Oustanding Issues for Ice Giants

David Stevenson*[1]

[1]Caltech – United States

Abstract

The ice giants are a key to understanding the formation and evolution of the solar system. With the explosion of data about exoplanets, especially from Kepler, it is now evident that planets in this class (which overlaps somewhat with so-called superEarths) are likely to be the most common kind of planets in the universe. Despite our limited knowledge, it is already evident that Uranus and Neptune are different from each other so in situ exploration of both ice giants is an essential long-term plan, though practicalities may dictate a shorter term choice. I will talk about the key questions for origin, evolution and structure and how these might be addressed in a future mission: (1)Are the ice giants in fact ice giants? (The natural building blocks, Triton or Pluto, are 2/3 rock by mass) (2) What happens during accretion? In particular, do the three constituent classes of material (ice, rock and gas) mix? (3) How do we get a convective interior needed for a dynamo? This is highly non-trivial if water and hydrogen mix (that would tend to give a double-diffusive system which cannot support a dynamo). What are the consequences of the likely limited solubility of water in hydrogen indicated by experiment? (4) Can giant impacts explain the Uranus-Neptune differences? (In particular difference in heat flow). (4) What do the very different satellite systems tell us? (5) How are different stories for formation and evolution expressed in atmospheric structure? (6) How can Uranus and Neptune inform us about exoplanets?

Keywords: origin, evolution, internal structure

*Speaker