Origins

10/28/2009

Opening Discussion

- http://www.youtube.com/watch?v=Qdb4NyHdFfE
- Have you seen anything interesting in the news?
- What did we talk about last class?
- Minute Essays
  - Difficulty in hiring graders.
  - Feelings on open book and other things.

Search for Origins

- One of the most fundamental questions of science is, “Where did we come from?”
- A large part of this question lies in the field of astronomy.
- We have already mentioned the Big Bang theory for the origin of the Universe.
- What about our solar system? When and how did our Sun and its host of planets and other bodies form?

Significant Solar System Properties

- There are a number of properties of our solar system that any formation hypothesis has to match.
  - Patterns of motion
    - Spinning the same way
    - Single plane
  - Terrestrial vs. jovian planets
  - Existence of small bodies
  - Allow for the exceptions

The Nebular Hypothesis

- Originally developed independently by Kant and Laplace.
- A giant cloud of gas collapses to form the star.
- A disk of material around it leads to the formation of planets.
- This happened for our solar system about 4.5 billion years ago.
- Now this is the nebular theory because it is so well supported.

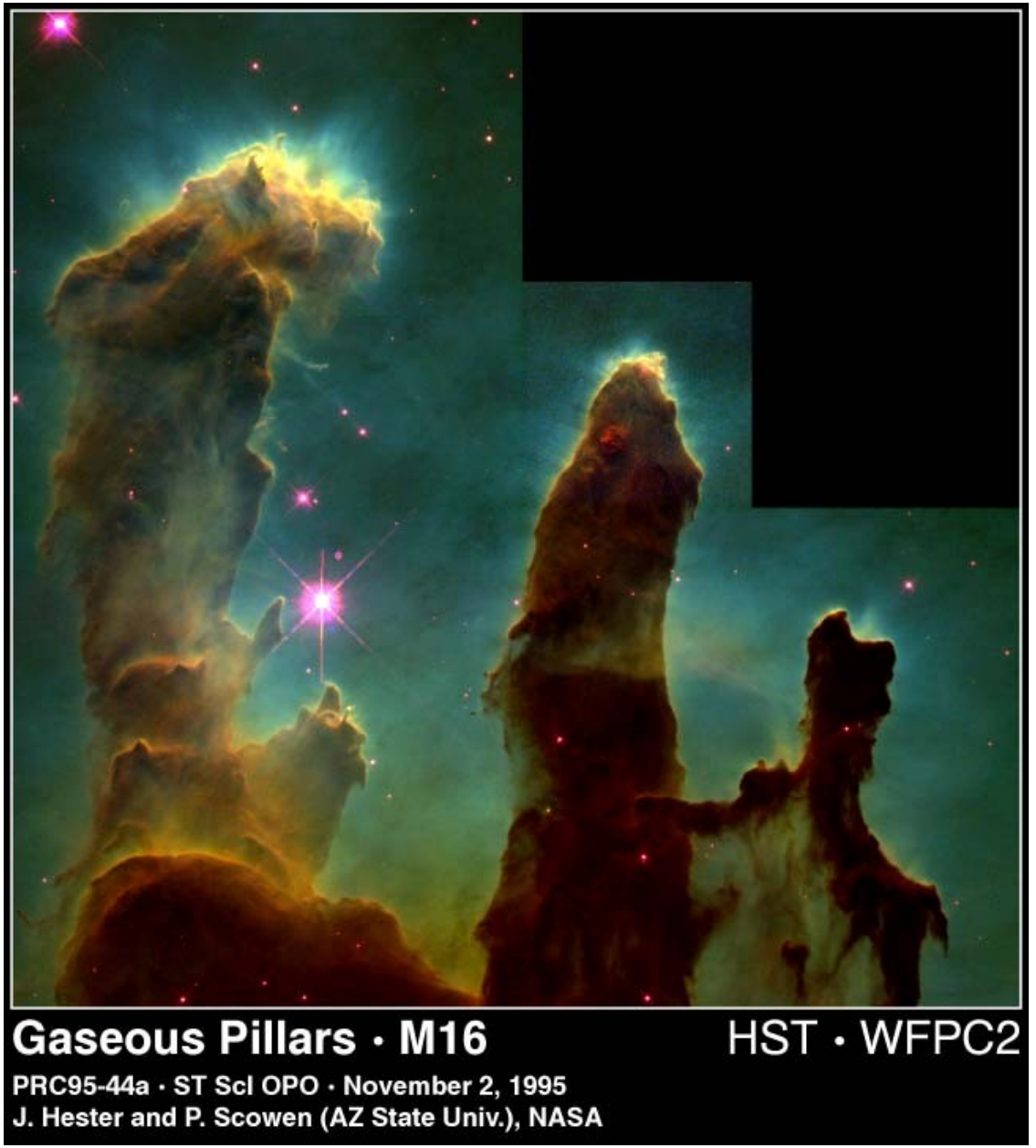
Close Encounter Hypothesis

- (Note: This ones doesn't work!)
- In the early 1900s a second hypothesis become popular.
- The idea was that a second star passed close to our Sun and the gravitational disruption pulled of material that formed the planets.
- Has a few problems:
  - Such encounters are extremely rare.
  - Doesn't reproduce motions of planets.
  - Doesn't produce terrestrial and jovian dichotomy.

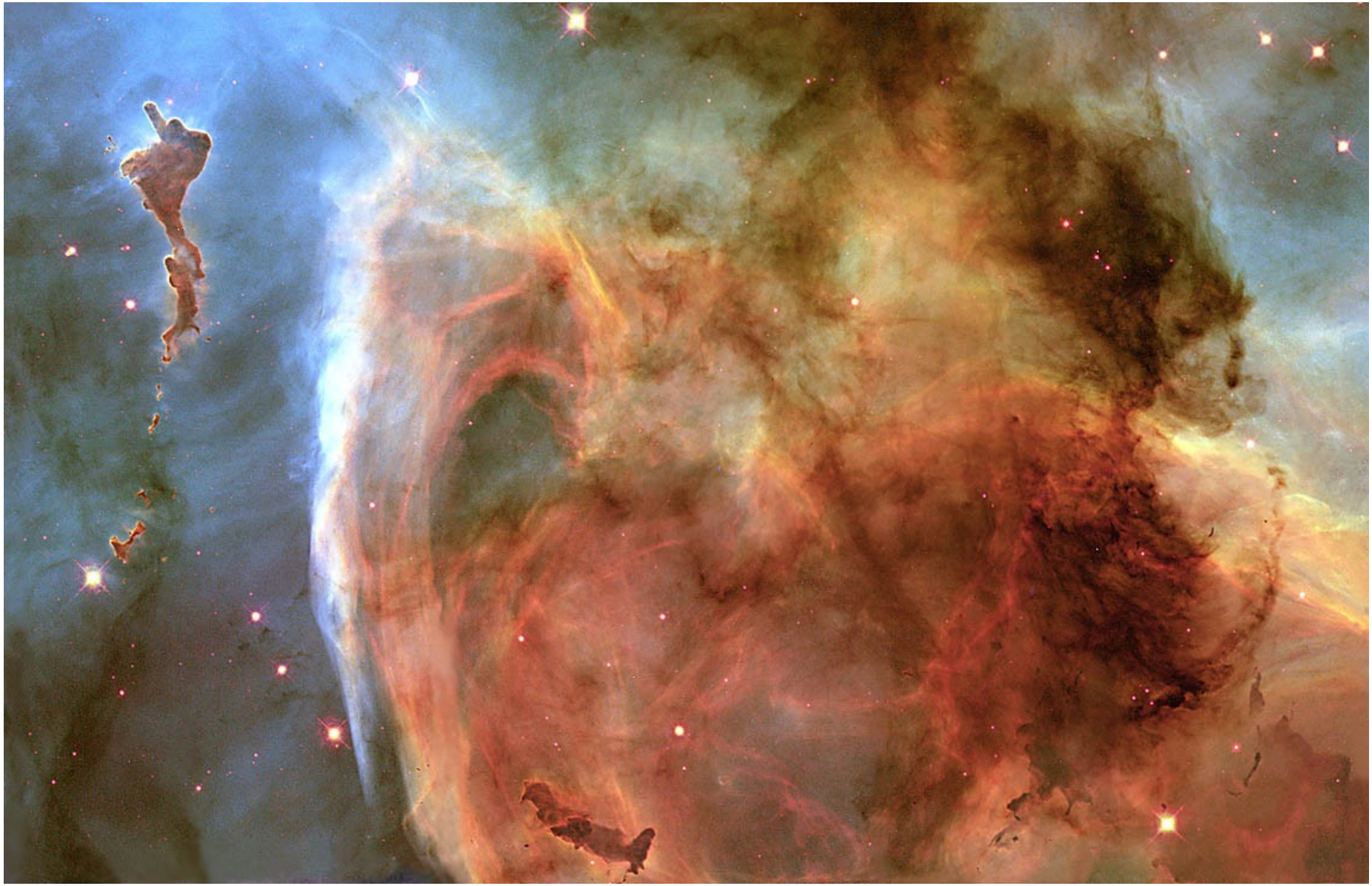
Galactic Recycling

- The Nebular theory begins with a giant cloud of gas.
- These clouds are found all through younger galaxies like our own.
- Originally they contained only hydrogen and helium.
- Exploding stars throw heavier elements into them. They can also lead to instability that causes gravitational collapse.

Observations



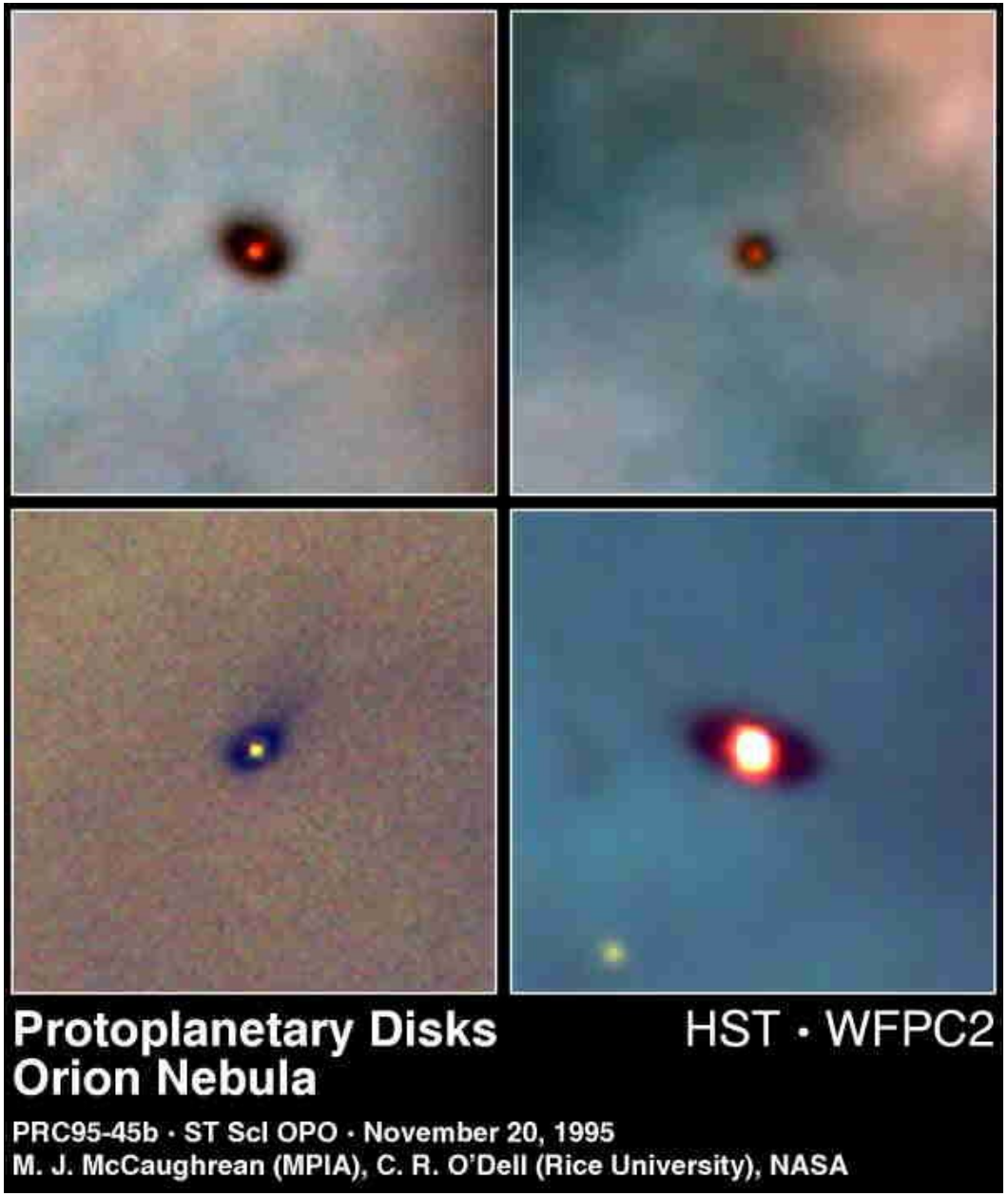
Observations



Forming a Hot Disk

- As the gas contracts it heats up. (Some radiative cooling is required to allow collapse to continue.)
- Conservation of angular momentum and averaging of motion in collisions have two effects.
  - The random motions average to a net spin and the spin rate increases dramatically with collapse.
  - The material flattens into a disk.

Observations



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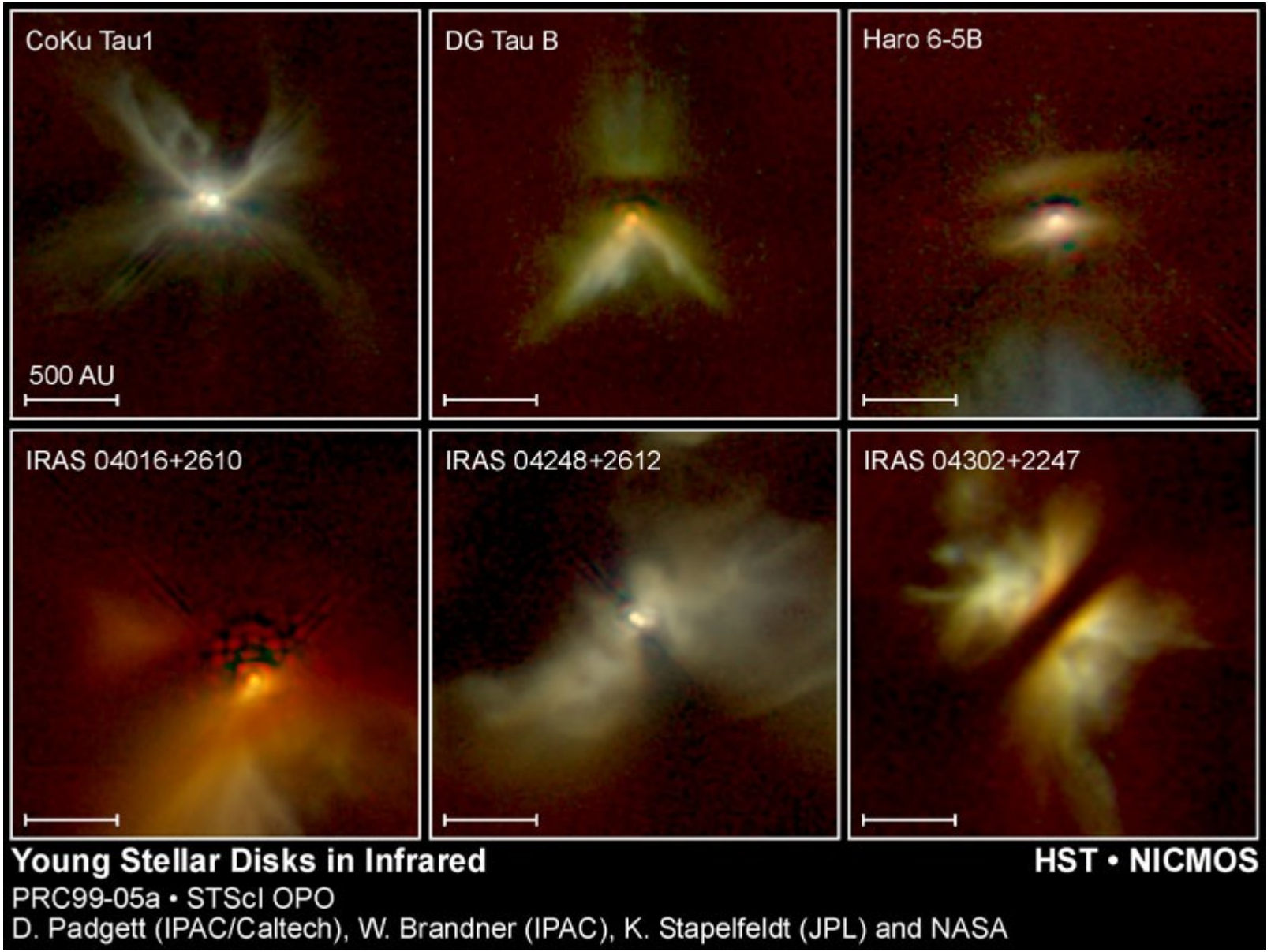

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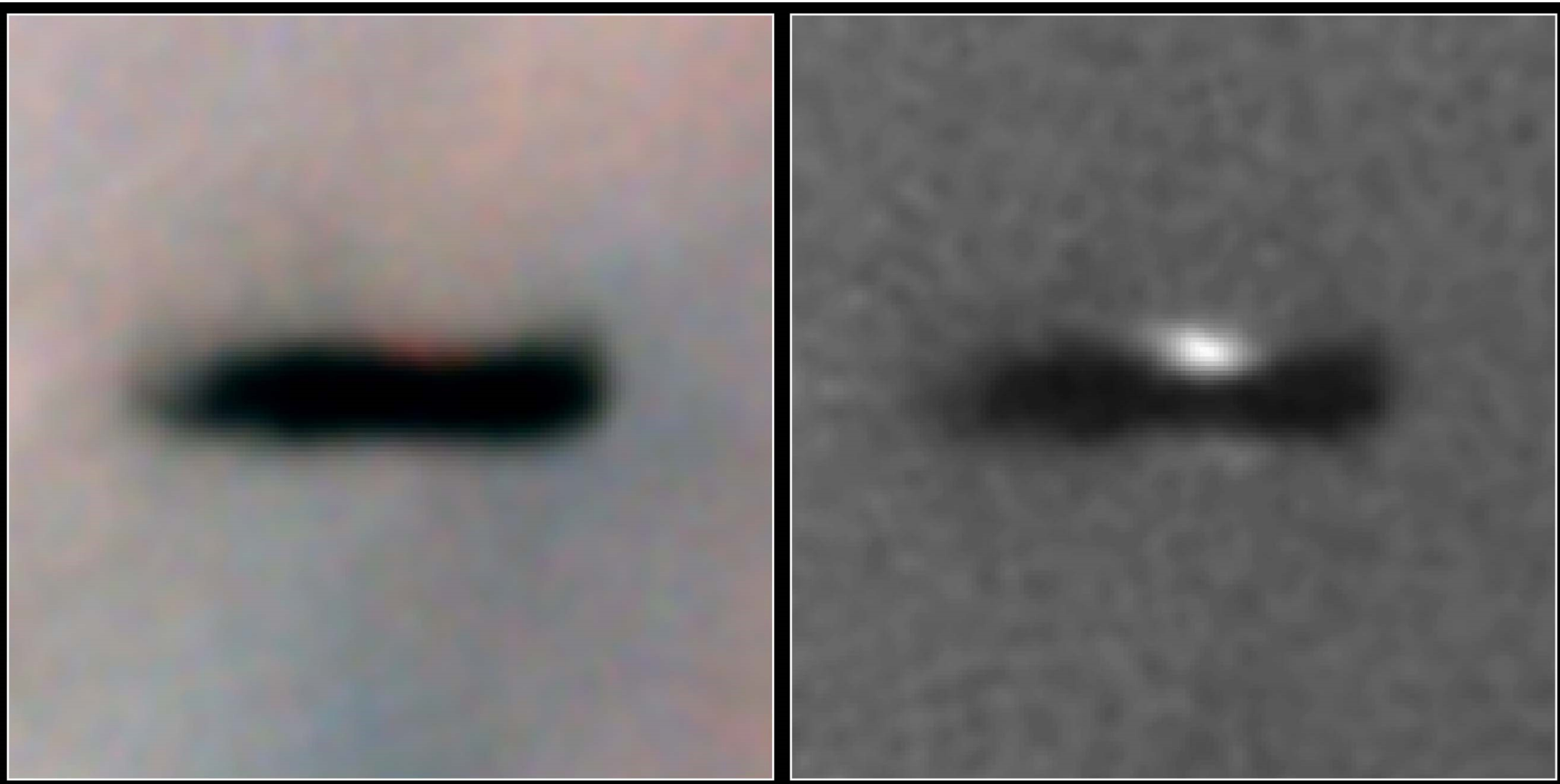
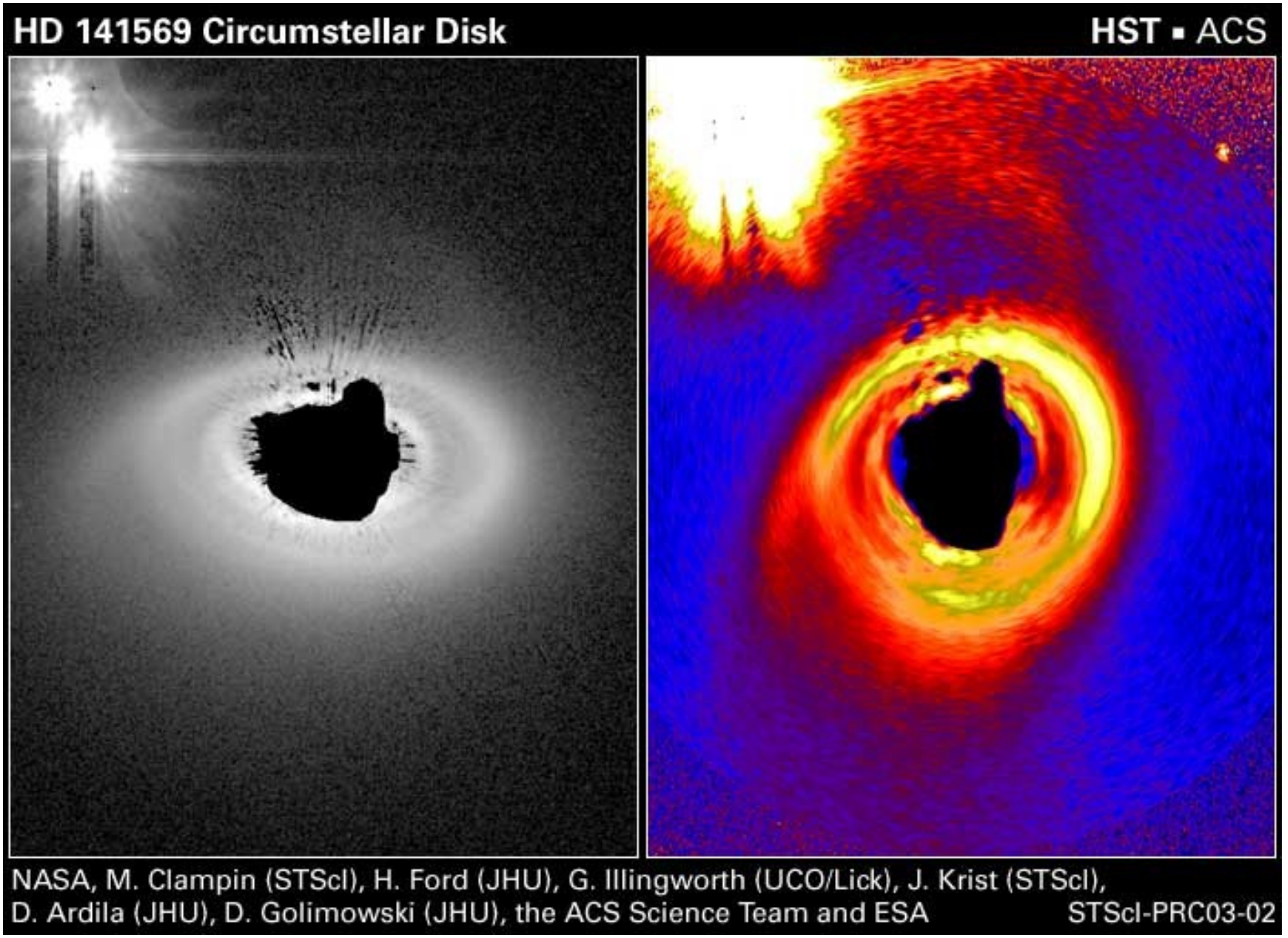


Edge-On Protoplanetary Disk • Orion Nebula

Hubble Space Telescope • Wide Field Planetary Camera 2

PRC95-45c • ST ScI OPO • November 20, 1995 • M. J. McCaughrean (MPIA), C. R. O'Dell (Rice University), NASA

Observations



Minute Essay

- Do you have any questions about the formation of our star and the disk around it? Do you understand why the Nebular hypothesis was elevated the the Nebular theory?
- We'll look at the formation of planets in the protoplanetary disk next class.