

PHOTOMETRYPIPELINE

**...and its use for robotic
telescopes**

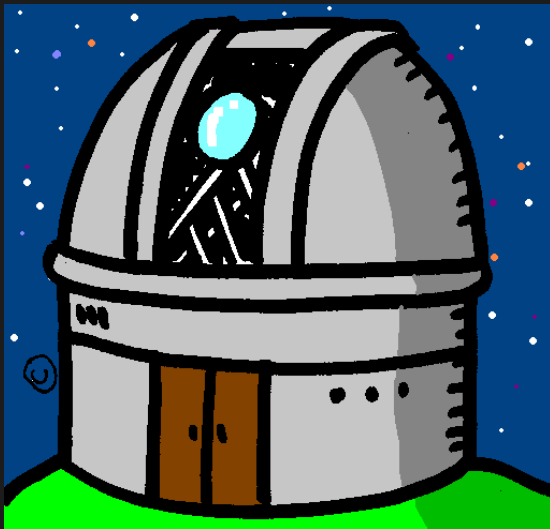
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Northern Arizona University

(soon: Lowell Observatory)

Motivation

- Large number of small telescopes
- Observers are left to themselves with analysis
 - Image calibration is tough
 - Low motivation to analyze imperfect data



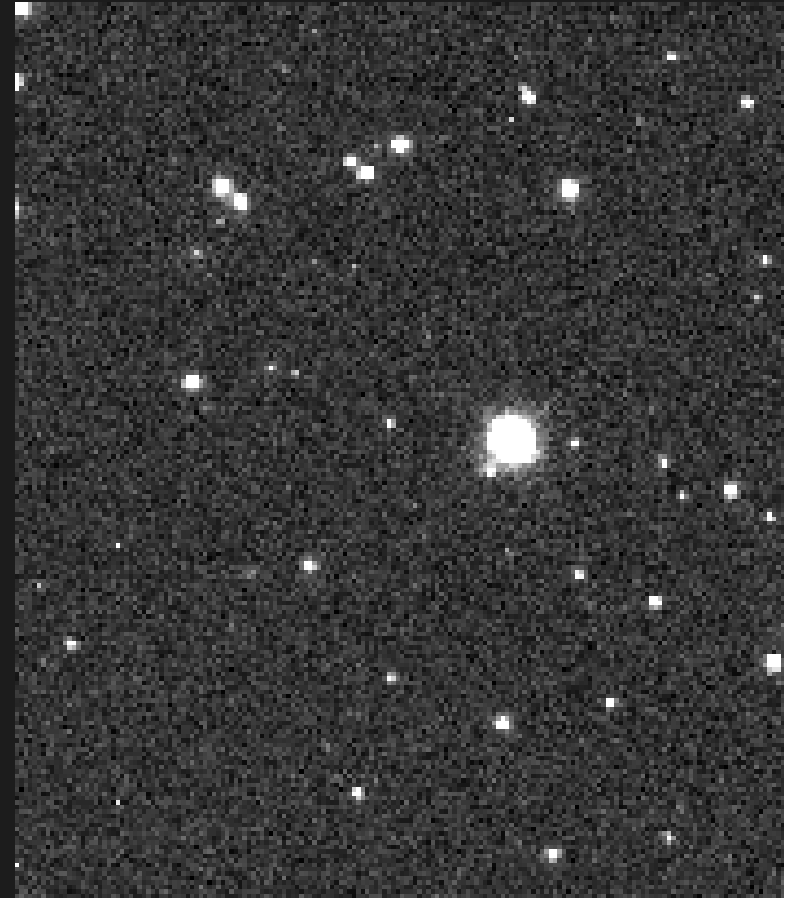
Some Magic
Pipeline

Calibrated
Data

PP – The Photometry Pipeline

- Automated astrometric and photometric calibration of imaging data
- Extraction of aperture photometry for point sources: stars, quasars, asteroids, satellites
- Currently ~20 telescopes implemented (0.3 m – 8.0 m apertures)
- Open Source, Python, uses Source Extractor and SCAMP
- Available on github:
github.com/mommerti/photometrypipeline
- Published in Astronomy and Computing:
[Mommert 2017, A&C, 19, 47](#)

Example: VATT Data

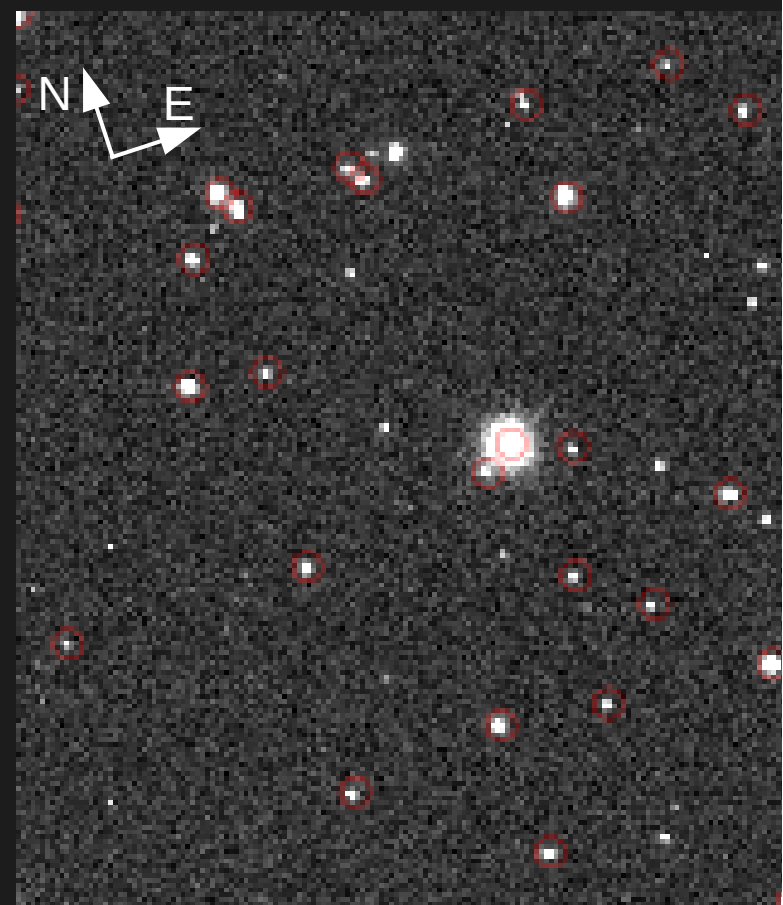


Example: VATT Data

- Image Registration using SCAMP

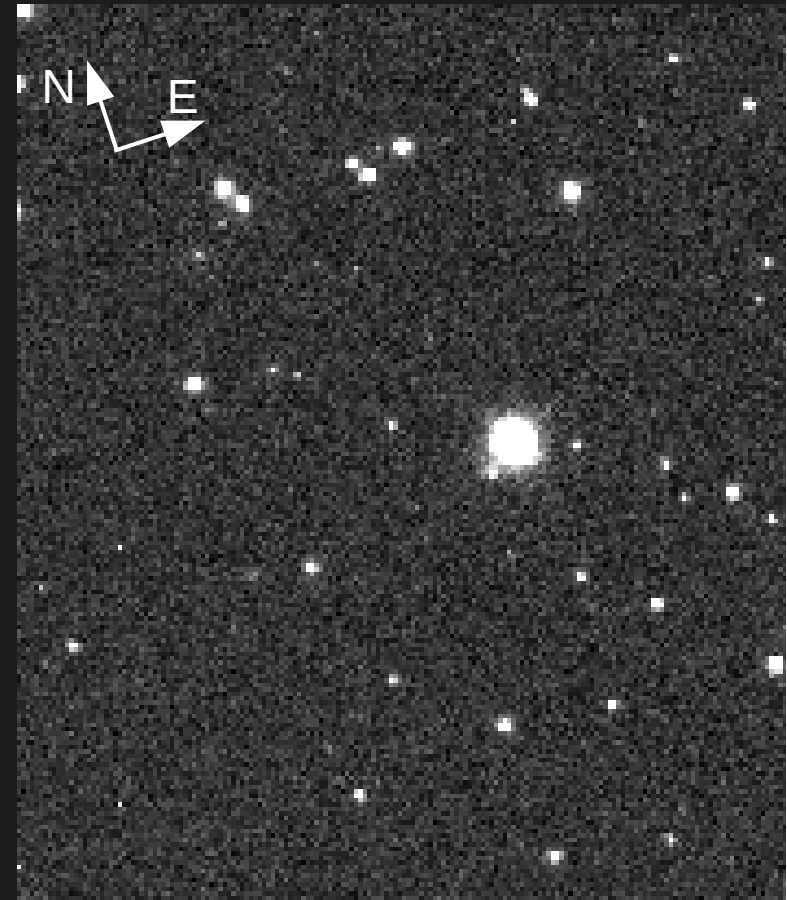
available catalogs:
Gaia DR1, TGAS, Pan-STARRS,
URAT-1, 2MASS ...

typical accuracy $\sim 0.3''$



Example: VATT Data

- Image Registration
 - Aperture Photometry
using Source Extractor
- curve-of-growth analysis
→ optimum aperture size



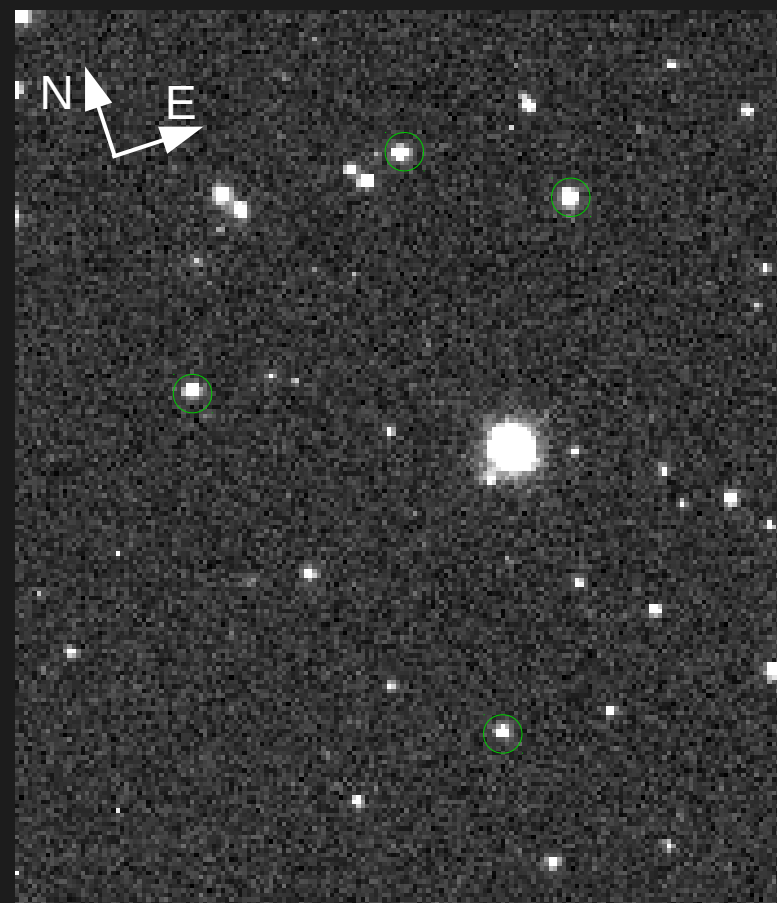
Example: VATT Data

- Image Registration
- Aperture Photometry
- Photometric Calibration using iterative sigma clipping

available catalogs:
Pan-STARRS, SDSS, APASS,
2MASS

systems: SDSS, Johnson, JHK

typical uncertainties: < 0.05 mag



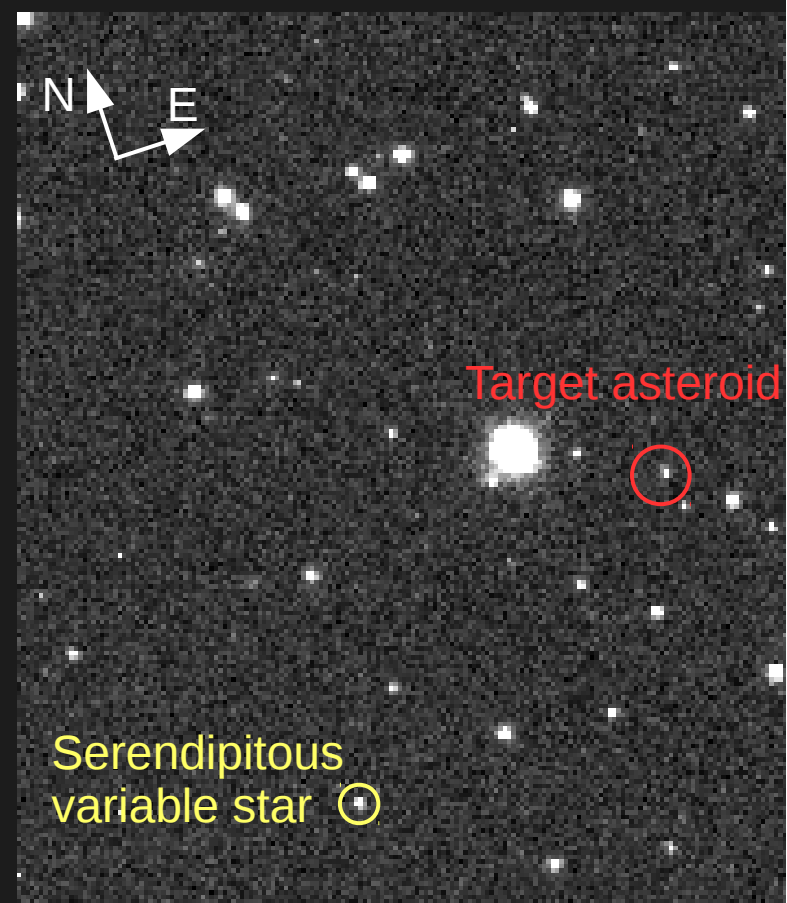
Example: VATT Data

- Image Registration
- Aperture Photometry
- Photometric Calibration
- Target Extraction

manual target positions/eph

online sources:

stars, small bodies, satellites,
QSOs, galaxies...



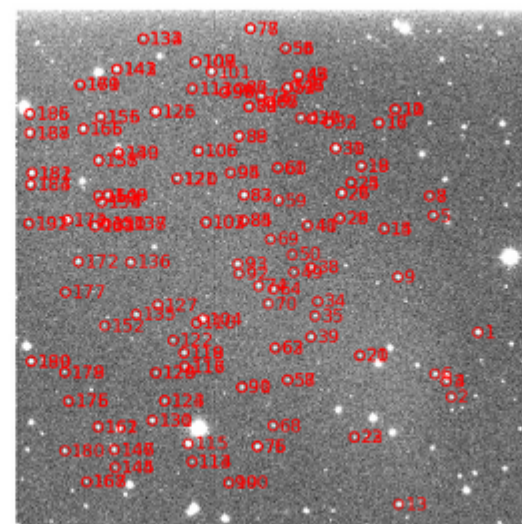
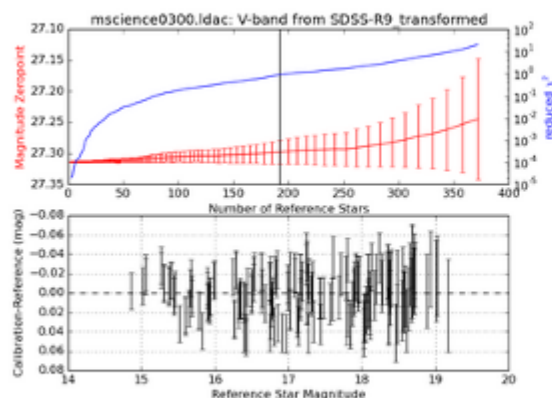
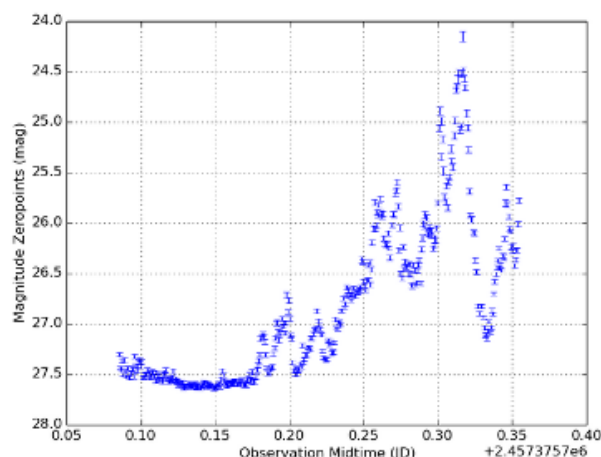
Example: VATT Data

- Image Registration
- Aperture Photometry
- Photometric Calibration
- Target Extraction
- Diagnostic output



Photometric Calibration - Catalog Match

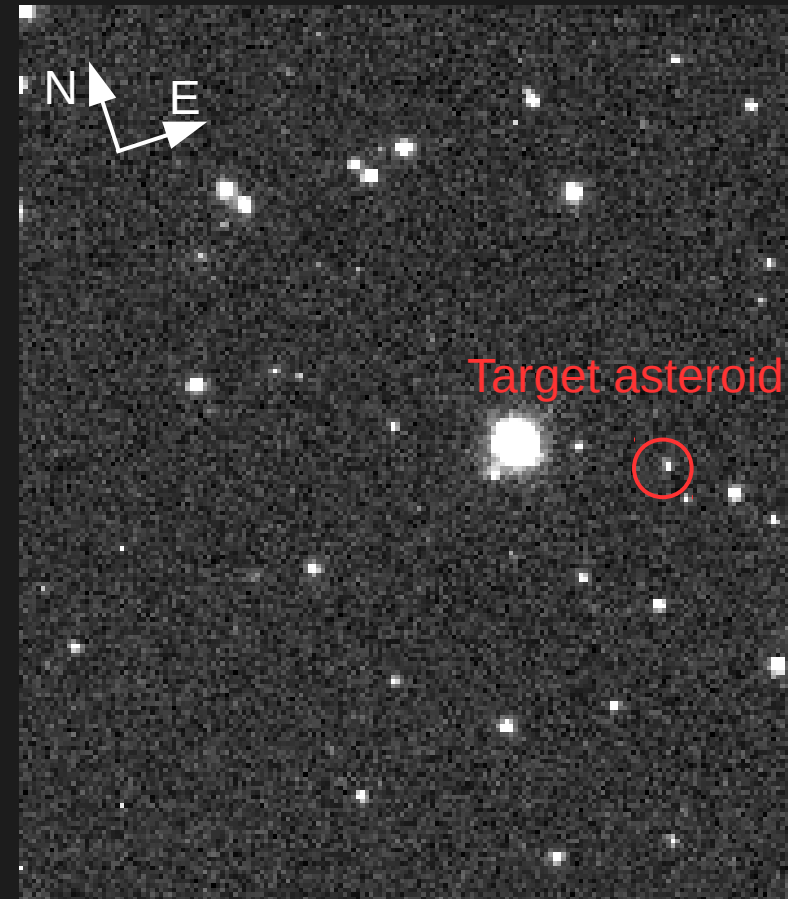
match image data with SDSS-R9_transformed (6242 sources downloaded, 777 transformed to V (



| | |
|-----|------------------|
| 90 | J081238.16+00592 |
| 91 | J081238.16+00592 |
| 92 | J081238.32+01020 |
| 93 | J081238.42+01022 |
| 94 | J081239.05+01043 |
| 95 | J081239.05+01043 |
| 96 | J081239.51+01063 |
| 97 | J081239.51+01063 |
| 98 | J081239.51+01063 |
| 99 | J081239.55+00570 |
| 100 | J081239.56+00570 |
| 101 | J081240.80+01070 |
| 102 | J081241.50+01032 |
| 103 | J081241.50+01032 |
| 104 | J081241.91+01010 |

Example: VATT Data

- Image Registration
- Aperture Photometry
- Photometric Calibration
- Target Extraction
- Diagnostic output
- Runtime:
 - ~3 min for 20 frames
 - on a laptop
 - near real-time analysis possible



Use Cases for Robotic Telescopes

- PP can provide near real-time astrometry and photometry for robotic telescope data

