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Scaling Relationship for Energetic Electron Beams Propagating in Air[1] R.F. FERNSLER, S.P. SLINKER, S.G. LAMBRAKOS, Naval Research Laboratory — Electron beams are the most efficient means for producing plasmas in air and other gases, and unlike discharges, beams ionize gas at rates almost directly proportional to the concentrations of the constituents. In addition, because the beam is responsible for ionization, the temperature of the plasma electrons (which far outnumber the beam electrons) is unusually low. The plasma potential and ion energies at adjoining surfaces are therefore low as well, properties that are important for certain applications. Electron beams are thus unique as a plasma source. Unfortunately, predicting the ionization generated by a beam over its entire range is difficult, and particle codes are usually used to do so. In this work scaling relationships for energy loss and scattering are combined with a particle code to construct a purely algebraic formulation capable of predicting the beam energy deposited in field-free, homogeneous air. This formulation is then combined with a simple fluid model to predict the plasma density and temperature. By this means, plasmas generated in air can be predicted easily and algebraically at every point in space for beams having an initial energy of several keV or more. Similar models are possible in media other than air.

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