

## First-principles simulations in condensed matter physics and their application to giant planets

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### Resumo

The Kepler satellite has detected over 1000 new planets in distant solar systems. Starting with a brief overview over the search for such extrasolar planets, this talk will discuss the state of matter at high temperature and pressure conditions that prevail in the interiors of giant planets. We describe how data from the Galileo mission to Jupiter has been combined with first-principles simulations to demonstrate that there is helium rain on this planet [1]. Then we characterize water ice at megabar pressures and describe the structural transitions that were recently predicted [2]. Since water ice is assumed to be one of the primary components of the cores of gas giants, we analyzed its stability when it is exposed to metallic hydrogen. We could show that the cores of Jupiter and Saturn have been eroded [3]. This presentation concludes by discussing different condensed matter simulation techniques and their applications. Ground-state quantum Monte Carlo, path integral Monte Carlo, density functional theory will be compared.