Conditions for a survey of everything to be a Solar System survey

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0. Surveys of everything: a good idea, with some risk

High performance telescopes and cameras are expensive

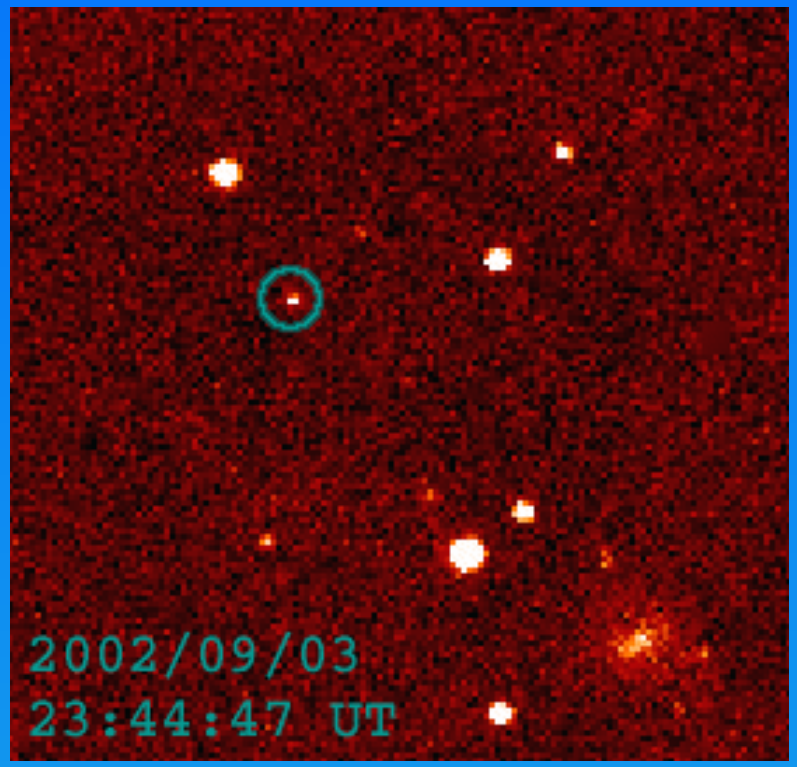
To justify this, there is the need to share the benefits with a large community of astronomers (and even outside)

Allocating telescope time to ~10 sub-projects (plus downtime) results in small shares, risk of mediocrity

Using the same images for many projects could be a good idea

Check that the requirements for different goals are compatible

1. Surveying for new Solar System bodies (Asteroids, Comets, TNO)



Asteroids are detected as moving pointlike light sources

Automated surveys: 3-5 images, detect alignements

A straight line does not allow the orbit determination

Key issues for surveys: limiting magnitude, efficiency of detection, reliability (no. of false), sky area covered

2.Orbit Determination

If you have an orbit, with low uncertainty, you can recover the object, else it is discovered and immediately lost

A single group of detections (tracklet) does not allow to compute an orbit; two or more belonging to the same object must be available. 3-4 tracklets required for good orbit

Follow-up accumulates observations of the same object until an orbit can be computed, good enough for recovery, and for the nature of the object to be determined

Identification selects two or more tracklets from archives and

3.Scheduling and filter requirements

To detect a moving object at least 3 separate images within ~1 hour are required; attempts to use only 2 images have so far failed (image difference is far from trivial; you want a fully automated method to select the moving objects)

The object must appear in all 3 (if 4 images, you can use 3/4). The limiting magnitude must be the same, for an object with the same visible spectrum. If different filters, the survey limiting magnitude is the worst. W filter better

Multiple nights, at least 3 in a lunation, each with a tracklet; if

4. Fill factor

The requirement is for 3 images (per night) in which the object appears, not 3 attempts

A critical parameter is the "fill factor", the fraction of the phocal plane actually covered by active sensing elements (not gaps between chips, hot/dark pixels, guiding, image defects)

If the probability of getting a tracklet is k, the probability of a discovery after 3 nights is k^3,

4.Priorities

If the telescope is off for clouds/maintenance, scheduling needs to adapt. Solar System discoveries suffer more from this, because if you have less data the rest may be useless.

Possibly the best program to share images with a Solar System survey is search for supernovas, because frequent revisit with same filter is useful. Example: Catalina Sky Survey images, scheduled for asteroids, are reused for novae.

I do not see a way to share images with extrasolar planet searches, thus synergies between solar system surveys and extrasolar planet searches is only cultural

5.Follow up

If a “discovery” is left incomplete, e.g., 2 nights of data, some use of the data: we now know how to compute orbits with 2 tracklets, but the identification can be false, and the orbit is anyway poor (loss of the object in few days/weeks)

If the number of images is below 9, then some additional data must come from other telescopes. But the higher the performance of the survey, the more difficult is to organize

The follow up resources should be actual, that is planned, not

6. Compatibility of SolSys survey

If the observing time is shared among many programs, each program has ~2 nights per lunation and a discovery survey has a much more limited performance than the telescope..

If the same images have to be used by different programs, the requirement for many images makes difficult to include a Solar System discovery survey

7. The example of Pan-STARRS

The PS1 consortium includes 12 Key Projects (+ space debris). More of 5% of exclusive time is hard to get

The ¾ of the sky astrometric and photometric survey requires the use of 6-7 filters

The PS1 telescope and camera could be the dominant NEO survey, if used >50 nights/year with the scheduling and filter optimum for solar system (NEO demo night)

So far, PS1 is only providing “discoveries” which need follow

8. Conclusions

Surveys of everything promising to include solar system discovery surveys have a serious problem.

Using only 2 images per night is not working yet; maybe it can work, but reference catalog is needed; LSST beware.

Lost discoveries and false discoveries are the main concern

A survey should not promise to do everything, but state in a transparent way what are the goals, the priorities, the time allocation and resource sharing rules.