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Calibration of the Main Linac Cryomodule Cavities for the CBETA Energy Recovery Linac

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I describe the method used for calibration the amplitudes and phases of the cavities in the Main Linac Cryomodule (MLC) for the CBETA energy recovery linac at Cornell University. The cavities are powered one at a time, and the phase of each cavity is set to a uniformly spaced set of values over a full 360 degree range, with cavity voltages set to one or more values. For each cavity, voltage, and phase, arrival time measurements are taken at BPMs upstream and downstream of the linac. No magnets lie between the linac and the BPMs. These measurements are used to obtain a least-squares fit the parameters of a model. The model is based on integrating through a fieldmap that was generated from a finite element computation. The parameters to be fit are the scaling factors between the programmed and actual cavity voltages, the offset between the programmed and actual cavity phases, and the the energy of the beam coming into the linac. The fitting process is accelerated by constructing a good initial guess for the parameters, and by computing the arrival time and its derivatives to the parameters so that Newton's method can be used to solve for the fitting parameters.

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Footnotes

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