CURE Summer 2017
Precision Astrometry

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Purpose:
Why do we do precision occultation asteroid astrometry?

- Asteroid characterization - size and shape
- Optical Navigation
- Accumulated Uncertainties
Occultation
Asteroids

Image from IOTA - occultations.org
Optical Navigation

Research Process

Predictions ➔ TMO Observations ➔ Data Reduction ➔ Data Delivery
Predictions

Choosing targets of opportunity based on the occultation schedule, Right Ascension and Declination.

Methods and equipment:

- Linux computer at JPL
- Trajectory Geometry Program
- Ghostview
- Hard copies
Predictions

Trajectory Geometry Program and Ghostview
Observations

Reducing uncertainty of ephemerides to within the diameter of the body. Precision level of uncertainty reduction is about 12mas.

- Caltech Table Mountain Facility
  - 24-inch Telescope
  - 4096x4096 CCD, FLI
  - Multiple 180s Exposures

- Windows computer
  - Off-the-shelf programs
  - Custom programs
  - Notepad
Observations

24in Telescope, 4k CCD FLI, 180s exposure, Red filter

You like windows?
You like Windows?
We have the best windows.
Observations

All the windows.
Observations

All the windows.
Observations

All the windows.
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Data Reduction

Locating targets and reduction of data by five orders of magnitude.

- Scripts
  - Least-Squares Fit
  - Weather/Refraction Effects

- Manual Troubleshooting
  - XROVER
  - Astrometric Data Analysis Program
Data Reduction

XROVER
Data Reduction

XROVER
Data Reduction

XROVER
Data Reduction

XROVER
Data Delivery

Sending data to interested parties in the form of updated R.A. and Dec values for targets.

Delivery Script

- Outputs R.A. and Dec
- Boilerplate heading
- MPC format

Interested Parties

- Minor Planet Center (MPC)
- International Occultation Timing Association (IOTA)
- JPL Solar System Dynamics Group
Data Delivery

Minor Planet Center publishes our data to their website.

(1149) Volga = 1929 PF
Discovered at Simeis on 1929-08-01 by E. Skvortsov.

Orbit
Orbit type: Main Belt
## Delivered Data

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<th>Latitude</th>
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If you learn one thing today...
Uncertainties accumulate.

Precision astrometry updates and refines ephemerides.

This corrects accumulated uncertainties.
Acknowledgement

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Resources
