A Novel Ultra-Cold Quantum Plasma: From Wigner Crystallization to a Molecular Bose-Einstein Condensate?

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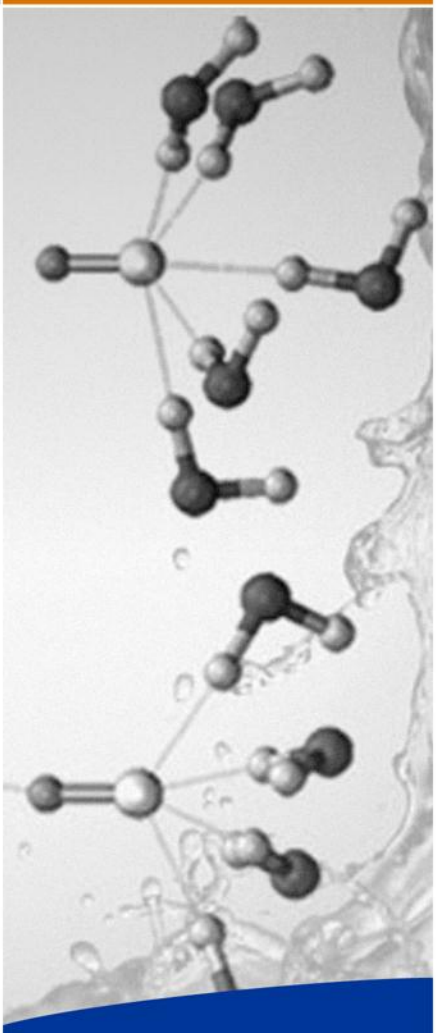

Presented by…

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Abstract

Bose-Einstein Condensation (BEC) was first achieved in the liquid phase in helium a century and, for gas phase atoms, a decade ago. The question arises if there could be a third BEC of a solid, crystalline, state. A possible pathway towards such a new state of matter is a *quantum plasma* for which the *de Broglie* wavelength becomes larger than the mean distance between particles. For the electrons in an ultra-cold ion-electron plasma this condition is fulfilled for a temperature below $0.1K$ and a density above 10^{15} cm^3. We produce such an ultra-cold Rydberg plasma by laser threshold ionization of NO molecules in the high-density expansion region of a supersonic jet close to the nozzle. This plasma has an extremely long lifetime of milliseconds, and it shows the compressibility of a "sponge like" ultra-soft solid. An explanation is the formation of an electron *Wigner crystal,* which according to *A A Abrikosov* should also lead to the formation of a lattice of the cations. A possible cooling mechanism for the molecular cations (such as $^{14}N^{16}O^+$ Bosons) towards quantum degeneracy, *i.e.* a *molecular Bose-Einstein Condensate,* will be discussed.

More info?

See http://www.pnnl.gov/cmsd/seminars/

Date: Monday, February 6

Location: EMSL Auditorium

Time: 11 am