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A Mass-Radius Relationship for the Study of Extra-Solar Planets: First Tests on the Solar System Bodies

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Since 1995, more than 170 extra-solar planets have been detected. New instruments and technical improvements have allowedthe recent detection of planets less than 10 Earth masses. Upcoming missions such as COROT (launch in 2007) and Darwin/TPF will be devoted to the discovery of such "small planets". Super-Mercuries and super-Earth are expected to be found, in addition to a new collection of bodies called "planet-oceans". The latter aresimilar to the icy moons of our solar system but much larger. Characterization of the different kind of planets (Mercury/Earth/icy type) will be achieved using the Darwin/TPF and COROT data if a relationship between the mass and the radius of the planets can be found. We propose a model for describing the M-R relation in the different cases based on the equation of state of iron, silicates and ices. Since the only constraints on the composition will be provided by the metallicity of the harbouring stars, the model forces the ratios [Si/Fe] and [Mg/Fe] for the planet. Results obtained on the solar system bodies (including small icy moons) will be presented. It will be shown that, except for Mercury, the model predicts accurately whether the body is either Earth-like(Moon, Venus, Mars, and Earth) or icy (icy moons) even for a simplified composition equal to solar composition. Investigation of the M-R relation for larger bodies (up to 10 Earth masses) is now conducted. A main issue is the determination of uncertainties. Indeed, equation of states for iron, silicates, and ices are well constrained for pressures and temperature relevant to the Earth case but no experimental data exist at larger pressures. Shock experiments provide equation of state for larger pressures but they are obtained at temperatures much larger than those expected in giant planets. Furthermore, other uncertainties, related to the effect of the star composition, the Mg number of silicates, or the temperature path within the planet will be presented.