



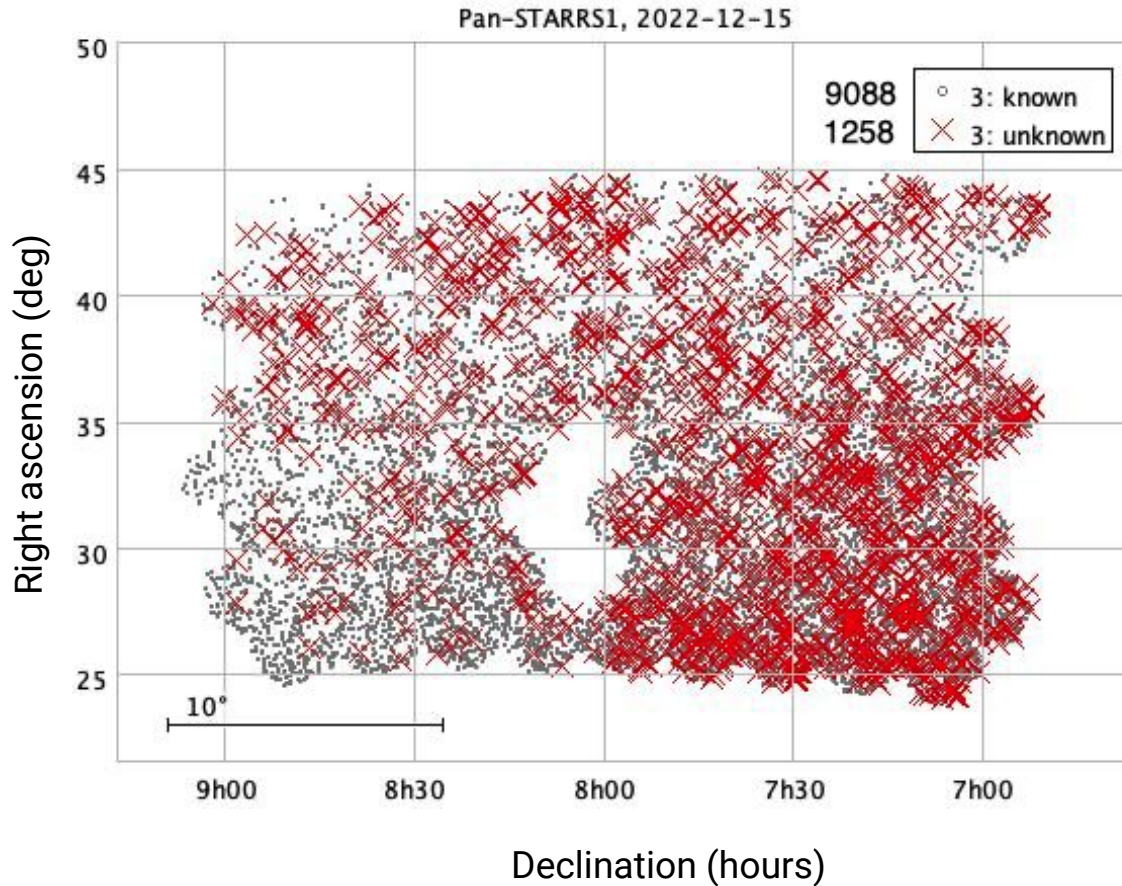
# Updated digest2

-

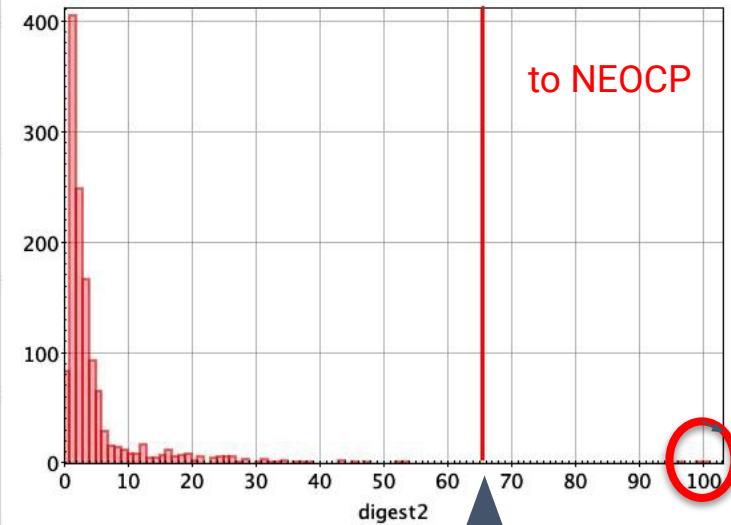
# NEO classification code

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# NEO discovery process



## NEO digest2 score



threshold > 65

# What is digest2

- Gives score **0 - 100** for each tracklet, quasi-probability for a given population (NEO, MBA, Hildas, Trojans, ....)
- Creates Sun-bound variant orbits (q,e,i,H)
- Weights the number of orbits with respect to a synthetic Solar System (Raw Score) or undiscovered part of the Solar System (NOID)
- Great-circle fit RMS
- Runs on multiple-cores
- Same code running and MPC and the community
- Publication: [Keys et al., 2019, PASP 131](#)

# Digest2 responsible for flagging NEOs since 2006

31,500 NEOs

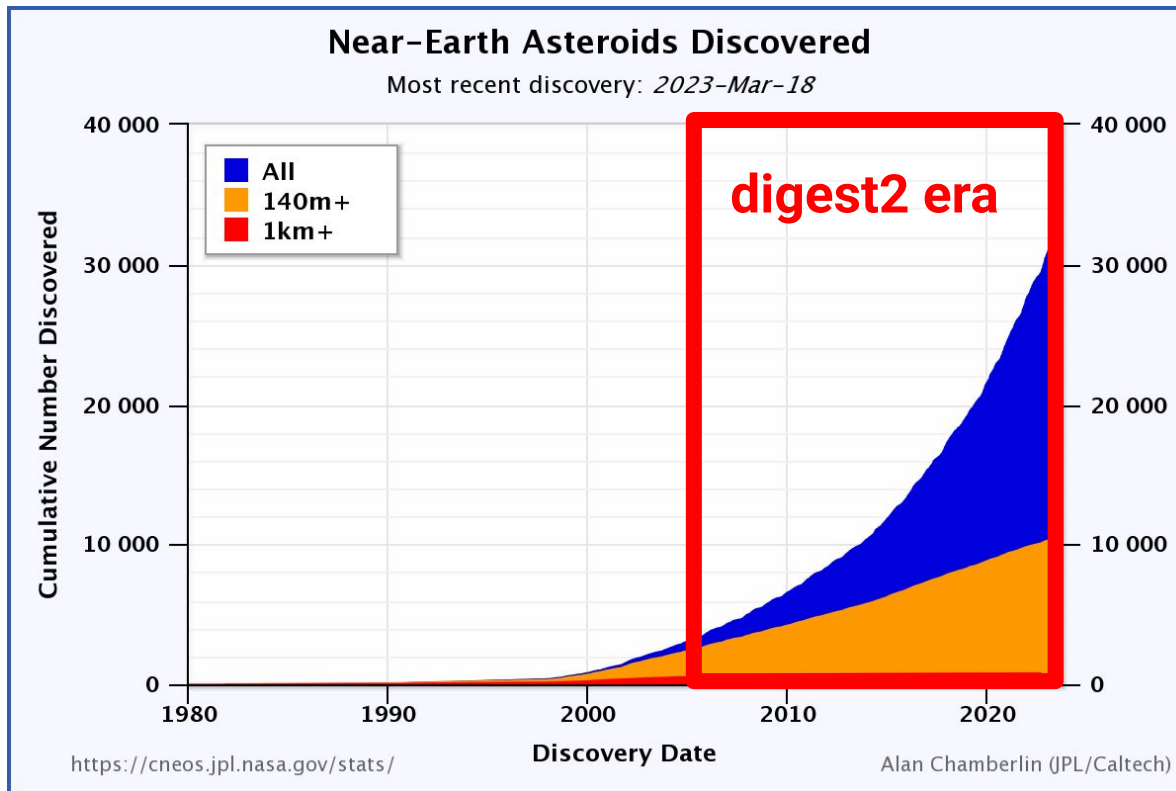


Image source: CNEOS, JPL

# Improved population model, astrometric uncertainties (1)

**NOID Score:** depends on the undiscovered population  
(model - MPCORB)

Updates: 2015: 700,000

2021: 1 million

**now : 1.25 million**

Dithering of tracklet end-points: tracklet's observatory code

**Updated list of uncertainties:** 134 obscodes (was 35)

# The Astrometry Data Exchange Standard (ADES) (2)

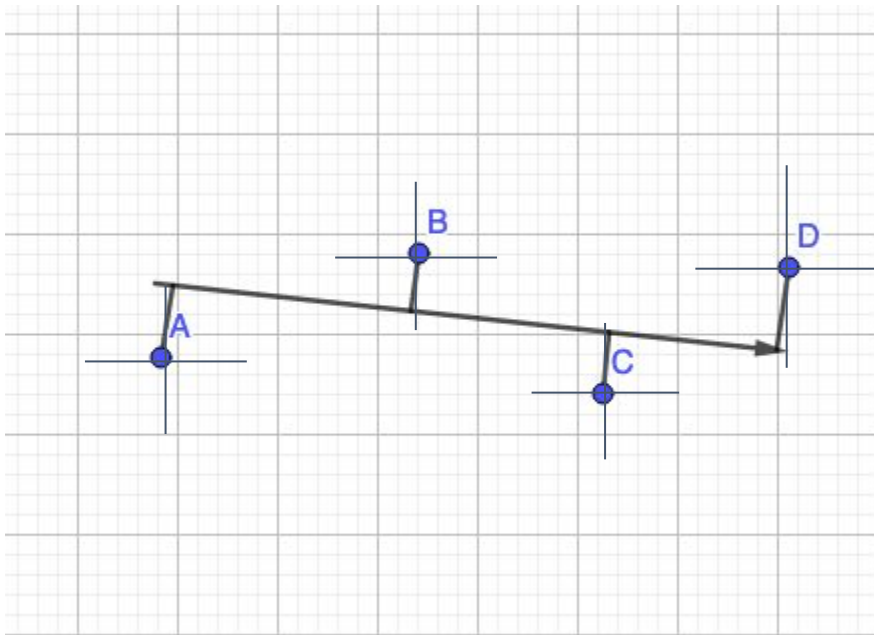
C88LQ02	1C2022	10	26.31536003	06	26.176+15	57	49.75	22.33GV	G96
C88LQ02	1C2022	10	26.32062103	06	25.942+15	57	49.90	21.77GV	G96
C88LQ02	1C2022	10	26.32588503	06	25.628+15	57	50.58	21.54GV	G96
C88LQ02	1C2022	10	26.33116703	06	25.348+15	57	50.18	21.63GV	G96

**MPC1992  
(80-column  
ASCII)**

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</optical>
</ades>
```

## ADES XML

# Curvature within a tracklet



short-arc motion vector along great-circle

residuals  $\leftrightarrow$  normally distributed uncertainties

**GCR's RMS** (RMS of residuals)

UNLESS

uncertainties are over/underestimated

Motion is NOT following great-circle (curved)

- **Compute RMS'** (reported unc.)

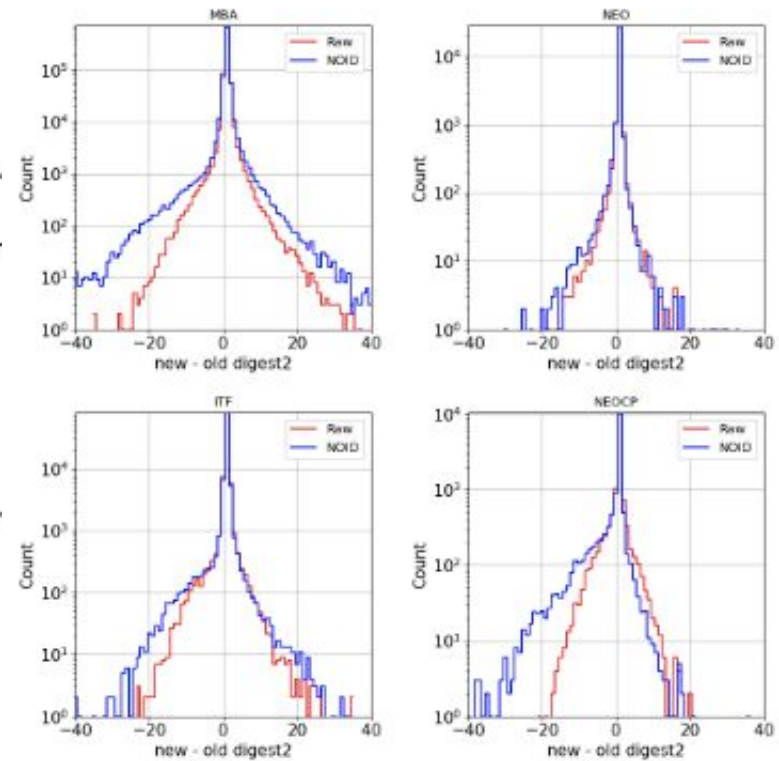
$$RMS' = \sqrt{\frac{\sum \Delta\alpha_i^2 + \Delta\delta_i^2}{N}}$$

if  $RMS > 2RMS'$  : curvature

# Data and code verification

- True-positive and false-negative identification
- Improvements

Type	Tracklets	Observations	Date-range
known NEOs	30,829	110,989	2020/01/01-2023/01/01
known MBAs	873,239	3,430,460	2020/01/01-2023/01/01
ITF	97,693	373,202	2020/01/01-2023/01/01
NEOCP	22,100*	83,125*	2019/02/26-2023/02/19





# Outcomes and recommendations

- Accurate values for individual measurements for uncertainties (ADES)
- Better weighting of NOID score
- Finding nearby low-digest2 NEOs by their in-tracklet curvature
- Community: please start submitting ADES
- TODO: coordinated MPC/community implementation
- TODO: improve digest2 update frequency
- TODO: explore other orbit classes identification
- TODO: along and cross-track acceleration in a tracklet

# digest2 resources

## **Code availability:**

<https://github.com/Smithsonian/digest2>

## **NEO Confirmation Page:**

[https://www.minorplanetcenter.net/iau/NEO/toconfirm\\_tabular.html](https://www.minorplanetcenter.net/iau/NEO/toconfirm_tabular.html)

## **Minor Planet Center:**

<https://minorplanetcenter.net>