The WIYN One Degree Imager: Updates and recent progress

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What is pODI

- Original plan (~2002-05):
  - 1 square degree
  - 64 OTAs with 4Kx4K → ~ 1 GPixel
  - OT shifting as ~semi-adaptive optics to improve seeing
  - Focus sensors to maintain perfect focus
ODI: Specs

Field of view:
~25x25 arcmin in center
+ 4x 8x8 “guide fields”

Pixelscale: 0.11"

Readout-time: 7s

Filters: SDSS griz + SDSS u, Hα, OIII
+ all Mosaic filters on request
User interface
ODI exposure GUI

Observing Target:
Object: monitoring M36

Instrument Templates:
Guided Exposure from stored Guide...

Exposure time [s] 120, 120, 120
Video Exposure time [s] 0.1
ADC mode: ON
Filter: ODI SDSS r'

Repeat Count: 10

Start Exposure
OTA Listener and Guide star tool
What does data look like?

→ Each exposure is a directory full of files
A closer look at OTA 3,3

1 OTA = 64 cells (w/ 64 overscan regions/gains/etc) = 1 fits w/ 65 extensions
Calibrations: Bias and dark
readout glow and detector glow
Trailing at low background levels

Potential problem for frames with background levels < 50-70 counts:

- short exposures: guiding, U-band during dark time
- narrow-band data
**Flat-fields: pupil ghost**

![Image of a flat-field test pattern with pupil ghost effect]

The image shows a flat-field test pattern with pupil ghost effect. The pattern is used to calibrate the imaging system. The grid pattern helps in assessing the uniformity and quality of the field of view.
ODI Pupil Ghost Images: Non-sequential Results

The model shows that the pupil ghost happens during the double passes between the filter and field lens.

2 field sequential ray tracing

Field Lens

Filter

2 field non-sequential ray tracing

78 mm
ODI Pupil Ghost Images: Change Filter Position Can Reduce The Intensity of The Pupil Ghost Image.

Move filter 31 mm forward, the diameter of the pupil ghost increase to 128.6 mm (the first filter position)

Move filter 31 mm backward, the diameter of the ghost pupil increase to 91.2 mm (the third filter position)
Comparing L2 and L1 flats
Image of pupil ghost template and before and after
## Standard Calibration Plan

### ODI Standard Dome Calibrations

**Dark & Bias:**
- 10 x Bias
- 3 x 600 sec dark

**Flat Fields:**
- 5x Dome Flat g'
- 5x Dome Flat r'
- 5x Dome Flat i'
- 5x Dome Flat z'
- 5x Dome Flat U'
- 5x Dome Flat g''
- 5x Dome Flat g
- 5x Dome Flat g''
OT shifting

Principle: (charge in) pixels follows image motion

Modes:
- Fast guiding ($\geq 1$ guide star)
- Coherent guiding ($\geq 3$ guide stars)
- Local guiding ($>1$ guide star per OTA)
OT shifting: Pros

- Better seeing or at least rounder stars
- Reduced windshake in windy conditions
pODI Coherent Correction Mode
First Light Jan 23 2013

No OT-correction: Elongated stars due to telescope drift.

OT-correction applied: Round stars, telescope drift is compensated.

pODI Image o20130123T224451.0
OT shift history

Shift history for: o20130131T053622.0.33_shift.fits -- #shifts = 590
OT shifting: cons

- Traps cause image artefacts
- Slightly smaller detector area (shift pixels off chip)
- Needs (many) bright guide stars
- For now: Guide readout too slow to make OT shifting effective (work in progress)
- Data reduction trickier: Need to convolve calibration files with shift history
OT shifting artefacts
OT shifting artefacts
OT shifting artefacts
Atmospheric dispersion corrector

- Two rotating prisms
Photometric calibration
Photometric calibration

ODI photometry - Zeropoint (linearity) 45s

14 15 16 17 18 19 20 21
sdss mag (filter)
Color terms ODI vs SDSS
Portal, Pipeline & Archive (PPA)

- portal.odi.iu.edu
- Run by Indiana U.
- Frontend to access/download/manipulate data → demo
- Official pipeline still under construction
  Rumours: Release at end of month
pODI Quickreduce pipeline

- Basic reduction directly at telescope (overhead, bias, dark, flat, [WCS], [[photometry]])
- Help judge data quality
- Written in Python, publicly available
- No IRAF/pyRAF
- Made in Wisconsin :-)}
Data reduction facility at UW

Local pODI reduction:

- 8-core machine
- 54 GB memory
- External Raid disk with ~10 TB capacity
- Raid-0 Solid State Drives with 1 GB/s read/write speed
- Talk to me for account
Things that (don't) work (yet)

- **Working:**
  Imaging/Dithering, guiding, data reduction, most GUIs, ADC

- **Kinda working:**
  pipeline, OT shifting

- **Not working:**
  Focus sensors
Some pretty pictures

M33, quickreduce reduced
Some pretty pictures

M33, quickreduce reduced
Horsehead nebula in Hα
Thank you!