OPTICALLY GUIDED, COMPACT, HIGH-POWER FEL AMPLIFIER FOR ATMOSPHERIC PROPAGATION

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Abstract

An optically guided, compact, MW|-|class FEL for atmospheric propagation is analyzed. The FEL operates in the exponential gain regime and the optical beam is guided by the electron beam, with a filling factor that is nearly constant. For an electron beam with good quality, the optical beam quality is also good (M|-|squared = 1.5). Lethargy is insignificant. The optical beam can be pinched by focusing the electron beam (using external fields or betatron focusing) allowing the diffractive spreading of the FEL output beam to be large enough to allow the first relay mirror to be close to the exit of the wiggler without exceeding the mirror damage threshold. Atmospheric laser propagation simulations (including aerosols, turbulence, and thermal blooming) were carried out. The wavelength 2.141 micron was chosen for propagation and generation efficiency as well as for eye safety. In this design the average output power is determined to be $\sim$ 1.5 MW, starting from a $<$ 50W input. The wiggler length is $<$ 2 m and the distance from the wiggler exit to the relay mirror can be $<$ 3m for a mirror damage threshold of 50 kW|/|cm^2. Related experiments at the Brookhaven National Laboratory will be discussed.

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