

PILOT Primer

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This document outlines the current baseline design for PILOT and its proposed instrumentation, and the expected performance (sensitivities and resolution). It is intended for use in the development of the PILOT science cases.

Telescope

The PILOT facility has the following key features:

- 2.5 metre Ritchey-Chrétien telescope
- Twin Nasmyth foci
- f/1.5 primary, f/10 overall
- Fast tip-tilt secondary
- For use from 0.35 μm – 40 μm
- Diffraction-limited optics over 1° field
- Installed on a 30 m tower
- Enclosure for temperature and humidity control
- 24 hour remote operation with minimal human intervention
- Wide-field image quality and pixel scale matched to median free seeing
- Diffraction limited imaging over small fields at all wavelengths $> 0.5 \mu\text{m}$

Instrument suite

The following baseline (primarily imaging) instruments are considered for PILOT. There are a number of additional instruments being developed by other groups. It is likely that the first light instrumentation for PILOT will be selected from this list at some point (to be determined) in the detailed design study phase.

- Fast optical camera: for lucky imaging to achieve diffraction limit in visible
0.45-1 μm , griz, 0.025 "/pix, 1K x 1K, 20" x 20" FOV
- Wide-field optical camera: with ground layer tip-tilt correction
0.45-1 μm , griz, 0.086 "/pix, 32K x 32K, 0.7° x 0.7° FOV
- Wide-field NIR camera: pixel scales matched to the near and mid infrared diffraction limit
1-5 μm , zyJHK_dLM, 0.15 "/pix, 4K x 4K, 10' x 10' FOV
1-2.5 μm zyJHK_d, 0.06 "/pix, 4K x 4K, 4' x 4' FOV
- Wide-field MIR camera: with tuneable R~3000 Fabry-Perot filters or GRISM spectrometer
10-25 μm , NQ, 1 "/pix, 1K x 1K, 16' x 16'
25-40 μm , 1.3 "/pix, 0.25K x 0.25K, 5.6' x 5.6'

Performance

Table below gives 5σ , 1 hour point source (and extended object) sensitivities for PILOT, assuming sky background summed over 4 x FWHM disc (for point sources), telescope is at 227 K with 5% emissivity, overall QE =50%, sky backgrounds are as given in Burton et al PASP, 2004. FWHM is assumed tip-tilt corrected resolution over imaging field of view for each camera.

Band	Wavelength	R	FWHM	m_{AB}	m_{AB}/arcsec^2
g	0.47	3.4	0.35	27.6	27.1
r	0.62	4.4	0.33	27.1	26.5
i	0.76	5.1	0.32	26.6	26.0
z	0.91	6.5	0.31	25.8	25.1
Y	1.04	5.1	0.30	25.5	24.8
J	1.21	4.6	0.30	25.0	24.3
H	1.65	5.7	0.29	24.6	23.8
Kd	2.40	10	0.32	25.3	24.7
L	3.76	5.8	0.40	21.2	20.8
M	4.66	19	0.46	19.6	19.4
N'	11.5	11	1.05	16.3	17.0
Q	20.1	20	1.80	14.6	15.8

Science Case

A series of primary and secondary science goals for PILOT have been identified. These will be included in the PILOT Science Case Document to be produced as part of the current “Phase A” PILOT design study. For consistency, a format similar to the following is preferred:

1. Impact:

- Provide an outline of the project and background.
- What are the key outcomes of the proposed study?
- Is it incremental or breakthrough science?

2. Other facilities:

- What has been previously achieved in this field by other facilities?
- What are the limitations of current facilities for performing this science?
- What proposed future facilities (e.g. TMT, GMT, JWST) could do this science?
- Why is this science uniquely achievable with PILOT?

3. Observations and requirements:

- What are the required observations for PILOT to achieve this science case? Specifically what type of fields (targeted or survey mode or a combination), how deep (AB mags), over what area (field size and temporal coverage if required), and what wavelength coverage (how many filters and what are they)?
- What are the trade-offs for time spent on this project? Does it require more than one full year of data? What can be achieved for a much smaller amount of observing time?
- What are the constraints imposed on observing conditions? How important is thermal background, optical dark time, image size, image field of view, PSF stability, etc?
- Are the baseline instruments appropriate? If not what is required?