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HCON and the Noble Gases in the Outer Planets

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Giant planets consist primarily of the six most abundant elements of baryonic matter in the universe: H, He, O, C, N, Ne. In addition, the noble gas Ar is an important atmospheric trace element in the ice giants for inferrence of their rock content and interior structure. Observations of atnospheric composition, gravity field, magnetic field, and luminosity constrain interior models. We do that in order to learn about the deep interior composition and the behavior of warm dense matter, such as phase separation in H/He, H/O, or H/C-systems. The isotopes of H as well as dense solid C are of great interest in fusion experiments for civil energy production.
After a long period of poor constraints, the recent Jupiter observations with NASA's Juno spacecraft and the improvements in the H/He-Equation of state are meanwhile posing challenges for interior modelers. The standard view of adiabatic, i.e constant-entropy interiors requires revision, as stable layers, sub-adiababic or super-adiabatic, appear to be needed nearly everywhere now in Jupiter. Moroever, the long-standing faintness-problem of Uranus has converted into a brightness-problem of Neptune.
I will give an overview of current interior and evolution models of the Outer Planets and lay out directions for future progress. Key words here are double-diffusive convection and diamond rain.

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