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Water-methane mixtures at extreme conditions MAL-SOON LEE, Michigan State University, SANDRO SCANDOLO, International Centre for Theoretical Physics (ICTP) — The solubility of methane in water is low at ambient conditions but grows at extreme conditions. A methane-water fluid mixture makes up more than 90% of the middle layer of Neptune and Uranus, where it is subject to pressures up to several hundred gigapascal. Separate studies on the mixture end-members, water and methane, show that extreme conditions lead pure water to form an ionic fluid, while methane dissociates forming hydrocarbons and precipitating diamond. Our first-principle molecular dynamic simulations show that the properties of a fluid water-methane mixture are qualitatively different, at extreme conditions, with respect to those of the individual components. Mixing of methane and water at extreme conditions is a consequence of the pressure-induced softening of their intermolecular interaction. Ionized water causes the progressive ionization of methane and the mixture becomes electronically conductive at milder conditions than pure water, suggesting that the planetary magnetic field of Uranus and Neptune may originate at shallower depths than currently assumed.

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