

DETECTION AND IDENTIFICATION OF SERENDIPITOUSLY OBSERVED NEAR-EARTH OBJECTS

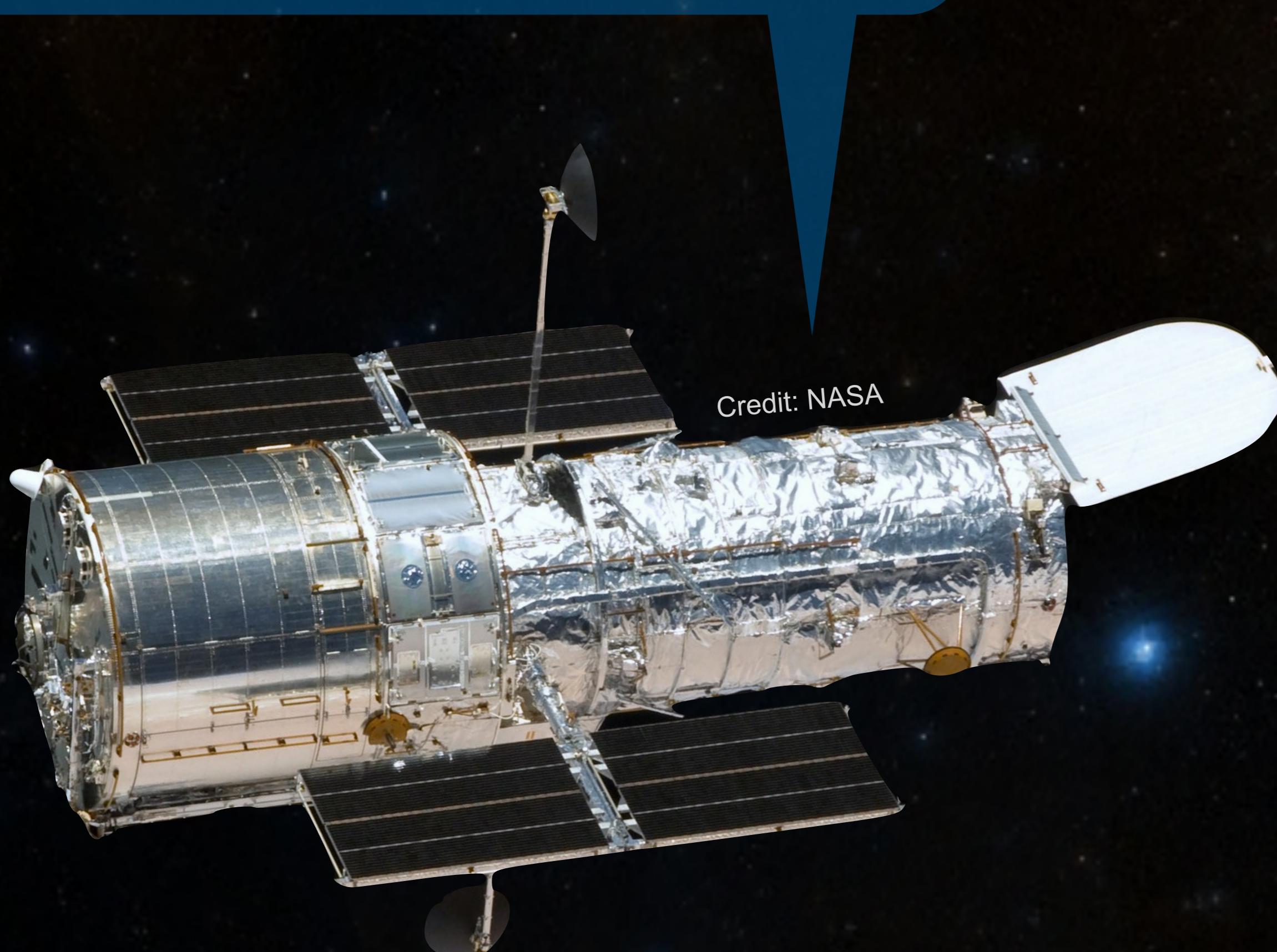
IN IMAGES OF THE HUBBLE SPACE TELESCOPE...

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1. TREASURE TROVE

In its 29-year operational lifetime so far, the Hubble Space Telescope has acquired more than 1.3 million observations in near-infrared and optical wavelengths.

We aim to identify serendipitously observed Near Earth Objects and Mars Crossers hidden in the images and recover their positions. The high precision astrometry helps us in confining their orbits, study their origins and assessing impact threats.



6. GET IN TOUCH

If you're interested in looking for Solar System Objects in images of the Hubble Space Telescope in upcoming Zooniverse project, or if you have images which you would like to search for asteroids, you can send me an email by scanning the QR code below.

2. NEEDLE IN THE HAYSTACK

The large number of observations makes a complete search of all images unfeasible. Using a cross-matching tool developed by *ESASky* and the *IMCCE*, we compared the predicted positions of 36,000 NEOs and Mars Crossers at the observation epoch with the coordinates of the 1.3 million HST observations.

We found 11,443 potential observations of 806 NEOs and 445 Mars Crossers within a cross-match radius of 1 degree. The actual number of observations is lower due to orbital uncertainties of the asteroids and the limiting magnitudes of the observations.

3. HUBBLE'S HUNT FOR ASTEROIDS

So far, we have recovered 155 positions of 29 NEOs and 18 Mars Crossers observed by chance by the Hubble Space Telescope, including 4 potentially hazardous objects.

We are now extending the search to all minor planets using a Zooniverse project. This includes more than 165,000 potential observations of 14,000 objects. A first version including observations of the Wide Field Camera 3 and the Advanced Camera for Surveys will soon be online.

... AND GROUND-BASED OBSERVATORIES

4. HIDDEN OBSERVATIONS

Astronomical archives are full of serendipitously observed minor planets, containing valuable astrometric and photometric measurements. These reservoirs are often untapped due to the lack of a dedicated recovery pipeline.

We developed the `ssos` pipeline to detect and measure serendipitously observed Solar System Objects in astronomical images - both known and unknown objects. It is based on the well-known SExtractor and SCAMP software suites, with a chain of filter algorithms written in python. Asteroids are detected by evaluating the apparent motion of all sources in the images.

5. A VERSATILE TOOL

Applying the ssos pipeline to public surveys, we have gathered over 70,000 observations of minor planets, with about 12,000 positions of unknown objects. These minor planets were detected in images acquired with ESO/VISTA, UKIRT/WFCAM, GTC/OSIRIS, and OAJ/T80Cam. A proof-of-concept was done for Subaru/HSC.

With each application, we are improving the ssos pipeline and forming it into a versatile template minor planet detection tool for all astronomical imaging campaigns. You can have a look at ssos at ssos.readthedocs.io



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