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### **A solid-state physicist's journey to the centers of planets**

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**Abstract:** Planetary interiors are totally inaccessible to direct exploration and are characterized by conditions of pressure and temperature that are difficult to reproduce in the laboratory. At those conditions materials undergo important changes including metallization, loss of magnetism, ionization and dissociation. Understanding such changes has wide ranging implications not only in planetary sciences and geophysics, but also in fundamental physics, chemistry, and materials science. In this context, atomistic simulations, in particular those based on density-functional theory, play an important role in extending our knowledge of the effects of pressure and temperature on materials well beyond the experimental limits. I will illustrate how atomistic simulations have contributed to our understanding of the interiors of giant planets and also how they have led to the discovery of a new, ultrahard form of solid carbon dioxide.