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Transient Plasma Physics: Nanosecond Pulsed Power Applied to Energy, Engines, and Other Things[1]

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Plasma in a formative state prior to equilibration of the electron energy distribution, (referred to here as "transient plasma"), is studied for improvement of engine efficiency in various types of fuel-burning engines. Ignition by transient plasma has demonstrated substantially reduced ignition delay, and shows promise for improving engine efficiency through improved combustion efficiency. This transient plasma persists for only a short time, and requires for operation short (< 100ns) pulsed high voltage, and typically small pulse energy (10mJ to < 1J). It thus requires nanosecond-time scale pulsed power. The plasmas, combined with the subsequent combustion, provide a rich physics. Results for studies of several varied engine types including internal combustion engines and pulse detonation engines will be reviewed. Experiments and modeling to determine the physics and some ideas for future directions will be presented. In addition, some other diverse applications for nanosecond pulsed power will be briefly described.

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