ULTRA-SHORT PULSE LASER-GENERATED PLASMA FLARES IN AIR AND ON DIELECTRIC SURFACES*

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We evaluate the use of an intense ultra-short pulse laser and a high-power millimeter wave beam or fiber laser beam to create and maintain a remote flare within the atmosphere or on the surface of a dielectric. The remote flare generation concept involves propagating an intense ultra-short pulse laser to generate the initial breakdown, followed by a longer high-energy millimeter-wave beam or laser to maintain the breakdown and deposit significant amounts of energy into the flare region. The localized plasma created by ultra-short laser pulse enhances the absorption of the longer pulse. The process involves a number of complex and inter-related nonlinear physical mechanisms that include photo-ionization, collisional ionization in air and solids, recombination, dielectric relaxation, plasma heating and hydrodynamics, the nonlinear propagation of the ultra-short pulse, and absorption in air. We analyze the physical processes discussed above and present laser, and millimeter wave requirements for initiating and sustaining the breakdown. In addition, we discuss future NRL experiments which will utilize an existing Ti-Sapphire ultra-short pulse laser, a 2 kW fiber laser, and a 15 kW 83 GHz gyrotron to demonstrate the breakdown. This concept has potential applications for electronic countermeasures, remote sensing, and guide star generation.

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* Work supported by ONR & NRL