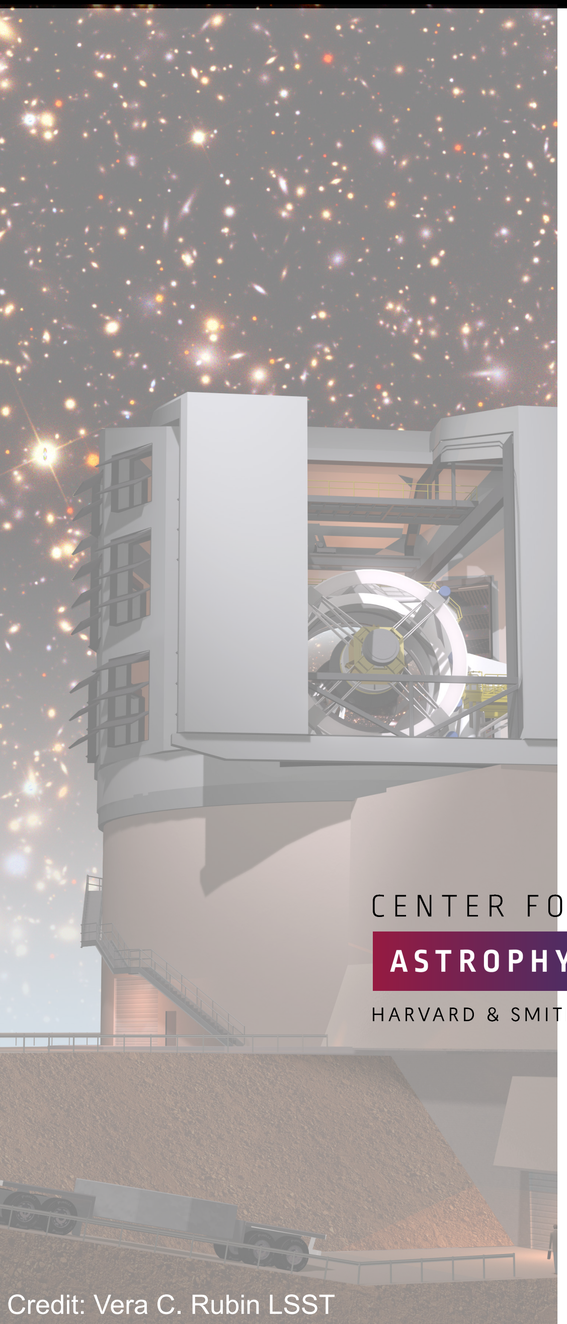


Credit: Vera C. Rubin LSST

Minor Planet Center: Update

CENTER FOR ASTROPHYSICS
HARVARD & SMITHSONIAN

Matthew Payne & Federica Spoto
Center for Astrophysics, Harvard & Smithsonian

IAWN, October 26th, 2023

The Minor Planet Center

The International Astronomical Union
Minor Planet Center

The Center for Astrophysics

The single worldwide location for receipt and distribution of positional measurements of minor planets, comets and outer irregular natural satellites of the major planets

We are responsible for the identification, designation and orbit computation of minor planets, comets and outer irregular satellites of the major planets

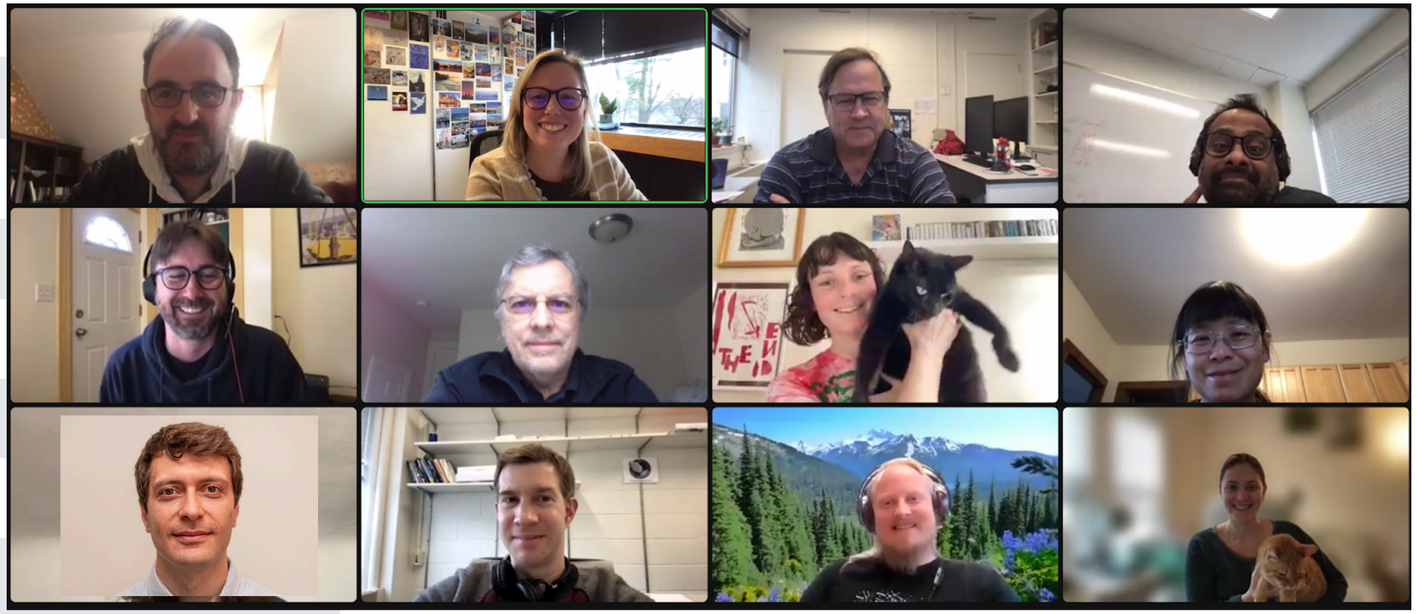
We maintain the entire dataset of available orbits and observations

We are responsible for announcing discoveries of new objects

We work under the auspices of Division F of the IAU and we are a functional sub-node of the Small Bodies Node of NASA PDS

The staff

Name	Role
Matthew Payne	Director
Michael Rudenko	Software & Sys-Admin; Comets
Peter Veres	Operations
Dave Bell	Software & DB-Dev; Operations
Paresh Prema	Software & Web-Dev; Operations
Margaret Pan	Pipeline development
Federica Spoto	Project Scientist
Rosemary Pike	TNOs, Natural Satellites
Mike Alexandersen	TNOs, Natural Satellites; Operations
Christopher Moriarty	Technical Manager
N Casale	Software Developer
Michael Lackner	Contractor: Database migration
Radiy Matveev	**Software Developer** - started on Tuesday Oct 10

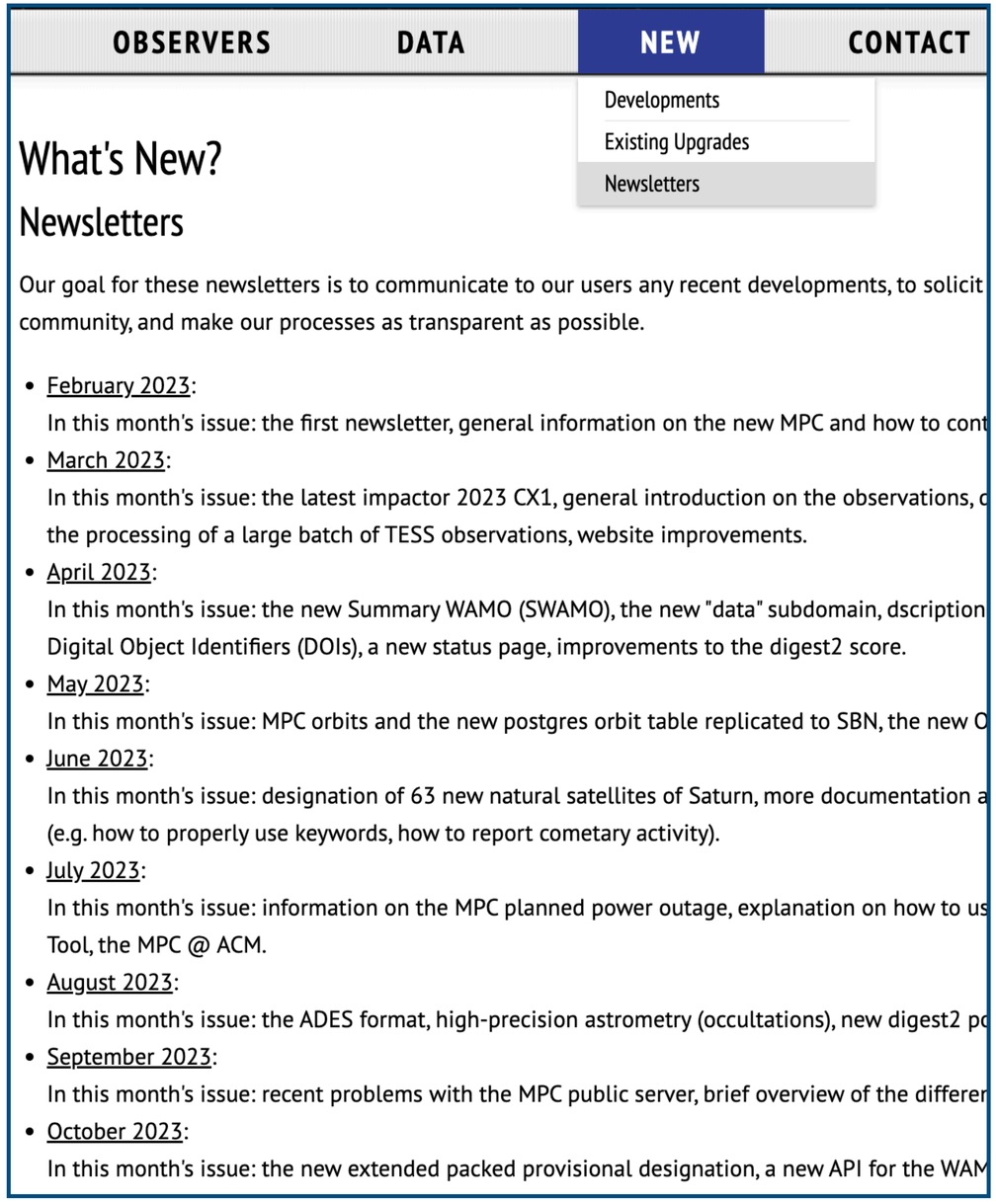


Screenshot of all the members of the MPC staff during a weekly meeting. From top to bottom, from left to right: the MPC director Matthew Payne, Federica Spoto, David Bell, Paresh Prema, Christopher Moriarty, Michael Rudenko, N Casale with Frankenstein, Margaret Pan, Benjamin Gafford, Peter Veres, Mike Alexandersen and Rosemary Pike with Gnocchi.

https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Feb2023.pdf

What's new?

The International Astronomical Union
Minor Planet Center



MPC monthly Newsletter

- Communicate recent developments
- Solicit feedback from the community
- Make our processes as transparent as possible

Find the Newsletters

We send them at the beginning of the month via email to:

- MPC ml - MPC mailing list
- MPML

They are always available on our **website**

Visit: https://minorplanetcenter.net/mpcops/new/newsletters/

What are we working on?

LEGACY SYSTEM

Maintain current services
- Data products (e.g. publications)
- Flat files of orbits and observations

Make our services more easily available
- Replication of database tables
- Develop new APIs for our more frequently accessed services
- Website improvement

Constant product validation
- Ensure the quality of the data

Observational Data Formats

The International Astronomical Union Minor Planet Center

Astrometric observations are disseminated in two different formats:

- Longstanding 80-character *MPC1992* format
- More recent Astrometric Data Exchange Standard (ADES)
  - https://github.com/IAU-ADES/ADES-Master/blob/master/ADES_Description.pdf

The *MPC-1992* format uses plain text files in a fixed 80-column format to communicate the core pieces of information.

```
K23R00S*1C2023 09 07.18057221 21 10.560-10 36 04.20          20.15GV~79PRG96
K23R00S 1C2023 09 07.18570021 21 04.540-10 35 10.90               V~79PRG96
K23R00S 1C2023 09 07.19083021 20 58.450-10 34 16.00          20.79GV~79PRG96
K23R00S 1C2023 09 07.19595621 20 51.890-10 33 17.60          20.42GV~79PRG96
K23R00S 1C2023 09 07.26776821 18 58.586-10 15 41.44          19.68GV~79PRG96
K23R00S 1C2023 09 07.26818321 18 57.776-10 15 33.08          19.97GV~79PRG96
K23R00S 1C2023 09 07.26859821 18 56.992-10 15 25.52          19.78GV~79PRG96
K23R00S 1C2023 09 07.26901221 18 56.221-10 15 17.78          19.66GV~79PRG96
K23R00S 1C2023 09 07.27174421 18 50.972-10 14 25.58          19.57GV~79PRG96
K23R00S 1C2023 09 07.27190421 18 50.666-10 14 22.42          19.70GV~79PRG96
K23R00S 1C2023 09 07.27206521 18 50.335-10 14 19.36          19.76GV~79PRG96
K23R00S 1C2023 09 07.27222621 18 50.022-10 14 16.08          19.75GV~79PRG96
```

ADES was introduced with the goal of standardizing the exchange and storage of astrometric data.

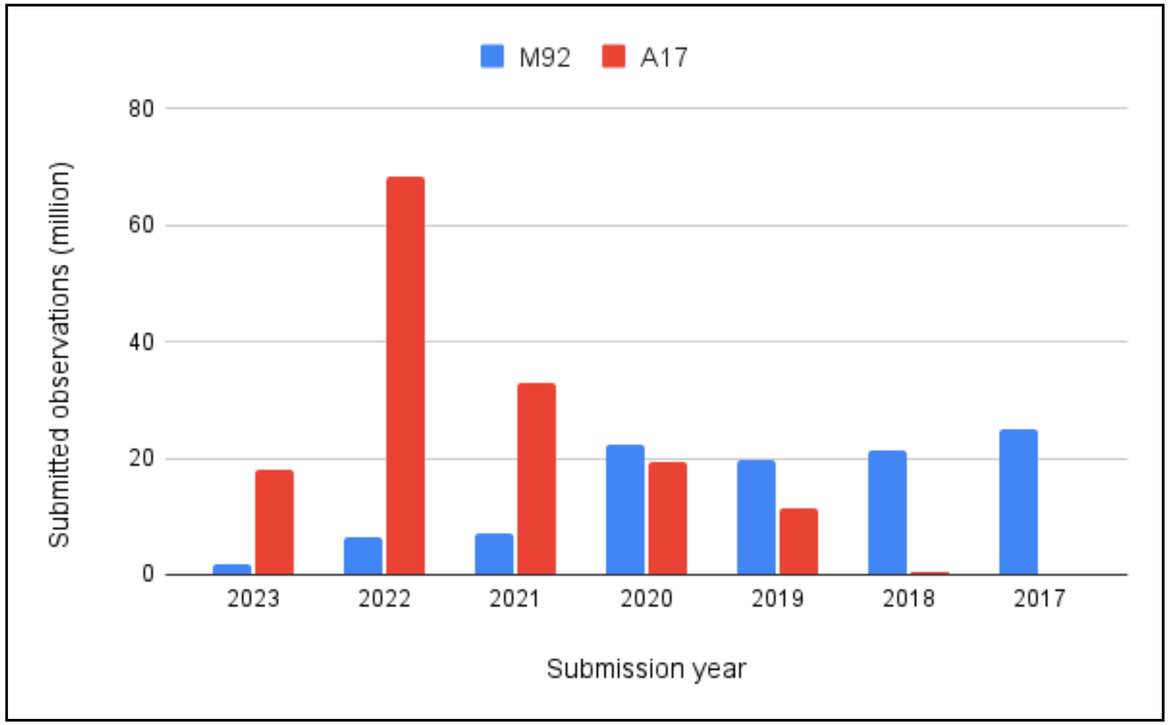
```
▼<ades version="2017">
  ▼<optical>
     <trkSub>A10XDtL</trkSub>
     <obsID>Leq9coBj0000Fua0010000001</obsID>
     <trkID>00000HXDL9</trkID>
     <mode>CCD</mode>
     <stn>W68</stn>
     <obsTime>2023-10-22T06:00:58.97Z</obsTime>
     <ra>24.287870</ra>
     <dec>-62.601300</dec>
     <rmsRA>1.017</rmsRA>
     <rmsDec>0.713</rmsDec>
     <rmsCorr>0.105</rmsCorr>
     <astCat>Gaia2</astCat>
     <mag>19.02</mag>
     <rmsMag>0.163</rmsMag>
     <band>Ao</band>
     <logSNR>0.788</logSNR>
     <subFmt>A17</subFmt>
     <remarks>atlas_W68/T2939279/D215382570</remarks>
   </optical>
```

Formats

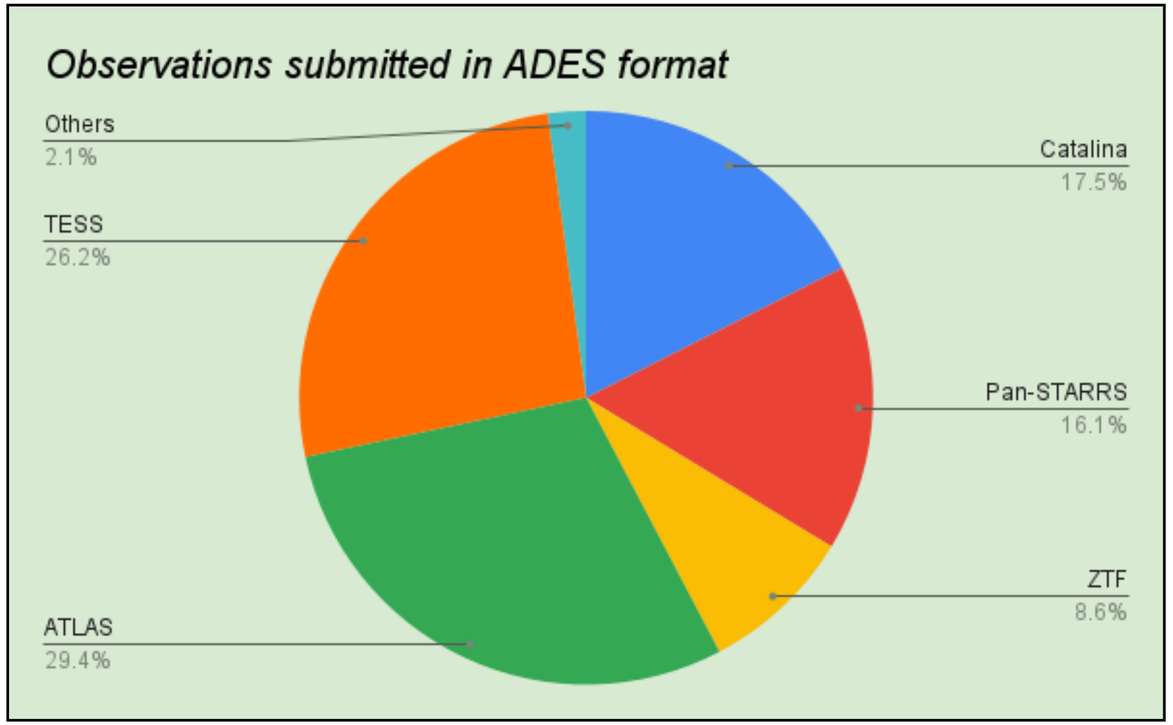
The International Astronomical Union Minor Planet Center

Majority of observations are now submitted using the ADES format

- All the major surveys are submitting observations using ADES
- Small part of the community is still using the obs80 format

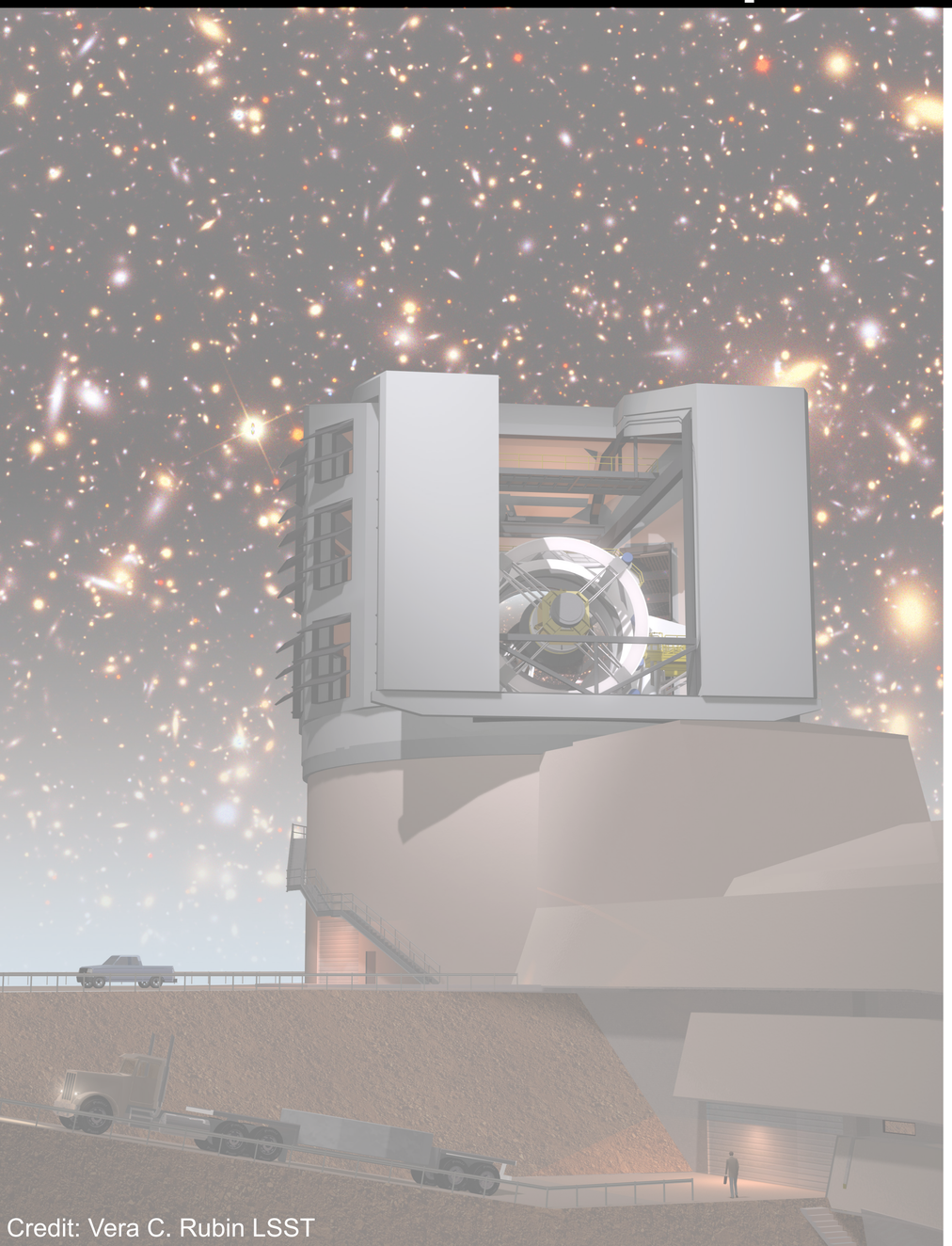


https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Aug2023.pdf



https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Aug2023.pdf

New extended packed provID



Credit: Vera C. Rubin LSST

What is a provisional designation?

The Minor Planet Center assigns new **provisional designations** when a new object is discovered.

The provisional designation can come in the standard, unpacked format (e.g. *2023 AB11*) or the *packed* (e.g. *K23A11B*) equivalent.

The format originally chosen for the packed provisional designation is limited to supporting only **15,500 new designations per half month.**

It is estimated that LSST will discover approximately **250,000 objects** during its most productive months

New extended packed provID

The International Astronomical Union Minor Planet Center

New definition of extended packed provisional designation

The first column MUST contain an underscore '_'

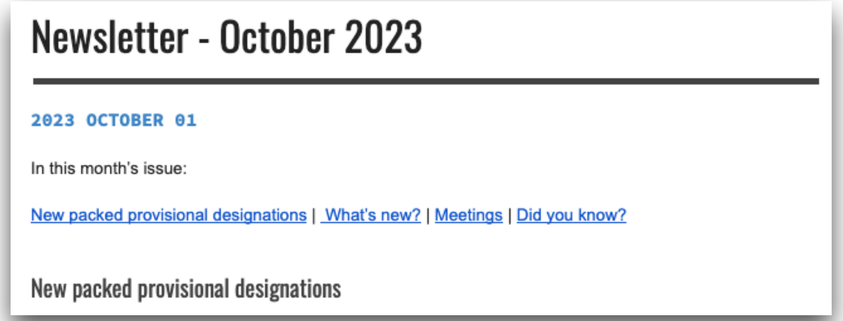
The character in the second column must be a capital letter, indicating the last two digits of the year of discovery (e.g. P=25, Q=26, …)

The third character is the capital letter for the half month

Columns from four to seven will contain four alphanumeric character [0-9A-Za-z] used as base62 representation of the order of designation after 15,500

The new extended packed provisional designation **WILL NOT** be used before June 2024.

Year	Half month	Order of designation within half month	Unpacked provisional designation	Packed provisional designation
2023	B	0	2023 BA	K23B00A
2025	D	15500	2025 DZ619	K25Dz9Z
2025	D	15501	2025 DA620	_PD0000
2026	D	15524	2026 DY620	_QD000N


Newsletter - October 2023

2023 OCTOBER 01

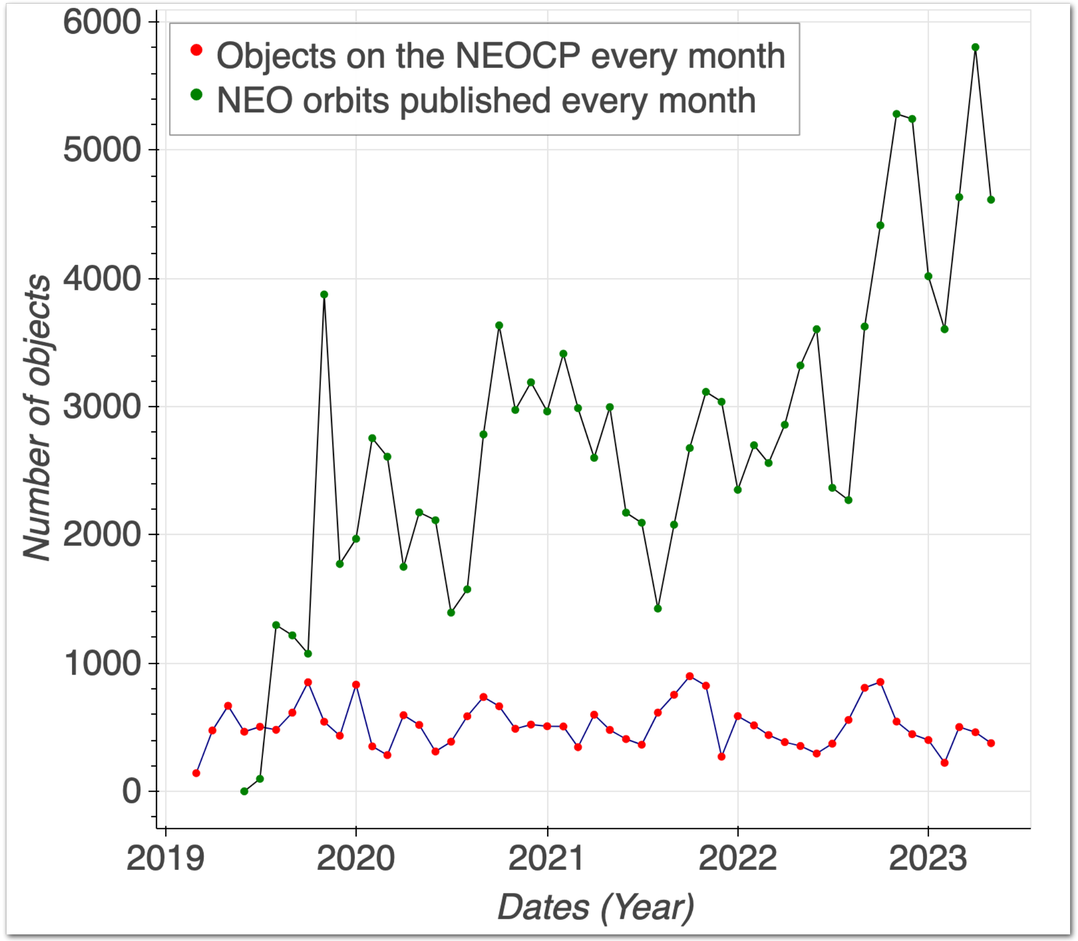
In this month's issue:

New packed provisional designations | What's new? | Meetings | Did you know?

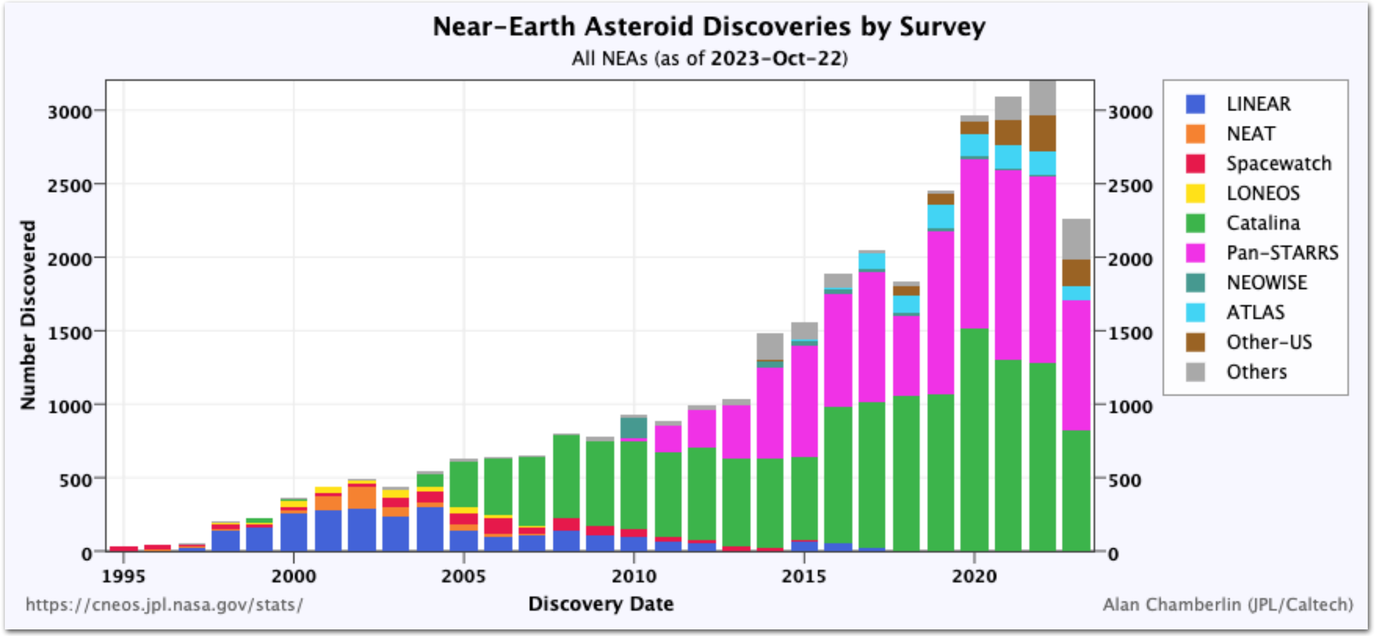
New packed provisional designations

https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Oct2023.pdf

Orbits



Over 1.3 M cataloged objects
Over 33K NEAs
Over 2K NEAs in 2023

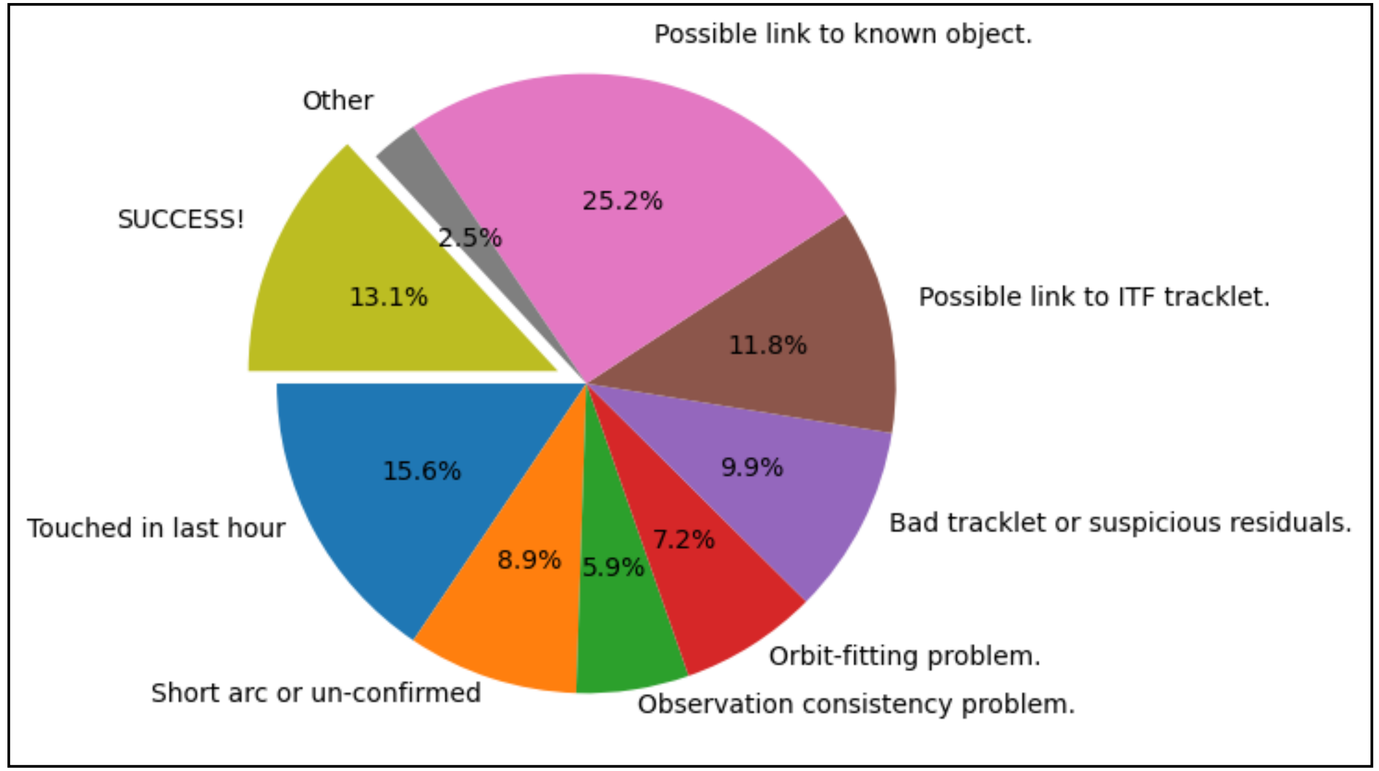


NEOCP Automated Processing

The International Astronomical Union Minor Planet Center

Automated processing for removing objects from the NEOCP

- The code runs every 10 minutes, but only attempts to process objects with new measurements in the last 10 minutes
- Does *not* automatically publish close-approachers / impactors



WIP to increase automation, handle increasingly complex cases, and decrease the average time-to-MPEC

- Excluding false links
- Include shorter arcs

Replicated tables

Many tables of data are available to replicate from the MPC's postgres database via the Small Bodies Node

Postgres mpc_sbn:

Table	Count	Created_at	Updated_at
neocp_els	113	2023-10-22 05:34:16.988429	2023-10-23 02:29:21.877811
neocp_events	202730	2023-10-23 02:29:24.453937	2023-10-23 02:29:24.453937
neocp_obs_archive	523081	2023-10-23 02:29:21.876256	2023-10-23 02:29:21.876256
neocp_obs	1248	2023-10-23 02:29:21.871615	2023-10-23 02:29:21.871615
neocp_prev_des	56579	2023-10-22 22:10:43.665944	2023-10-22 22:10:43.665944
neocp_var	220545	2023-10-23 02:29:24.427542	2023-10-23 02:29:24.427542
current_identifications	1848059	2023-10-23 01:34:46.097918	2023-10-23 01:35:30.449734
numbered_identifications	629776	2023-09-28 14:11:21.420171	2023-09-28 14:11:21.420171
primary_objects	1375969	2023-10-23 01:34:46.08503	2023-10-23 01:34:46.08503
obs_sbn	415939717	2021-12-08 07:21:05.857242-05	2023-10-22 22:40:31.824084-04
obs_alterations_deletions	909256	2023-10-22 16:46:17.476013	2023-10-22 16:46:17.476013
obs_alterations_redesignations	2730	2023-10-13 18:23:23.071906	2023-10-13 18:23:23.071906
obs_alterations_unassociations	44303	2023-10-23 01:21:23.250712	2023-10-23 01:21:23.250712
mpc_orbits	1315007	2021-02-04 02:24:14.325311	2023-10-23 02:40:50.449828

No change to Postgres mpc_sbn database structure
YYYY-MM-DD - latest record is older than 3 days
YYYY-MM-DD - latest record is older than 1 day
YYYY-MM-DD - latest record is less than 1 day old

NEOCP related tables

Identifications

Observations & Orbits

WIP: Various tables of metadata & standardized data products are being added on an ongoing basis

New services and APIs

The International Astronomical Union Minor Planet Center

Newly Developed Services

OBSERVERS | DATA | NEW | CONTACT | STATUS

- Developments
- Existing Upgrades
- Newsletters

What's New?

New Developments

This page lists new services that are in development at the MPC (alpha, beta) that are in the testing phase.

(Beta) Where Are My Observations (WAMO) API

The WAMO API extends the functionality of the WAMO page, while preserving the original service. This page describes how to use the new API. https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Oct2023.pdf

Last Updated 2023-10-01

(Beta) MPC Database Tables Schema

- Further guidance on the MPC database tables

Last Updated 2023-05-31

(Beta) Orbit Comparison Tool for NEOs

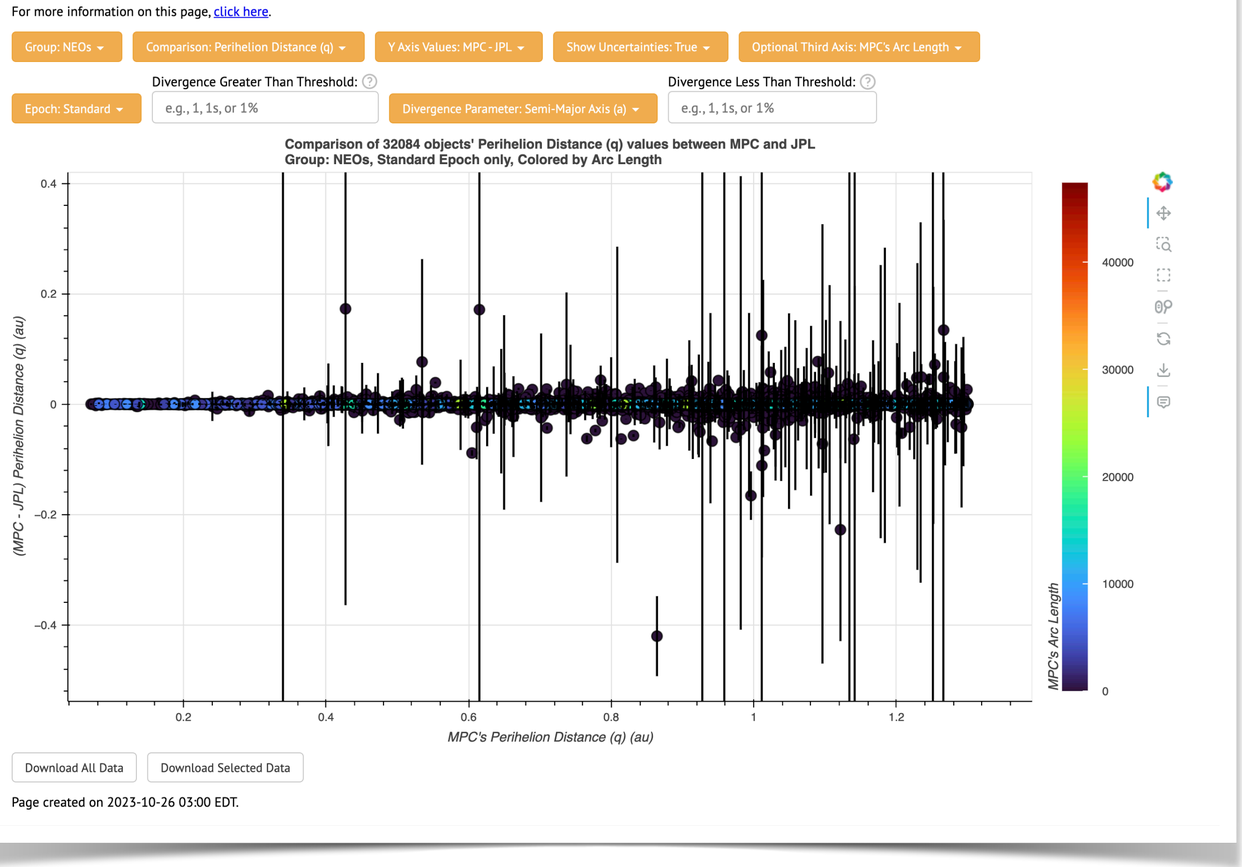
This tool allows you to compare the orbital parameters that are present in MPC's MPCORB.DAT files with JPL's values for the same objects.

Last Updated 2023-04-28

(Beta) Summary of Where Are My Observations - SWAMO

SWAMO lets you explore the outcomes of all submissions over the MPC's history at a month-level granularity, and the SWAMO-R dashboard lets you explore the outcomes of the past six months worth of submissions at a day-level granularity. https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Apr2023.pdf

Orbit comparison tool



https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_May2023.pdf

https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Jul2023.pdf

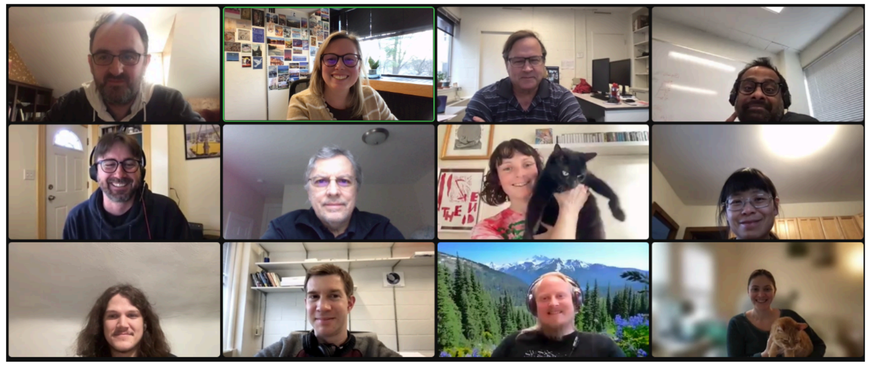
https://minorplanetcenter.net/media/newsletters/MPC_Newsletter_Oct2023.pdf

Restructuring the website

The International Astronomical Union
Minor Planet Center

Welcome!

To the new MPC guide. We need your feedback to ensure that this is a useful and welcoming resource. Please use Jira Helpdesk to send us your feedback and suggestions. If you want to contact the MPC, please follow these instructions.



The Minor Planet Center (MPC) is the single worldwide location for receipt and distribution of positional measurements of minor planets, comets and outer irregular natural satellites of the major planets. The MPC is responsible for the identification, designation and orbit computation for all of these objects. This involves maintaining the master files of observations and orbits, keeping track of the discoverer of each object, and announcing discoveries to the rest of the world via electronic circulars and an extensive website. The MPC operates at the Smithsonian Astrophysical Observatory, under the auspices of Division F of the International Astronomical Union (IAU). All of the MPC's operating funds come from a NASA Near-Earth Object Observations program grant.

localhost:8000/mpcops/mpc_guide/

Implemented locally

Featured guides:

Data/Publications	MPC Services	Jira Helpdesk

Documentation and latest MPC news:

Documentation	Newsletter	Contact Us

Restructuring the website

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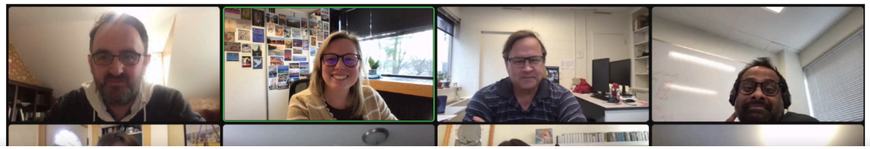


localhost:8000/mpcops/mpc_guide/

Implemented locally

MPC Services and Tools

The MPC develops and maintains a variety of different services and tools that should help amateur astronomers and more expert users to plan their observations or to retrieve the data they need.

Main MPC Services:

- **NEO Confirmation Page (NEOCP)** - Ephemerides for newly-discovered possible new objects +
- **Possible Comet Confirmation Page (PCCP)** - Ephemerides for newly-discovered possible comets +
- **Search in the MPC database (DB search)** - Observations and orbits for a single object +
- **Ephemeris Service (MPES)** - Ephemerides for asteroids and comets +
- **Minor Planet Checker (MPChecker)** - List of known objects in a specified region +
- **Recovery Page** - Recovery Page for NEOs and TNOs +

Documentation and latest MPC news:

Documentation	Newsletter	Contact Us

How are we getting ready?

SOFTWARE

- **Migrating towards a database-centric system**
- **Migrate towards the use of new systems, such as AWS, Docker, RabbitMQ, NGINX, …**
  - Both for receipt and processing
- **All the new software is under version control** (GitHub)
  - Continuous integration tests
  - We are importing the legacy code under GitHub as well
- **Constantly validate to ensure quality control of data products**

How are we getting ready?

OrbFit Docker Image

minorplanetcenter / **orbfit**

Description

This repository does not have a description

Last pushed: 3 days ago

Docker commands

To push a new tag to this repository:

Public View

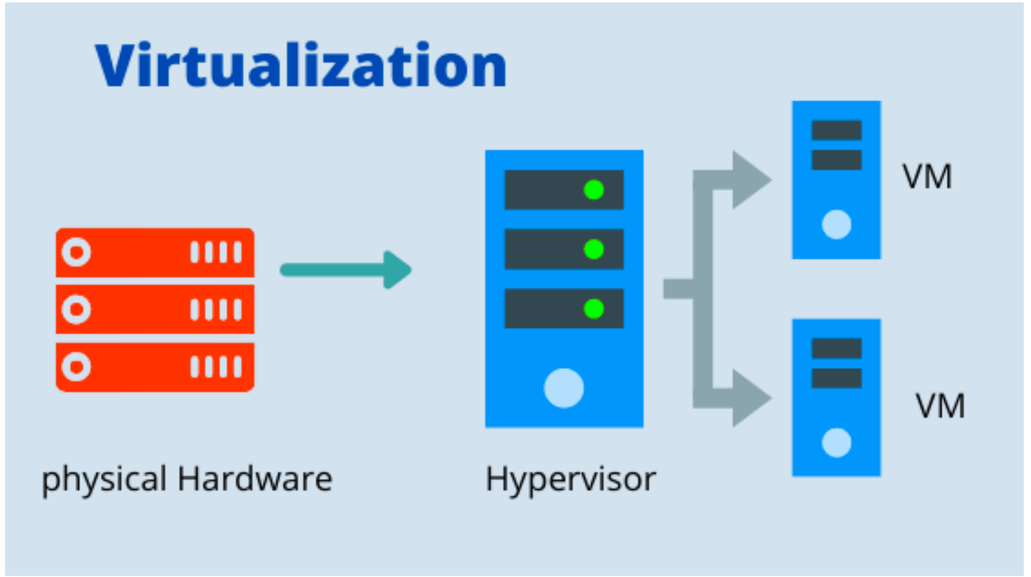
```
docker push minorplanetcenter/orbfit:tagname
```

- **The image is generated and pushed via GitHub workflow:**
  - The container is updated every time the repository is updated (branch is merged)
  - OrbFit now includes unit tests that are run before creating and pushing the image
  - The code is exactly the same one available at the MPC - we are also working towards making it available via GitHub
  - We are already using this image internally when developing the new processing pipelines

How are we getting ready?

HARDWARE

- **Moving towards Virtualization**
  - Efficient resource use
  - Automated IT management
  - ☆ **Faster disaster recovery**



Requests

The International Astronomical Union Minor Planet Center

Communications

1. Please report problems in a timely manner via Jira: it really helps us to find and fix problems.

2. If you have any questions/suggestions, we always happy to hear them.
   You can also send your suggestions to **MPC User-Group members** (https://pdssbn.astro.umd.edu/about/comment_form_MPC.shtml)

3. Please take a look at our Newsletter.

Data

1. Please submit observations in the ADES format: it allows for the communication of richer data, including observation uncertainties.

2. Please try to follow the “Community best practices” that will be described in Davide Farnoccia’s talk later today:
   E.g.
   1. Accurately calibrate exposure times.
   2. Do not reuse exposures when stacking
   3. Report photometry
   4. Use ADES and report uncertainties
   5. Ask the MPC for an obs-code if you need one