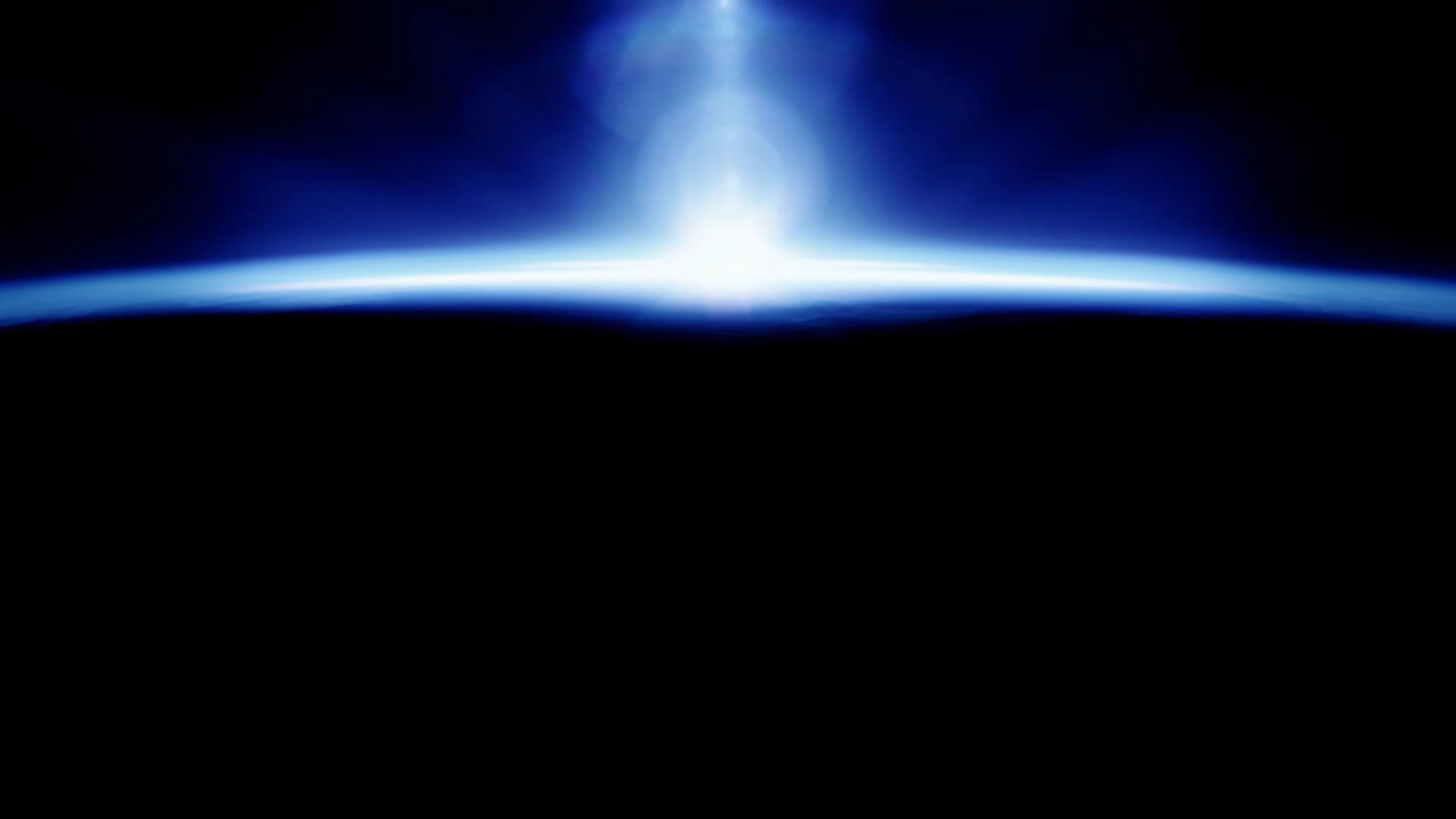
Near Earth Objects

Roxy Vabrey
Dr. Nahum Melamed

November 2025



Aligned to the National Interest

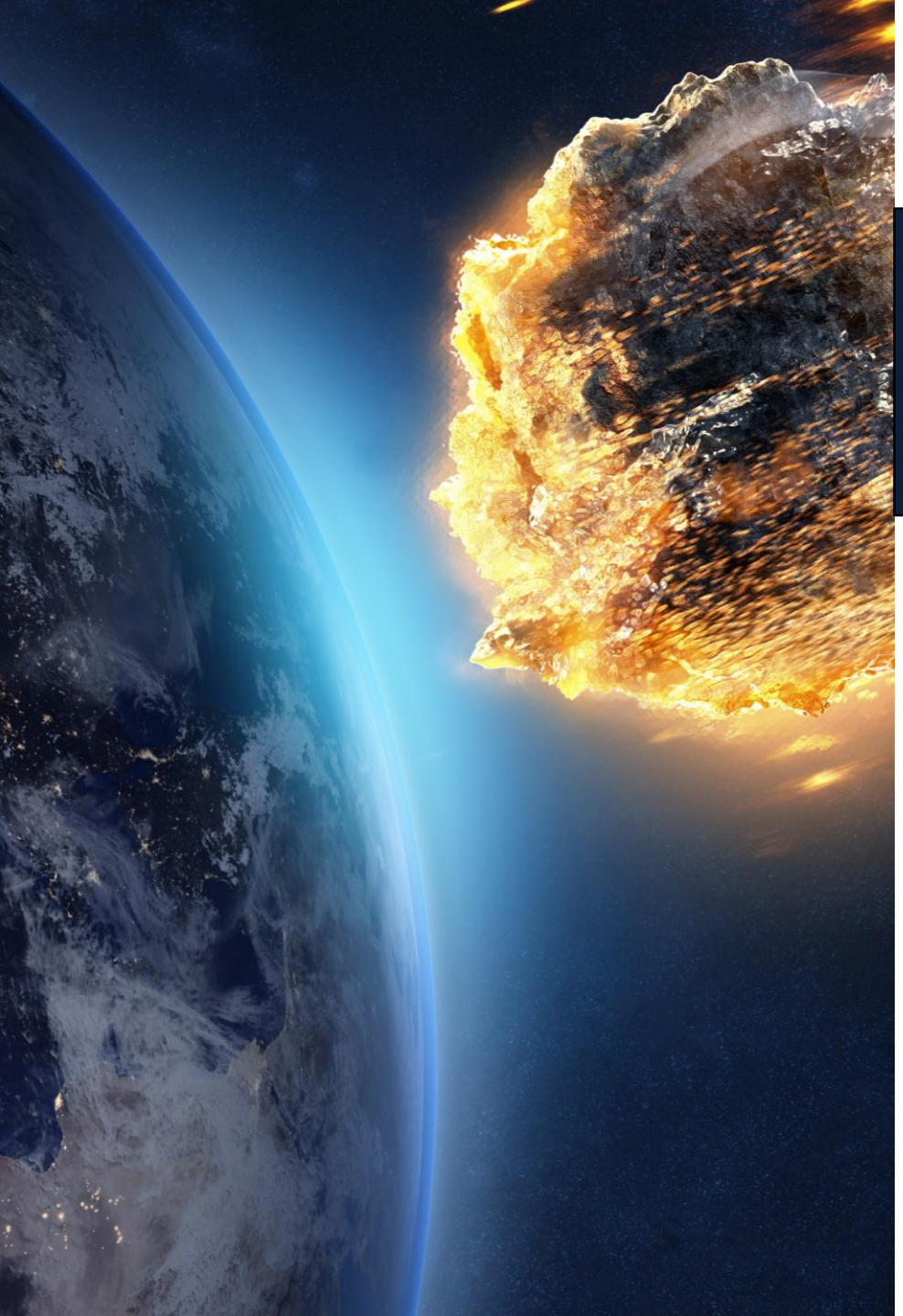
OUR VISION

The nation's trusted partner, solving the hardest problems for the preeminent space enterprise.

OUR VALUES

- Dedication to Mission Success
- Technical Excellence
- Commitment to Our People
- Objectivity and Integrity
- Innovation

Photo: Lockheed Martin



Near Earth Objects

Dr. Nahum Melamed

Project Leader: Guidance, Navigation, and Control Engineering

Planetary Defender!

Near Earth Object Review

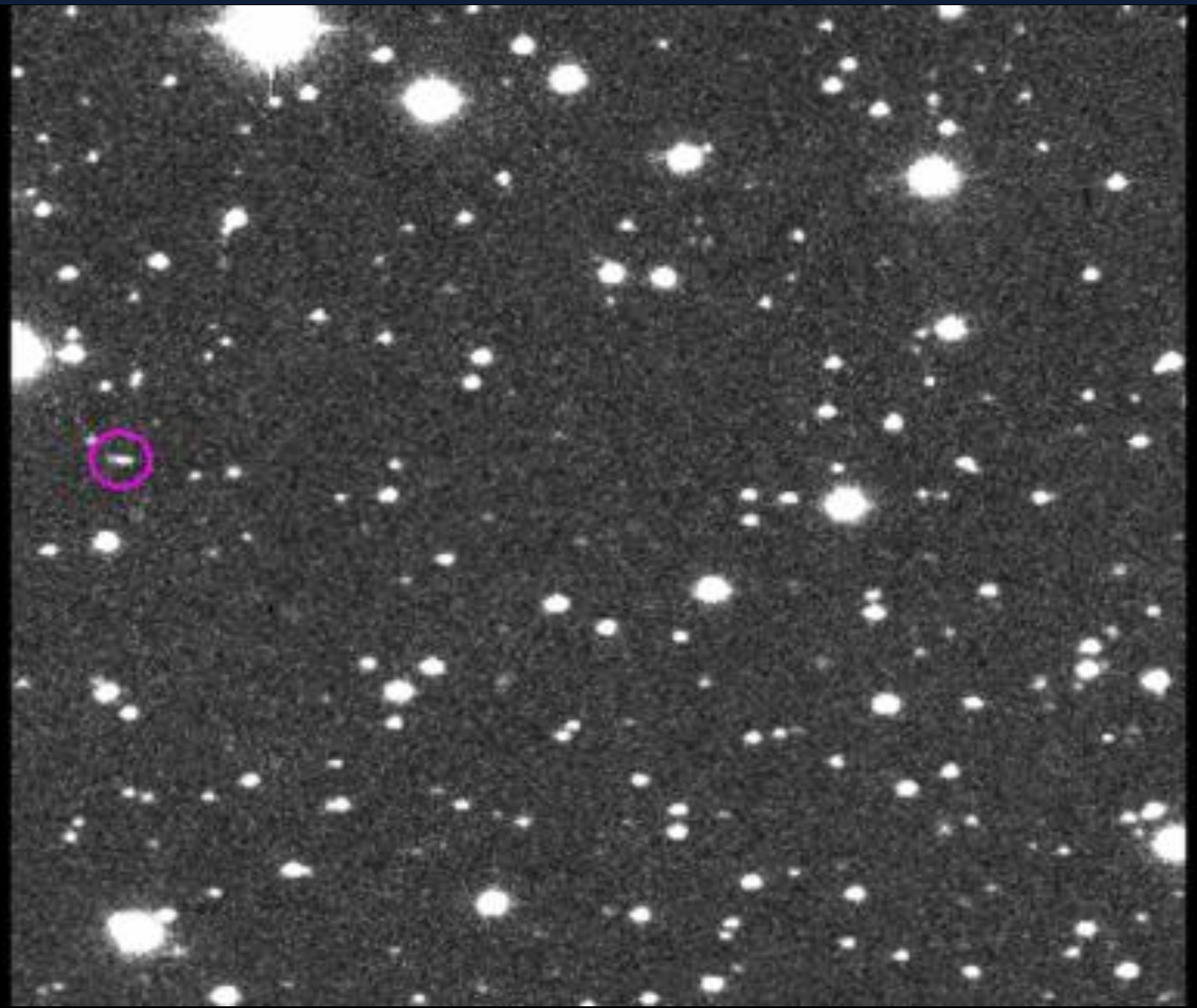
How was the Solar System Formed?

Near Earth Object Review

What are NEO’s and how are they formed?

Discovery of Asteroids

How do we find Asteroids?

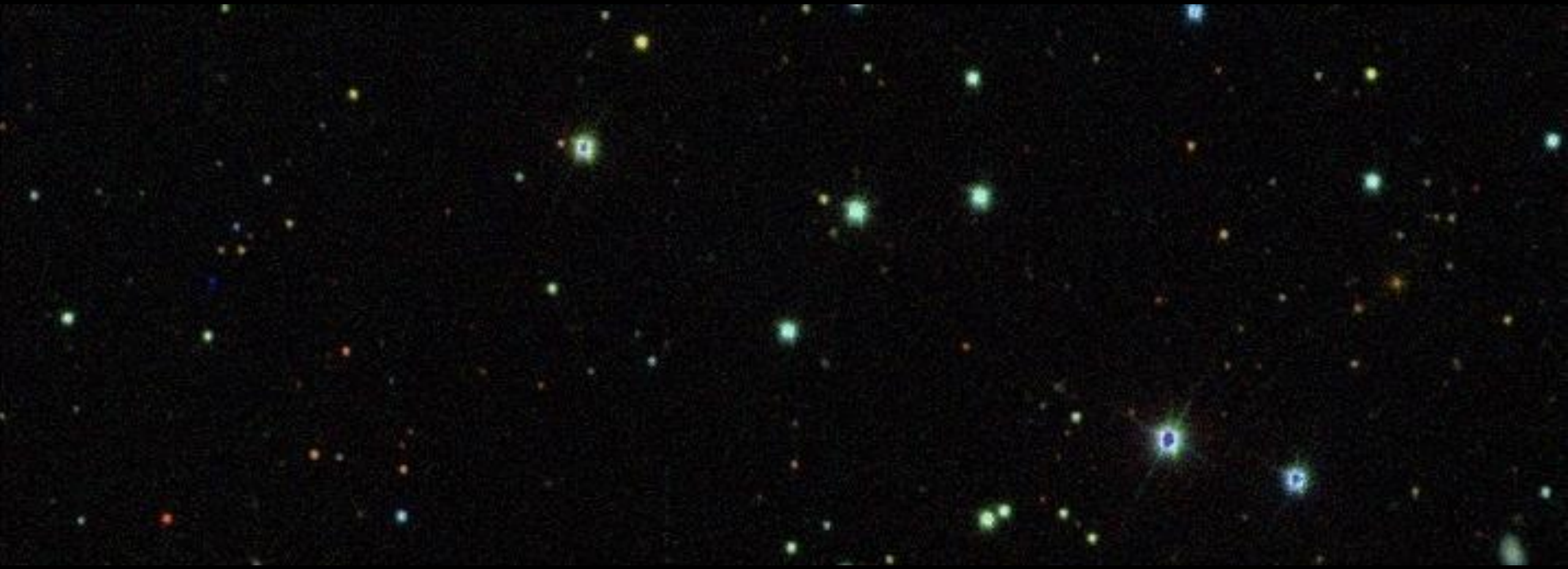


https://www.jpl.nasa.gov/spaceimages/details.php?id=PIA21712

Image credits:
NASA/JPL

Discovery of Asteroids

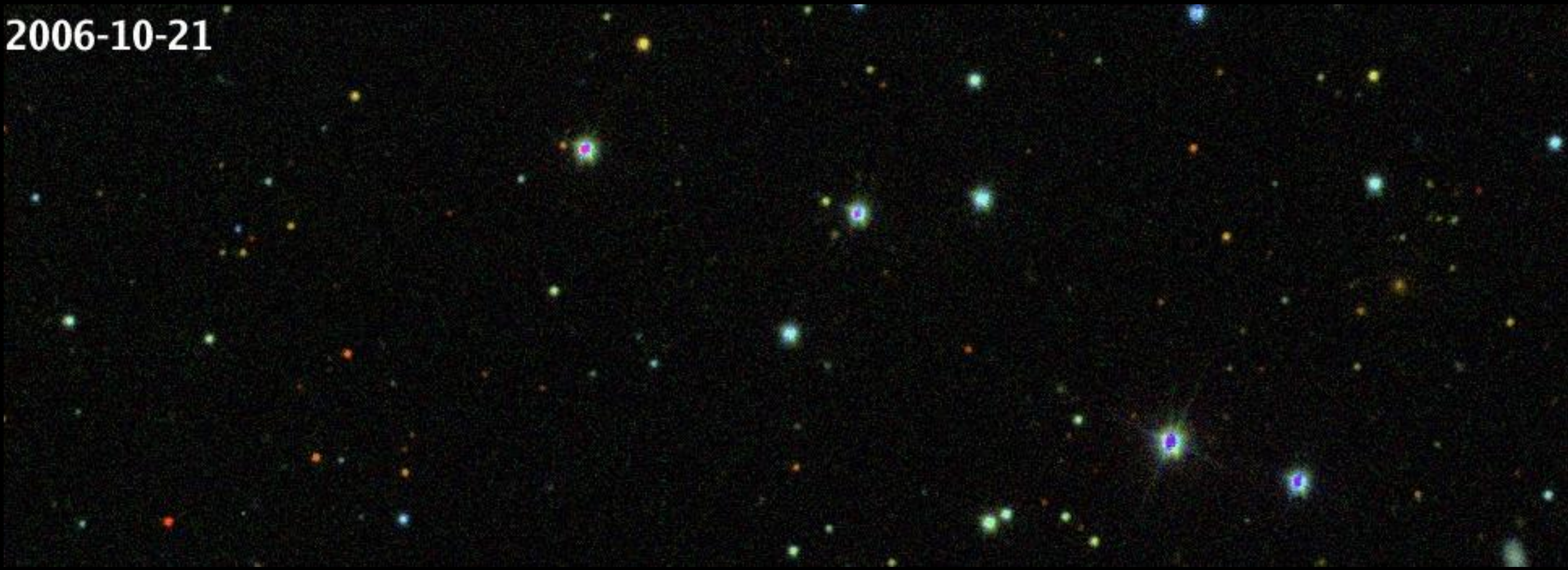
Asteroid 2006 SQ372



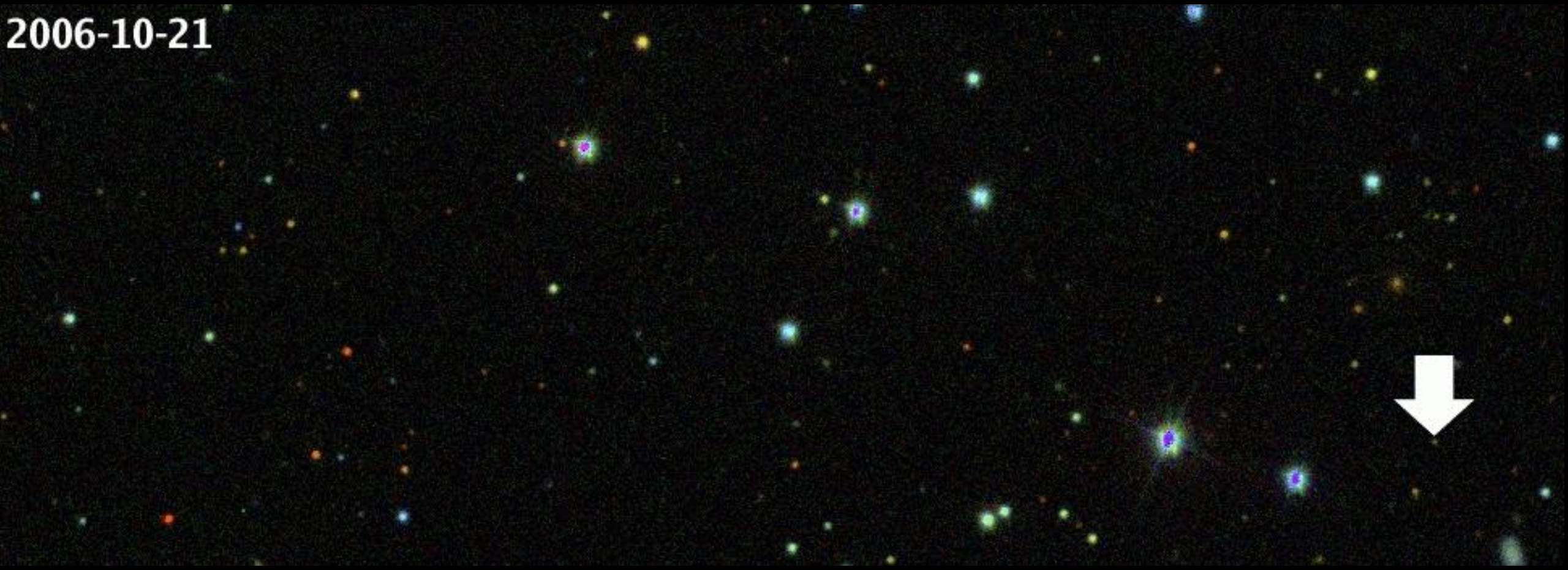
http://www.astronomy.ohio-state.edu/~dhw/SDSS08/sq372_discovery_anim.gif

Discovery of Asteroids

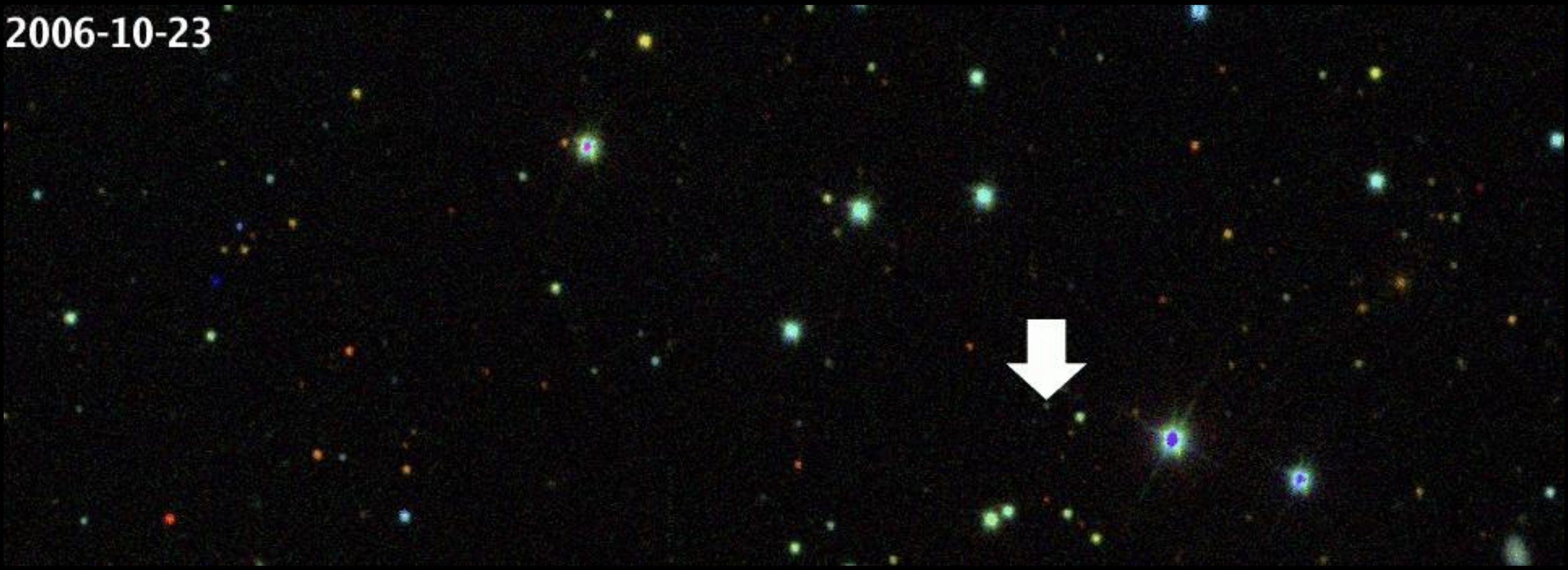
Asteroid 2006 SQ372: An ice-rock minor planet 30 to 60 miles in diameter, discovered in 2006 between the orbits of Uranus and Neptune



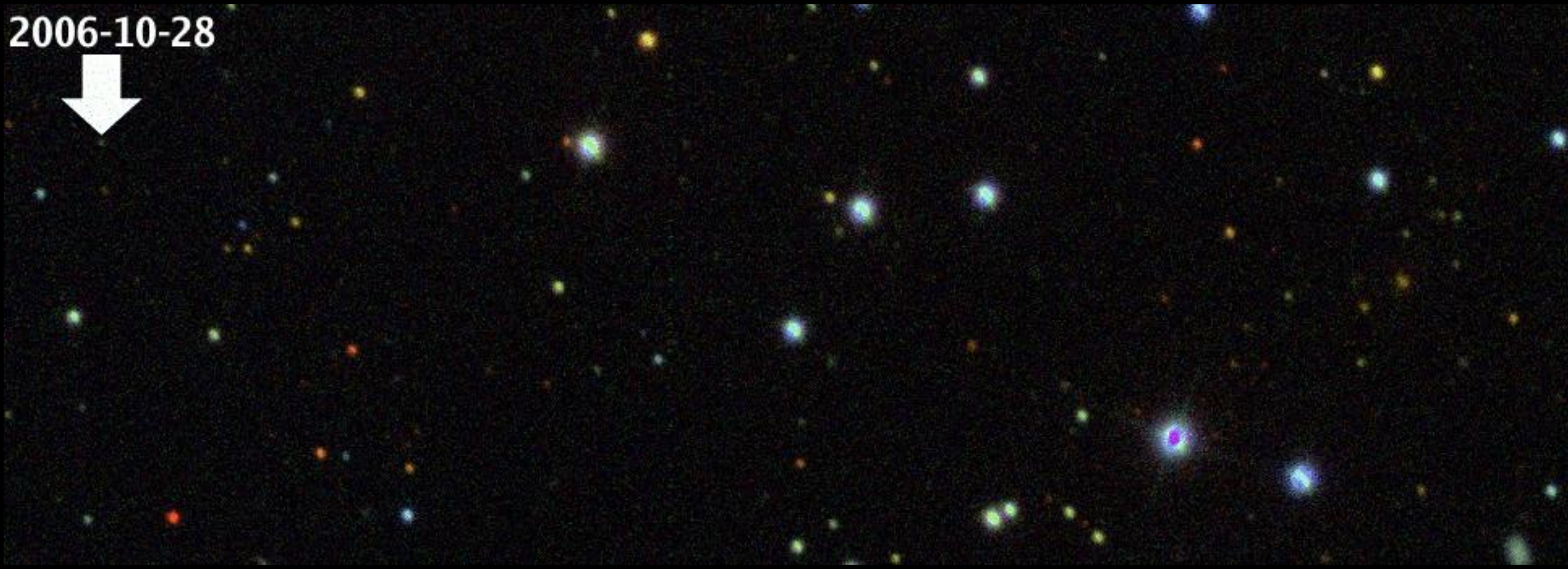
Discovery of Asteroids



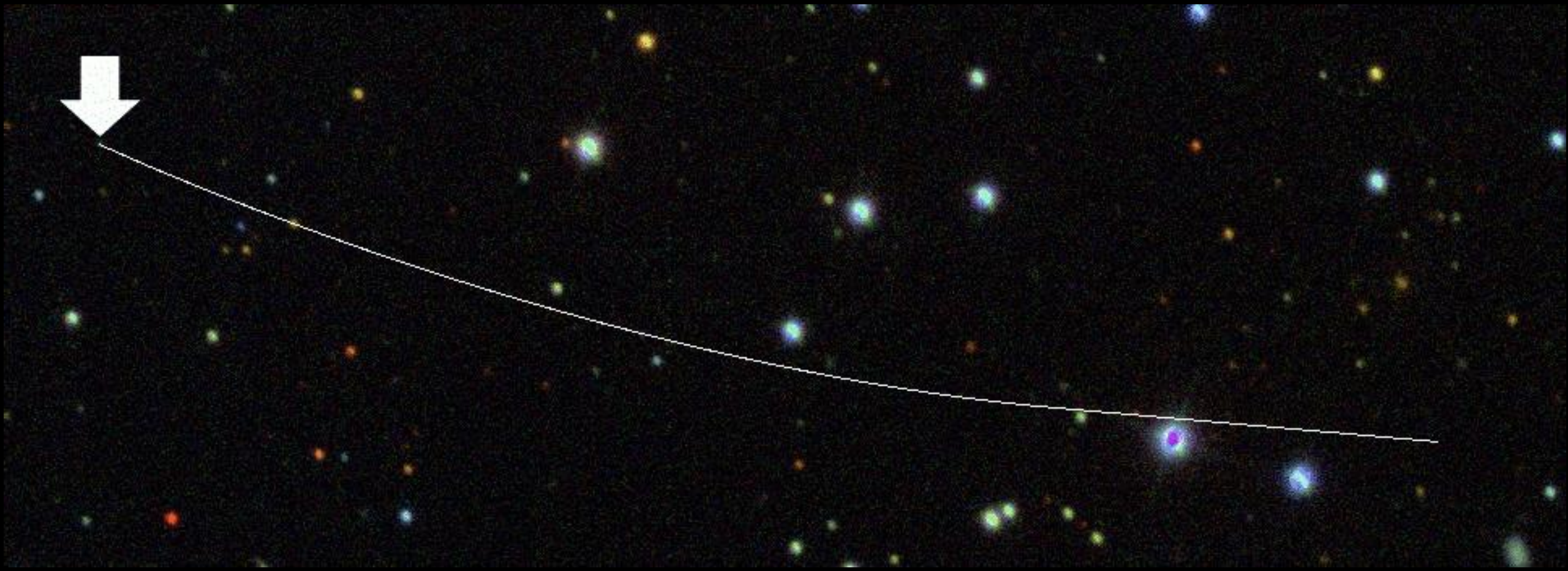
Discovery of Asteroids



Discovery of Asteroids



Discovery of Asteroids

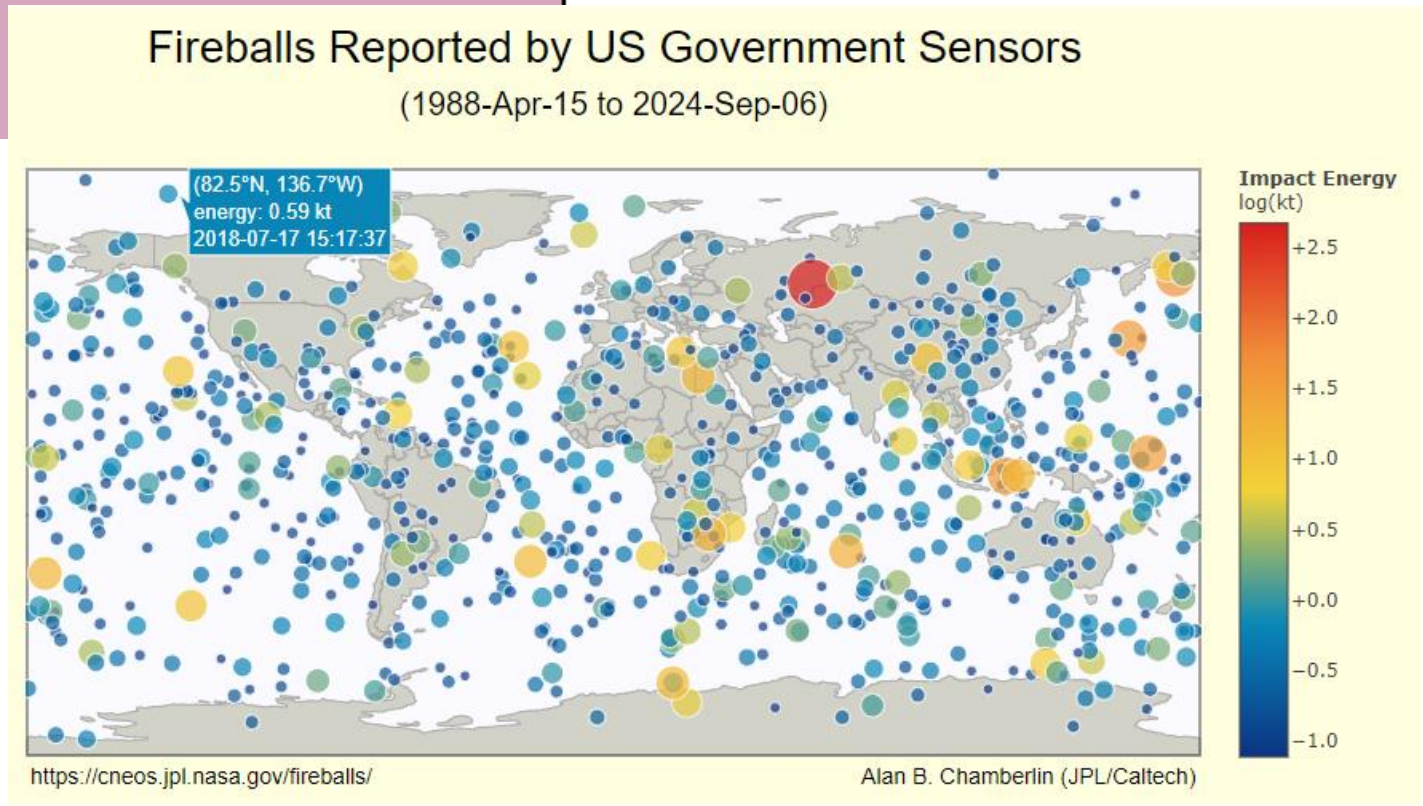


Fireballs Reported by NASA JPL

Let's Investigate!

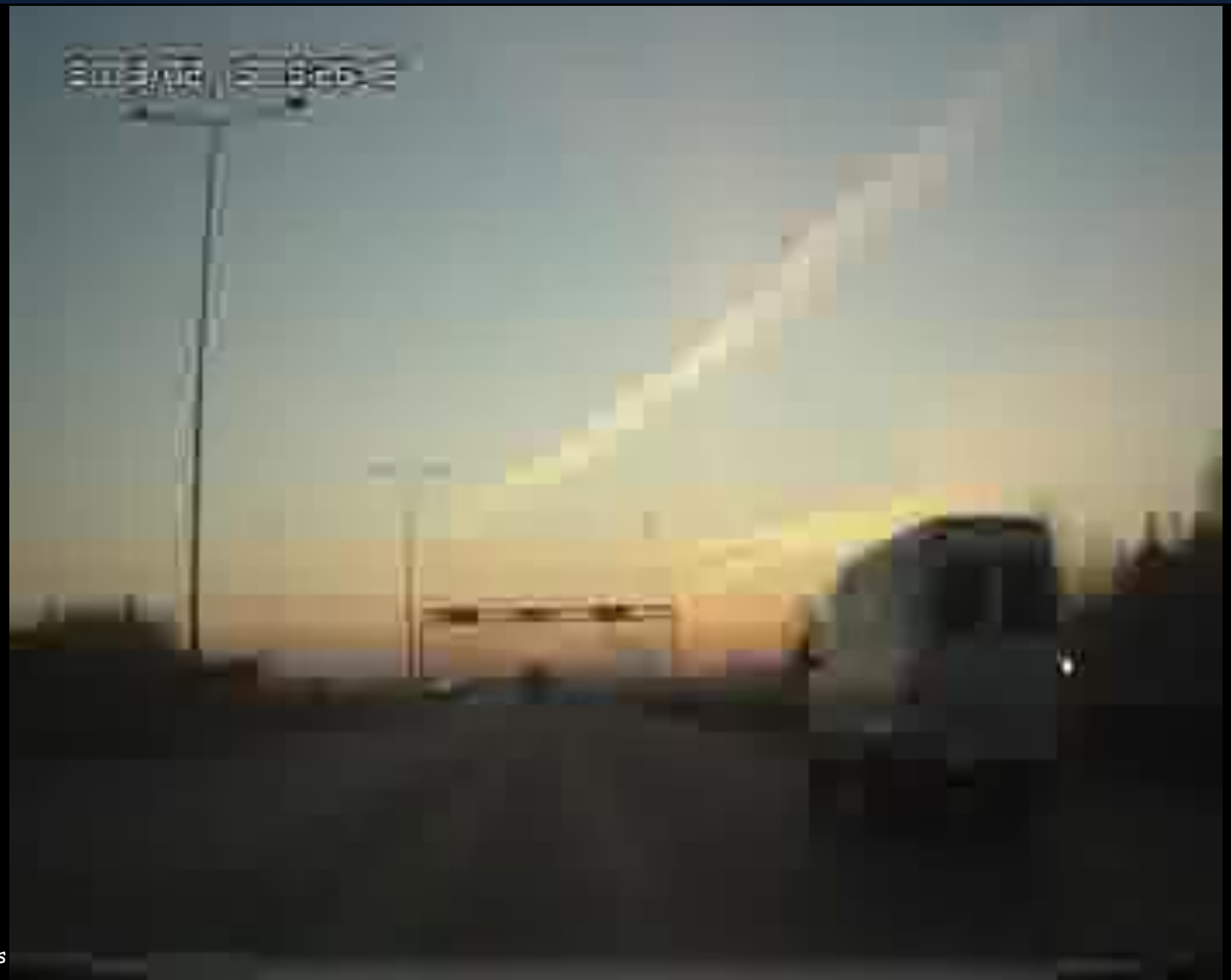
Section G: Fireballs

1. Students get a computer/tablet and go to NASA Fireballs. Play and investigate what all the buttons and zoom features do. Then highlight which area your teacher is having you focus on from the list:
   a. Date ranges
   b. Impact size ranges in kt
   c. Latitude and longitude ranges
   d. Energy ranges
   e. Velocity ranges



Asteroid Explosion - Russia

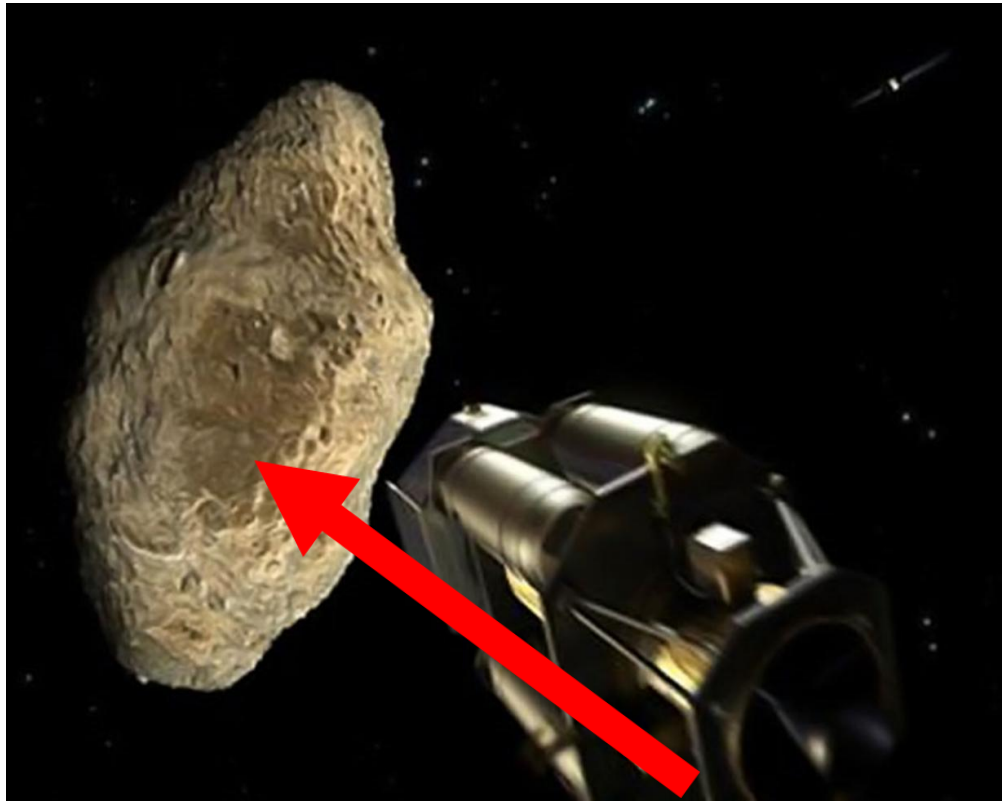
Chelyabinsk 15 Feb 2013



http://www.youtube.com/watch?v=V-0w3FPkXds

Planetary Defense – Asteroid Deflection

Defending Earth



Section H: Defending Earth

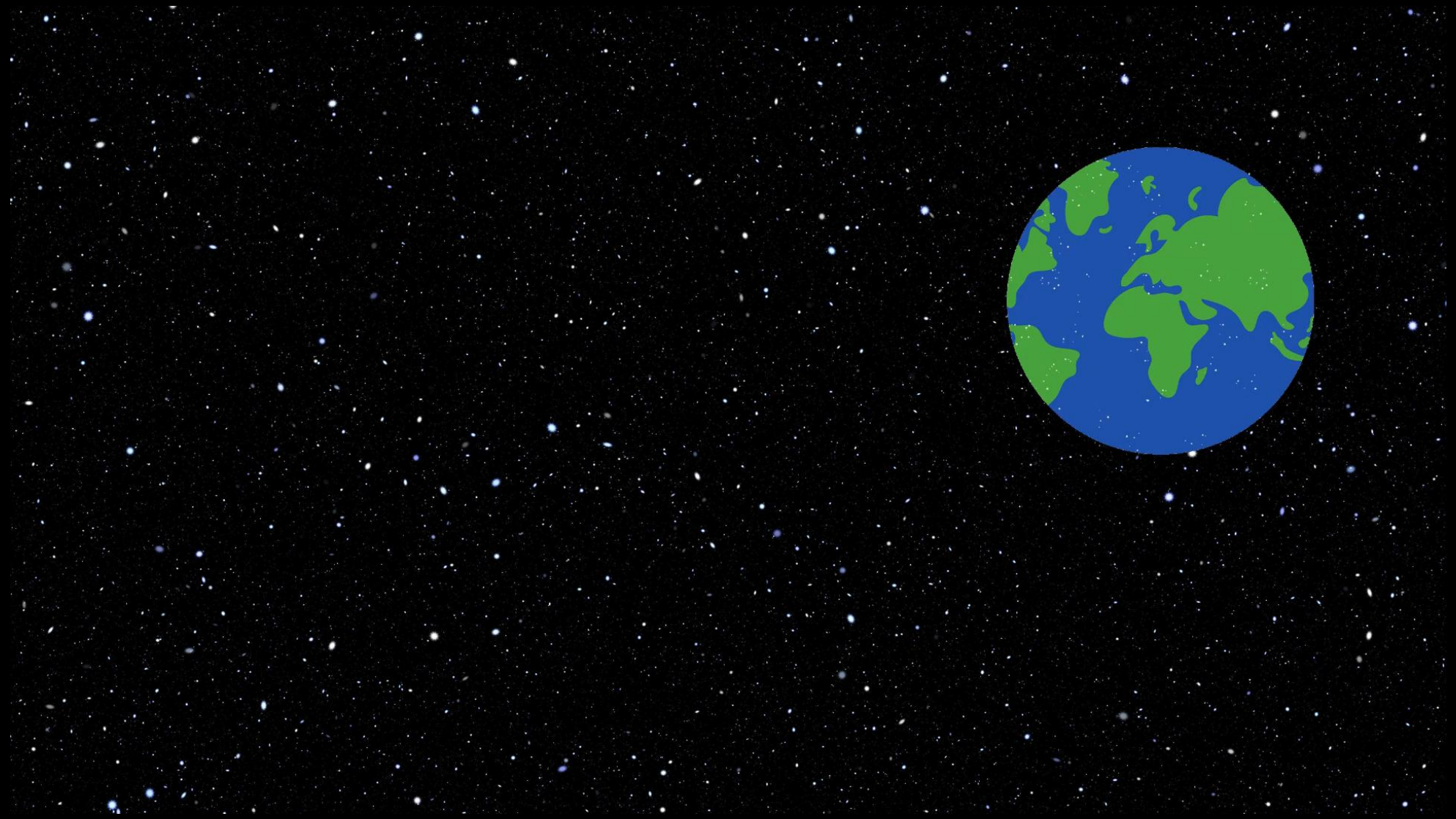
What would you do to keep a NEO from hitting Earth?

KINETIC IMPACT

Heavy spacecraft collide with the asteroid and deflect it

http://spacefellowship.com/news/art23176/how-to-deflect-an-asteroid-with-today-s-technology.html

Incoming Asteroid



Incoming Asteroid Deflection

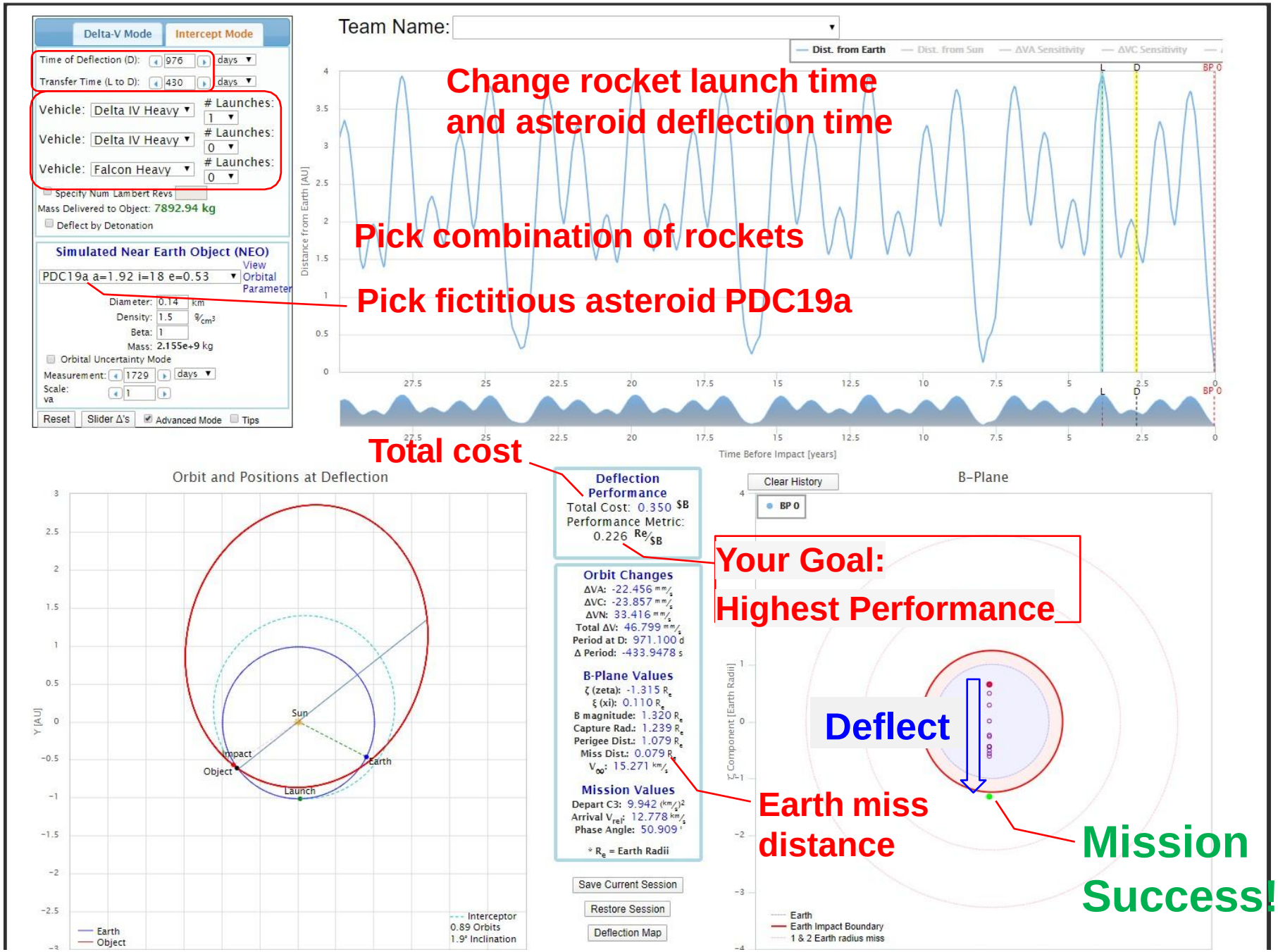
Incoming Asteroid Destruction

Deflect an Asteroid!

Use the NEO app to deflect an asteroid

Get a computer and go to https://cneos.jpl.nasa.gov/nda/. Make yourself familiar with the settings below!

Section I: NEO Deflection App Students get a computer/tablet and go to the link: https://aerospace.org/asteroids	
Experiment with all the following options. Write what **happens** when you change each of these:	
1. Delta-V Mode	
2. Intercept Mode	
3. Time of Deflection	
4. Simulated near-Earth objects	
5. Density (Intercept Mode)	
6. Beta (Intercept Mode)	
7. B-Plane	



Performance
=
Miss distance
Total cost

Deflect an Asteroid!

Your Turn

	$B	Performance Metric	R_e (Earth Radii away)	Time of Deflection (D)	Transfer Time (L - D)
Your Team's Solutions					

	Atlas V551	Delta IV Heavy	Falcon
Total Number of Launches			

1. What is your total $B?	
2. What is your Performance Metric?	
3. Write 5 to 6 sentences about your team's solution and performance. Explain why your group found the best solution and saved Earth.	

Make note of your performance on your worksheet and discuss!

Complete a Scenario

Objective: Find the least number of days from discovery and the minimum number of days from launch to impact that would yield the smallest missed distance.

- Asteroid "2019 PDC" is discovered on March 26, 2019
- The most likely potential impact occurs on April 29, 2027 – 8 years and 36 days away
- The asteroid's mean size could be anywhere from roughly 100 meters to over 300 meters.


Thank you