EQUATION OF STATE FOR METALLIC HYDROGEN AND ATOMIC HELIUM AND THE INTERIOR OF JUPITER AND SATURN

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S u m m a r y

An equation of state for a mixture of metallic hydrogen and atomic helium has been proposed. The explored intervals of pressure, temperature, and density correspond to the conditions on the largest solar system planets, Jupiter and Saturn. The substance of a planet is modelled as a mixture of protons, helium atoms, and electrons. A theory, where the electron-proton and electron-atom interactions are considered as a perturbation, has been used to find the pressure in the mixture. The electron subsystem is analyzed in the random phase approximation, and the proton-proton, atom-atom, and proton-atom interactions in the hard-sphere approximation. The applicability of the polytropic sphere model for the simulation of Jupiter's and Saturn's internal structures has been analyzed, and a specific value for the polytropic index has been proposed. The density, pressure, and temperature on Jupiter and Saturn as functions of the distance from the planet center have been found. Possible fractions of hydrogen and helium in the planet composition have been estimated.