

Solar System Debris

Physical Sciences

Broward College

Prepared for AST 1002

Horizons in Astronomy

Objectives

- What is the debris of the Solar System?
- Planetesimals
- Comets
- Formation of the Solar System

What are the debris?

- Planetesimals: Small rocky bodies that do not have enough gravity for roundness and are in debris field.
- Comets: Small to large icy bodies that do not have enough gravity for roundness and are formed in the outer Solar System.

Planetesimals - Asteroids



- An irregular piece of rock planetesimal.
- Main Asteroid Belt: 2.8 AU
- The biggest asteroids are around 11 km.
- Gaspara, one of the biggest asteroids
- Types
 - S-type
 - Lighter in color, stony in composition
 - C-type
 - Darker in color, carbon in composition
 - M-type
 - Almost shiny in color, iron in composition
- Meteoroids are small asteroids

Figure 1. Gaspra Asteroid (Wiki)

Asteroid Orbits and Asteroid Nacogdoches

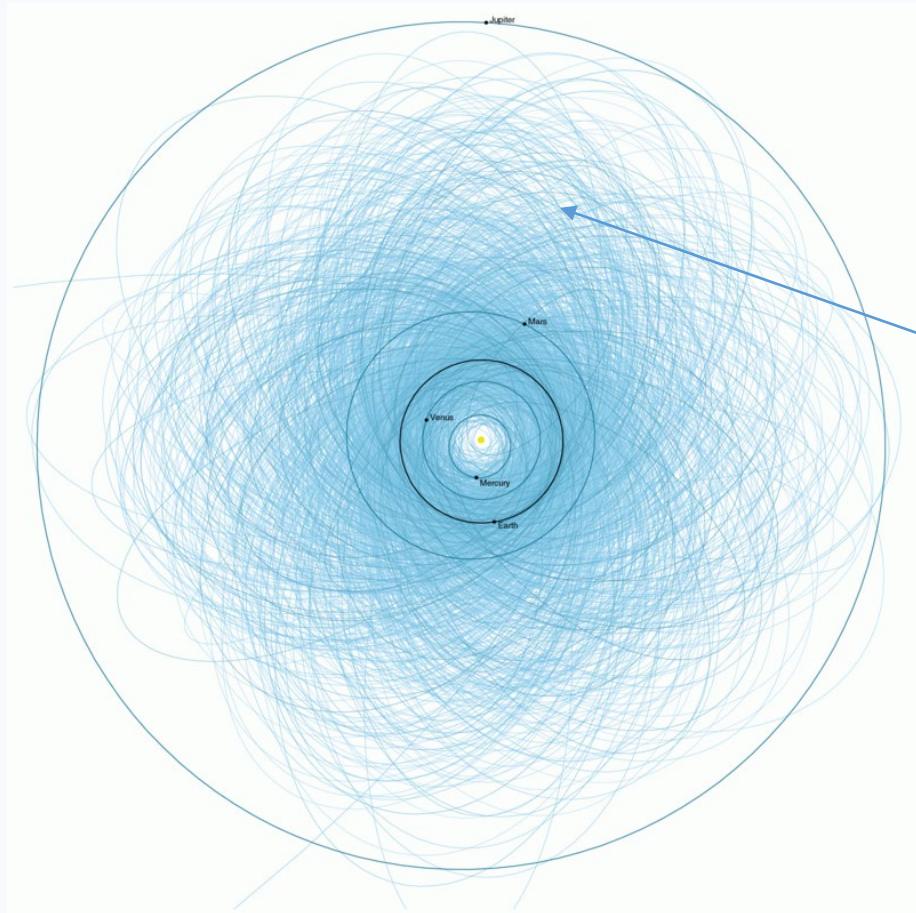
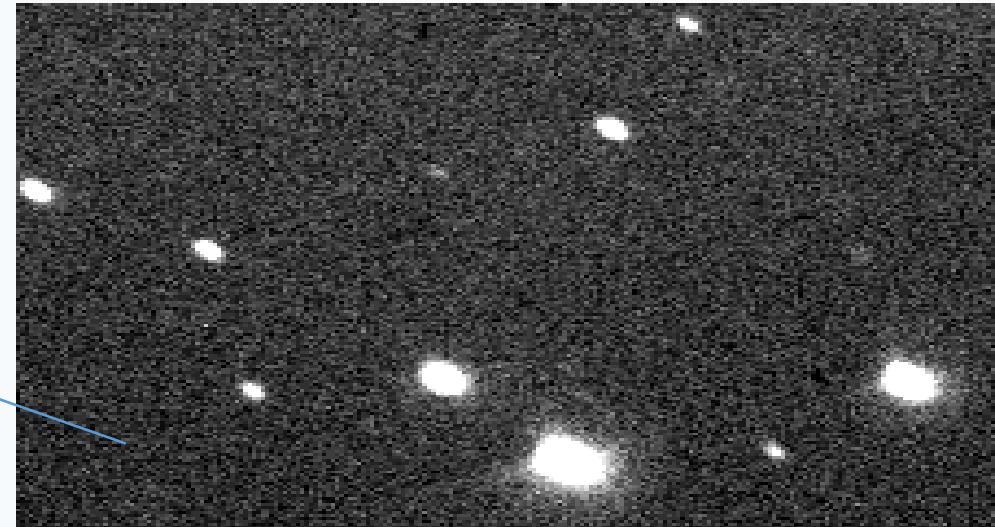


Figure 2. Near Earth Asteroid Orbits (Wiki)



Dan Bruton and Ryan Williams while observing at Stephen F. Austin State University Observatory in 2002 “rediscovered” (observed again) an asteroid. They calculated the orbit and were able to name the asteroid.

Figure 3. Asteroid Nacogdoches , Dan Bruton and Ryan Williams

Planetesimals - Meteors

- When an asteroid/meteoroid interacts with the atmosphere of a planet they become a meteor.
- If several asteroids/meteoroids interact, such as tail of a comet, then we receive a meteor shower
- The two main showers in the year:
 - Persieds
 - Leonids



Figure 4. Leonid Asteroid (Wiki)

Meteorite

- The leftover material from a meteor, parent bodies.
- Three types: Iron, Stony-Irony, and Stony.
- Found in the center of craters.
- Dating done according to their radioactive elements.



Figure 5. Iron Meteorite (Wiki)



Figure 6. Stony-Irony Meteorite (Wiki)



Figure 7. Stony Meteorite (Wiki)

Close up of a Meteorite

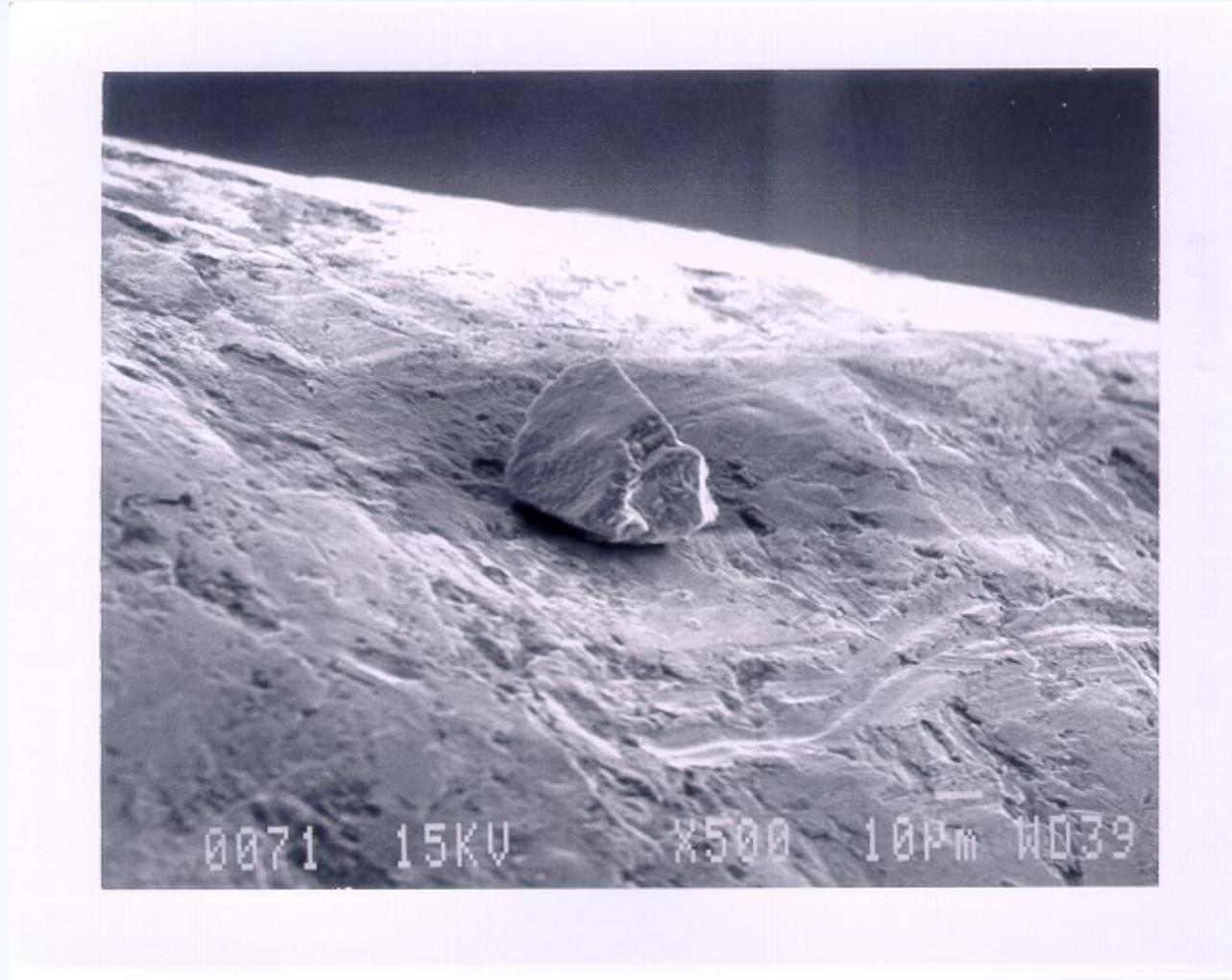


Figure 8. Close up of a Meteorite - Robert Friedfeld and Emily Howard, Stephen F. Austin University

Comets

- Snowballs with mixtures of dirt and organic material.
- Produced in the Oort cloud, and leftover set of debris around 100,000 AU away from the sun.
- Types of Comets
 - Short Period: Halley's Comet
 - These comets orbit within the Solar System.
 - Long Period: Comet Hale-Bopp Comet
 - These comet orbit through the Oort Cloud.
 - Parabolic: Comet Hyutake
 - These comets do not return to the central Solar System.

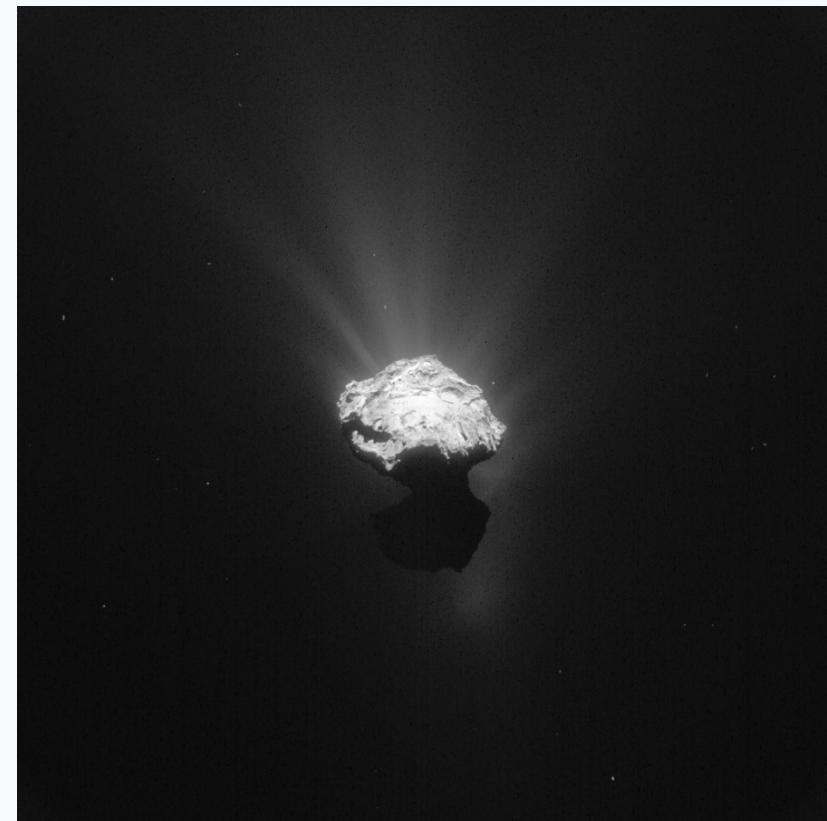


Figure 10. Comet Coma (ESA/Rosetta/NAVCAM, 2013)

Comet's Anatomy

- Coma (Forms in Oort Cloud)
 - Central snowball of material
- Ion Trail (Forms at orbit of Jupiter)
 - Trail of charge particles
- Dust Trail (Forms at orbit of Earth)
 - Trail of particle and dust

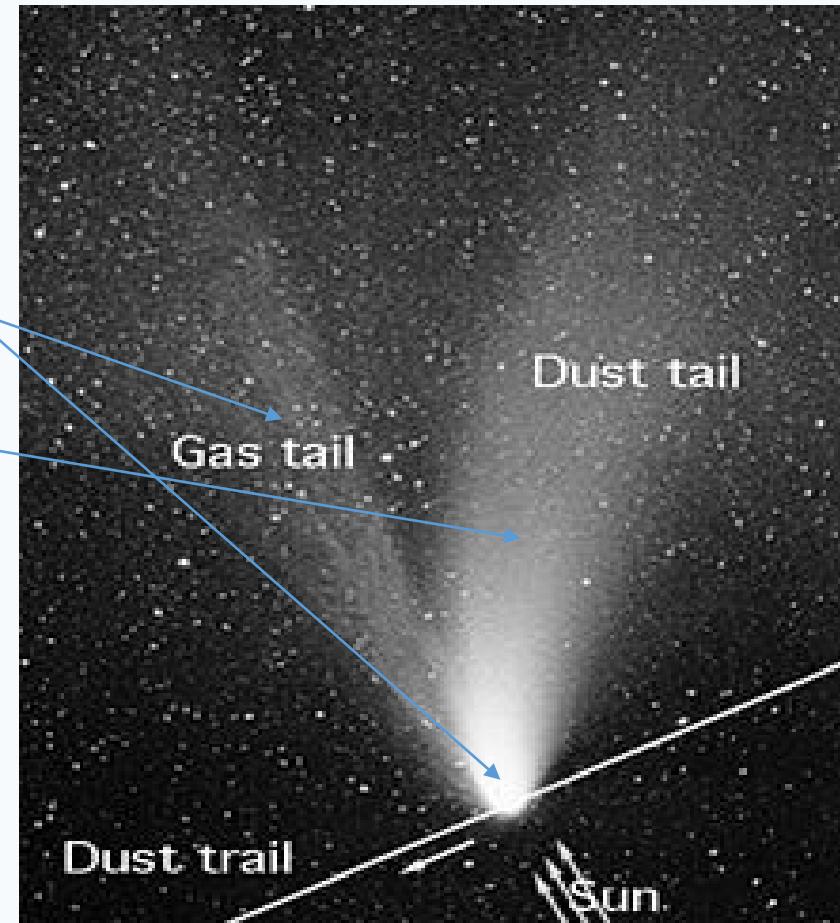


Figure 12. Anatomy of a Comet (Wiki)

The Formation of the Solar System

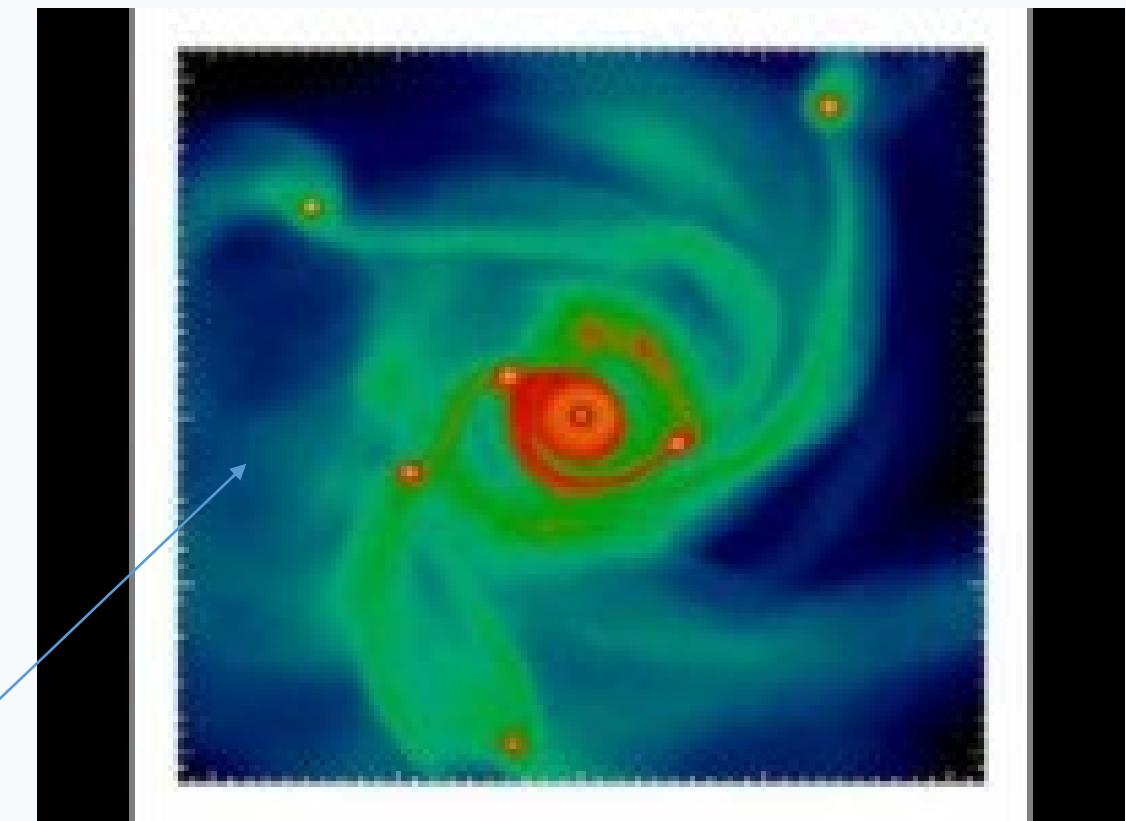
- Originally there were three models.
 - Accretion
 - Planets and Sun form at the same time after interstellar disturbance of primordial cloud.
 - Capture
 - Sun forms first from the primordial cloud and then captures rogue planets.
 - Nebular
 - Sun forms first from the primordial cloud and then the planets from second from small planetesimals from the cloud.
- But the combined Nebular-Accretion Model seems to explain all the observations.

Observations of the Solar System

- The planets revolve counterclockwise around the sun; the sun rotates in the same direction.
- The major planets, except Mercury and Pluto, have orbital inclinations close to the plane of the solar system.
- Except for Mercury and Pluto, the planets move in orbits that are nearly circular.
- Except for Venus, Uranus and Pluto, the planets rotate counterclockwise, in the same direction as their orbits.
- The planet's orbital distances from the sun follow a regular spacing.
- Most satellites (moons) follow the same direction and lie close to the plane of the planet.
- Some satellites follow the regular spacing rule.
- Long-period comets come in all inclinations, but all other objects are fairly well behaved.
- All Jovian planets have rings.

Nebular-Accretion Model

- Interstellar Medium collapses.
- Proto-star forms.
- Planetesimals form.
- Gravity waves cause cores to form which in turn attract more material.
- Planets build while the sun becomes a star.
- When the sun becomes a star, all the material is blown away and the planets are locked into their positions and masses.
- Click on the image to see how this process works with a Super Earth around another star.



Book/Course References

- ESA/Rosetta/NAVCAM (2013) *Comet on 7 June 2015 – NavCam* Retrieved from:
http://www.esa.int/spaceinimages/Images/2015/06/Comet_on_7_June_2015_NavCam

Wiki Commons/Wikipedia Image References

- Anatomy of a Comet: "Comet Parts" by NASA Ames Research Center/K. Jobse, P. Jenniskens - NASA:http://solarsystem.nasa.gov/multimedia/display.cfm?IM_ID=903http://solarsystem.nasa.gov/multimedia/gallery/Comet_Parts.jpg. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Comet_Parts.jpg#/media/File:Comet_Parts.jpg
- Asteroid Orbits Near Earth: "Potentially Hazardous Asteroids 2013" by Jet Propulsion Laboratory, NASA - <http://www.jpl.nasa.gov/spaceimages/details.php?id=PIA17041>. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Potentially_Hazardous_Asteroids_2013.png#/media/File:Potentially_Hazardous_Asteroids_2013.png
- Gaspra: "951 Gaspra" by NASA - Cropped from TIFF image from [<http://www.solarviews.com/cap/ast/gaspra3.htm> Solarviews.com. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:951_Gaspra.jpg#/media/File:951_Gaspra.jpg
- Iron Meteorite: "Murnpeowie meteorite" by James St. John - Flickr: Murnpeowie Meteorite. Licensed under CC BY 2.0 via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Murnpeowie_meteorite.jpg#/media/File:Murnpeowie_meteorite.jpg
- Leonid Meteor: "Leonid Meteor" by Navicore - Own work. Licensed under CC BY 3.0 via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Leonid_Meteor.jpg#/media/File:Leonid_Meteor.jpg
- Planet Eris: "Eris and dysnomia2" by NASA, ESA, and M. Brown - http://www.nasa.gov/mission_pages/hubble/news/eris.html . Originally uploaded to en.wikipedia by en:User:Serendipodous. For more information, see the description page. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Eris_and_dysnomia2.jpg#/media/File:Eris_and_dysnomia2.jpg
- Stony Meteorite: "Meteorito Marília" by Gabisfunny - Own work. Licensed under Public Domain via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Meteorito_Mar%C3%ADlia.jpg#/media/File:Meteorito_Mar%C3%ADlia.jpg
- Stony-Irony Meteorite: "Pallasite-Esquel-RoyalOntarioMuseum-Jan18-09" by User:Captmondo - Own work (photo). Licensed under CC BY-SA 3.0 via Wikimedia Commons - <https://commons.wikimedia.org/wiki/File:Pallasite-Esquel-RoyalOntarioMuseum-Jan18-09.jpg#/media/File:Pallasite-Esquel-RoyalOntarioMuseum-Jan18-09.jpg>