# A Dedicated Lunar Trojan Asteroid Survey With Small Ground-Based Telescopes Cole Gregg Supervisor: Dr. Paul Wiegert

## Background/Motivations

### **Near-Earth Asteroid Significance**

- Asteroids are the leftover remnants of the early Solar System
- Planetary defense
- Further scientific research and space missions



NASA/JPL-Caltech/UCLA/MPS/DLR/IL

#### Lunar Trojan Asteroids



Credit: http://www.astronomy.ohio-state.edu/

The last survey dedicated to Lunar Trojan detection was conducted nearly 40 years ago, no candidates were found (Valdes & Freitas Jr., 1983). Lissauer and Chambers (2008) used numerical integrations to find that orbits  $\pm 60^{\circ}$  from the Moon, can survive for several million years, even when solar and planetary perturbations are included.

#### **Survey Motivation**

- Surveys that currently search for potentially hazardous
- asteroids include Pan-STARRS, ATLAS, Spacewatch, and the Catalina Sky Survey
- Lunar Trojans would be moving too quickly for these larger surveys to detect • Typical surveys have

maximum detectable

8000 7000 6000 Observatory: 500 Observatory: Q62 Observatory: H06 <u>م</u> 5000 ا Observatory: 189 4000 2000 -1000 2000 2500 3000 1500

On-Sky Apparent Velocity (arcsec/hr)

rates of ~750"/hr (5 $^{o}$ /day) while these asteroids would be moving at rates of >900"/hr

The University of Western Ontario

## Methodology

#### **Data Collection**



Smaller more accessible telescopes on the

iTelescope network that can be remotely used to significantly contributing to sky surveys.

Full control over how the images would be taken, allows the process to be configured such that its specifically sensitive to fast moving objects.











#### Image Processing

- Fields of 3 images are run through a pre-existing Python program created by Dr. Paul Wiegert (Wiegert et al., 2007)
- Uses Source Extractor (Bertin & Arnouts, 1996)
- Sensitive to any objects moving within our detectable range of on-sky motion rates (i.e. NEOs)



Results

This survey succeeded in searching the Moon's orbit during its 12 months of operation, designed to detect Lunar Trojans and other bodies moving at  $300 - 3000''/hr (2 - 20^o/day)$  down to the 15<sup>th</sup> magnitude

No Lunar Trojans were discovered



Proof of concept was the observation of a previously unknown NEA (temporary designation of ALA2xH) This asteroid had a most probably miss distance with Earth of  $\sim 3 R_{\oplus}$  and H = 24.3An upper limit of  $\leq 5$  Lunar Trojans currently present with H < 26.4 is proposed

References

outs, S. 1996, Astron. Astrophys. Suppl. Ser., 117, 393 issauer J. J., Chambers J. E., 2008, Icarus, 195, 16 , Balam D., Moss A., Veillet C., Connors M., Shelton I., 2007, The Astronomical Journal, 133, 1609



