RTEMS telescope A&G OS completed successfully in early 2022
- GPOL-N recently removed & shipped to Herzberg Astronomy & Astrophysics (Canada) for testing & refurbishment
- Community Team Lead: **Jennifer Hoffman (University of Denver)**
- In-kind effort & support from **Gemini Instrument Upgrade Program**

Initial on-sky commissioning anticipated timeframe: 2023