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Properties of the ultracold molecular plasma formed in a seeded supersonic beam of NO EDWARD GRANT, JONATHAN MORRISON, CHRISTOPHER RENNICK, University of British Columbia — We have prepared an ultracold plasma of NO^+ molecular cations and electrons, entrained in a seeded supersonic molecular beam as a 1 mm^3 volume element with a charge density exceeding 10^{12} cm^{-3}. Crossed laser beams defining this volume element produce a dense gas of NO molecules excited to a single rovibrationally selected nf Rydberg state. Rydberg-Rydberg Penning interactions initiate the evolution to a plasma on a 100 ns timescale. The first of these electrons escape, after which Rydberg molecules and electrons – now trapped in the potential well formed by the macroscopic space charge – undergo an avalanche of ionizing collisions. The reservoir of Rydberg binding energy appears to moderate free electron temperature, and the high charge density acts to suppress exothermic three-body recombination. We have measured a rate of plasma expansion over 30 μs that accords with the Vlasov equations for a quasi-neutral plasma with an electron temperature that falls from an initial 8 K to 1 K, corresponding to an electron correlation, Γ_e, as high as 10.

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