Minor Planet Center 2024 Update

Matthew Payne
Center for Astrophysics | Harvard & Smithsonian

CENTER FOR
ASTROPHYSICS
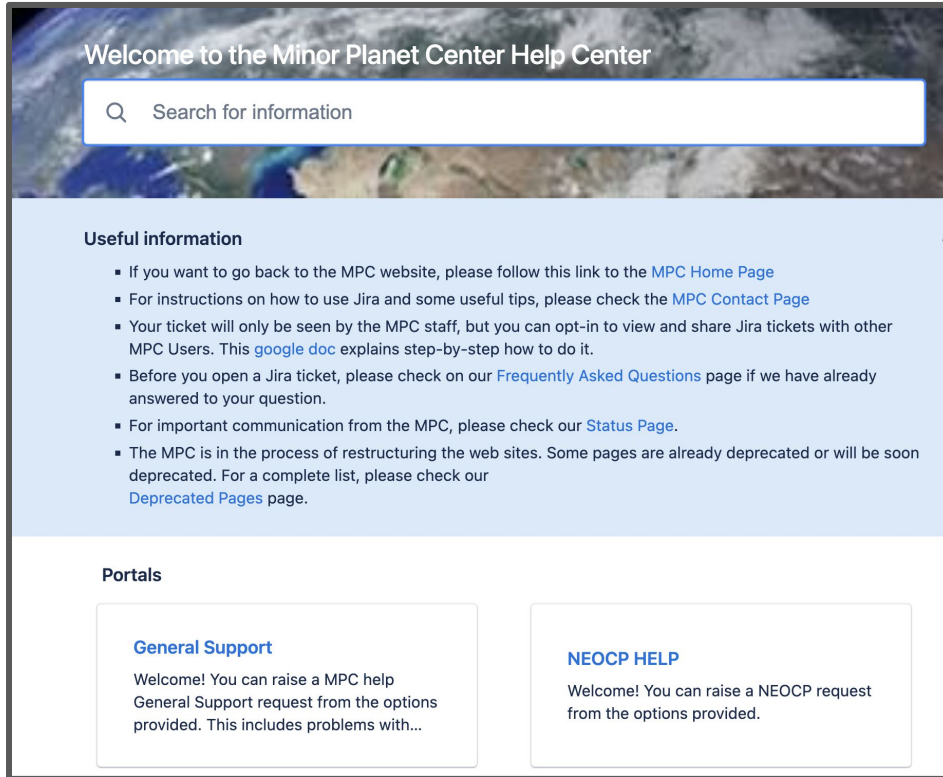HARVARD & SMITHSONIAN

Community Interactions

Newsletters

Monthly Newsletter

- Announce new developments
- Provide advice
- Solicit community feedback

Download

- *URL:*
  https://minorplanetcenter.net/mpcops/new/newsletters/
- *QR Code*

Jira Helpdesk

Welcome to the Minor Planet Center Help Center

Search for information

Useful information

- If you want to go back to the MPC website, please follow this link to the MPC Home Page
- For instructions on how to use Jira and some useful tips, please check the MPC Contact Page
- Your ticket will only be seen by the MPC staff, but you can opt-in to view and share Jira tickets with other MPC Users. This google doc explains step-by-step how to do it.
- Before you open a Jira ticket, please check on our Frequently Asked Questions page if we have already answered to your question.
- For important communication from the MPC, please check our Status Page.
- The MPC is in the process of restructuring the web sites. Some pages are already deprecated or will be soon deprecated. For a complete list, please check our Deprecated Pages page.

Portals

General Support

Welcome! You can raise a MPC help General Support request from the options provided. This includes problems with...

NEOCP HELP

Welcome! You can raise a NEOCP request from the options provided.

Jira Helpdesk

- Dedicated help-desk functionality.
  - Queries
  - Bug reports
  - Requests

Access

https://minorplanetcenter.net/contact

https://mpc-service.atlassian.net/servicedesk/customer/portals

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Archival Submissions Committee

Announced in June 2024 Newsletter

In reaction to concerns regarding occasional erroneous measurement of archival data.
- Single measurements especially problematic when no other observations available in an opposition:
- Can significantly change calculate orbit and impact probability.

The MPC and the MUG have formed a committee of impartial external experts to help review individual cases.
- 6 members: PanSTARRS, ATLAS, Catalina, and NEOWISE, one member with follow-up experience, and one non-NASA-funded astrometry expert
- Committee members provide advice:
  - To submitters regarding preferred methodology
  - To MPC regarding accuracy of submitted data

Started to implement this new mechanism on a few test cases.
- Committee members interact with the submitter via Jira ticket.
- Postage-stamp images can be requested and analyzed

The MPC has put a lot of effort into increasing their presence during large conferences and medium or small meetings or workshops.

In the last two years (2023 and 2024), MPC's staff members have attended or are going to attend the following large conferences:
- PDC, April 2023, Vienna
- ACM, June 2023, Flagstaff
- DPS, October 2023, San Antonio
- TNO meeting, June 2024, Taipei
- IAU, August 2024, Cape Town
- DPS, October 2024, Boise

We have also attended smaller size meetings, equally important for the NEO/Asteroid community, such as:
- SBN User Group meetings
- SBAG
- IAWN
- Radar
- ADASS
- NEOO

And workshops in preparation for V. Rubin and NEO Surveyor:
- LSST Science Collaboration meetings
- NEO Surveyor Science Workshop

In addition to that, we are also very active inside the CfA and for outreach events in Cambridge and outside the US.

New Services and Data Products

MPC Explorer

MPC Explorer 🔭

Designation NEOCP Documentation Known issues

Search for designation (e.g. Bennu, A1234, 1, 401P, Jupiter X, K23A00B, 2024 AA, 2019JD24, C/2019 Y4, CK18Y010, S/2020 S1, SK03J020).

12345

Selected Object: **12345** ⓘ

Designation Observations

Id Type	Values
Permanent ID	12345
Name	None
Object Type	Minor Planet
IAU Designation	(12345)
Unpacked Primary Provisional Designation	1993 FT8
Unpacked Secondary Provisional Designations	1995 UW49
Packed Permanent ID	12345
Packed Primary Provisional Designation	J93F08T
Packed Secondary Provisional Designations	J95U49W

Download JSON

Replacement for our db_search functionality

Available Now
- Designations and Identifications
- Observations
- NEOCP

Coming Soon
- Orbits
- Discovery Details

Access Methods
- Web-forms
- API

URL & QR-Code

- https://data.minorplanetcenter.net/explorer/

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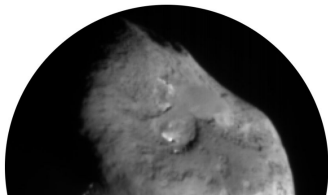# Database Replication

Minor Planet Center Annex @ SBN

SBN-MPC

The Minor Planet Center (MPC) is the world's (International Astronomical Union designated) nerve center for asteroid and comet observations, and has become a functional sub-node of the Small Bodies Node of the NASA Planetary Data System. The MPC collects, processes, and distributes all positional measurements, orbits, and discovery information for all minor planets and comets (and some natural satellites too). The MPC also alerts the NASA Planetary Defense Coordination

MPC Database Tables Schema

The MPC makes its PostgreSQL database of observations and orbits available for replication via the SBN. Additional information on the replicated tables, including examples and status reports, can be found here (add link to the MPC Database User Guide).

The table below shows the *name* and *description* for all the tables that are currently replicated to the SBN.
By clicking on the name of each table, you will get to the page of the schema of the specific table, including the column names, types, and descriptions.
Please click on the header to change the columns order.

Table name	Description
current_identifications	Table containing all the primary designations (minor planets, comets and natural satellites) and their secondary designations, when available.
mpc_orbits	Table containing orbits and related information for any minor planet that has been designated and for which it is possible to fit an orbit with the available observations.
neocp_els	Table containing the nominal orbital element for each tracklet that is currently on the NEOCP
neocp_events	Table containing NEOCP related processing events
neocp_obs	Table containing observations for objects currently on the NEOCP
neocp_obs_archive	Table containing archived NEOCP observations
neocp_prev_des	Table containing objects that were previously listed on the NEOCP, their designation if designated and the reasons for their removal
neocp_var	Table containing variant orbits for every object on the NEOCP
numbered_identifications	Table containing the number and primary provisional designation for any object that has been numbered.
obs_alterations_corrections	Table used to record the corrections made to the observations that have been published.
obs_alterations_deletions	Table used to record the corrections made to the observations that have been published by the MPC (in an MPEC, DOU or monthly circular) and that have been also deleted
obs_alterations_redesignations	Table used to record the observations that have been redesignated
obs_alterations_unassociations	Table used to record the observations that were unassociated from their original designation and relocated to the Isolated Tracklet File (ITF)
obs_sbn	Table used to record all the observations published by the MPC. Contains observations associated with designated objects and observations associated with the Isolated Tracklet File (ITF).
primary_objects	Table used to keep a record of all the primary designations for minor planets, comets and natural satellites that have been designated by the MPC.

Multiple postgres database tables are now available for replication via the SBN

Available Now
- Designations and Identifications
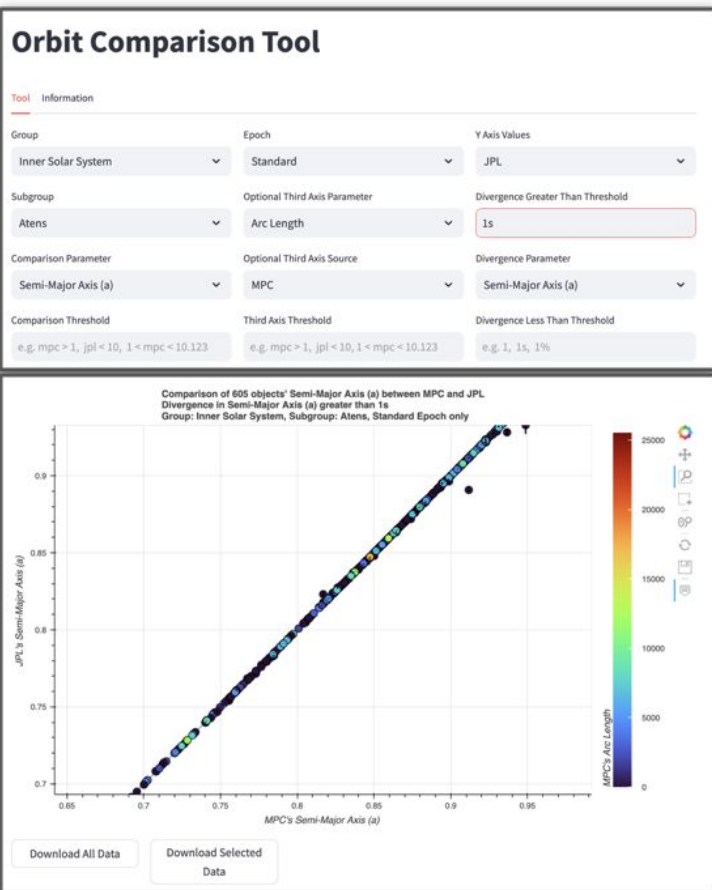- Observations
- NEOCP
- Orbits

SBN
- MPCDB now distributed via AWS
  - Increased redundancy

URL & QR-Code
- https://sbnmpc.astro.umd.edu/
- https://data.minorplanetcenter.net/mpcops/documentation/replicated-tables-schema/

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Orbit Comparison Tool

Compare the MPC's orbit for an object with that calculated by another center.

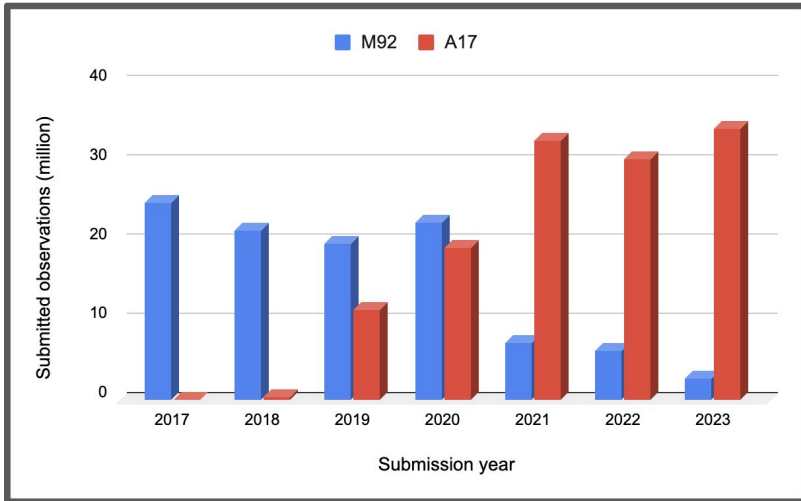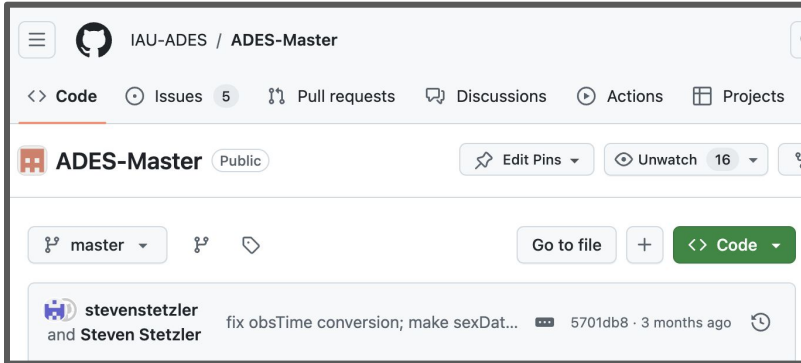- Identify discrepancies

Available Now

- JPL/CNEOS orbits

Coming Soon

- NEOFixer orbits

URL & QR-Code

- https://data.minorplanetcenter.net/comparison/index.html

ADES

Preferred submission format

Preferred format for internal MPC processing

The GitHub repository containing the ADES code is continuously updated if fixes or improvement are needed:
- Co-maintained by JPL & MPC
- Available for public download
- Available for public *discussion* of issues and improvements

URL & QR-Code

https://github.com/IAU-ADES/ADES-Master

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ADES

Switching to ADES

If you are still using the 80-character format, some help with switching can be found in the ADES repo.

There is code that converts 80-char to ADES format:

- https://github.com/IAU-ADES/ADES-Master/blob/master/Python/bin/mpc80coltoxml.py

The above will just help get you underway …
- You probably want to add uncertainties …

There are examples of data that include uncertainties
- https://github.com/IAU-ADES/ADES-Master/blob/master/new_tests/input/obs.xml

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Documentation

MPC Documentation
Frequently Asked Questions (FAQ)

• List of FAQs

MPC APIs

• Where Are My Observations (WAMO)
  WAMO API documentation.

• Designation Identifier
  Designation Identifier API documentation.

• Observations
  Observations API documentation.

MPC's replicated postgreSQL tables

• Introduction and examples
• Schema

Improvements to website documentation.
● April 2024 Newsletter

Documentation Page
● https://minorplanetcenter.net/mpcops/documentation/
● API related documentation
● PostgreSQL replicated table documentation

Documentation

Improvements to website documentation.
- [April 2024 Newsletter](#)

Ongoing improvements
- Reorganized & Updated Guide to Astrometry
- Reorganized & Updated Guide to the ADES format

Our goal is to keep improving this documentation section
- Reorganizing & Updating material from across the website.

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Documentation

Improvements to website documentation.
- [April 2024 Newsletter](#)

Ongoing improvements
- Reorganized & Updated Guide to Astrometry
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Our goal is to keep improving this documentation section
- Reorganizing & Updating material from across the website.
- Cross-linking to updated documentation

https://data.minorplanetcenter.net/explorer/

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Infrastructure Updates

The International Astronomical Union
Minor Planet Center

The MPC's infrastructure updates are centered around preparing for the Vera Rubin/LSST and the NEO Surveyor mission.

Software Management
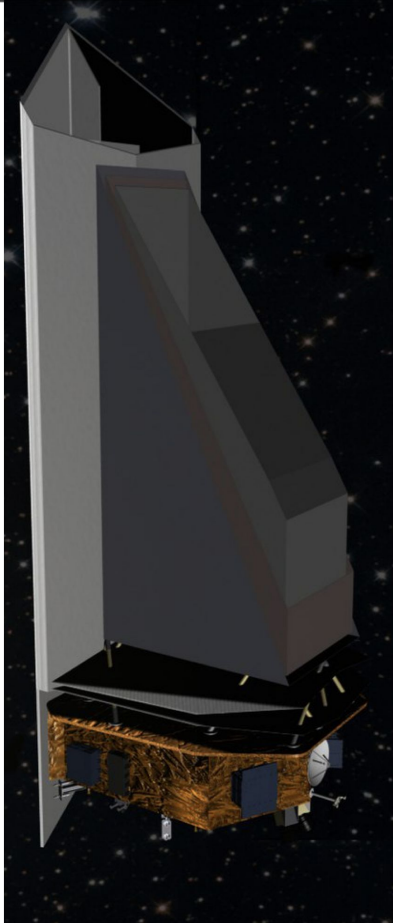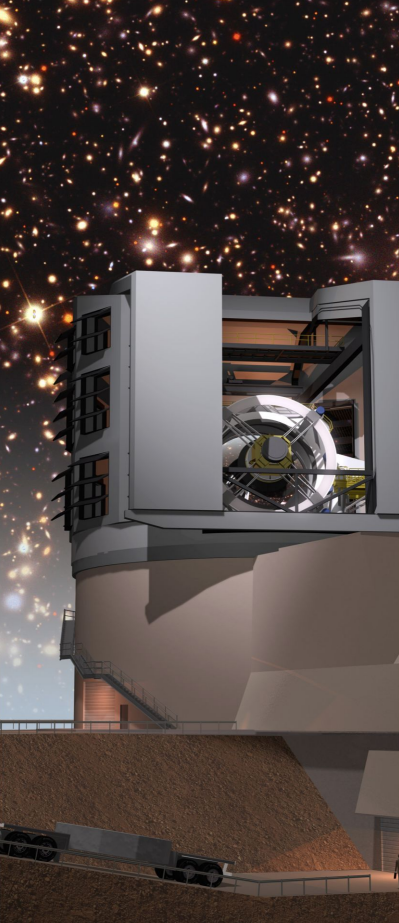
MPC Staff are using modern software practices

Entire team is comfortable with Jira	Branching training turning into adoption	Adopting latest Python packaging standards	More unit tests running in the cloud every commit	More Code Reviews and Human Testing

- Three full-time software engineers
- Recently advertised additional positions for database & software staff

Hardware Virtualization
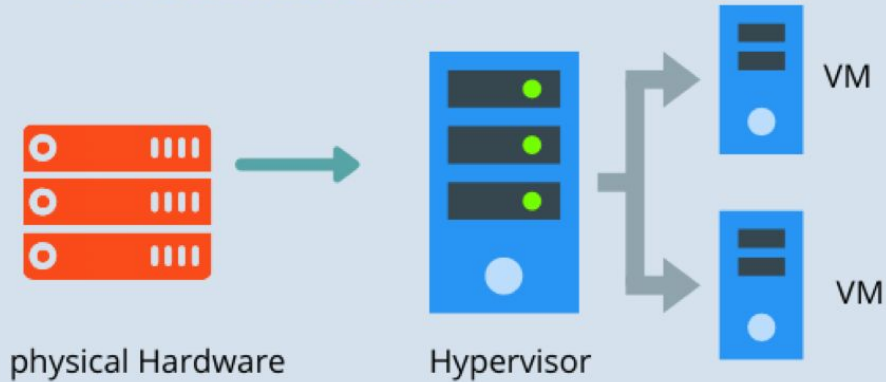
- Created our own internal cloud system
  - Multiple servers
  - Large, modern storage
  - Cluster: Software hypervisor
  - Deploy multiple VMs and containers to the cluster
- Efficient resource use
- Faster processing times
- Simple backup and upgrade paths
- Faster disaster recovery

Orbit Fitting Containers

Orbit-Fitting

- Group of containers orchestrated via *Docker Swarm*.
- Deployed onto virtualized cluster
- Multiple workers per container
- Each worker is running orbit fitting jobs using the MPC's `pyorbfit` wrapper around the `orbfit` fortran binary.

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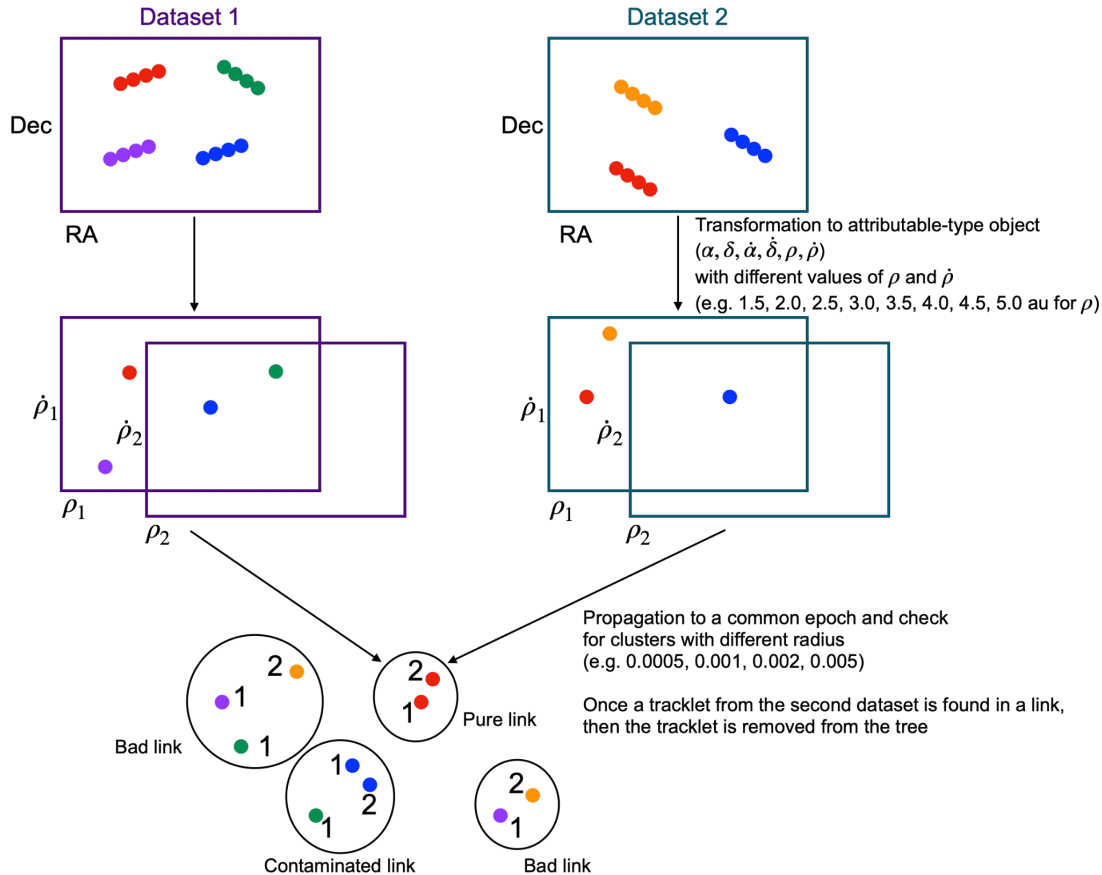
HelioLinc Algorithm
- *Guess/assert a distance (and radial velocity)*
- *Transform tracklets to state-vectors*
- *Propagate*

Look for "Clusters"
- *If the assertion is true, tracklets from the same object will "cluster" at a common location after propagation.*
- *If you see clusters, you have found an object with those (approximate) properties*

Heliocentric Linking

Linking Development

- WIP to migrate the code to database-centered data format;
  - **Radiy Matveev**
- To be deployed to virtual machine
- Integrate into the RabbitMQ-based queuing system …

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NEOCP Automatic Processing

The International Astronomical Union
Minor Planet Center

NEOCP Automated Processing last message for 2548 objects from 2024-01-01 to 2024-09-16
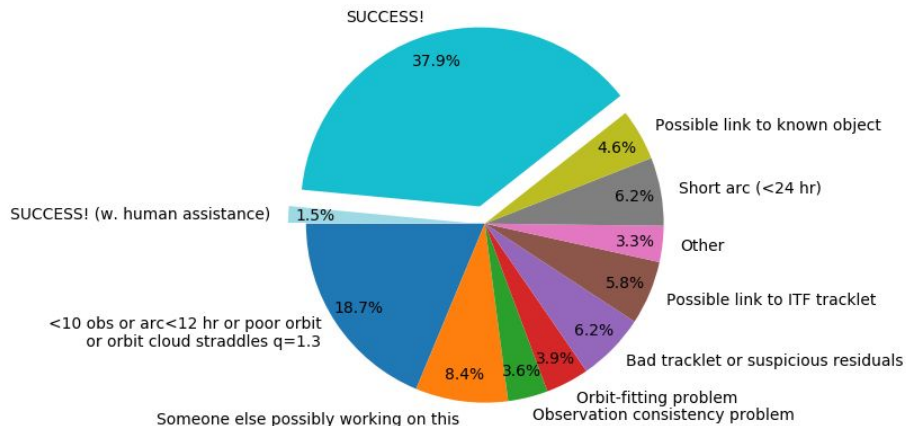
NAP:
- An automated script process and designate objects on the NEOCP
- Regularly develop and improve: increase level of automation

Checks:
- Objects are thoroughly vetted prior to publication: a Huge number of properties are checked
- Recently added / improved checks include:
  - Orbit uncertainties
  - Differences in magnitude between the object and the possible ITF matches
  - Geocentric score
  - Singletons

WIP:
- Increase Automation

The International Astronomical Union
Minor Planet Center

Old (1): NEOCP Follow-up reports

```
2024-02-20 12:59:16 UTC
I52 — Steward Observatory, Mt. Lemmon Station
K24D00Z
targeting - I52

691 — Steward Observatory, Kitt Peak-Spacewatch
Attempting recovery of K24C08N
Started recovery attempt for K24C08N on 2024 Feb 20 at
approximately 1228 UT

2024-02-20 13:12:18 UTC
I52 — Steward Observatory, Mt. Lemmon Station
CA9CDD2
reported - R. A. Kowalski
```

https://www.minorplanetcenter.net/neocp_followup_reports/

Negative Observations

- Allow users to report objects that could *not* be recovered.
- *Partial* evidence against an orbit / variant-orbits
- Difficult topic: many caveats around depth, completeness, etc.
- But we want to start collecting information: hopefully something is better than nothing.

Negative Observations: WIP

Old (2): Pointings

```
id              | 1
surveyexpname   |
mode            | survey
mpccode         | 691
time            | 2008-01-01 00:00:00
astrometric     | f
date_only       | t
duration        | 0
jdmid           | 2454466.5
ra              | 71.871
dec             | 29.342
ra_sw           | 70.813
dec_sw          | 28.477
ra_se           | 72.929
dec_se          | 28.477
ra_ne           | 72.947
dec_ne          | 30.207
ra_nw           | 70.795
dec_nw          | 30.207
width_ra        | 1.86
width_dec       | 1.73
rot_angle       | 0
fielddiam       | 1.73
circular        | f
healf           | 294760974
healc           | 1124
desig           |
maglimit        | 21.7
nonsidereal     | f
filter          |
ignore          | 0
rawjson         |
created_at      | 2018-10-24 20:14:04.515747
updated_at      | 2018-10-24 20:14:04.515747
```

https://minorplanetcenter.net/pointings

Negative Observations

- Allow users to report objects that could _not_ be recovered.
- _Partial_ evidence against an orbit / variant-orbits
- Difficult topic: many caveats around depth, completeness, etc.
- But we want to start collecting information: hopefully something is better than nothing.

New: Updated Pointings API   → Negative Observations

You can specify a **negative observation** of an object when you searched for a given object but could not find it in a field. This information is specifically desired for NEOCP objects. The following keyword are MANDATORY in case of a negative observations:

- **found** - boolean, true or false, (was the object found?)
- **desig** - object designation in a packed format (known object - 5,7,8 characters, string) or a trksub for NEOCP
- **submitter** - name of the submitter who reported the negative observation (string. e.g. 'A. Tomatic')

OPTIONAL fields that can be provided with the negative observation:

- **limiting_mag_method** - integer: allowed values 1, 2, 3, 4 (explained below).
- **notes** - string, up to 255 characters.
- **number_of_stars_fov** - number of stars in the field (>0, integer), helpful information when the field is crowder or not crowded.
- **pixel_scale** - float, number > 0, in arc seconds.
- **seeing** - float, number > 0, in arc seconds.
- **software** - string, software used for image processing and reduction.
- **stacked** - boolean (true/false)
- **fill_factor** - fill factor, a number > 0 and <=1 (1 means entire field is visible).

Limiting magnitude methods:

- 1 - On star stack, measure faint objects at the limit, and scale their magnitude to 5-sigma.
- 2 - On stack, measure sky noise. Scale for area of a point-source. Scale for 5-sigma.
- 3 - Insert artificial objects in individual frames, find them in stacks and sub-stacks (limiting magnitude where detection efficiency is equal to 50%).
- 4 - Manual/custom method.

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New: Updated Pointings API → Negative Observations

Minimal Example

```
{
"action": "exposed",
"surveyExpName": "20180101-EX0132",
"mode": "target",
"mpcCode": "I52",
"time": "2024-03-03T12:20:33.46",
"duration": 45,
"center": [255.167,-29.008],
"widths": [0.82, 0.64],
"desig": "P11Uypl",
"limit": 22.7,
"nonsidereal": true,
"filter": "V",
"found": false,
"submitter": "A. Tomatic",
"fill_factor": 0.98
}
```

More Verbose Example

```
{
"action": "exposed",
"surveyExpName": "20180101-EX0132",
"mode": "target",
"mpcCode": "I52",
"time": "2024-03-03T12:20:33.46",
"duration": 45,
"center": [255.167,-29.008],
"widths": [0.82, 0.64],
"desig": "P11Uypl",
"limit": 22.7,
"nonsidereal": true,
"filter": "V",
"found": false,
"submitter": "A. Tomatic",
"fill_factor": 0.98,
"limiting_mag_method":4,
"notes":"I searched a lot, not found, large chip gap in FOV",
"number_of_stars_fov":1000,
"pixel_scale":0.4,
"seeing":1.2,
"software":"Tycho tracker",
"stacked":true
}
```

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Summary

Survey Preparations

- LSST
  - Main survey starts next summer
  - Com-Cam data expected October 2024

- Infrastructure developments
  - Many pipeline upgrades
  - Deploying "Sandbox Pipelines" in collaboration with LSST

- NEO Surveyor
  - MOUs & ICDs Signed
  - Ongoing testing schedule

Community Wide Improvements

- New Services and Data Products
  - Database-Centric Data & Services

- Improving Communication and Documentation
  - Newsletters
  - Helpdesk
  - Talks/Conferences/Workshops

- Let us know how we can help!
  - Jira Helpdesk
  - Open to suggestions!