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Energetic cavitation collapse: tabletop high energy density once per minute with ~1 J, ~1 kW driver MARC RAMSEY, ROBERT PITZ, Vanderbilt University — Liquid water is compressed to high energy density in an efficient and precisely controlled cavitation event with a repetition rate up to several times per minute. A vapor bubble of radius 1-2 mm is driven to collapse with a uniform pressure of 2-20 bar provided by a symmetric array of pulsed piezo-electric transducers, resulting in total kinetic energy of 1 to 100 mJ. Spherical symmetry is maintained to a convergence ratio of at least 100. Prior to stagnation a plasma is generated at a radius of 10-40 μm which persists for 2-10 ns over the range of collapse energies. In all cases, light emission begins abruptly (rise time < 1 ns) in the liquid just outside the bubble wall when it reaches a velocity of 4 km/s and acceleration above 10^{15} m/s^2 . At this point, inertial forces have adiabatically compressed the water to a pressure of roughly one megabar. The remainder of the collapse is obscured within this opaque plasma, which emits at a blackbody temperature above 5500 K. However, based on the final size of the cavity observed after the plasma quenches, it can be inferred that the implosion proceeds to significantly higher velocity higher before stagnation and emission of a strong shock wave. Diagnostic data to be presented includes 80 MHz 2D imaging and sub-ns time resolved spectral and spatial streak imaging.

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