# Stability Charts for the FNAL Proton Driver

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**Abstract**

This document is a compilation of simulations performed by the codes `TRACK` (ANL) and `ASTRA` (DESY) for the FNAL Proton Driver with the purpose to compute the stability charts.

# Linac main section lengths and output kinetic energy.

| Section | Length | $W_{out}$ |
|---|---|---|
| Ion Source+LEBT | ∼0.2 m | 50 keV |
| RFQ | ∼4.0 m | 2.5 MeV |
| MEBT+RT-TSR | 12.6 m | 8.8 MeV |
| SSR1+SSR2 | 43.1 m | 121 MeV |
| TSR | 81.6 m | 421 MeV |
| S-ILC | 85.4 m | 1.2 GeV |
| ILC1+ILC2 | 451.4 m | 8 GeV |

# JP's Comments on Plots

Fig. 13-14 : Start of the 1.3 GHz section begins at kz/kx ∼0.8 (kx/kx0 and ky/ky0 ∼0.9) and goes to the "right" as indicated by the arrows. For both figures the kz/kx goes to the far right part (>1.2) before coming back to lower kz/kx.

Fig 15-16 : These two figures show the phase advance at zero current at the start of the linac, in the Room-Temperature Triple Spoke Resonator section (16 periods, start at ∼2.8 meters / end at ∼ 12.6 meters, i.e 9.8 meters long section). In these two figures only 14 periods are represented since the 2 first are "unstable" and neither TRACK nor ASTRA give any "real" numbers for the phase advances. What is presented in Figure 15-16 are periods 3 to 16. Therefore if we count the 2 first sections it takes in X and Y 11 periods (from 2.3 m to 8.2 m i.e ∼5.9 meters) to get the phase advance at zero current below 90 degree.

Fig. 17 : The longitudinal phase advance stays below 90 degree at the start of the linac.

Fig 18-19-20 : These 3 figures show the emittance increase at 45mA at the start of the linac (in the RT-TSR section). At 45mA, the transverse and longitudinal emittance increase by about 6 to 7 %.

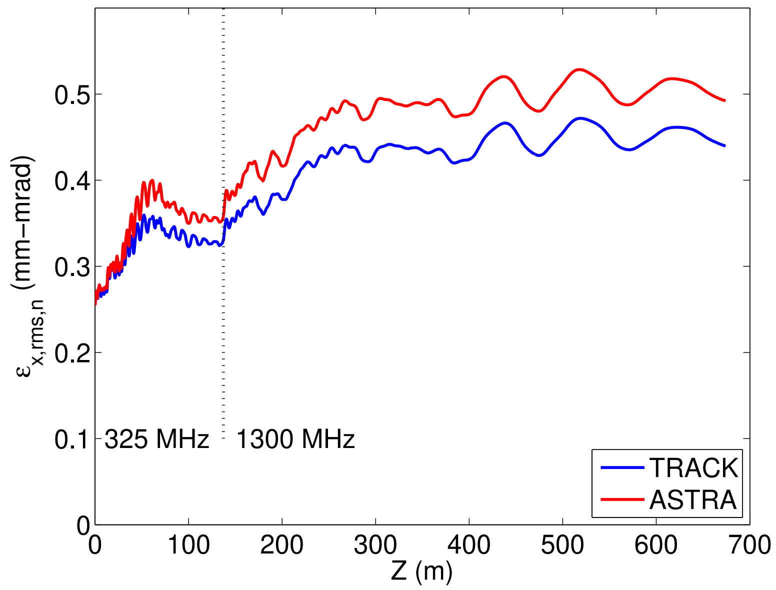


Figure 1: Horizontal RMS normalized emittance along the linac at 45 mA for `TRACK` and `ASTRA`.

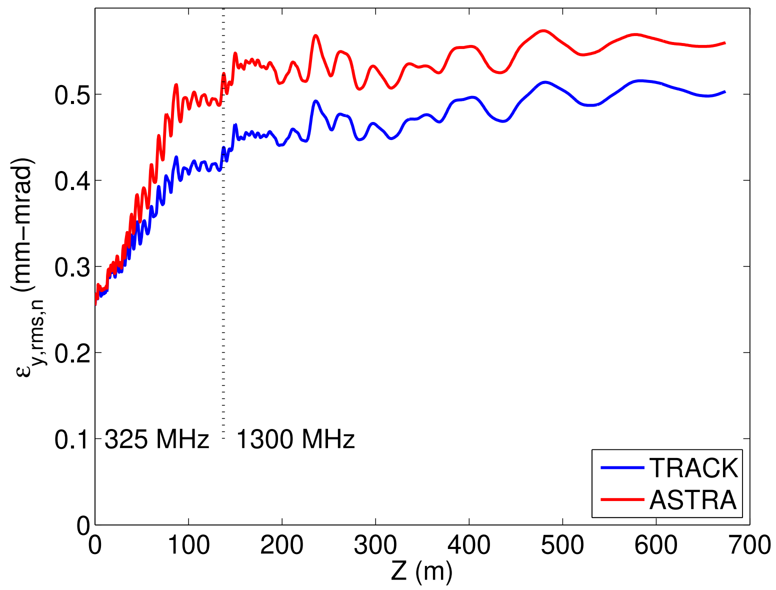


Figure 2: Vertical RMS normalized emittance along the linac at 45 mA for `TRACK` and `ASTRA`.

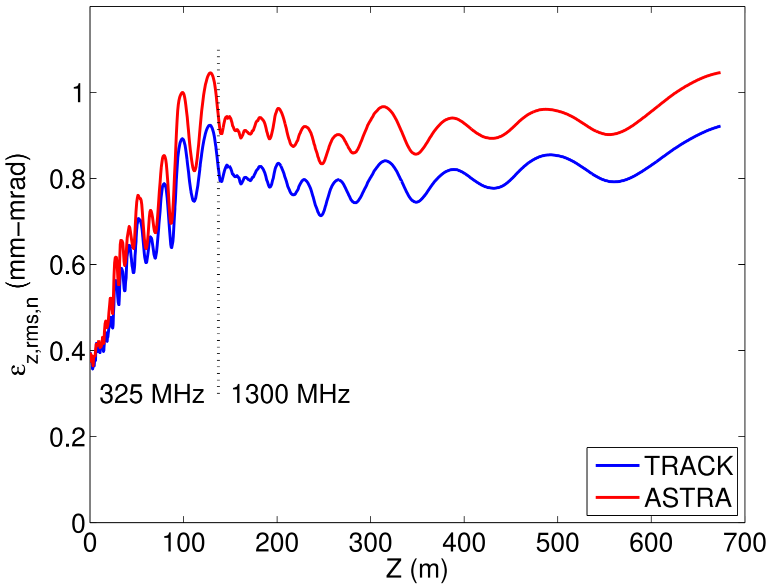


Figure 3: Longitudinal RMS normalized emittance along the linac at 45 mA for `TRACK` and `ASTRA`.

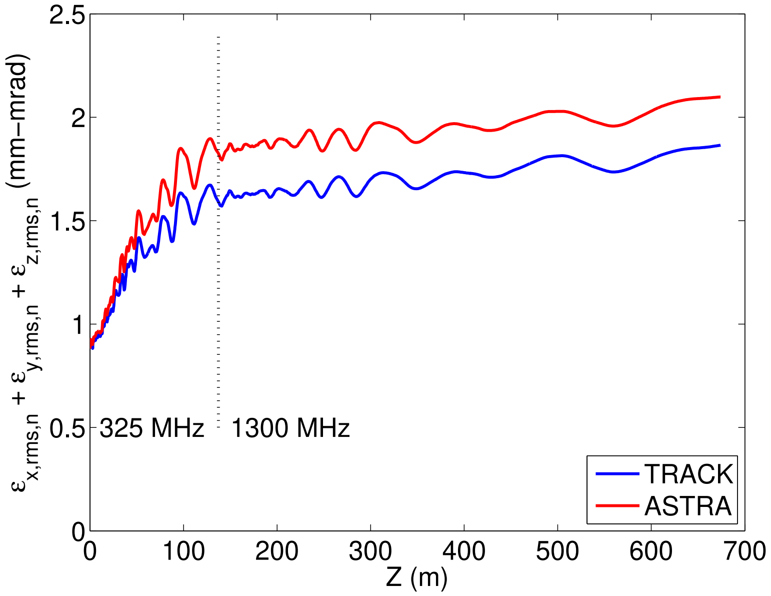


Figure 4: Sum of the Horizontal Vertical and Longitudinal RMS normalized emittance along the linac at 45 mA for `TRACK` and `ASTRA`.

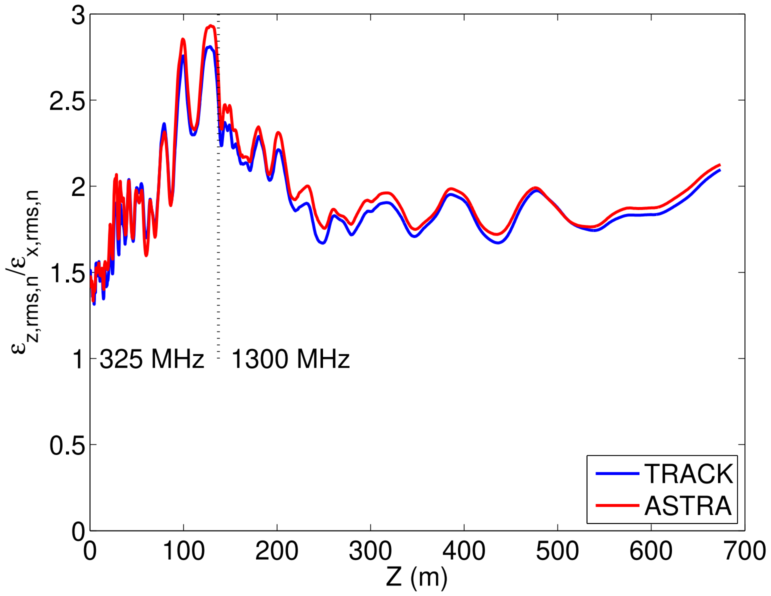


Figure 5: Ratio Longitudinal/Horizontal RMS normalized emittance along the linac at 45 mA for `TRACK` and `ASTRA`.

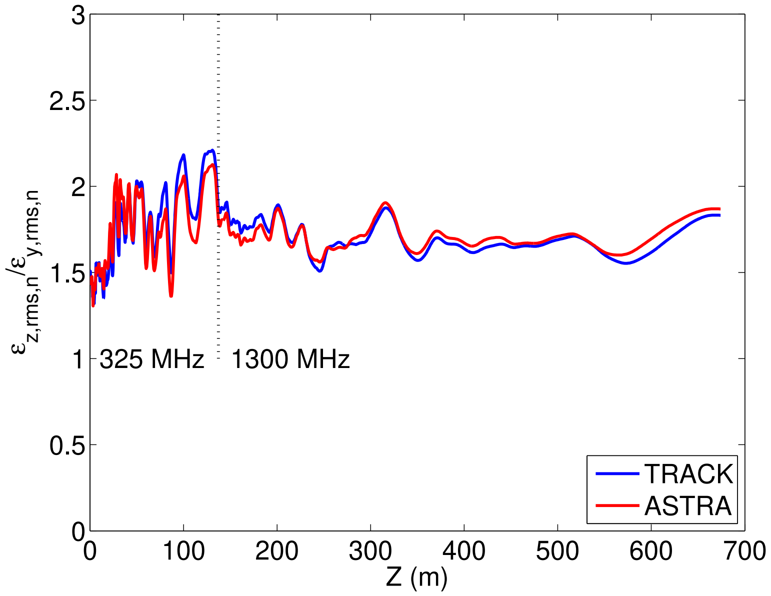


Figure 6: Ratio Longitudinal/Vertical RMS normalized emittance along the linac at 45 mA for `TRACK` and `ASTRA`.

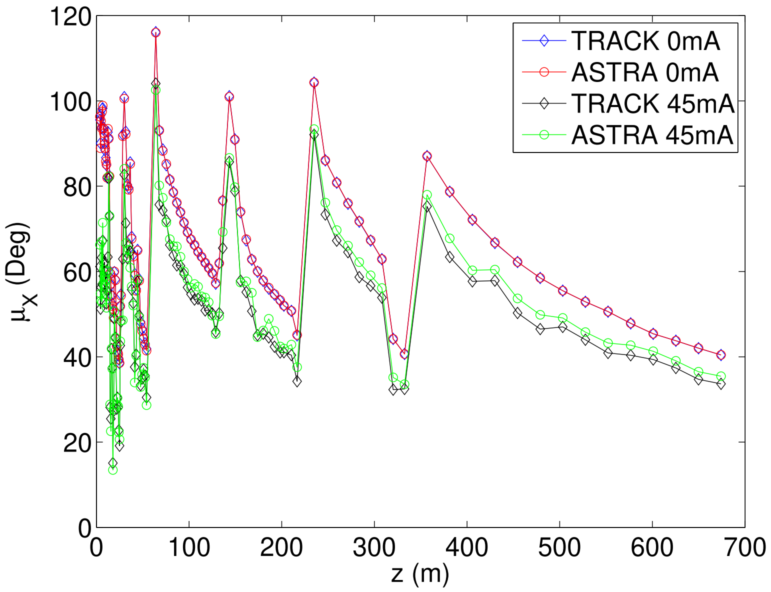


Figure 7: Horizontal phase advance along the linac at 0 mA and 45 mA for TRACK and ASTRA.

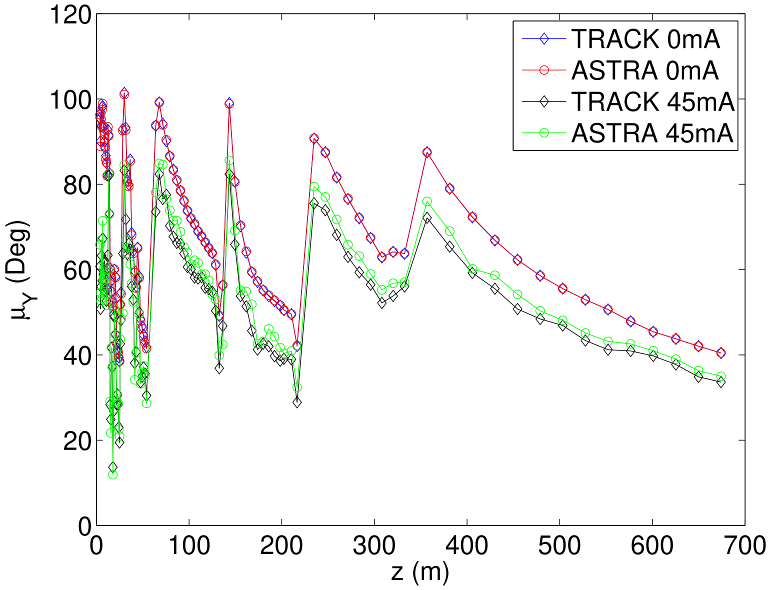


Figure 8: Vertical phase advance along the linac at 0 mA and 45 mA for TRACK and ASTRA.

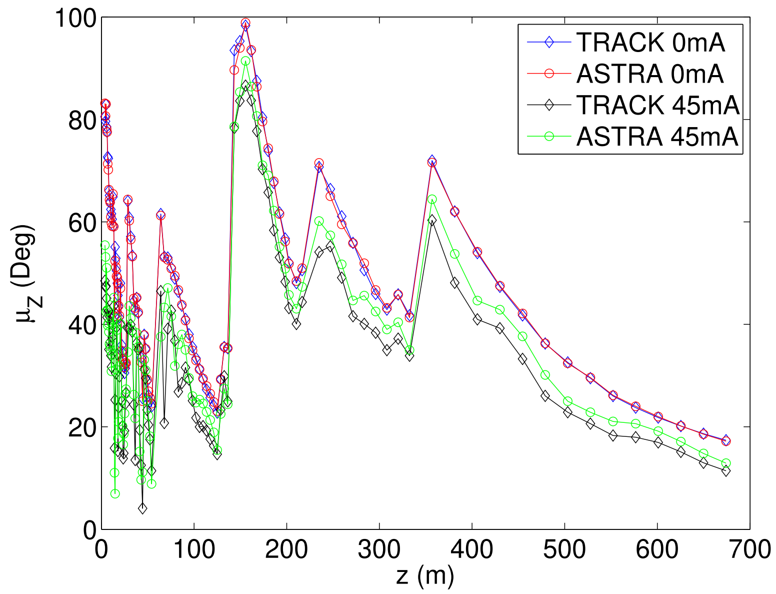


Figure 9: Longitudinal phase advance along the linac at 0 mA and 45 mA for TRACK and ASTRA.

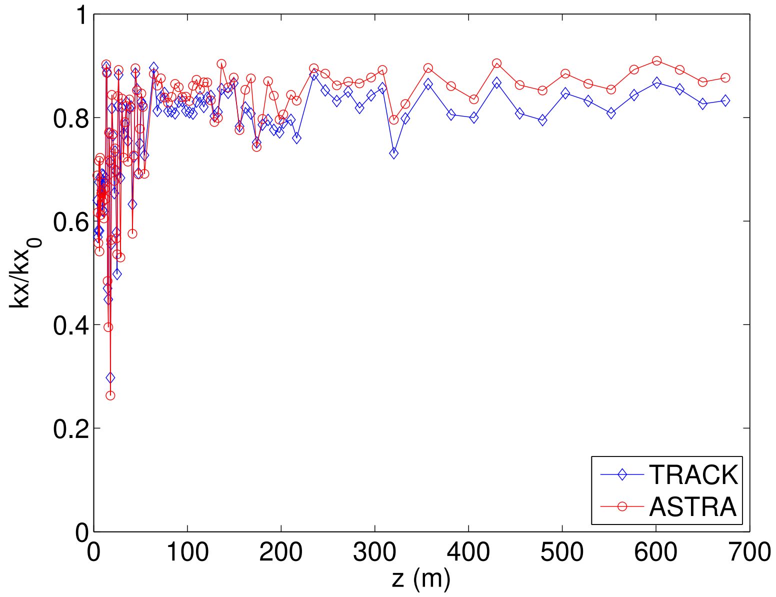


Figure 10: Horizontal tune depression along the linac for TRACK and ASTRA.

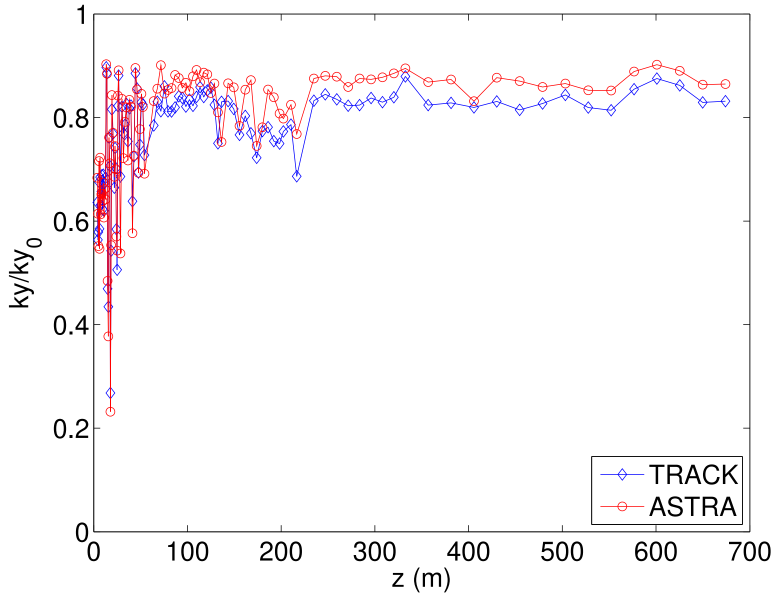


Figure 11: Vertical tune depression along the linac for TRACK and ASTRA

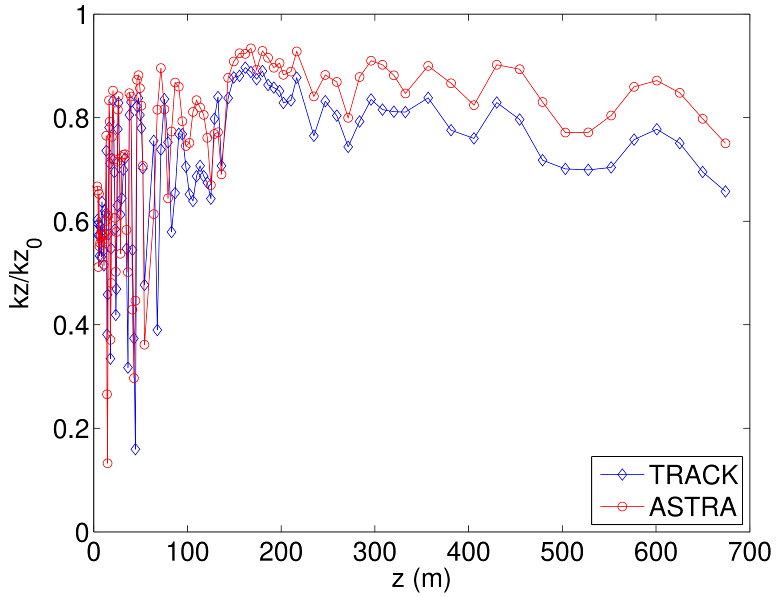


Figure 12: Longitudinal tune depression along the linac for TRACK and ASTRA

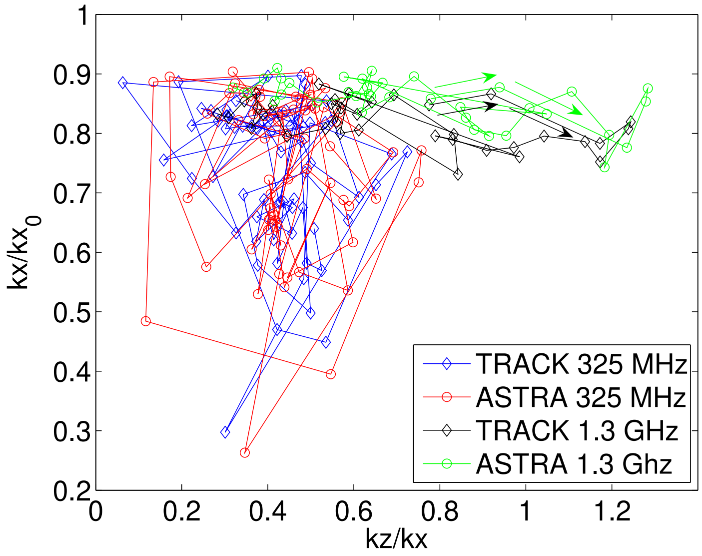


Figure 13: Stability Chart X

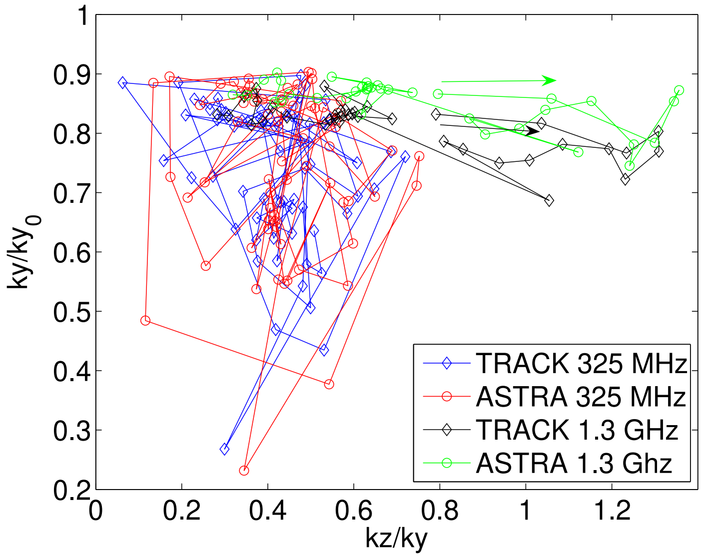


Figure 14: Stability Chart Y

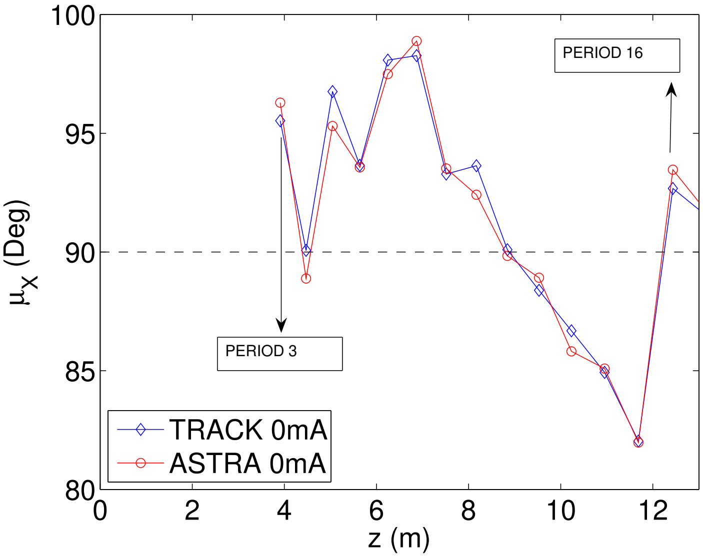


Figure 15: Horizontal phase advance at the start of the linac at 0 mA for TRACK and ASTRA.

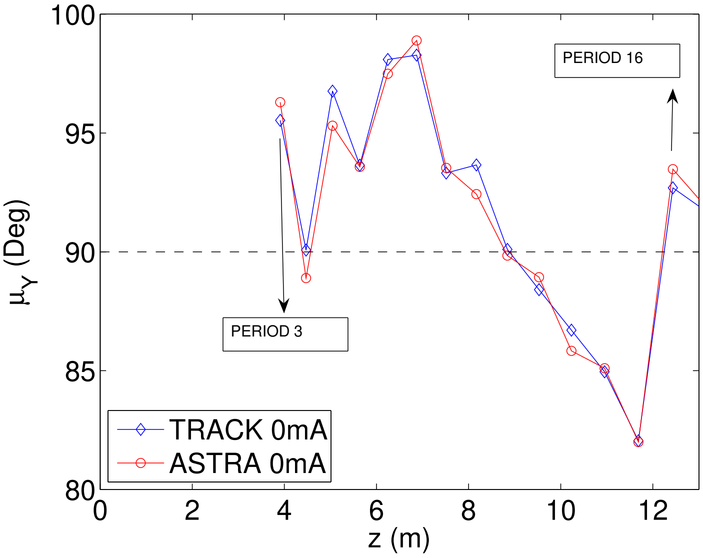


Figure 16: Vertical phase advance at the start of the linac at 0 mA for TRACK and ASTRA.

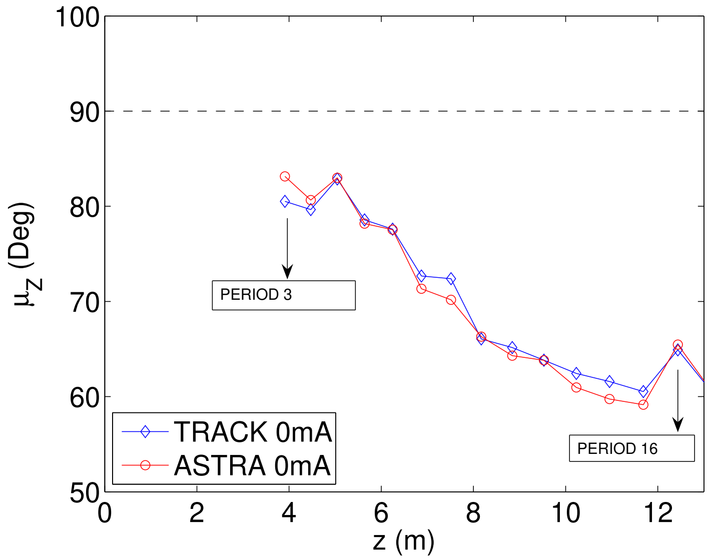


Figure 17: Longitudinal phase advance at the start of the linac at 0 mA for `TRACK` and `ASTRA`.

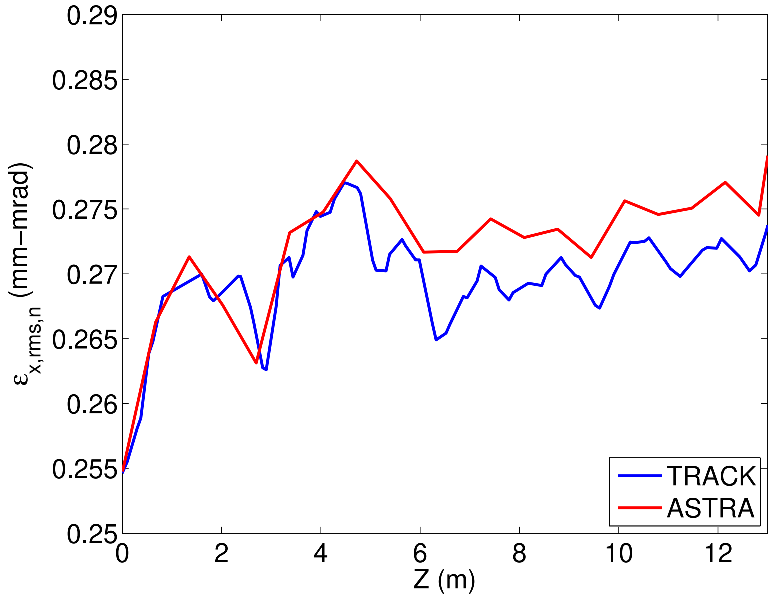


Figure 18: Horizontal RMS normalized emittance at the start of the linac at 45 mA for `TRACK` and `ASTRA`.

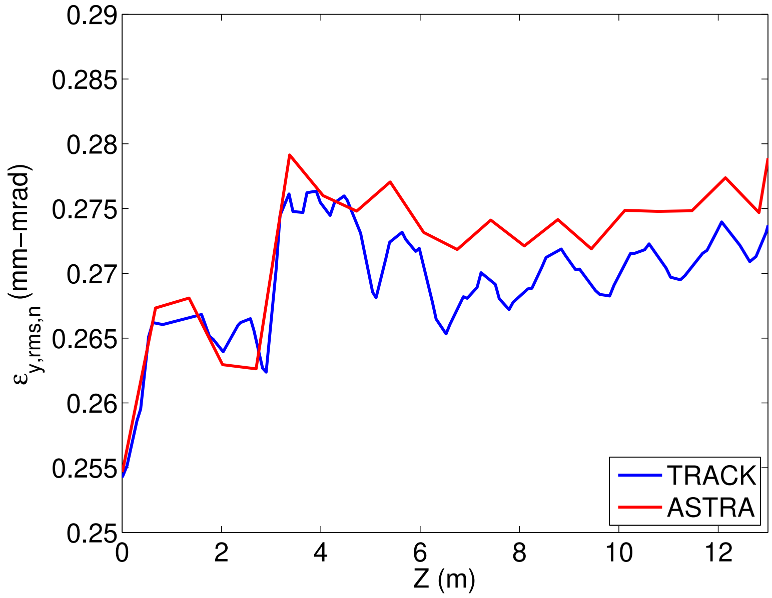


Figure 19: Vertical RMS normalized emittance at the start of the linac at 45 mA for TRACK and ASTRA.

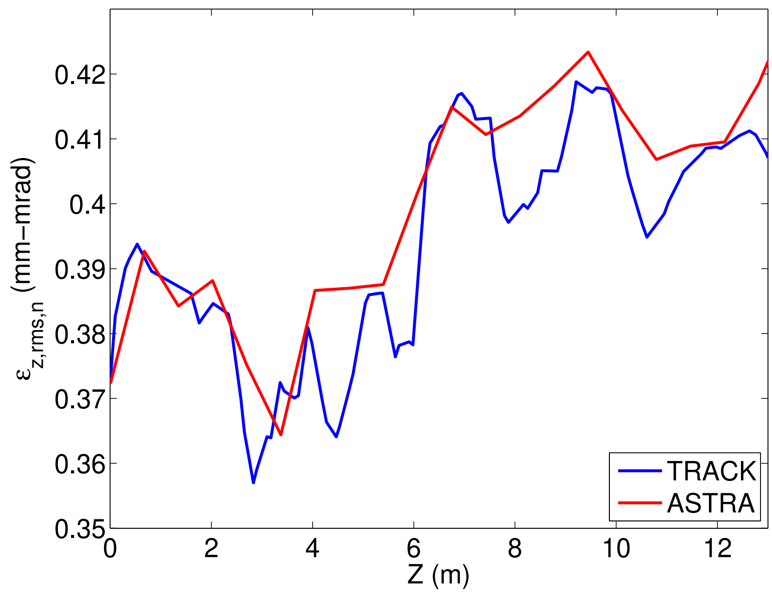


Figure 20: Longitudinal RMS normalized emittance at the start of the linac at 45 mA for TRACK and ASTRA.