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The use of infrared lasers to power optical-scale lithographically fabricated particle accelerators is a developing area of research that has garnered increasing interest in recent years. The physics and technology of this approach is reviewed, which is referred to as dielectric laser acceleration (DLA). In the DLA scheme operating at typical laser pulse lengths of 0.1 to 1 ps, the laser damage fluences for robust dielectric materials correspond to peak surface electric fields in the GV/m regime. The corresponding accelerating field enhancement represents a potential reduction in active length of the accelerator between 1 and 2 orders of magnitude. Power sources for DLA-based accelerators (lasers) are less costly than microwave sources (klystrons) for equivalent average power levels due to wider availability and private sector investment. Because of the high laser-to-particle coupling efficiency, required pulse energies are consistent with tabletop microJoule class lasers. Combined with the very high (MHz) repetition rates these lasers can provide, the DLA approach appears promising for a variety of applications, including future high-energy physics colliders, compact light sources, and portable medical scanners and radiative therapy machines.

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**CONTENTS**



*england@slac.stanford.edu