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Efficient treatment of steady state and transient beam loading in electron linacs

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The two-beam accelerator is one of two primary concepts for the structure wakefield acceleration approach to an e+e- collider. Transient beam loading effects are a significant challenge for the drive beam in a TBA structure, where energy droop in ~50 nC electron bunch trains must be understood and compensated. This problem is being studied at the Argonne Wakefield Accelerator (AWA), where the need for new algorithmic approaches is pressing. The Hellweg code [1] accurately models steady state beam loading for traveling wave RF structures with a reduced model that is 1,000x faster than full electromagnetics. These capabilities can leverage technological synergies between electron-positron colliders and industrial/medical applications for electron linacs. We will discuss present Hellweg capabilities and plans for implementing transient beam loading capabilities in the future.

[1] S.V. Kutsaev, Y. Eidelman and D.L. Bruhwiler, "Generalized 3D beam dynamics model for industrial traveling wave linacs design and simulations," NIM A 906 (2018), p. 127.

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