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Design and characterization of n benchtop electron beam system for validation of gas transport

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The transport of electron beams through moderate pressure gases is a challenging problem that involves beam evolution due to self fields and plasma generation through complex chemical pathways. The modeling of such experiments is made even more difficult due to low repetition rate, shot to shot variation, and large geometries. This work reports on the development and characterization of a field emission-based electron beam system designed specifically for model validation. The source is driven either by a self-matched transmission line switched through a spark gap or by a solid state pulser. In both cases the nominal pulsewidth is on the order of 10 ns with a beam voltage of 10 kV and a cathode (carbon velvet) current density of approximately 200 A/cm². Current and voltage diagnostics, beam imaging, and energy spectra are presented, followed by a discussion of future work.

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