Shock waves produce QED Radiation – not high temperatures!

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Abstract
Since the 1940's, physicists have been captivated [1] by how shock waves can heat gases to several thousands of degrees in the time scale of a few molecular collisions with the thermal transfer of energy in the temperature range 1000 to 10,000 K. However, the high temperatures based on classical thermodynamics calculations was never confirmed experimentally because sensors cannot be placed inside the infinitesimally thin shock thickness. Instead, gas temperatures were inferred from spectroscopic analysis of the frequency of EM radiation emitted from specific molecules assuming the molecules are in fact thermally excited. EM stands for electromagnetic. Today after about 75 years, nothing has changed: claims [2] of measurements of shock temperatures to an accuracy of 6 K over a range from 700-1200 K are made based on the NIR vibrational states of the CO_2 molecule.

High temperatures in shock waves are generally thought caused as a fast moving disturbance compresses gas molecules to nanoscale thicknesses. Based on classical thermodynamics, shock wave compression produces high pressure resulting in a sharp rise in temperature with monatomic gases producing temperatures near 10,000 K. Shock wave thicknesses are calculated [3] based on gas viscosity, e.g., for air having viscosity $\mu = 1.67\times10^{-5}\ m^2/s$, the shock thickness at Mach 2.71 is about 27 nm. However, QM and not classical physics govern the temperatures produced in the nanoscale shock thickness. QM stands for quantum mechanics. In fact, QM given by the Planck law precludes any temperature increase, let alone 10,000 K because the heat capacity of the atom vanishes through the thickness of the shock wave, and therefore high shock temperatures based on thermodynamics calculations or inferred from spectroscopy have no meaning.

Unlike classical physics, QM predicts the work of compressing the gas to the nanoscale shock thickness is conserved by the emission of non-thermal QED induced EM radiation. QED stands for quantum electrodynamics. Because of the high surface to volume ratio of the shock, the heat of compression is confined almost totally in the surfaces of the shock wave. For shock thickness d, atoms are therefore momentarily placed under high EM confinement. Since the temperature cannot increase by QM, QED conserves the surface heating by creating QED induced standing EM waves from the surface heat having half-wavelength $\lambda/2 = d$ within the shock thickness. Once the surface heat is expended in creating the standing QED radiation, the balancing EM confinement is lost and the QED radiation having Planck energy $E = h\upsilon$ is emitted to the surroundings. Here, h is Planck's constant and υ is frequency, where $\upsilon = (c / n) / \lambda = c / 2nd$, c the velocity of light, and n the refractive index of the compressed gases. QED induces non-thermal EM radiation in the UV and beyond, thereby exciting molecular vibration states without high temperatures. Hence, the shock thickness d may be inferred by measuring the frequency υ of QED induced UV radiation, i.e., $d \approx (\upsilon / c) / 2$, where $n \approx 1$ for gases. See diverse QED applications at http://www.nanoqed.org/, 2008-2016, and "Shock wave thickness by QED", 2015.

References
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