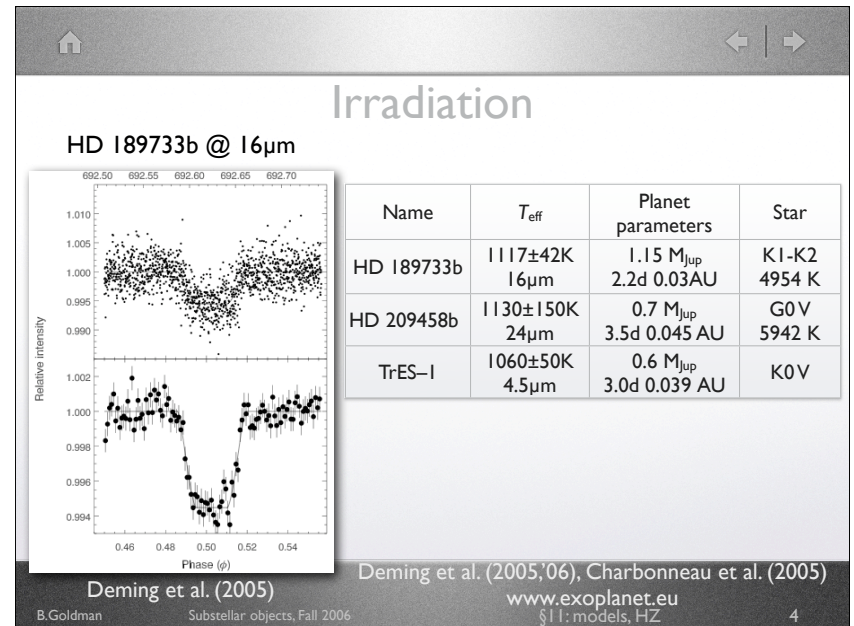
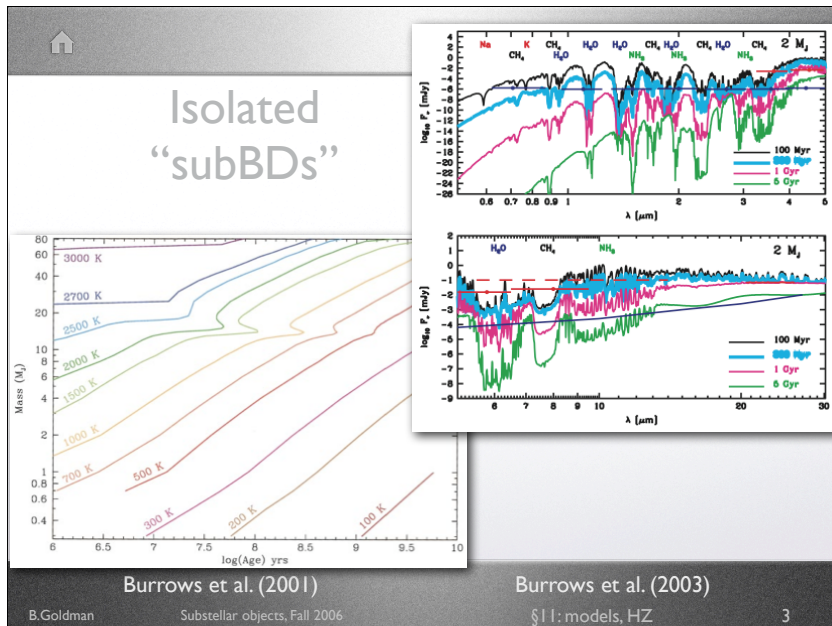
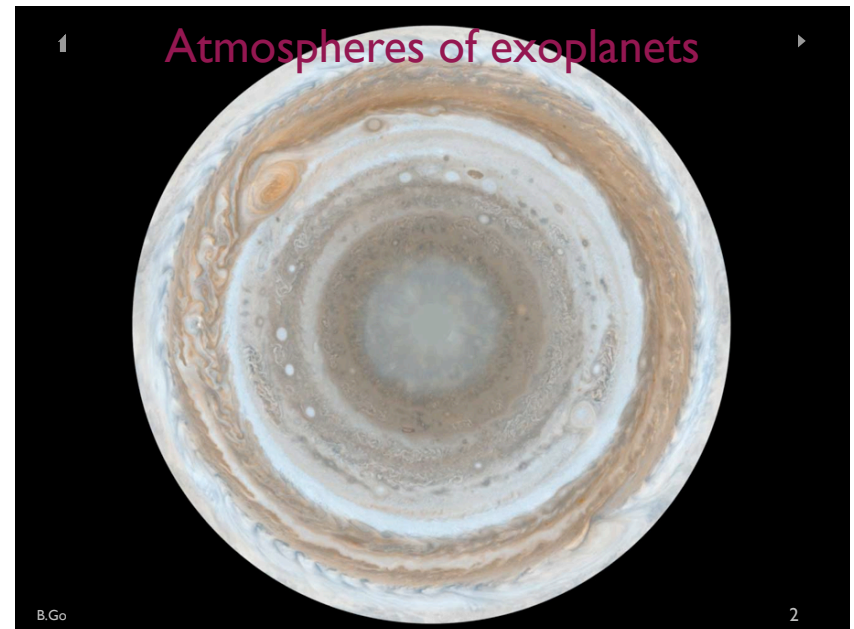
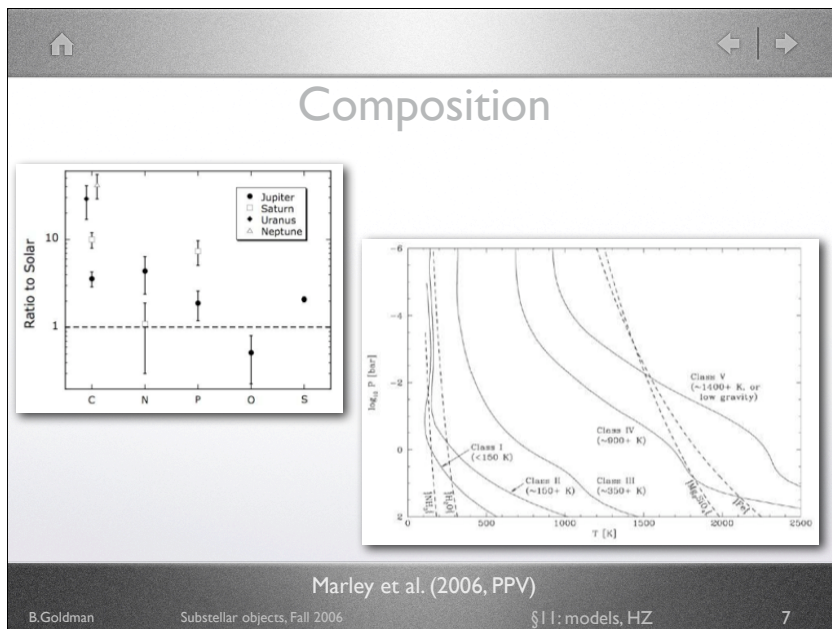
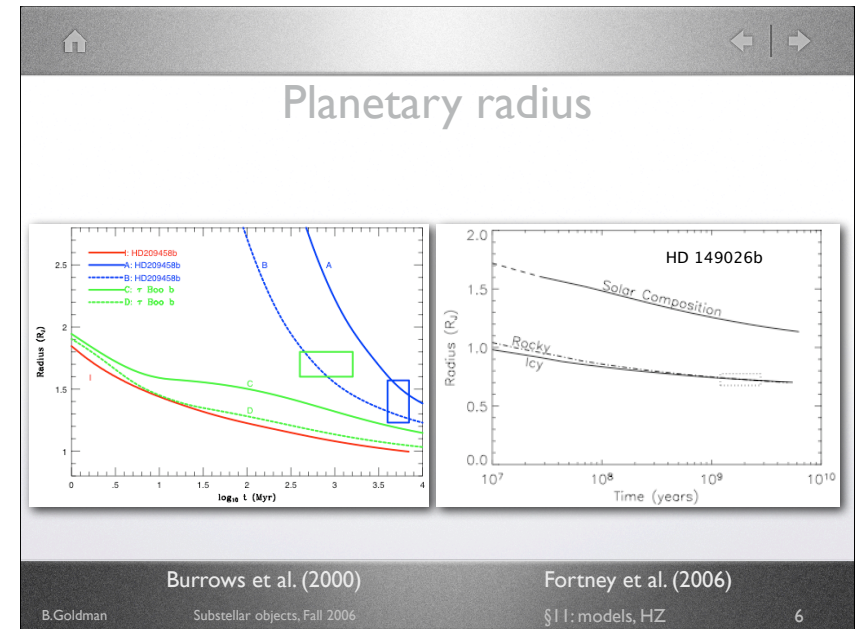
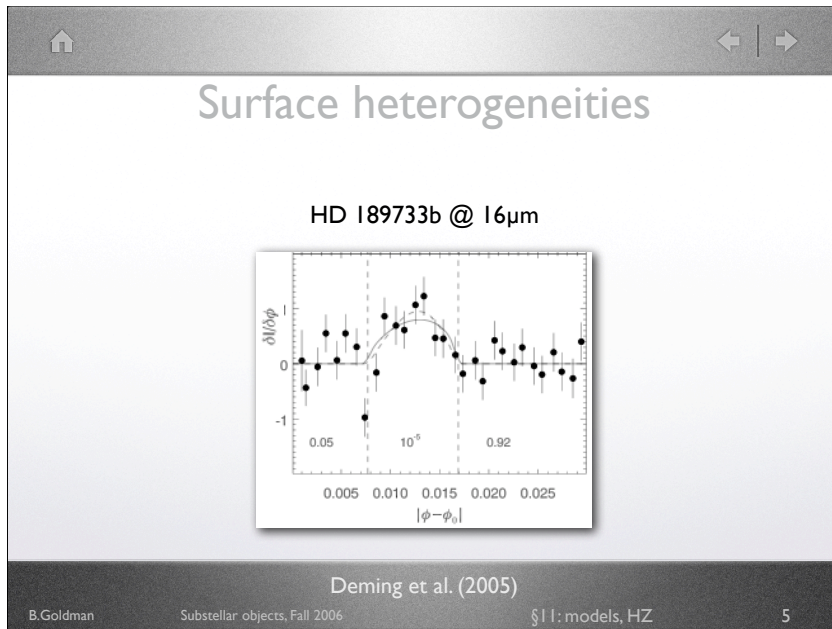


Models of exoplanets, habitable zones

January 18, 2007





- ## Life in the Universe
- Definition of Life
 - Requirements:
 - Carbon-based, with H, N, O, P, S
 - Liquid water
- B.Goldman Substellar objects, Fall 2006 §11: models, HZ 8

Home navigation icons: a house icon, a left arrow, and a right arrow.

Habitable zones

- Galactic habitable zone?
 - High metallicity
 - Few SNe
- Stellar habitable zone
 - Standard definition
 - Continuous habitable zone
 - energy source
 - durability

B.Goldman Substellar objects, Fall 2006 §11: models, HZ 9

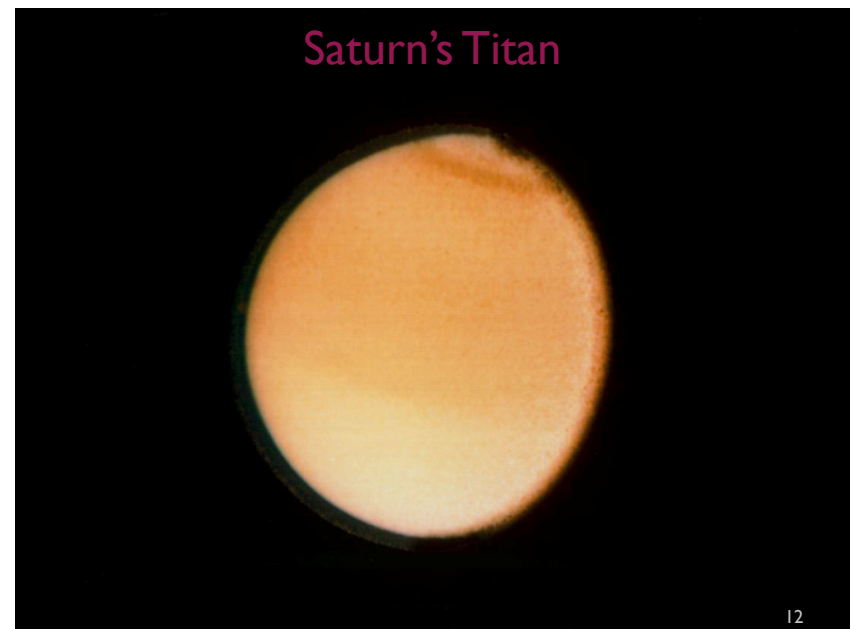


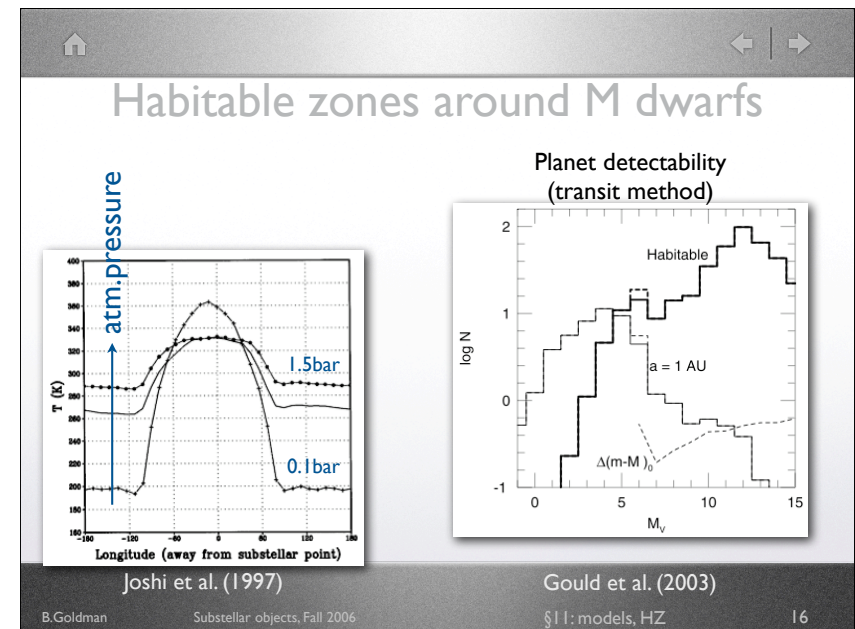
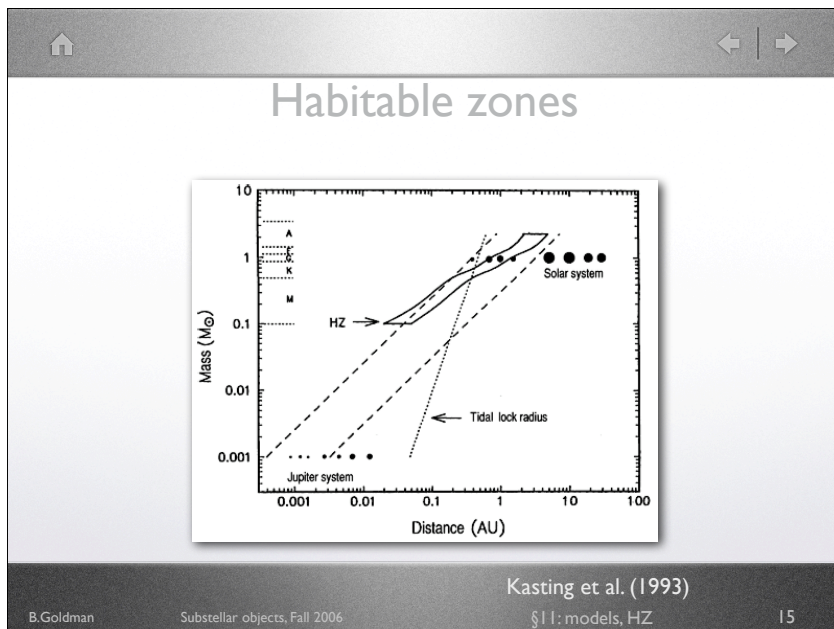
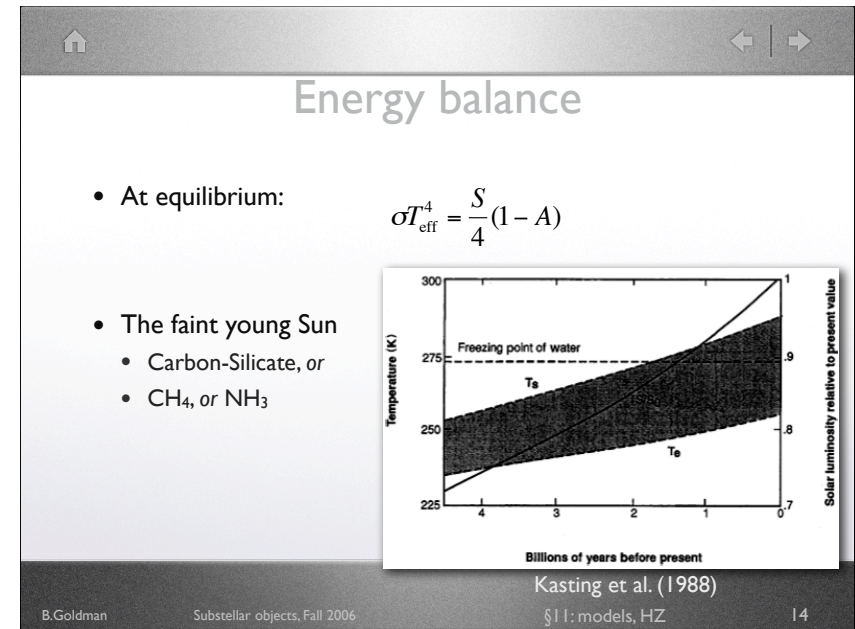
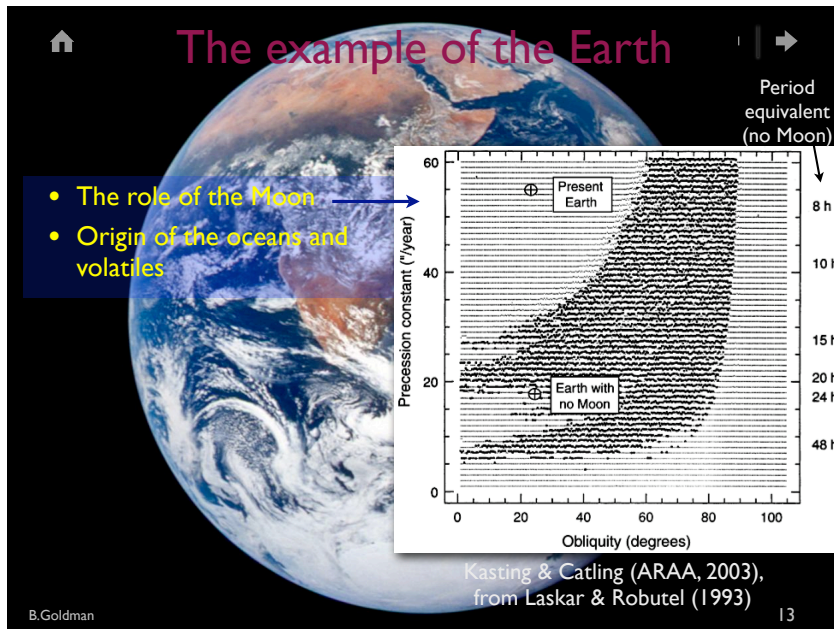
Home navigation icon: a house icon.

Jupiter's Europa

Galileo Orbiter

B.Goi Substellar objects, Fall 2006 §11: models, HZ 11





Origin of Life

- Bottom-up approaches
- Top down
- Time scale:
 - the first living elements on Earth
 - last sterilizing impact event

Heavy bombardment period

The graph plots Impact energy (Joules) on the left y-axis (log scale from 10²¹ to 10³³) and Water evaporated (m) on the right y-axis (log scale from 0.003 to 3000) against Time before present (billions of years) on the x-axis (from 4 to 0). A shaded region at the top indicates the 'Heavy bombardment period' between approximately 4.5 and 3.8 billion years ago. Key impact events are marked: Hadean, Or, Im, Ir, Tr, A, H, Su, L, Co, M, K/T, Ty. Geological eras are labeled at the bottom: Hadean, Archean, Proterozoic, Phanerozoic, and Future.

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Intelligent life in the Universe

- Drake's equation: $N=R_* \cdot f_{pl} \cdot n_e \cdot f_i \cdot f_c \cdot L$
- Anthropic principle
- (Absence of) Visitors
- SETI

B.Goldman Substellar objects, Fall 2006 §11: models, HZ 18

Next lecture

Monday, February 5, 15:15:
conclusion and prospects

VISTA, Paranal

DARWIN, ESA

B.Goldman Substellar objects, Fall 2006 §11: models, HZ 19