Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Metallic Hydrogen[1] ISAAC SILVERA, MOHAMED ZAGHOO, ASHKAN SALAMAT, Lyman Laboratory of Physics, Harvard University — Hydrogen is the simplest and most abundant element in the Universe. At high pressure it is predicted to transform to a metal with remarkable properties: room temperature superconductivity, a metastable metal at ambient conditions, and a revolutionary rocket propellant. Both theory and experiment have been challenged for almost 80 years to determine its condensed matter phase diagram, in particular the insulator-metal transition. Hydrogen is predicted to dissociate to a liquid atomic metal at multi-megabar pressures and T=0 K, or at megabar pressures and very high temperatures. Thus, its predicted phase diagram has a broad field of liquid metallic hydrogen at high pressure, with temperatures ranging from thousands of degrees to zero Kelvin. In a bench top experiment using static compression in a diamond anvil cell and pulsed laser heating, we have conducted measurements on dense hydrogen in the region of 1.1-1.7 Mbar and up to 2200 K. We observe a first-order phase transition in the liquid phase, as well as sharp changes in optical transmission and reflectivity when this phase is entered. The optical signature is that of a metal. The mapping of the phase line of this transition is in excellent agreement with recent theoretical predictions for the long-sought plasma phase transition to metallic hydrogen.

[1]Research supported by the NSF, grant DMR-1308641, the DOE Stockpile Stewardship Academic Alliance Program, grant DE-FG52-10NA29656, and NASA Earth and Space Science Fellowship Program, Award NNX14AP17H.

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Date submitted: 14 Nov 2014 Electronic form version 1.4