Setting Sliding Joints for CBETA[⋆]

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Abstract

The sliding joints are set to give the desired phasing of the MLC. The R sliding joints are initially set in the design zero positions, while the S sliding joints are set to give the desired phase. The R sliding joints are then adjusted to find the maximum energy gain (or loss for the last pass), then adjusted to offset the phase from crest by the desired amount. The relevant parameters are tabulated for 150 MeV energy recovery.

Keywords: energy recovery linac

1. Sliding Joint Settings

In the lattice file, each path length adjustment chicane is controlled by an overlay named `O_[RS]#.SLI`, where `#` is the pass number, and `[RS]` refers to either `[R]` or `[S]`. The overlay contains two attributes: `delta` (I will write this as δ in formulas), the total path length difference created by the chicane, and `angle` (I will write this as θ in formulas), the angle of each of the two dipoles at the center of the chicane. The chicane contains three sliding joints, the outer two of which are directly controlled by moving stages. The offset of the sliding joint for a given `delta` and `angle` is given by

$$\frac{\delta}{4\sin^2(\theta/2)} \tag{1}$$

This can be seen in `tao` by executing

```
show element [RS]#.SLI01
```

and looking at the formula in the controller lord. Table 1 gives the lattice parameters and the amounts to move the sliding joints from their nominal positions.

When setting RF phase on the next pass, first the R sliding joints are adjusted to find the the maximum energy gain in the linac ("on crest"). Then the R sliding joints are moved to change the arrival phase by the

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[1]I forget what the contract is

Table 1: Values needed for setting sliding joint phases on each pass.

Line Energy (MeV)	42	78	114	150
S `delta` (mm)	−2.511	+1.314	−1.835	+1.260
S `angle` (deg.)	−19.714	−26.571	+22.450	+29.632
S Sliding Joint Offset (mm)	−21.423	+6.220	−12.105	+4.816
Expected R Sliding Joint Offset to Reach Crest (mm)	+6.116	−3.512	+4.881	−2.855
Measured phase offset from crest on R BPM (deg.)	−1.304	+1.229	−1.204	+1.204

appropriate amount by using the phase read on the last BPM in the R line (`IR#BPM01`). Table 1 gives an estimate of the amount that the sliding joints should be moved from their nominal position to achieve the maximum energy gain. It also gives the amount that the phase read on a BPM in the R line should change when you subsequently move the sliding joints to the required position to give the design phase (this is the effective linac phase). If the real machine perfectly matched the design, then the sliding joints would move by the negative of the amount given in Table 1 when you move from the crest to the design phase.