Planethood Definition Thoughts

Brian C. Laskeiwicz[1]

This paper is submitted in support of a planetary definition based on the intrinsic gravitational properties of celestial objects.[2] The planetary definition adopted by the IAU focuses on dynamics, leads to anomalous results[3], applies only to our solar system, and does not incorporate discoveries concerning extrasolar planets.[4] Therefore, a more scientifically sound definition, flexible enough to incorporate new discoveries and make predictions, is required. Such a definition begins with a consideration of an object's intrinsic properties based on fundamental forces of physics exerted by its own matter and energy. Astronomical observations have established the existence of objects whose origins stem from one of three basic classes:

(1) objects with mass insufficient for gravity to force its shape into hydrostatic equilibrium, such as comets and small asteroids;

(2) objects with mass sufficient for gravity to force its shape into hydrostatic equilibrium, as opposed to mechanical strength, surface tension, rotation rate, or other factors, in less than Hubble time, which consist of planetary-class objects; and

(3) objects with mass sufficient for both the manifestation of hydrostatic equilibrium and deuterium- or thermonuclear-based fusion reaction at some point during its lifetime, such as brown dwarfs, stars, and black holes.[5]

In order for this definition to be more useful, it is necessary to define secondary, tertiary, and quaternary characteristics, such as dynamics, mass, and composition, and for these additional characteristic to be defined flexibly enough to accommodate new discoveries, such as the following non-exhaustive proposals:[6]

Characteristic Trait	Description of Sub-Categories
Dynamics	(0) 0^{th} degree, or free planet (not directly orbiting star or planet) (1) 1^{st} degree, or primary planet (directly orbiting star) (2) 2^{nd} degree, or secondary planet (directly orbiting planet)
Mass	Sub-Dwarf (≤ 0.03 Earth); Dwarf (0.03-10 Earths); Sub-Giant (10-100 Earths); Giant (100-1,000 Earths); Super-Giant (1,000-30,000 Earths)

---

[1] Brian C. Laskiewicz, Esq. is an amateur planetary astronomer studying physics at Rutgers University and attorney admitted to practice law in New Jersey and New York, with an email address of brianlask2000@yahoo.com.

[2] D.A. Weintraub, Is Pluto A Planet?, pp. 224-226, 2007, Princeton University Press (Princeton, New Jersey) (hydrostatic equilibrium-based definitions advocated by S.A. Stern, H.F. Levison, and M. Buie).

[3] M.V. Sykes, "The Great Planet Debate," *Planetary Science Institute Newsletter*, Fall 2006.

[4] International Astronomical Union Planetary Definition Resolutions 5A and 6A, adopted August 24, 2006.

[5] S.A. Stern and H.F. Levison, "Regarding the Criteria for Planethood and Proposed Classification Schemes," in *Highlights of Astronomy*, vol. 12, ed. H. Rickman, Astronomical Society of the Pacific (San Francisco), 2002, pp. 2005-13.

[6] *Id.*, Weintraub at pp. 225-226, citing M. Buie definition and criteria set forth in personal communication.

Composition[7]	Iron, Silicate/Rock, Carbon, Water/Ice, Carbon Monoxide, Hydrogen, various mixtures of these compositions

As applied to our solar system, classification examples for some planetary-class objects include:

Planetary Class Objects	Dynamics	Mass	Composition
Jupiter, Saturn	Primary	Giant	Hydrogen
Uranus, Neptune	Primary	Sub-Giant	Ice
Mercury, Venus, Earth, Mars	Primary	Dwarf	Silicate/Rock
Ceres	Primary	Sub-Dwarf	Silicate/Rock
Pluto, Eris, other known KBOs	Primary	Sub-Dwarf	Ice
Moon, Galilean satellites, Titan	Secondary	Dwarf	Silicate/Rock
Triton, Charon, "Saturn/Uranus satellites"[8]	Secondary	Sub-Dwarf	Ice

The exact contours of the definition, including but not limited to, hydrostatic equilibrium threshold for various kinds of materials, as well as brown dwarf deuterium fusion threshold, need to be further established throughout continued observation in order to more accurately convey a description of the intrinsic physical properties of celestial objects both in our solar system as well as the rest of the universe.[9]

---

[7] *Id.*, M. Kuchner, S. Seager, C. Hier-Majumder, B. Militzer work in "Scientists Model a Cornucopia of Earth-sized Planets," September 24, 2007, http://www.nasa.gov/centers/goddard/news/topstory/2007/earthsized_planets.html, retrieved June 19, 2008 (discussing observed and hypothetical types of planetary compositions).

[8] Stern and Levison (last cell includes 6 largest Saturn satellites after Titan and 5 largest Uranus satellites).

[9] Weintraub at 185-202, 209-211 (as to lower bound for hydrostatic equilibrium and brown dwarf mass limit).