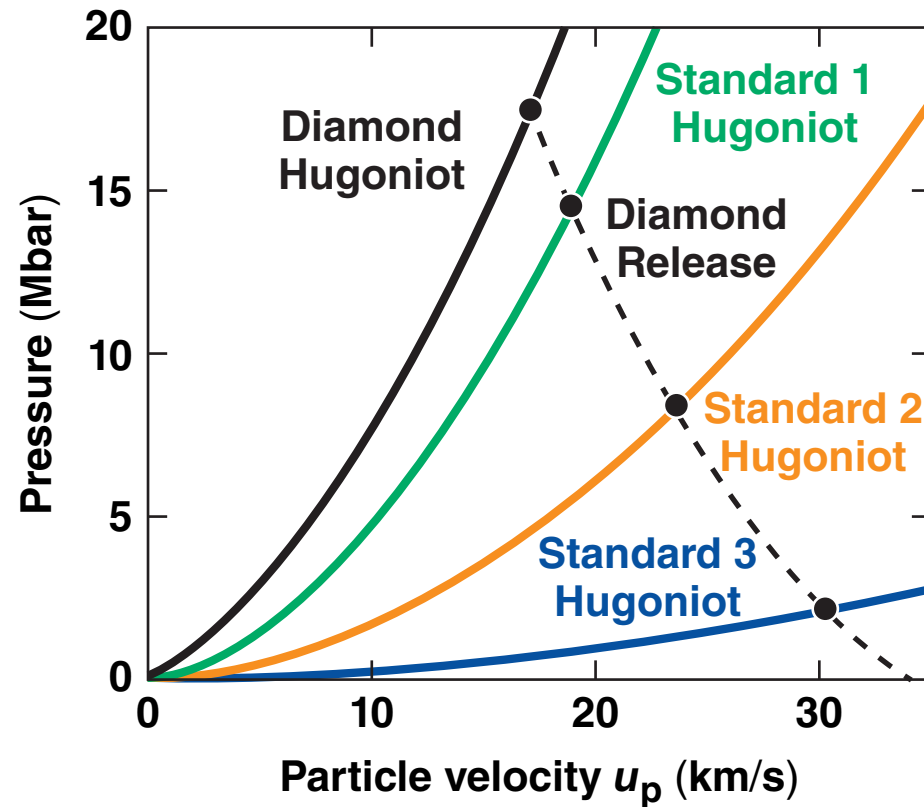


# The Release Behavior of Diamond Shocked to 15 Mbar



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American Physical Society  
Division of Plasma Physics  
New Orleans, LA  
27–31 October 2014

## Summary

# The release of shocked diamond is studied by impedance matching with known standards

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- **The National Ignition Facility (NIF) uses ultra-nanocrystalline high-density carbon (HDC) ablaters**
- **Knowledge of the diamond release behavior is critical for inertial confinement fusion (ICF) target designs**
- **Release data are obtained by impedance matching with known standards**
- **Release models for both single-crystal (SC) diamond and HDC will be constrained by the experimental data**

# Collaborators

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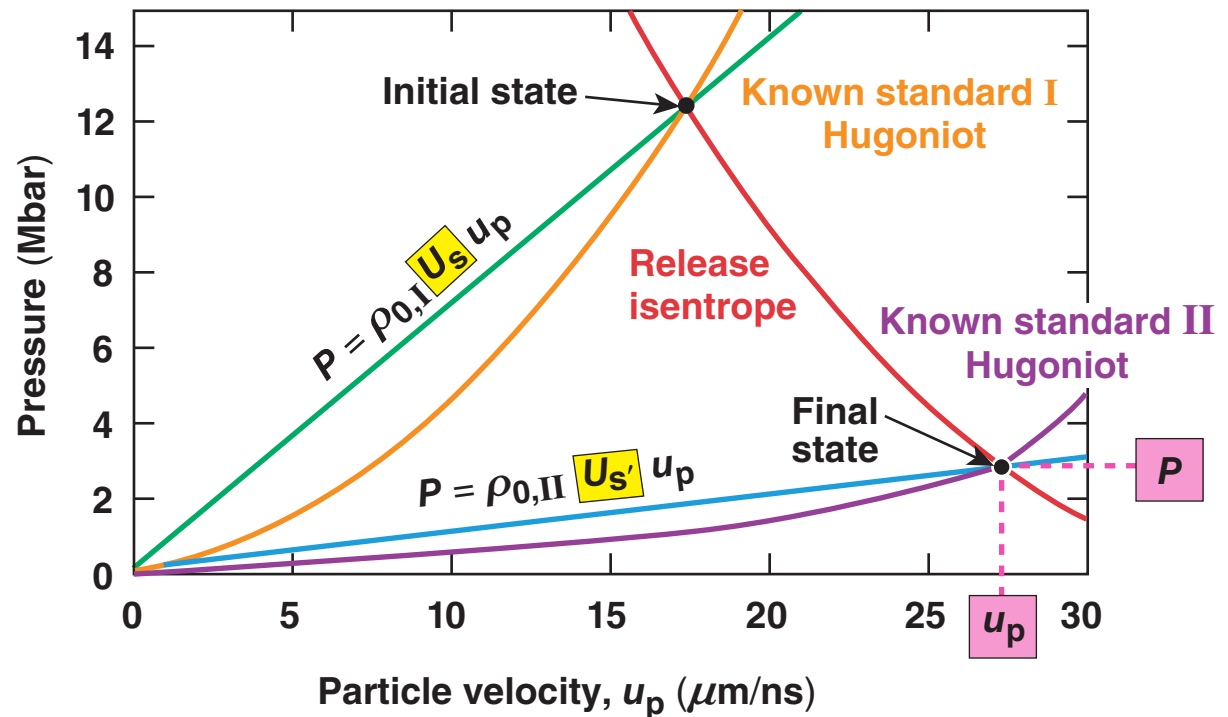
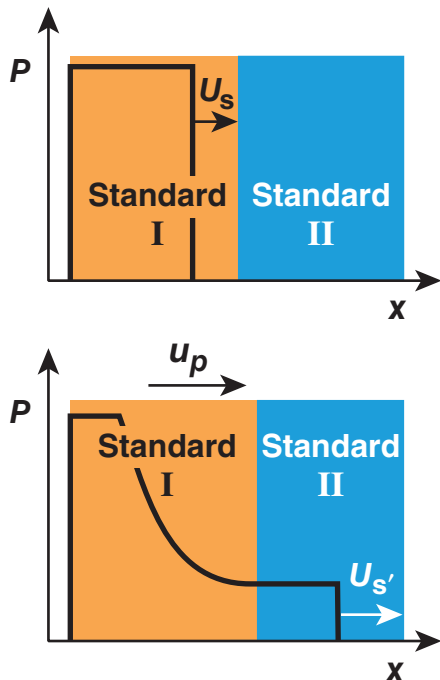
**T. R. Boehly, C. A. McCoy, D. N. Polsin, and D. D. Meyerhofer**

**University of Rochester  
Laboratory for Laser Energetics**

**D. E. Fratanduono, P. M. Celliers, and G. W. Collins**

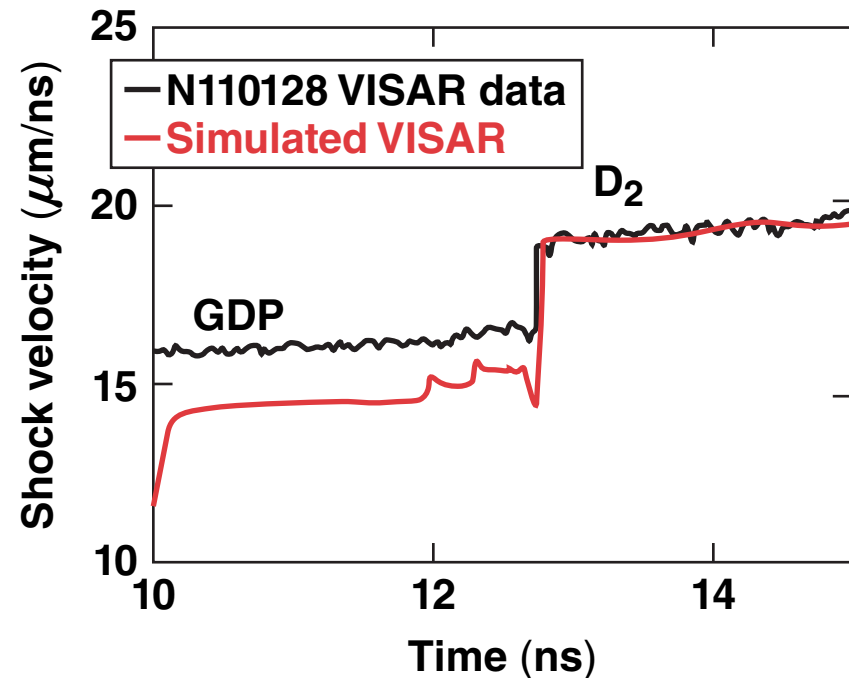
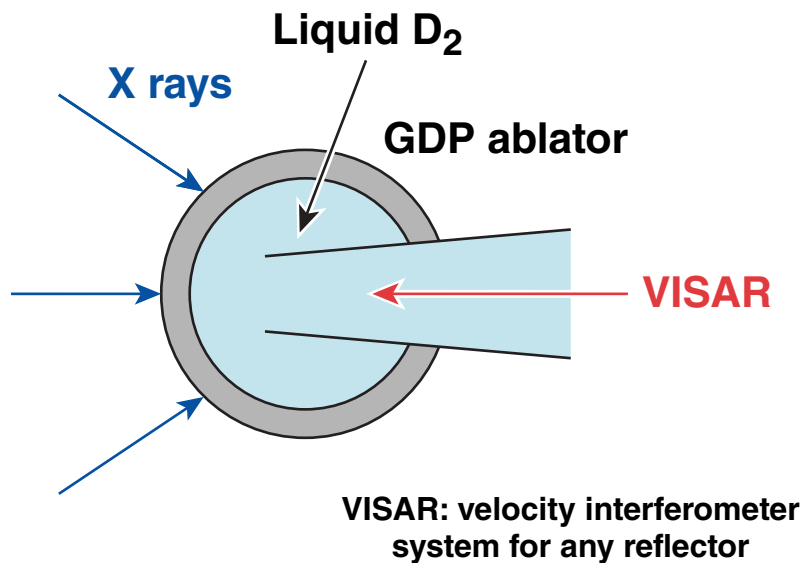
**Lawrence Livermore National Laboratory**

# Release data are obtained using the impedance-matching technique between known standards



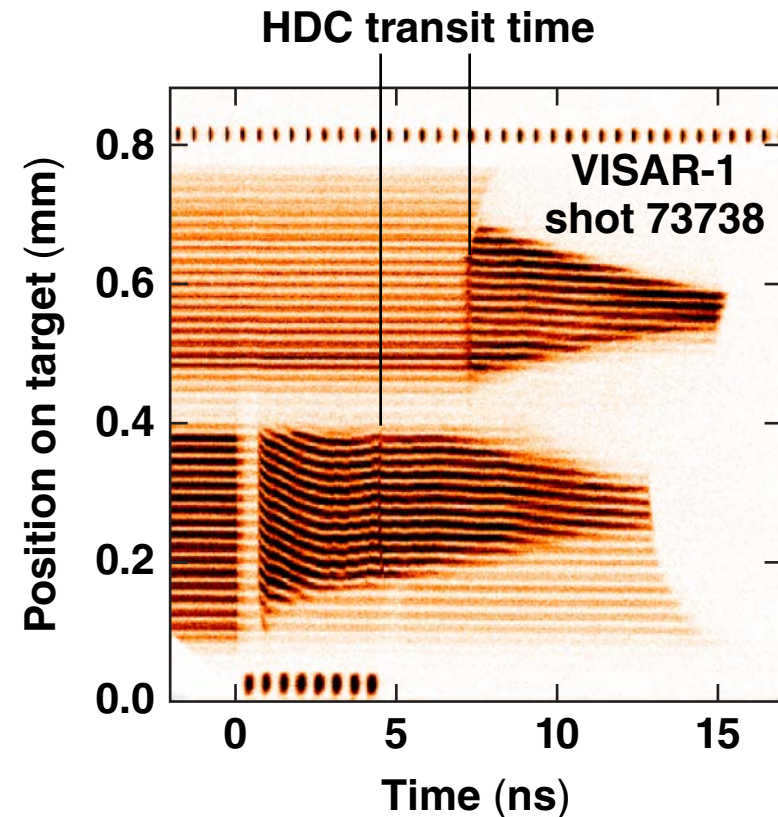
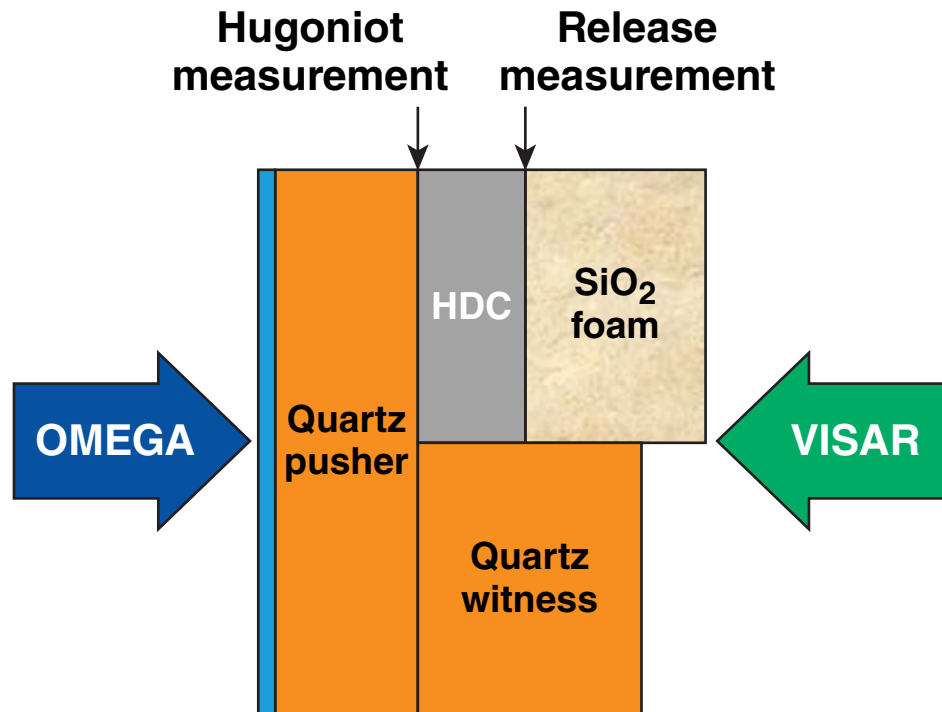
## Motivation

# Initial NIF shock-timing experiments revealed inaccuracies in the ablator release model



The glow-discharge polymer (GDP) equation-of-state model was corrected using release data into liquid D<sub>2</sub>.\*

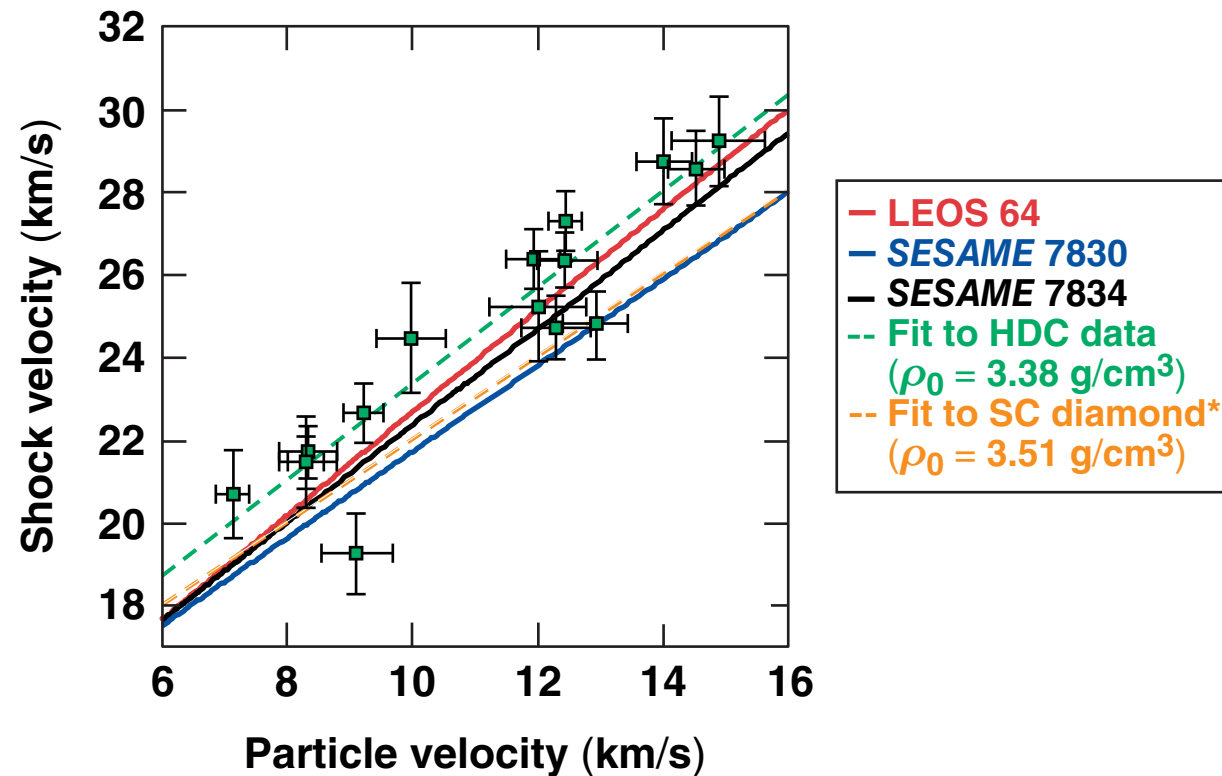
# Experiments with HDC provide both Hugoniot and release measurements



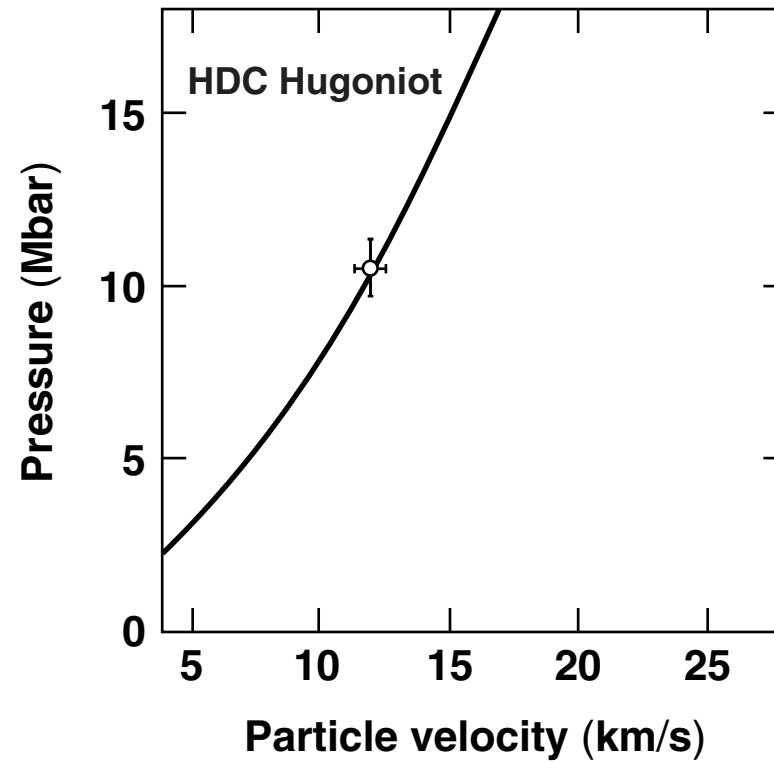
- Instantaneous shock velocities in HDC are determined using an unsteady waves correction\*

C. A. McCoy *et al.*, CO3.00006, this conference;  
D. E. Fratanduono *et al.*, JO7.00008, this conference.  
\*D. E. Fratanduono *et al.*, J. Appl. Phys. 116, 033517 (2014).

# Hugoniot measurements were used to create a $U_s-u_p$ relation for HDC

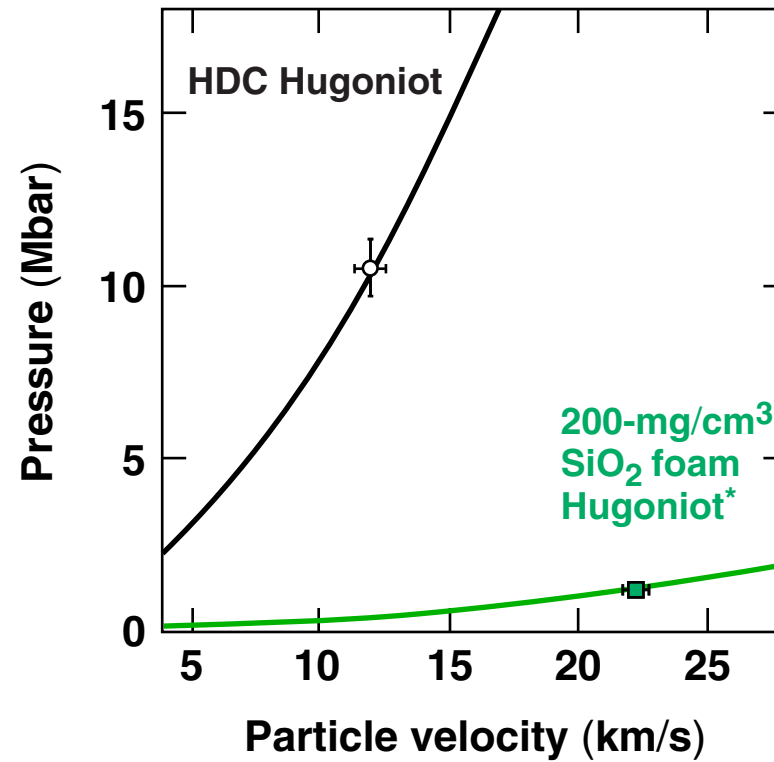


# The HDC release model is constrained by the experimental data



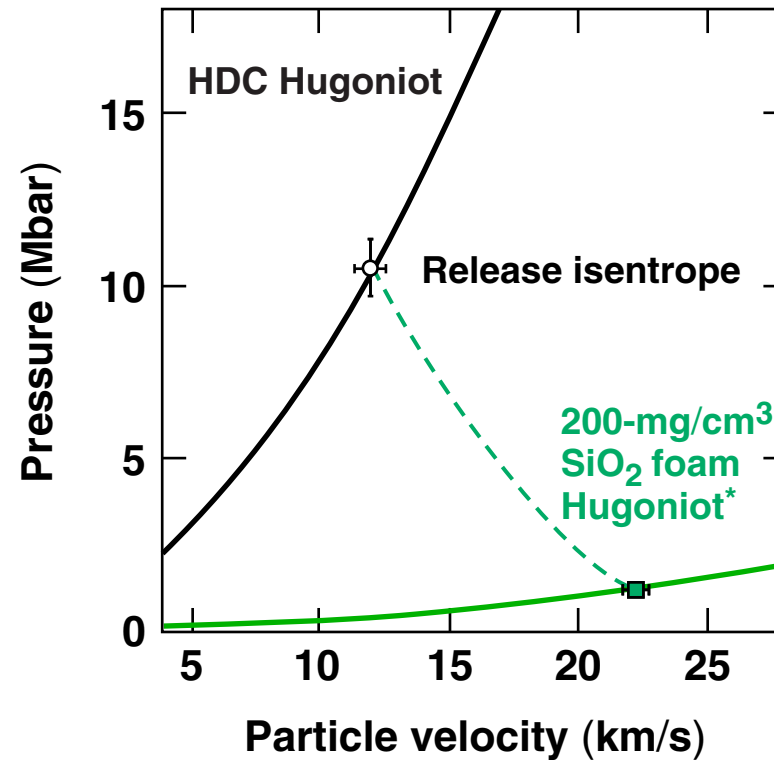


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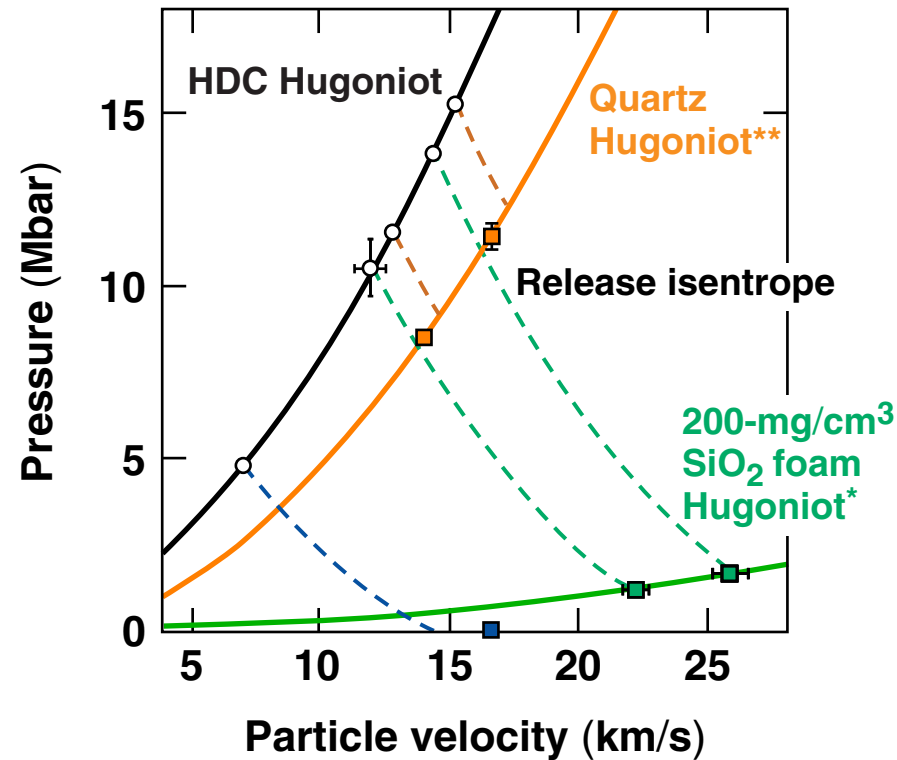
\*M. D. Knudson and R. W. Lemke, J. Appl. Phys. 114, 053510 (2013).

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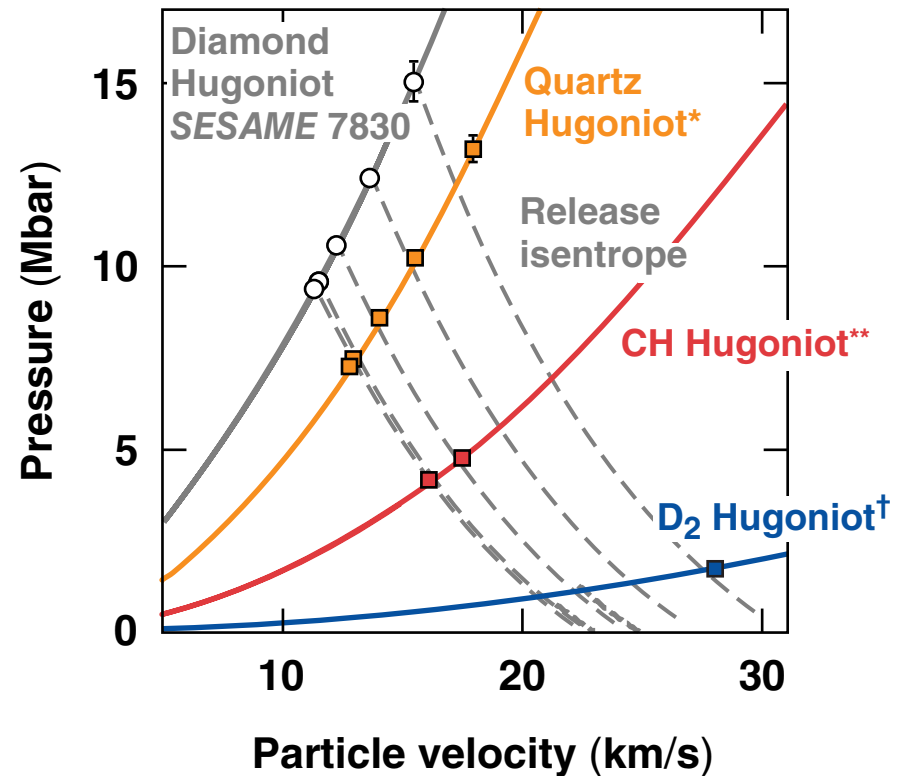
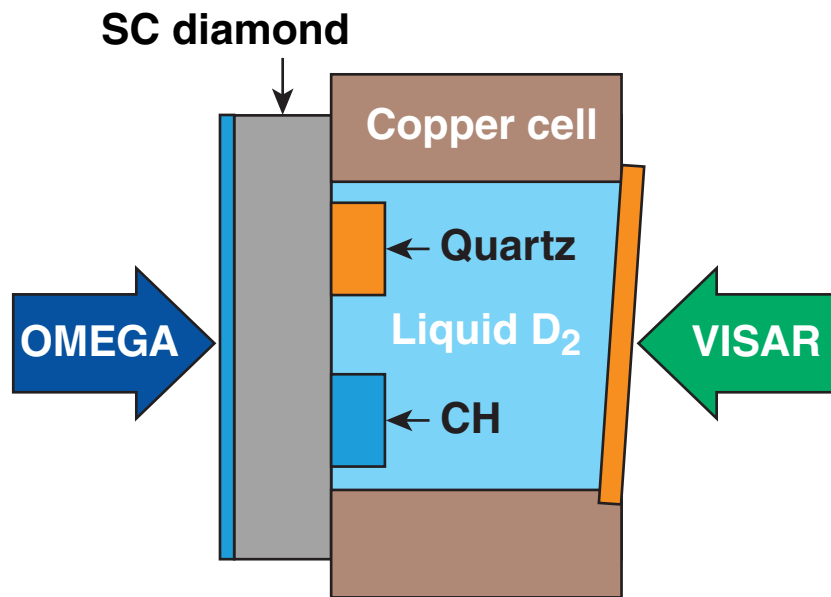
\*M. D. Knudson and R. W. Lemke, J. Appl. Phys. 114, 053510 (2013).

# The HDC release model is constrained by the experimental data



\*M. D. Knudson and R. W. Lemke, J. Appl. Phys. **114**, 053510 (2013).  
\*\*M. D. Knudson and M. P. Desjarlais, Phys. Rev. B **88**, 184107 (2013).

# The SC diamond release model is constrained using multiple standards



\*M. D. Knudson and M. P. Desjarlais, Phys. Rev. B **88**, 184107 (2013).

\*\*M. A. Barrios *et al.*, Phys. Plasmas **17**, 056307 (2010).

†D. G. Hicks *et al.*, Phys. Rev. B **79**, 014112 (2009).

# The release of shocked diamond is studied by impedance matching with known standards



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