Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Kinetics of shock-induced phase transitions in water[1] PHILIP MYINT, LORIN BENEDICT, ALEXANDER CHERNOV, BURL HALL, SEBASTIEN HAMEL, BABAK SADIGH, JONATHAN BELOF, Lawrence Livermore National Laboratory — The transition from liquid water to ice VII, a high-pressure solid polymorph of water, is believed to play an important role in the dynamics of the cores of certain outer Solar System planets and their moons. Although there have been some experimental studies over the past decade to study the water-ice VII transition through shock-wave compression, many of the details concerning the phase transition are still poorly understood. We present simulation results that closely match the experimental results, including those from highly overdriven systems where nanosecond freezing has been observed. The results are produced by a large-scale, multiphysics code developed by Lawrence Livermore National Laboratory that is linked to a phase transition kinetics library that we have recently developed. The library employs models based on classical nucleation theory. For example, the phase fraction is evolved in time according to the Kolmogorov-Johnson-Mehl-Avrami equation. Our simulations provide insight into the kinetics of freezing, particularly the importance of accounting for an induction time in the nucleation models.

[1]This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Date submitted: 25 Jan 2017 Electronic form version 1.4