NEO Research Activities in Korea
2005 Progress Report

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1. NEO Search :
Wide-Field Survey

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NEO programs in Korea : 1998~1999

1998 : YUO[1] started **YSTAR[2]** program and developed 50 cm wide-field telescope systems for detection and monitoring optical brightness variations and moving objects.

1999 : KASI[3] formed a task force named **NEOPAT[4]** and started NEO follow-up observation using their 0.6-m and 1.8-m optical telescopes.

[1]Yonsei University Observatory, [2]Yonsei Survey Telescopes for Astronomical Research
[3]Korea Astronomy and Space Science Institute, [4]Near-Earth Object PATrol

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NEO programs in Korea : 2000~2005

The Korean Ministry of Science and Technology awarded a research grant to the KASI NEOPAT group to establish the National Research Lab (NRL) for NEO survey.

NEOPAT and YSTAR groups started to work together in order to combine their expertise and resources.

In late 2003, our 1st telescope, started regular operation in Sutherland, South Africa. In early 2005, we commissioned 2nd telescope in Siding Spring Observatory, Australia.

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OBSERVING STRATEGY

With the small aperture size and large pixel scale, our telescope cannot produce comparable results with major NEO survey facilities which can reach much fainter magnitudes.

Therefore, our strategy is focused on the sky coverage by employing multiple telescopes, making the network most efficient in searching fast moving objects passing through relatively nearby space.

OBSERVING STRATEGY

In line with this, we selected locations of the observing stations in the southern hemisphere.

- South Africa : SA Astronomical Observatory
- Australia : Siding Spring Observatory
- Chile : Cerro Tololo Interamerican Obs. (planned)

This arrangement will enable us 24 hour monitoring and tracking of southern sky objects continuously considering their longitude distribution.

Southern Survey Telescope Network for All-Sky Variability

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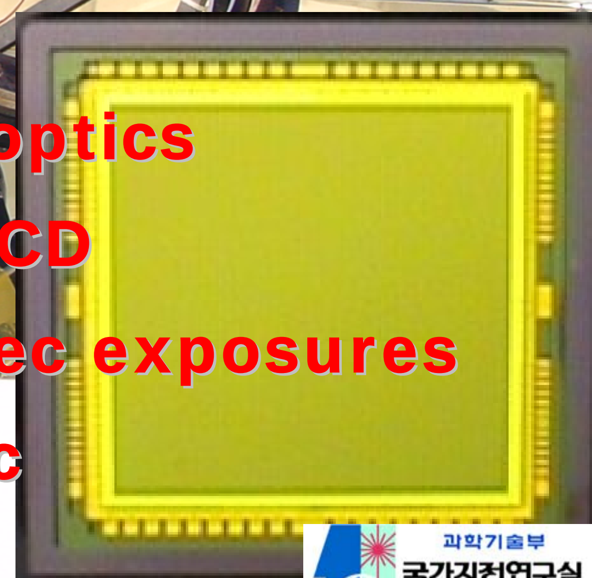
TELESCOPE SYSTEM : T1-T2

- 0.5 meter aperture, very fast optics
- FOV 1.73 × 1.73 deg with 2k CCD
- Reaches ~ 17^{th} mag with 60 sec exposures
- High speed mount, 10 deg/sec



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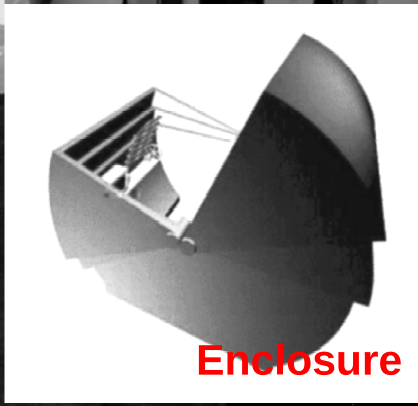
Observatory System



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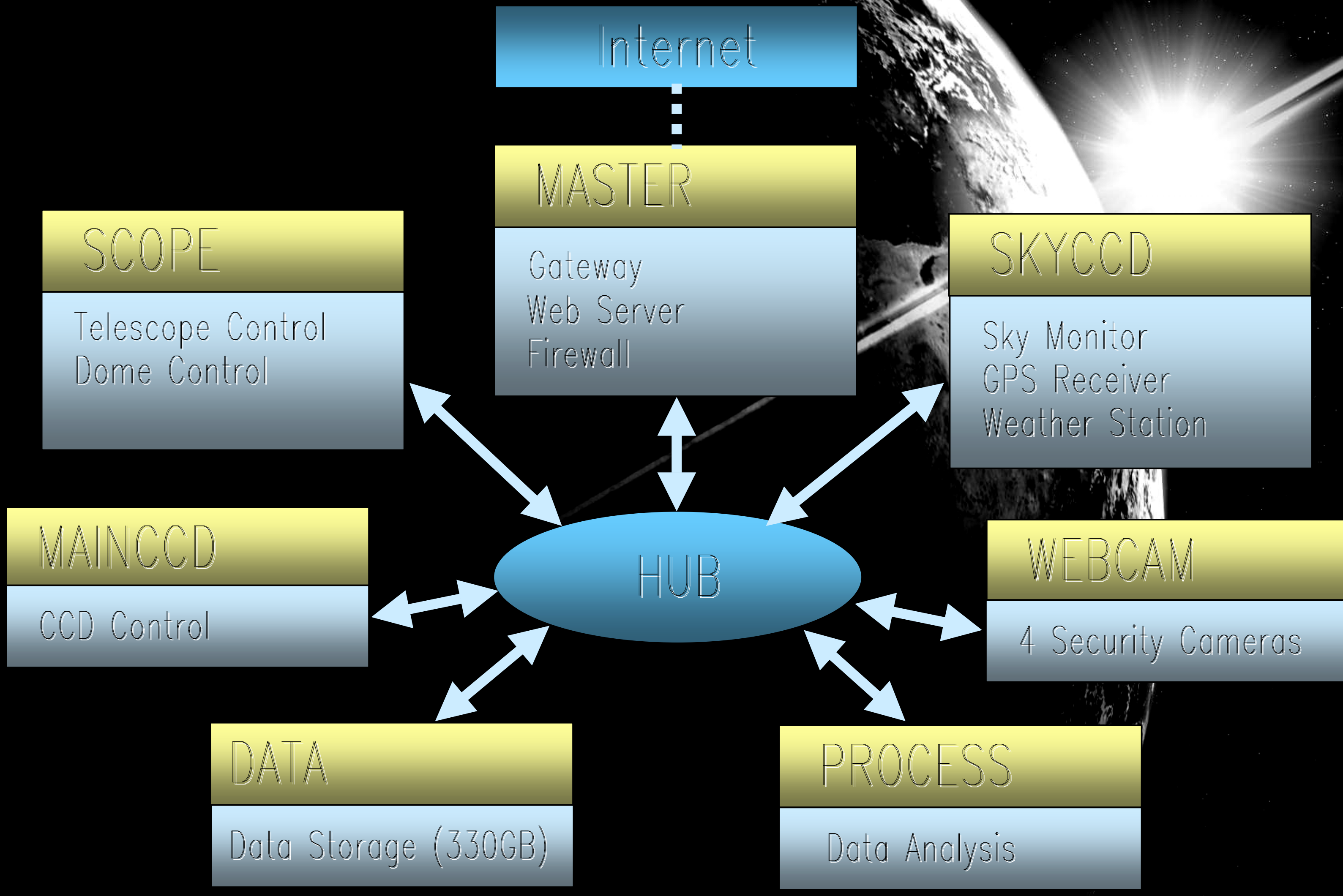
Computer System



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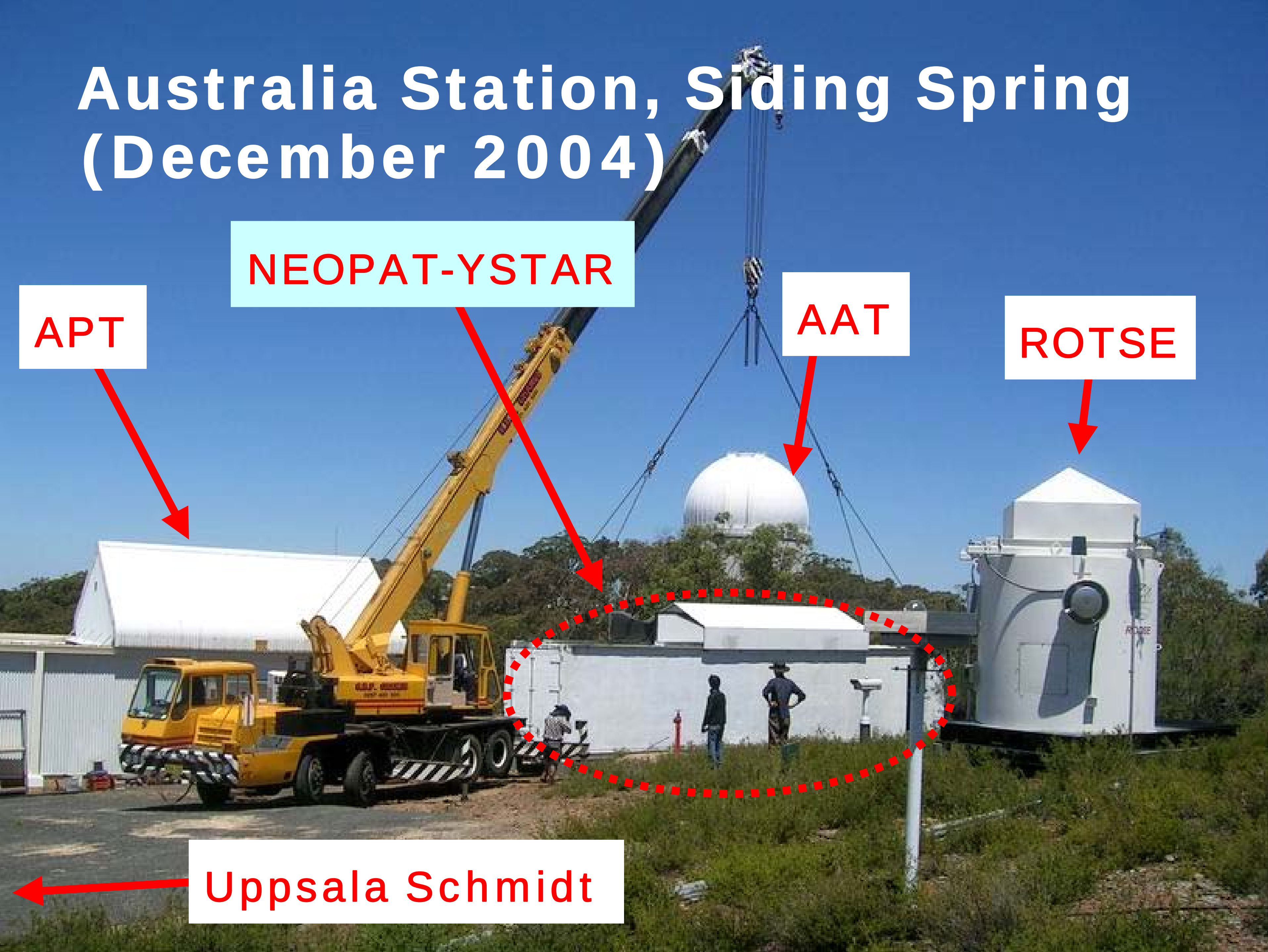
South Africa Station, Sutherland (April, 2002)

Australia Station, Siding Spring (December 2004)



The First Image from Australia Station (Dec 2005)

The Large Magellanic Cloud and Tarantula Nebula

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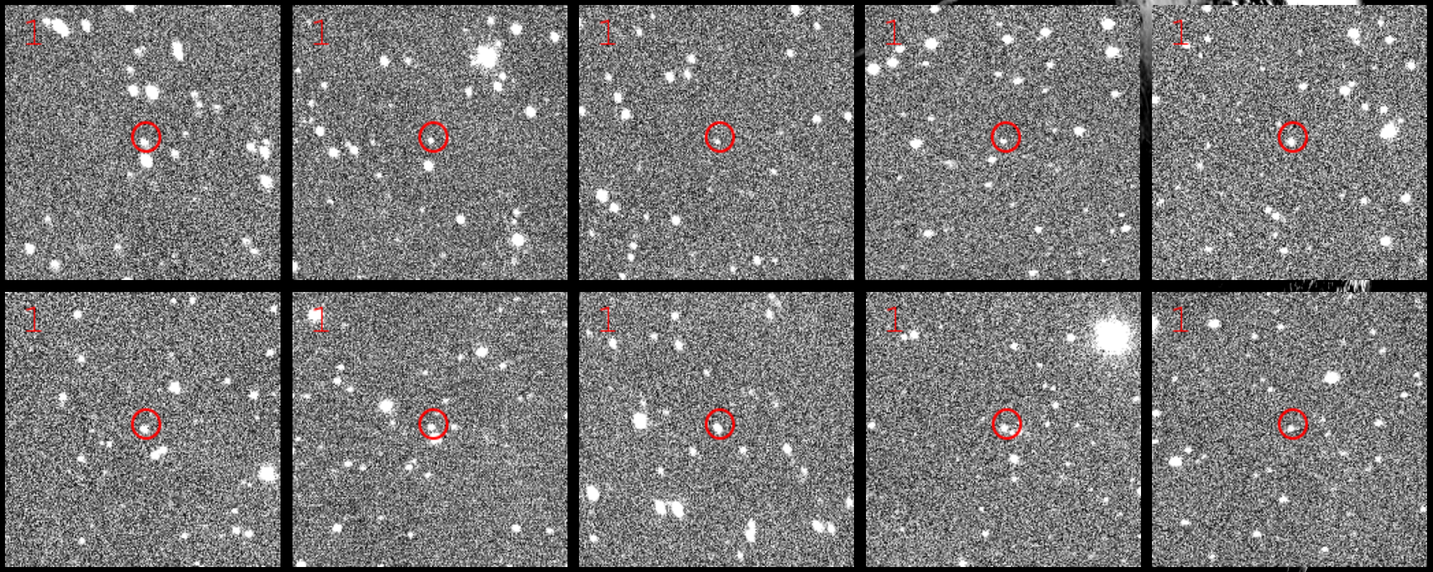
Prepare by Y. H. Bae

DATA PIPELINE : FindMovers

On-Site computers run near real-time image processing and discovery routines. For each NEO candidate, a stamp animation and report file is created and forwarded to Korea for visual confirmation.



South Africa Station

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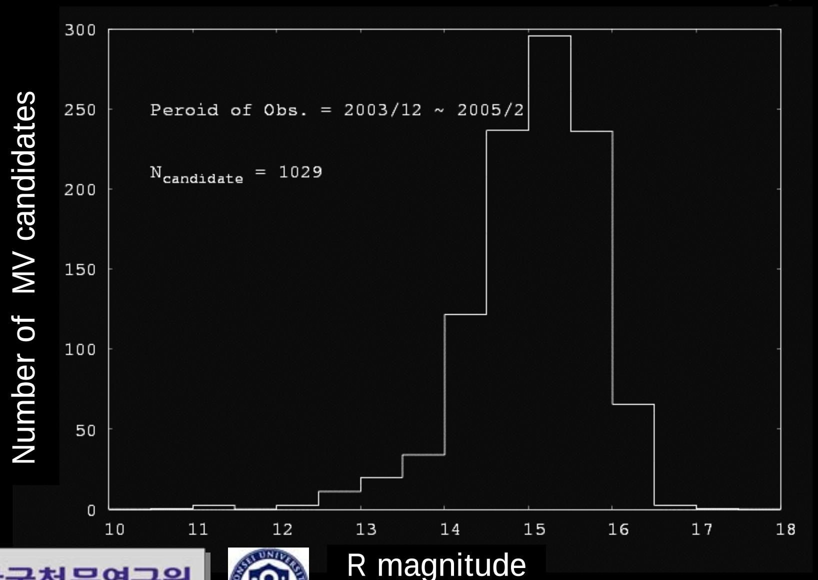
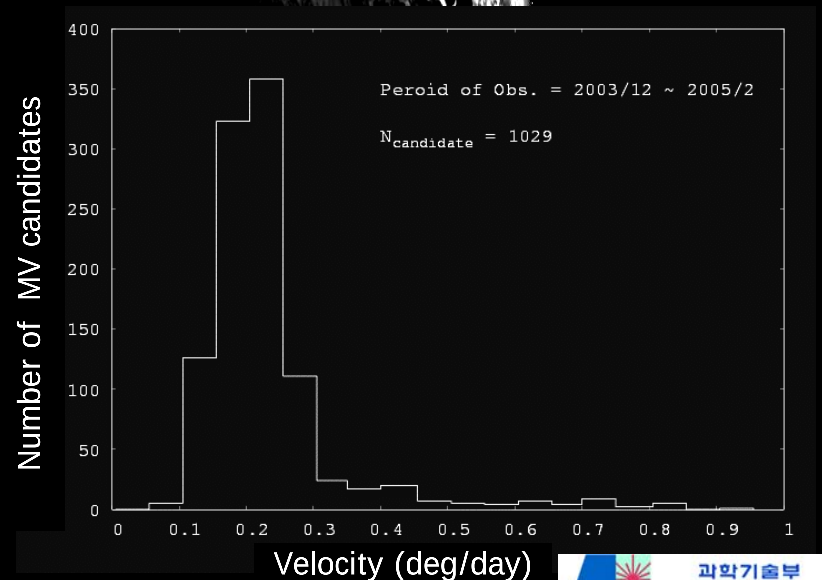
Magnitude and Velocity Distribution

- Number of Nights : 73
- Number of Mover Candidates : 1029
- Peak Magnitude : R~15
- Peak Velocity : ~0.2deg/day





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Estimated Productivity

- Sky Coverage : 17,000 □° / month / site
  (LINEAR 10000 / month, LONEOS 4300 / month)
- The "total sky coverage" : 54,000 □° / month
  (with the *southern survey telescope network*)
- Highly competitive for wide-area search for bright NEOs and very close encounters as well as
  - "Nearly isotropic comet" population
  - NEAs of large inclination / elongation

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2. Terrestrial Impact Records : Time-Series Analysis

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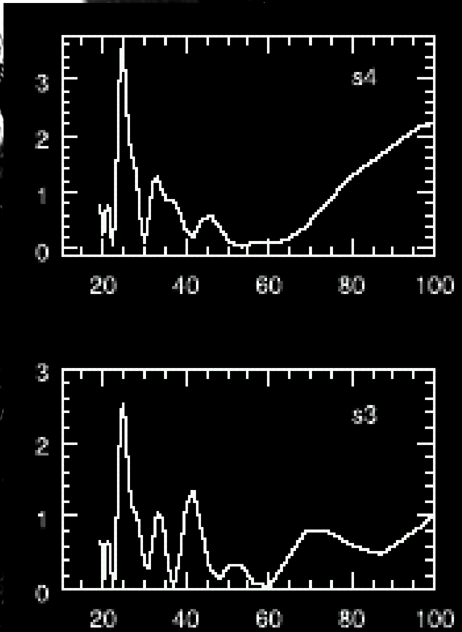
Time-Series Analysis of Terrestrial Impact Crater Records

Chang & Moon (2005) developed a new technique to find frequency of a data set with gaps.

They applied this technique to recent cratering records (2004) and found the presence of a ~26 Myr periodicity in the cratering rate over the last ~250 Myr.



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3. Orbit Deflection :
3-D Single Impulse

Mihn et al. 2005

Optimal Deflection of ECOs using a 3-D Impulse : An Introduction

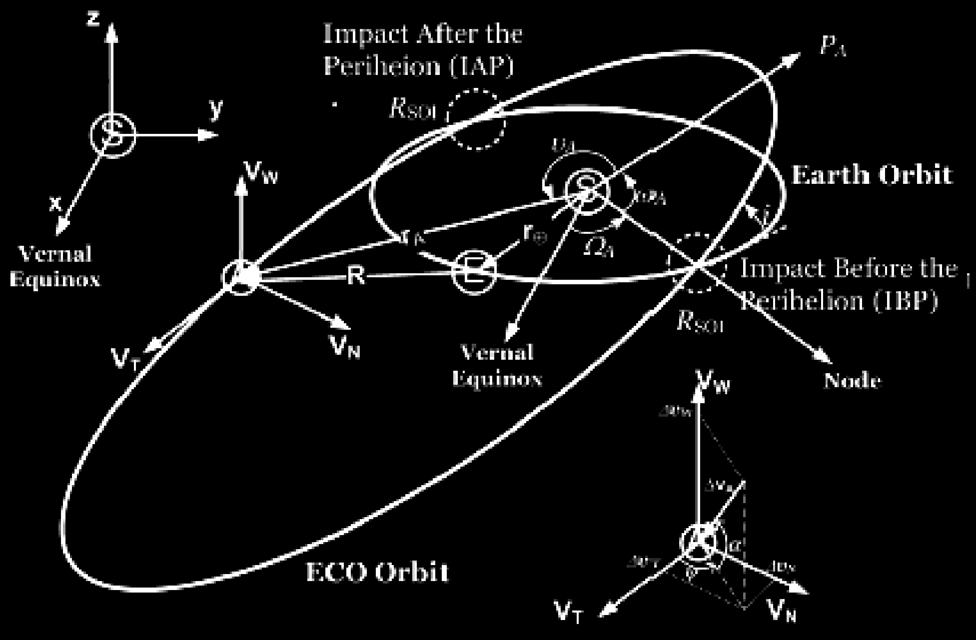
Mihn et al. (2005) formulated a method to calculate optimal impulse for deflecting Earth Crossing Objects (ECOs) using Nonlinear Programming.

This method allows an analysis of velocity changes ΔV in normal direction to the ECO's orbital plane which has been neglected in many previous studies.

Mihn et al. 2005

Optimal Deflection of ECOs using a 3-D Impulse : Results

The optimization in 3-D space yields impulsive ΔV to deflect a target. The solution depends on the relative positions and the velocities between Earth and the target.



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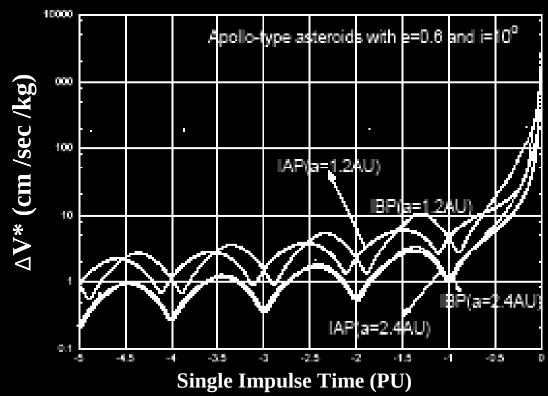
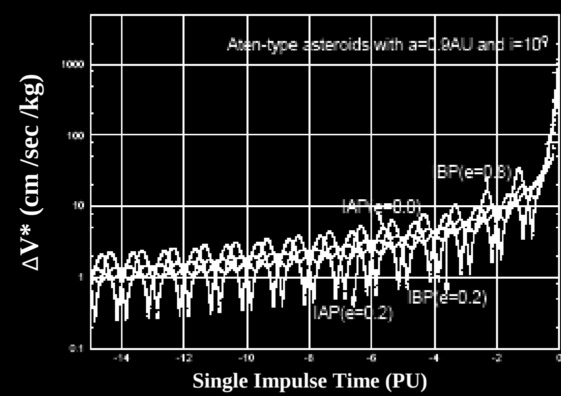
Mihn et al. 2005

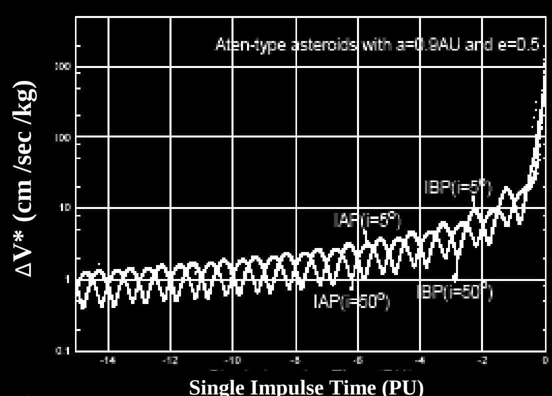
Optimal Deflection of ECOs using a 3-D Impulse : Results



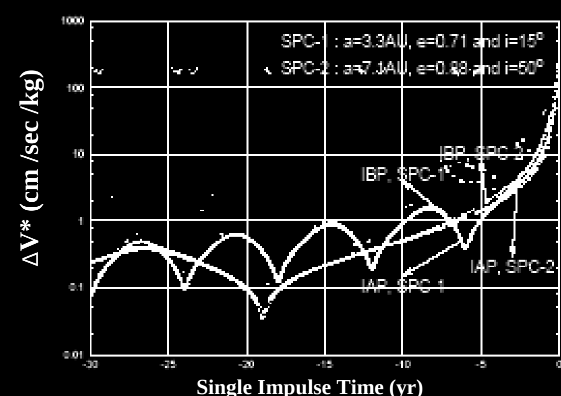
Δ(Semi-major axis) vs. ΔV* of an Apollo-ECO



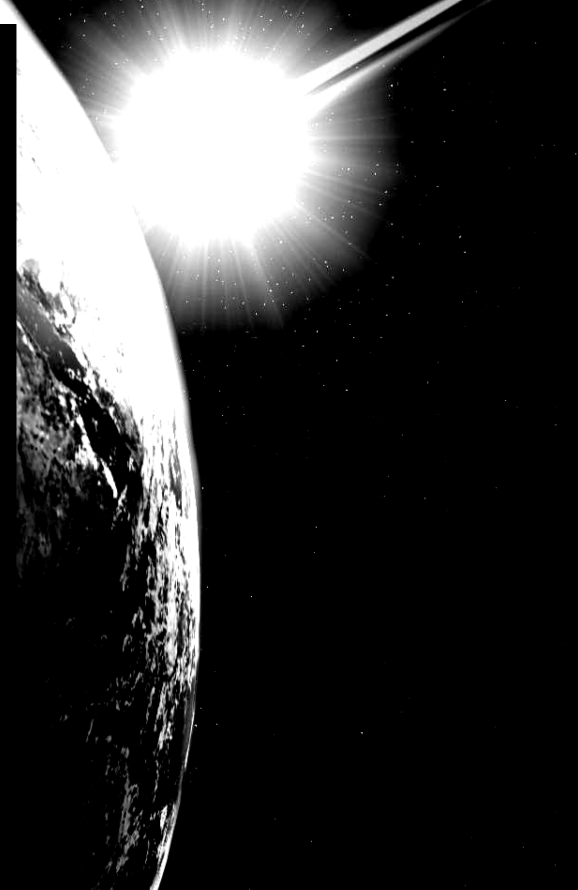
Δ(Eccentricity) vs. ΔV* of an Athen-ECO



Δ(Inclination) vs. ΔV* of an Athen-ECO



ΔV* of two different types of short-period comets with different *e* and *i*



IAP : Impact After Perihelion

IBP : Impact Before Perihelion

Mihn et al. 2005

Optimal Deflection of ECOs using a 3-D Impulse : Results

The **perpendicular component of ΔV** sometimes plays a non-negligible role as the **impulse time approaches to an impact.**

The **optimal ΔV is increased** when the original **orbit of an ECO is similar to that of the Earth.**

This method can be utilized in future NEO deflection missions.

Future Works

A detailed strategy for finding NEOs with a network of small survey telescopes

Test and refine our detection algorithm for finding fast moving objects.

Construction of Chile station; Completion and operation of the southern survey telescope network

Study for revisit periodicity in the terrestrial impact records with different sets of crater size and ages