

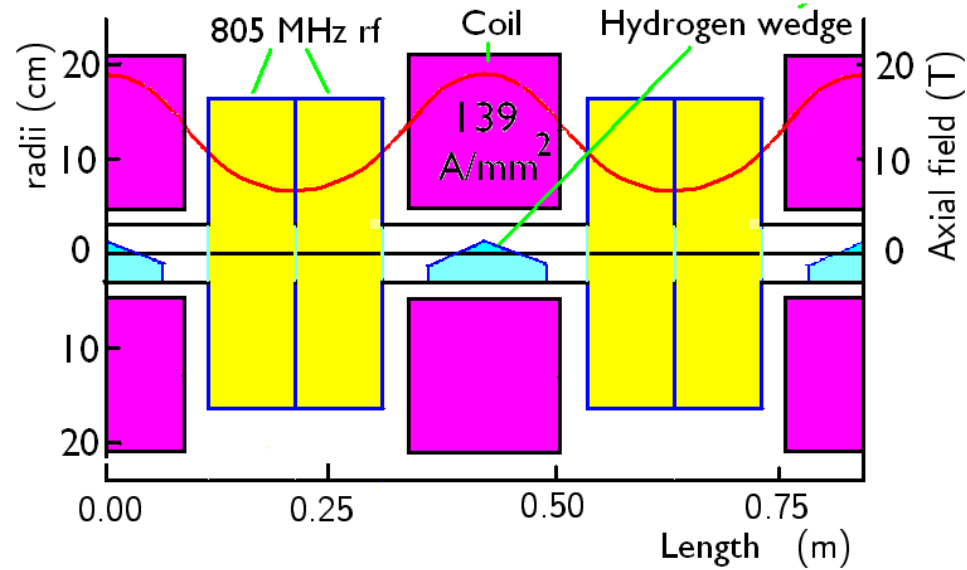
6D Cooling including Non-Flip lattices

Bob Palmer

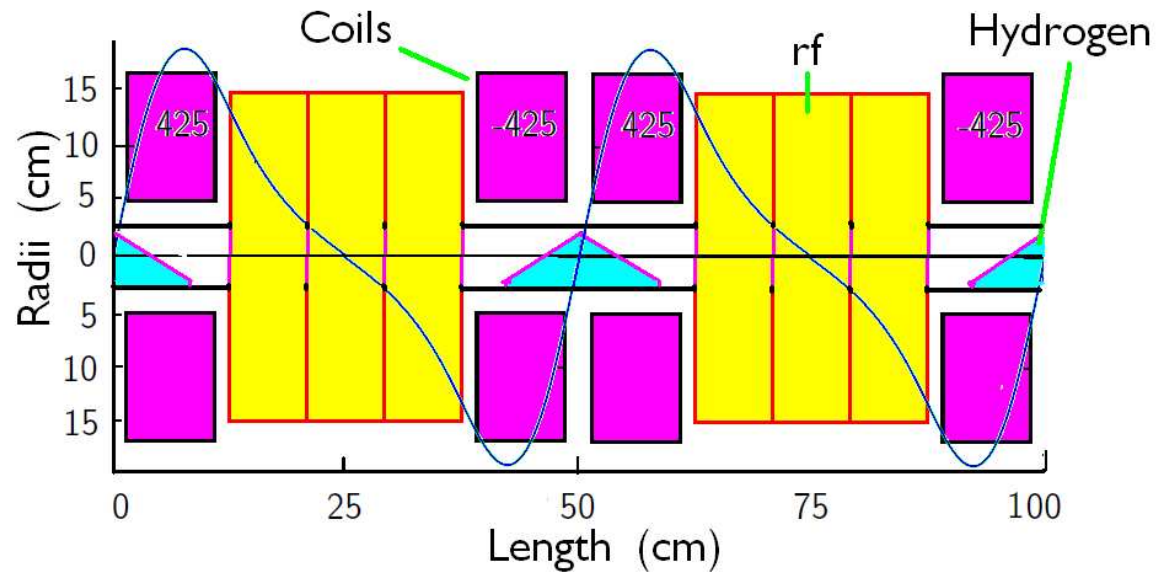
October 17, 2012

Flip vs. Non-flip cooling lattices

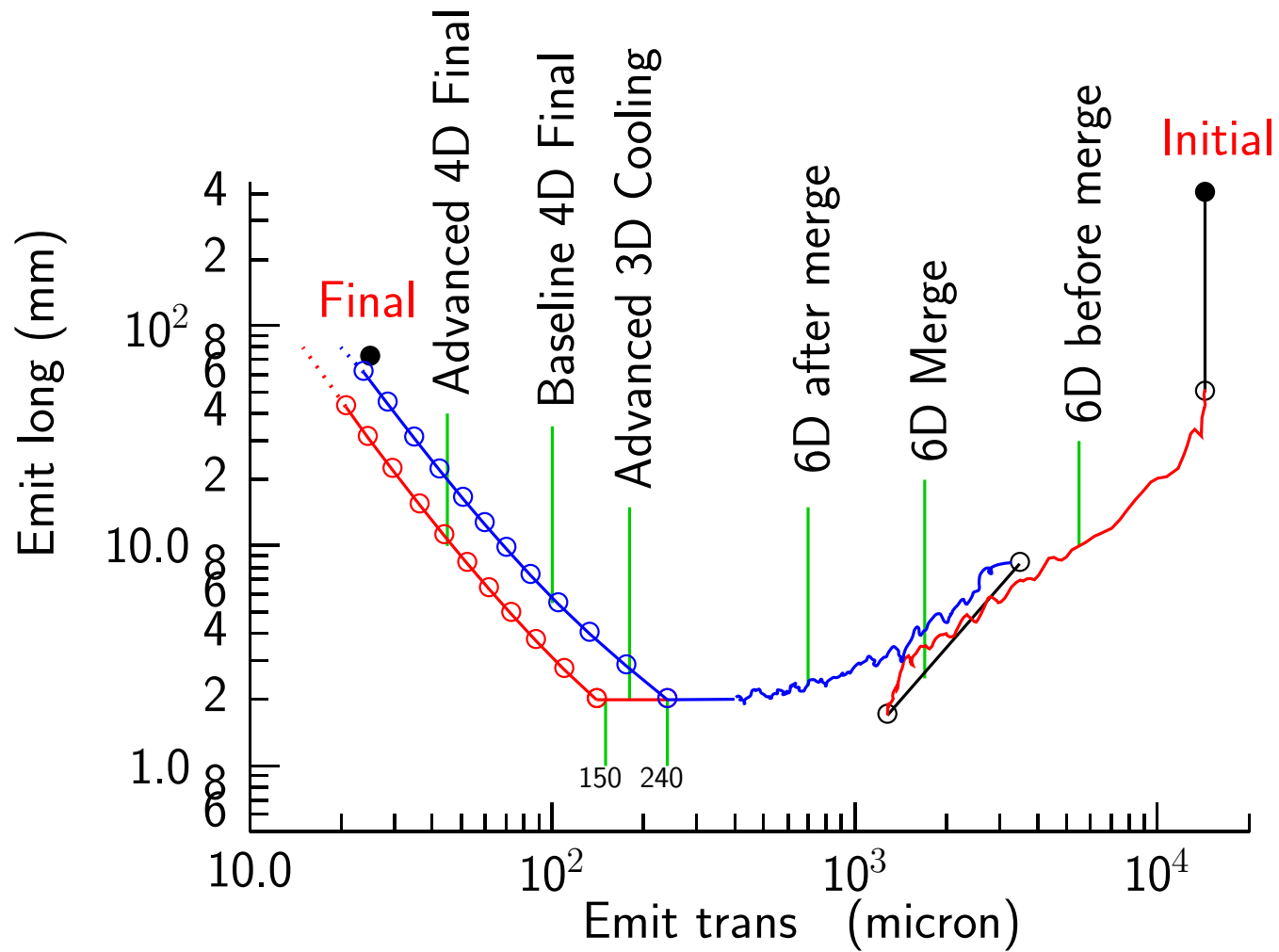
(nf102a)



(rbk9h1)

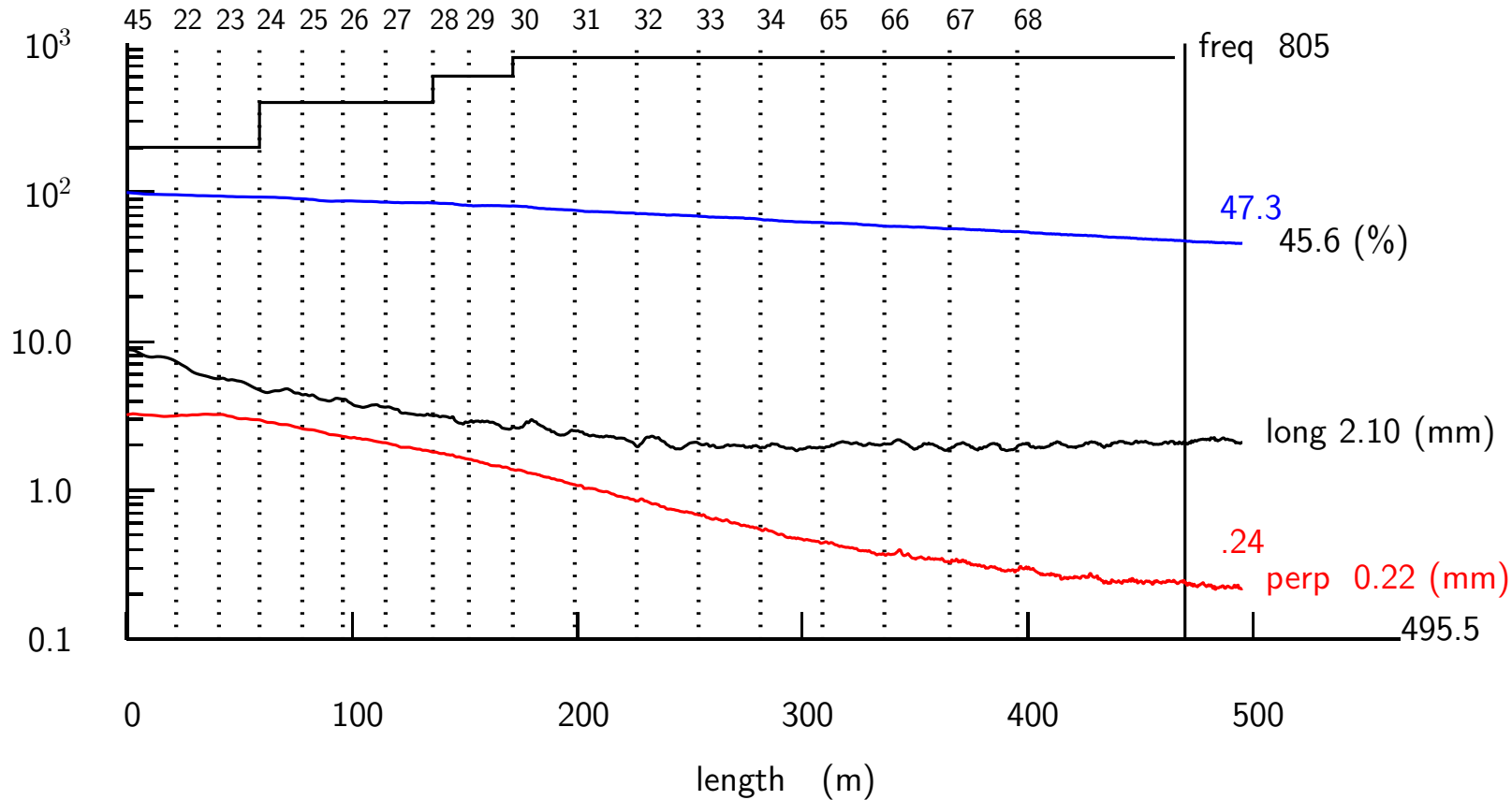


Emittance Evolution



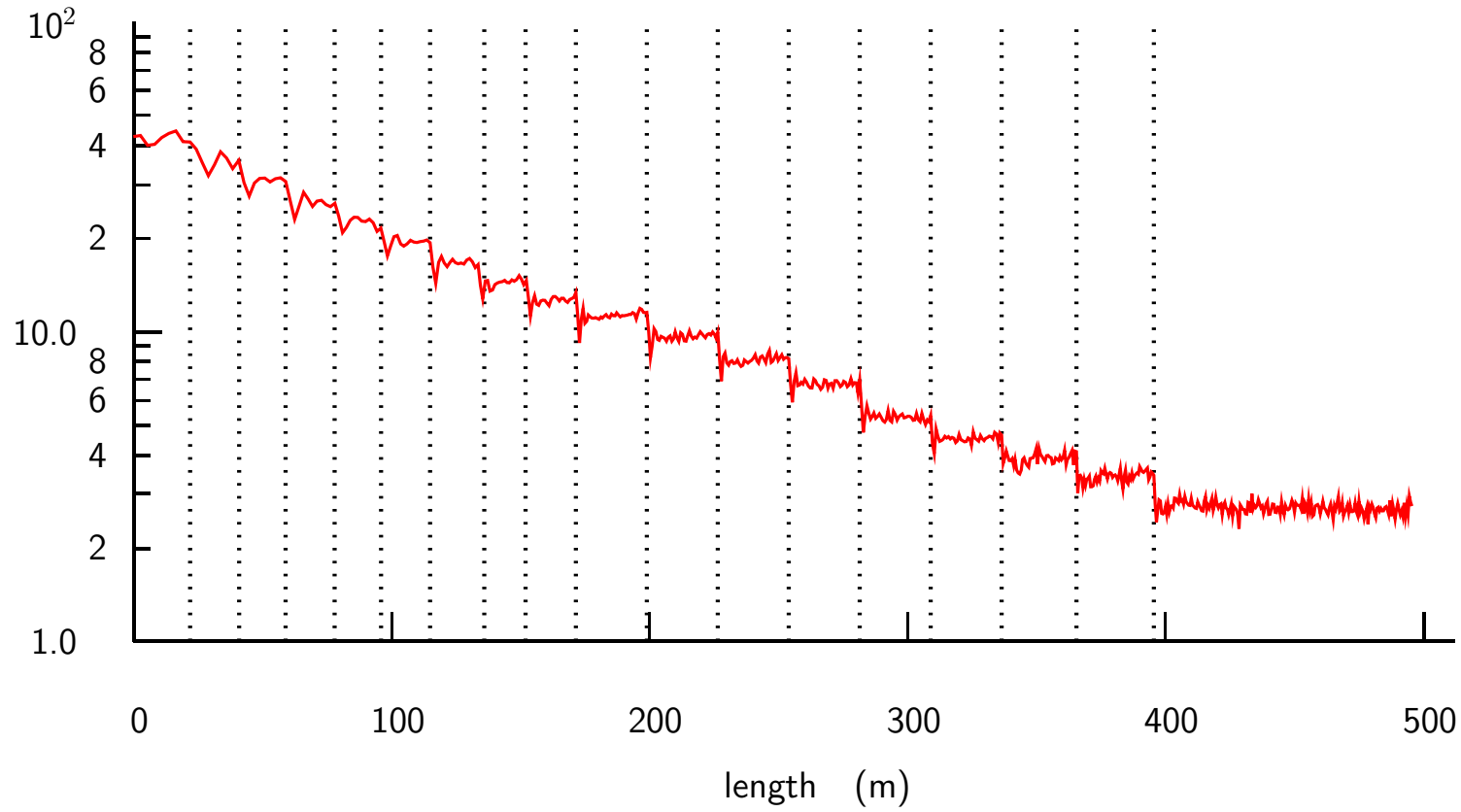
- Cool to 240 microns for Baseline
- Cool to 150 microns for Advanced

Old ICOOL Simulation of Cooling with RFQFO Lattices (with flips)

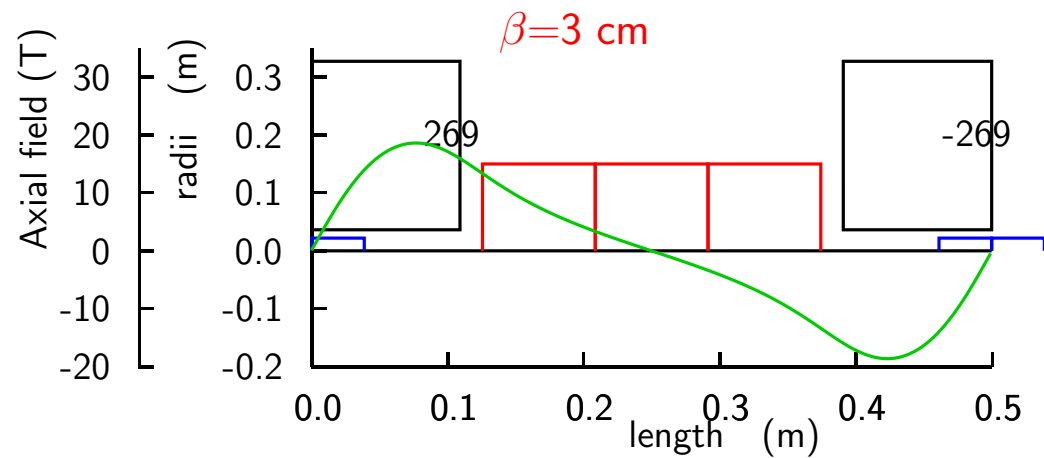
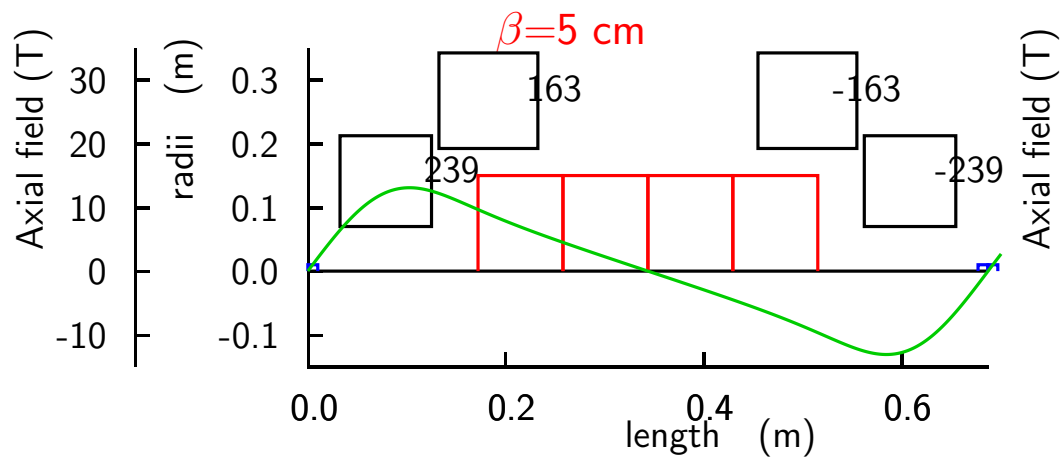
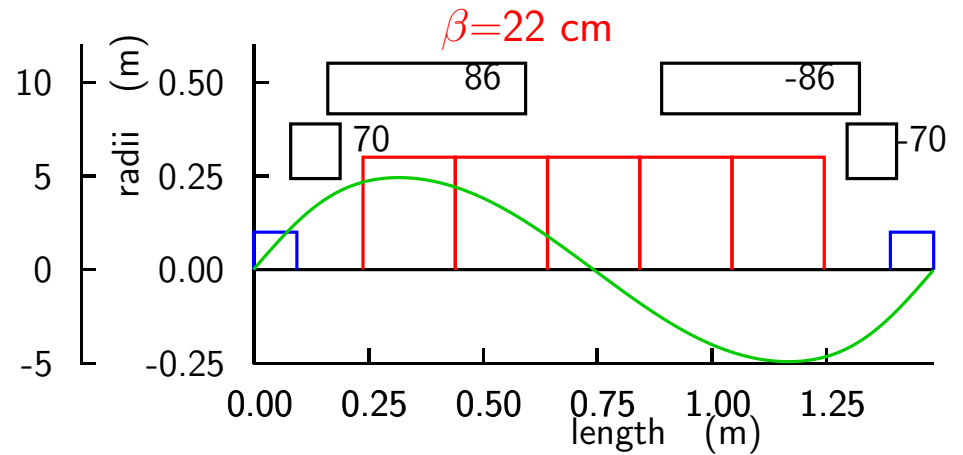
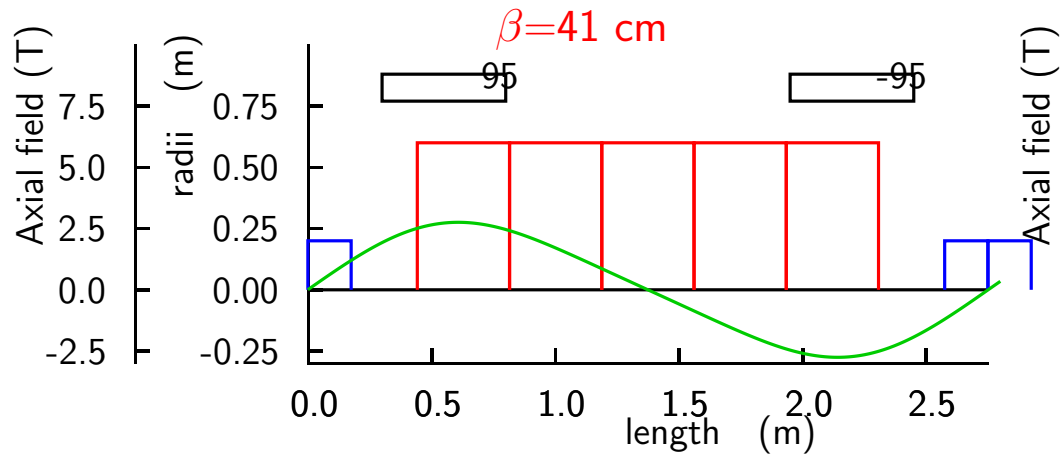


- Cooling to 240 microns for baseline with 47.3% transmission
- But not to 150 microns for advanced case

Betas vs length

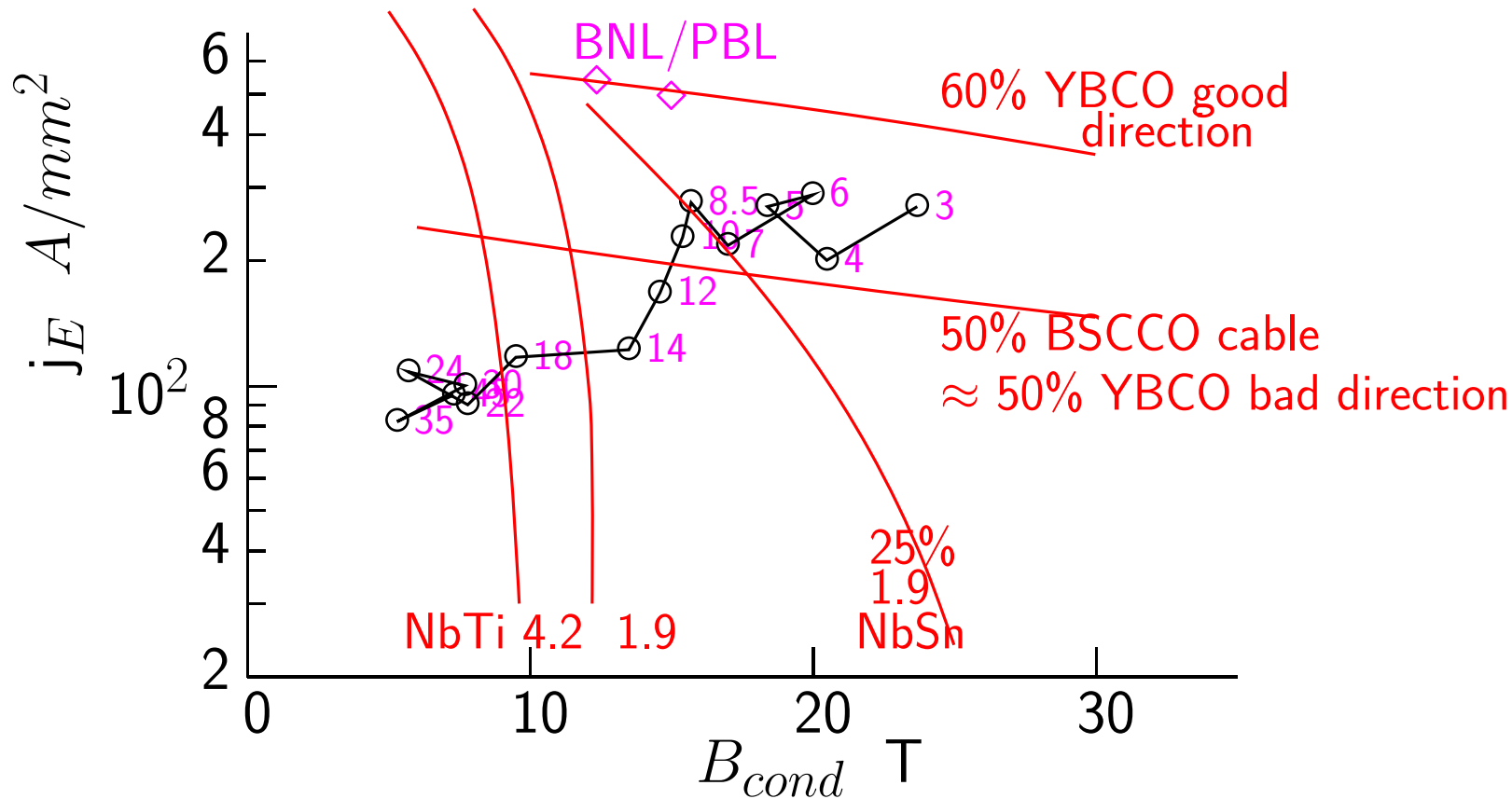


Examples of RFQFO Lattices



Required SC current densities

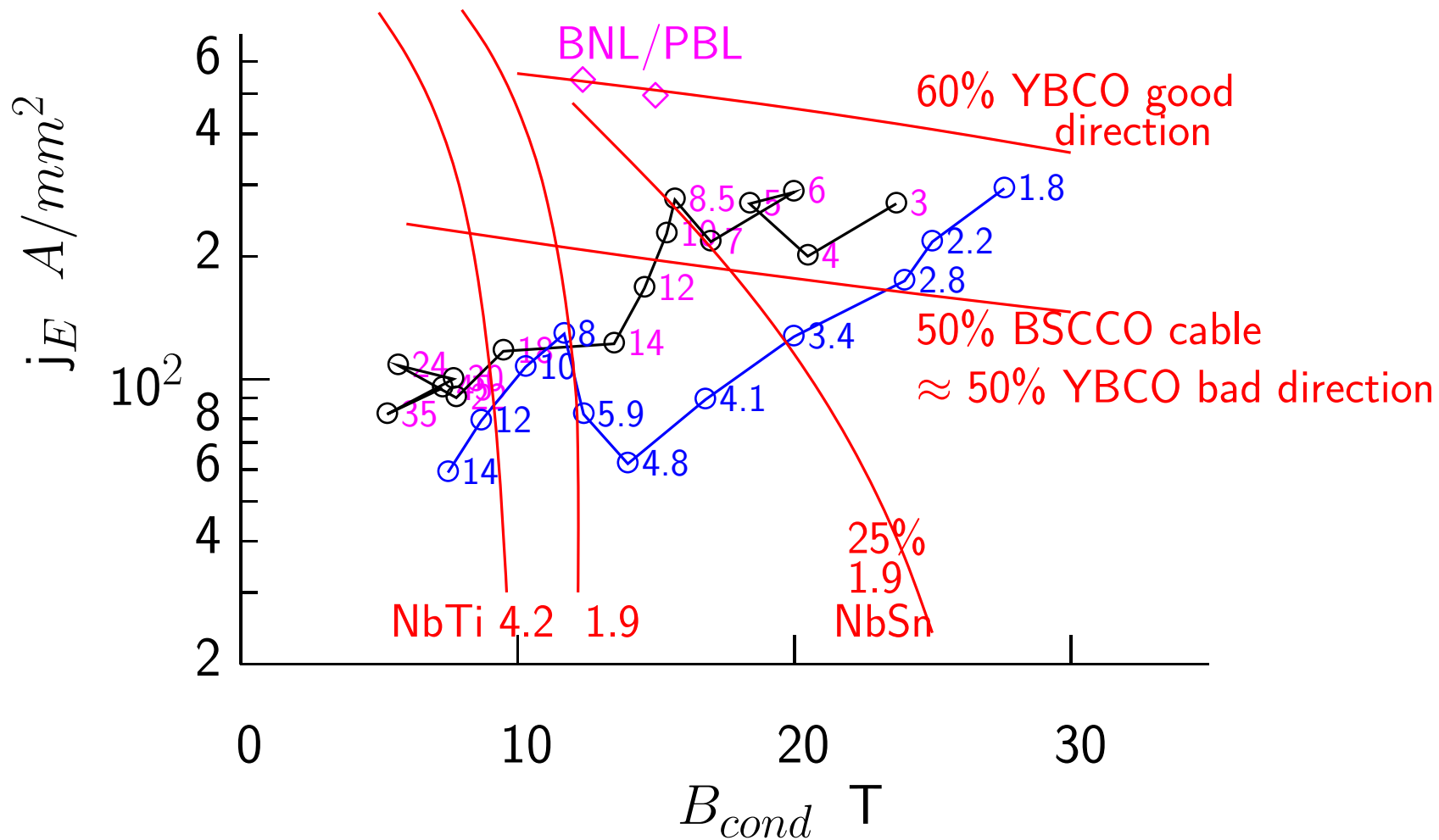
Numbers after point show absorber β s in cm



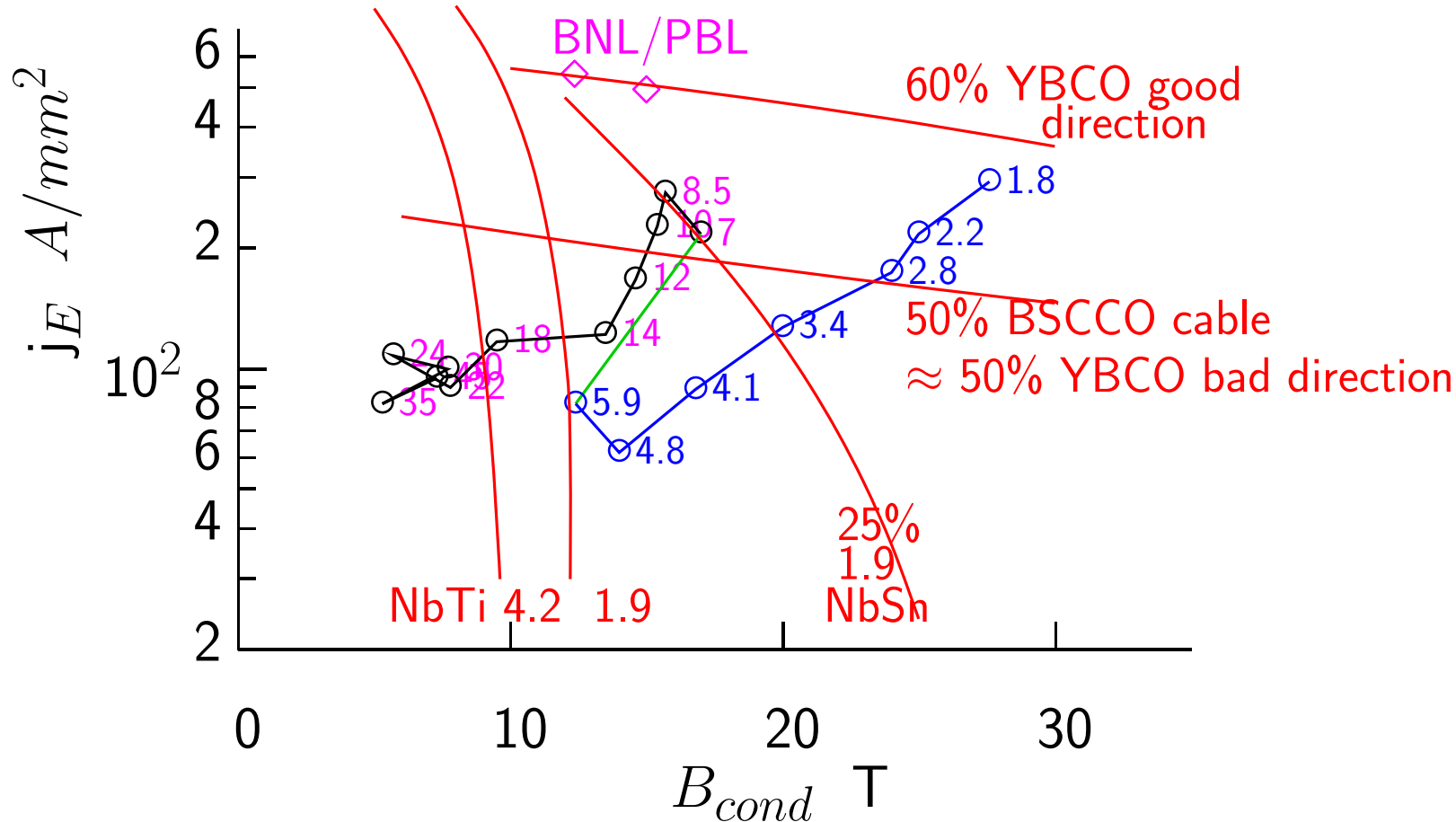
- Fields are mostly in the bad directions for YBCO
- For $\beta < 7$ cm, current densities too high for Nb₃Sn or BSCCO
- But ok for $\beta_s \geq 7$ cm

Current densities for Non-Flips

- Black points are RFOFO (with field flips)
- Blue points are for Fernow's Non-flip lattices

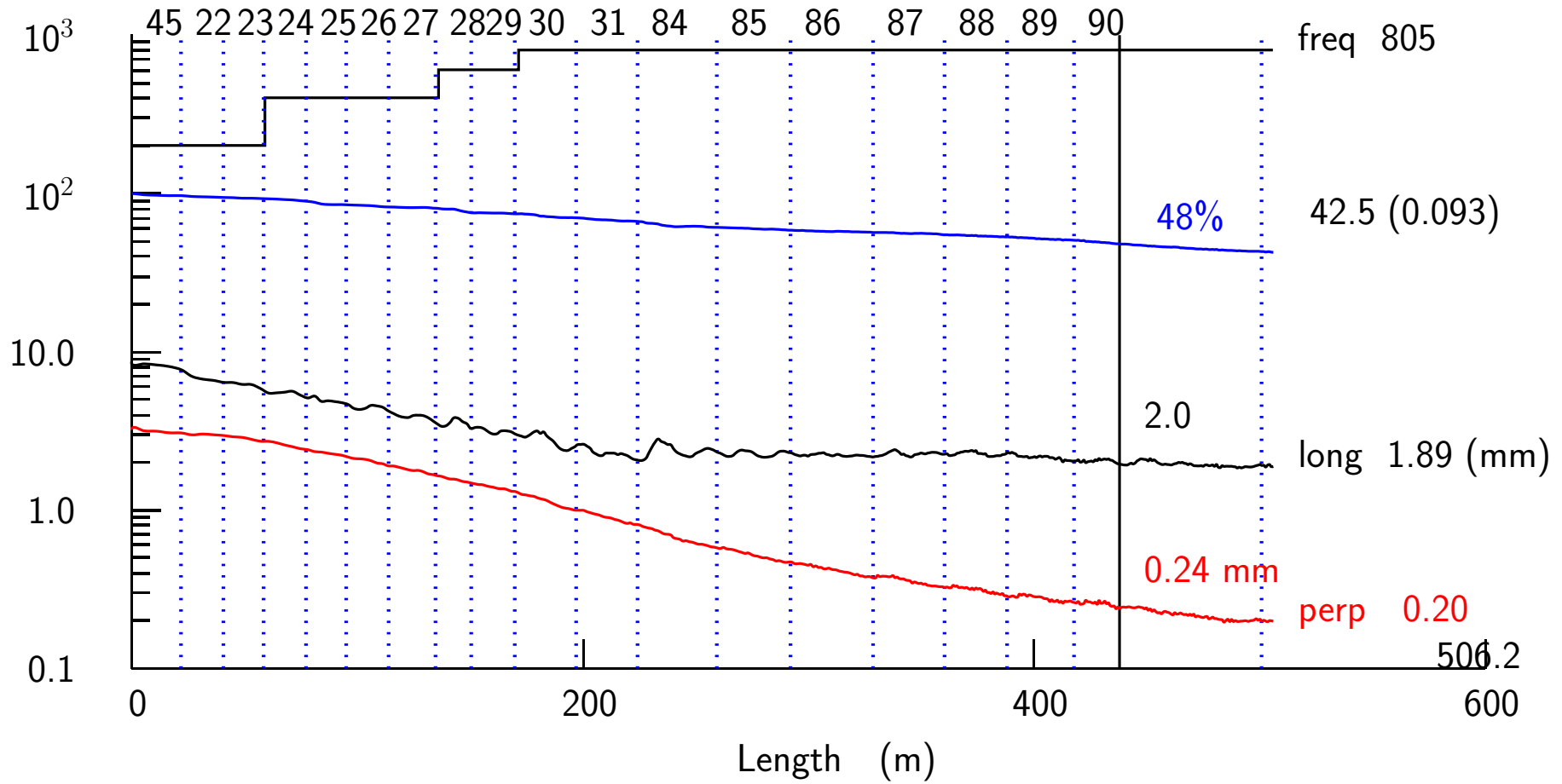


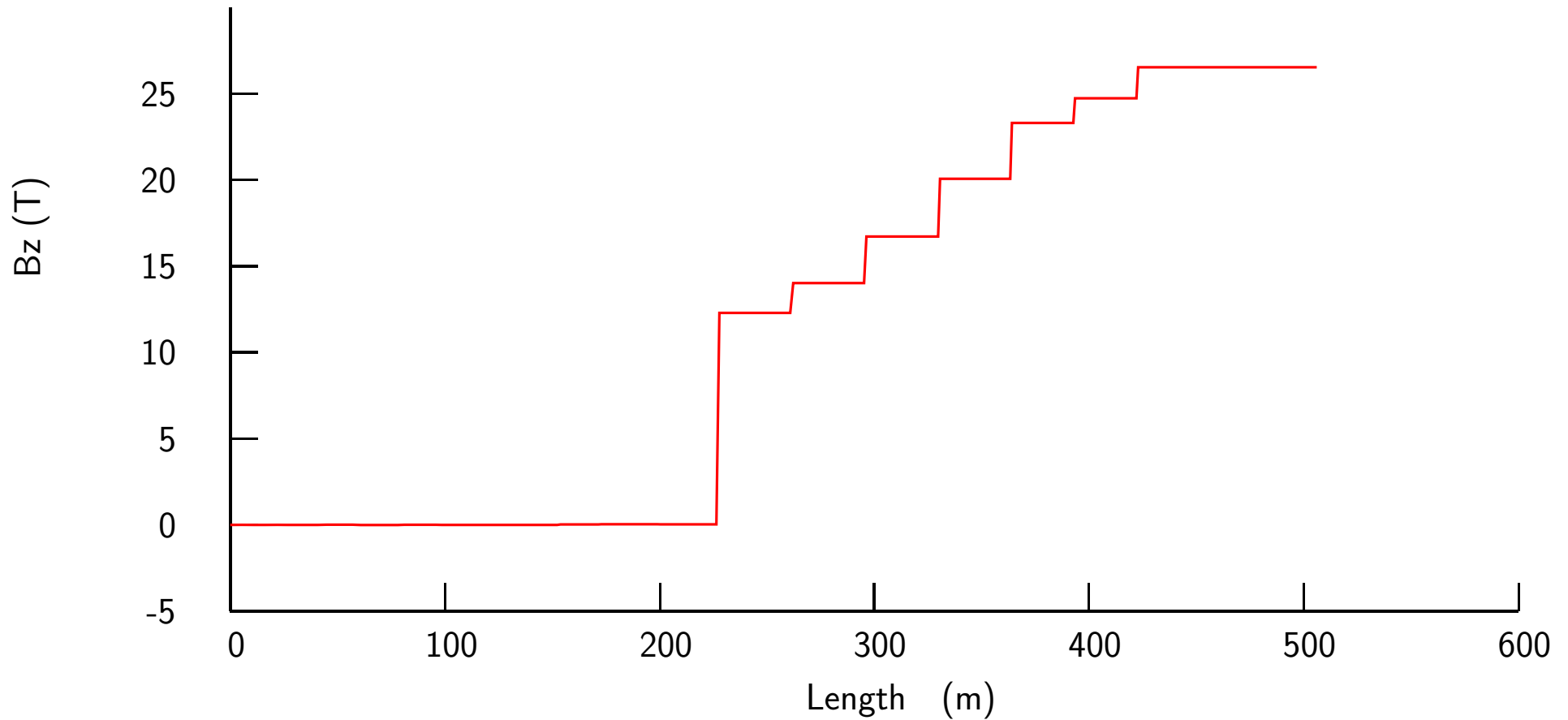
Use Fernow (non flip) Lattices for $\beta < 7$ cm



- Simulation will use 'Hard Ends' between stages with angular momentum correctly added
- Note: betas now down to 1.8 cm (vs 3.2 for RFOFO)

ICOOOL Simulation

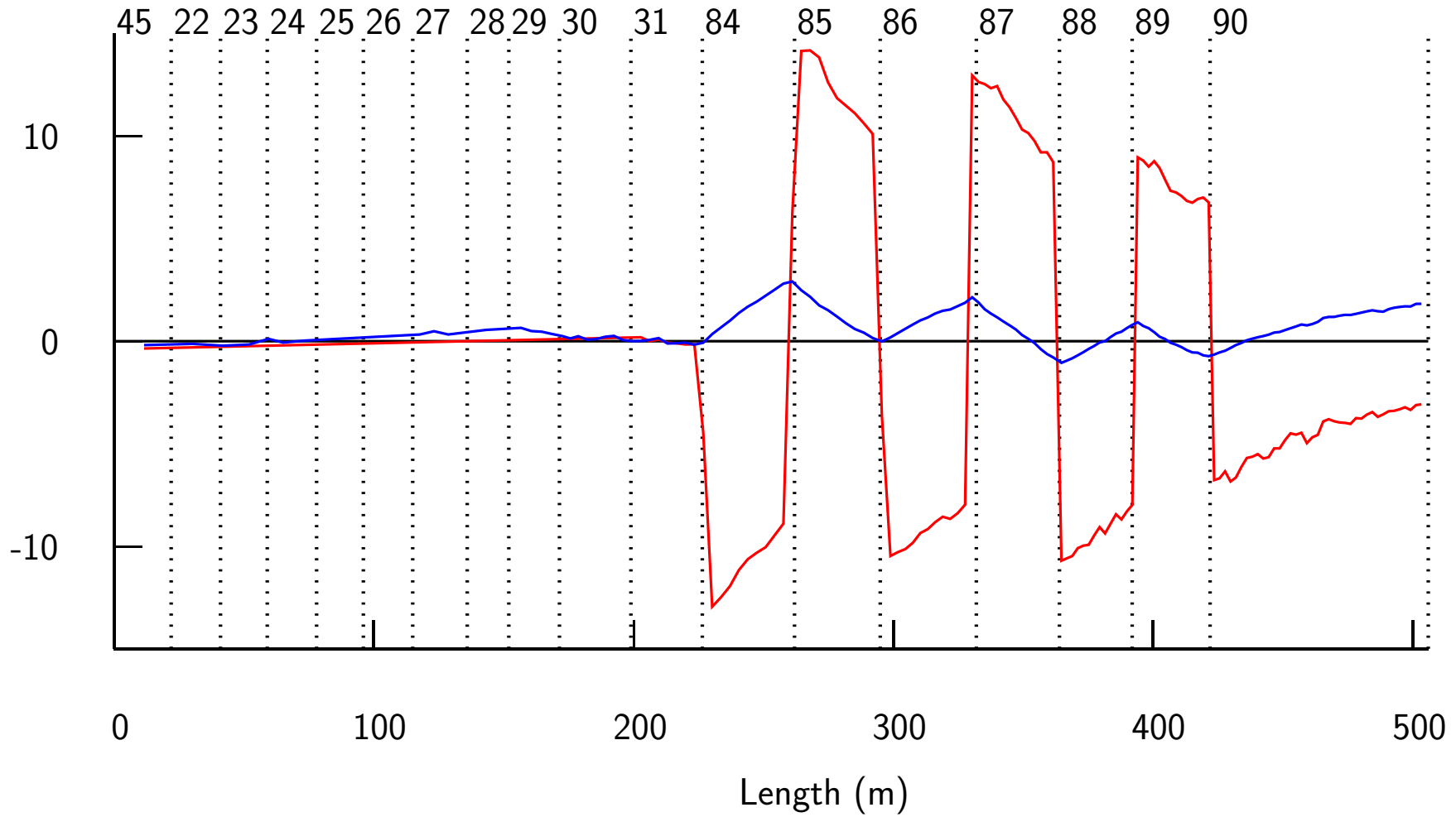




- Cooling to 240 microns for baseline with 48% transmission
- But not to 150 microns for advanced case

Angular momentum in rf

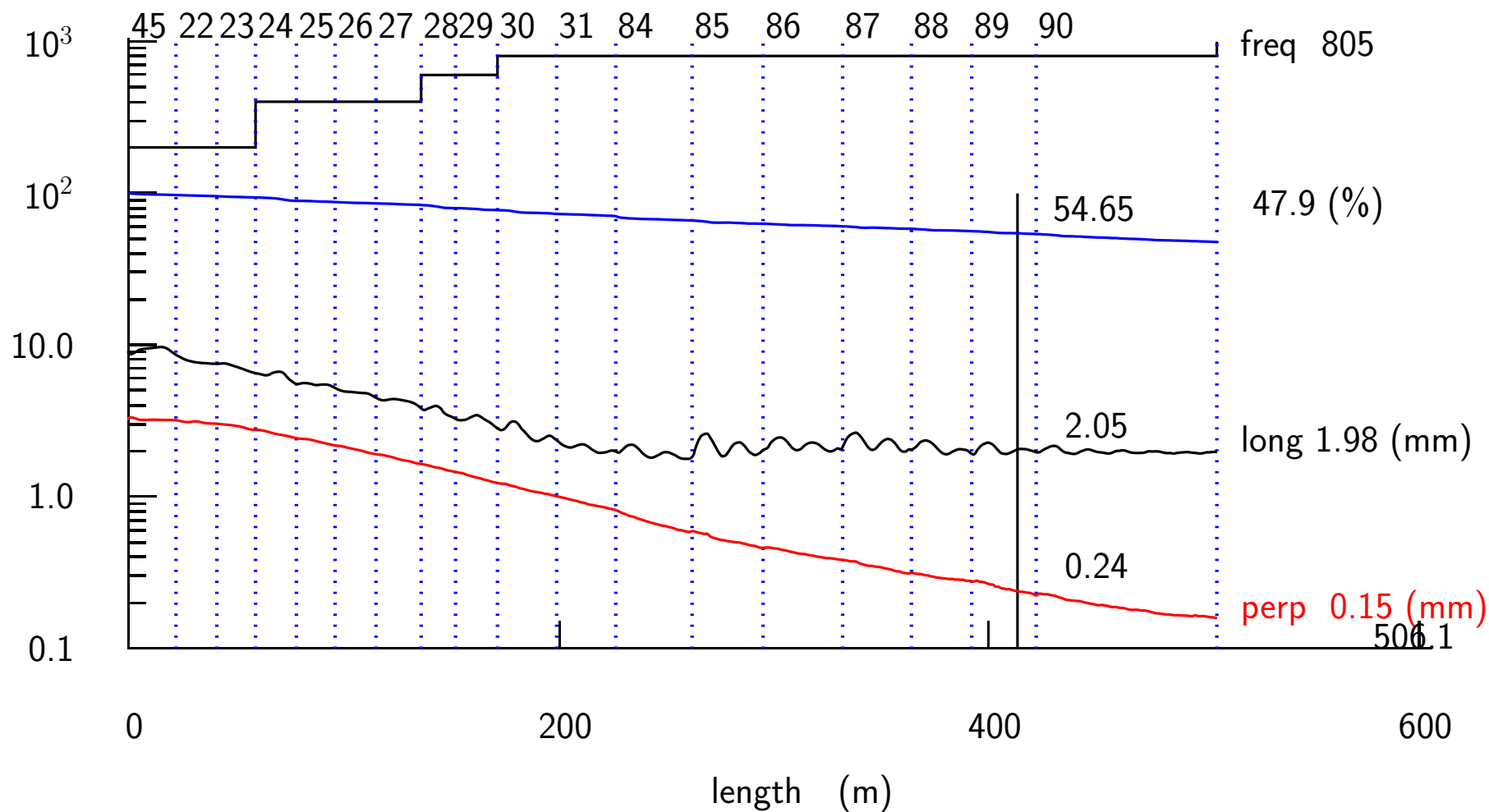
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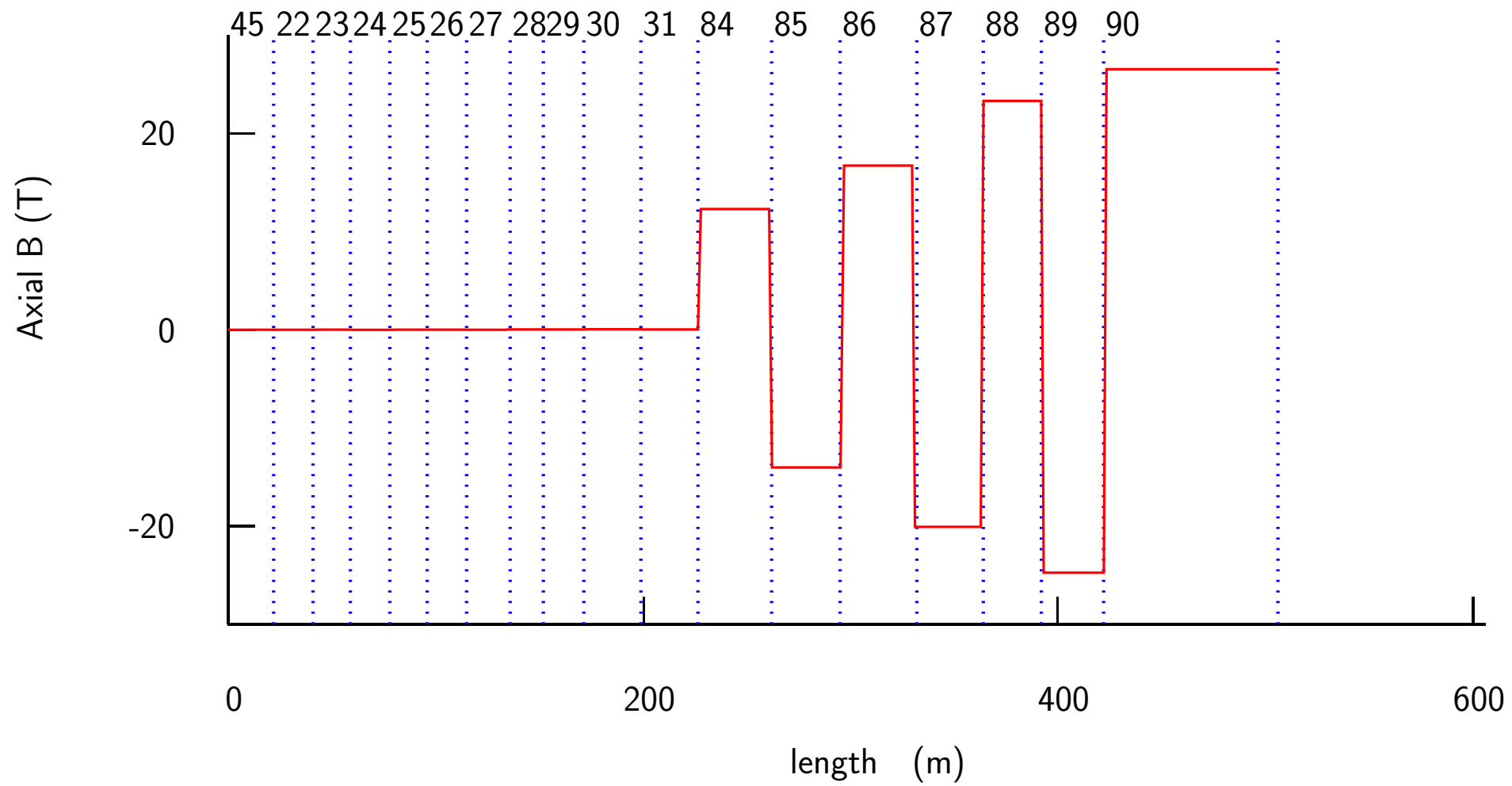


Discussion

- The problem is that the real angular momentum falls causing the focusing to become weaker
- What is wanted are occasional field reversals between stages
- Such flips can be done at lower fields & higher betas, where there is no material

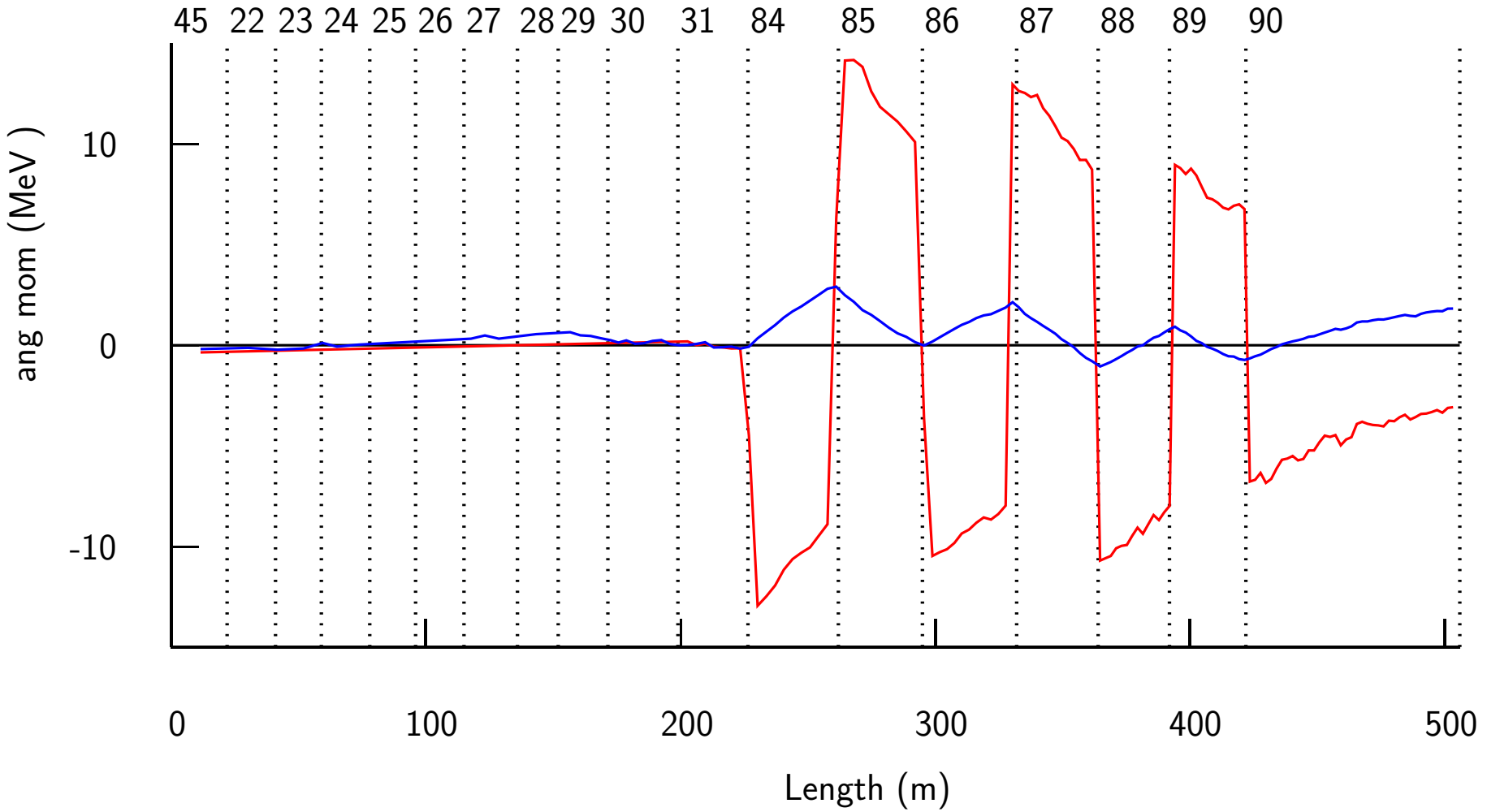
Fernow (non-flip) Lattices for $\beta < 7$ cm But with flips between stages



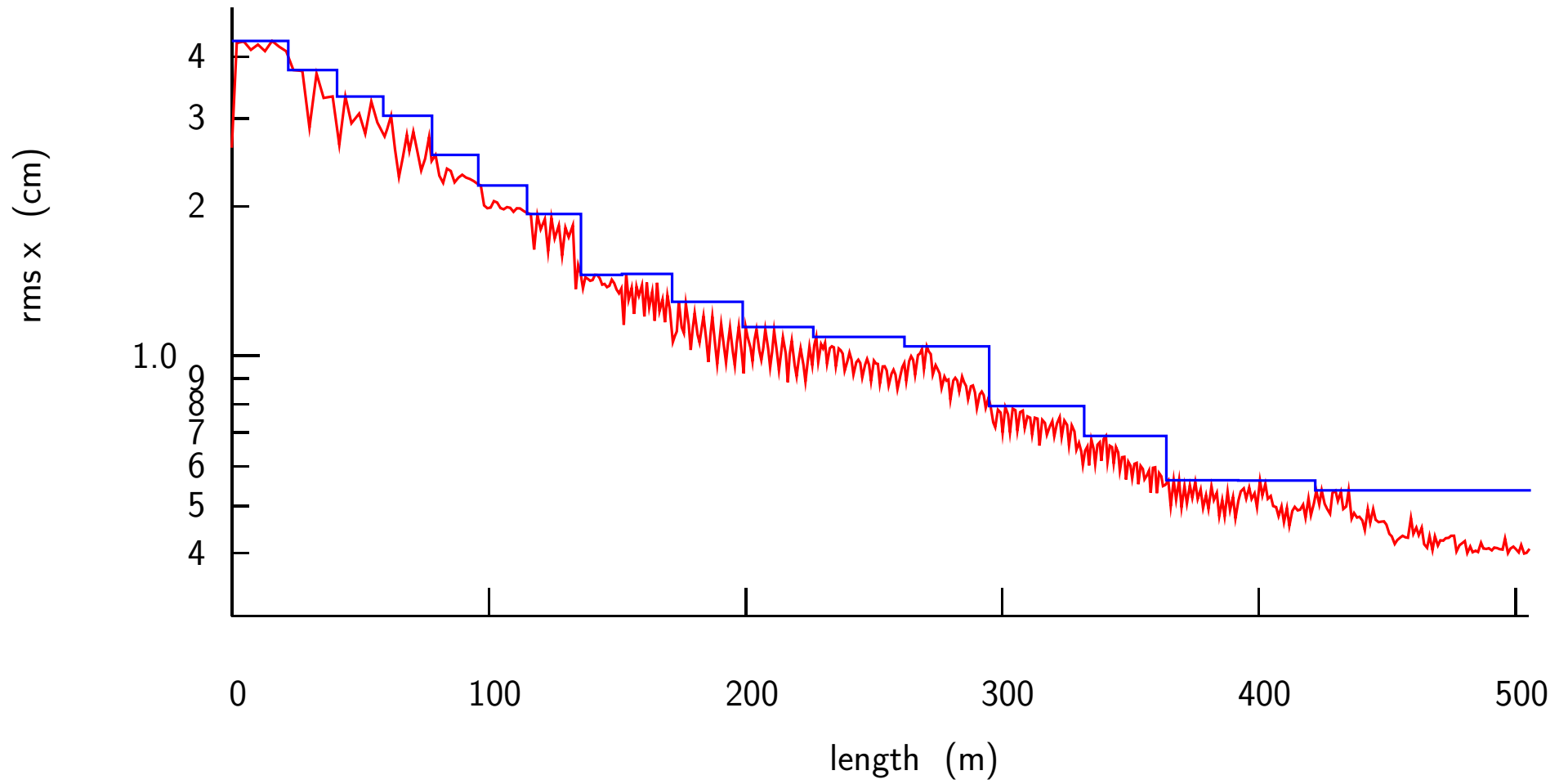


Angular Momenta

red=true blue=Canonical



rms radii in rf



Discussion

- Cooling to 240 microns for baseline with 53.5% transmission
- And to 150 microns for advanced case with 46.6%
- I tried using non-flip lattices even for the earlier stages, but I got very poor transmission. the problem is with longitudinal acceptance when the momentum spread is still large. So this remains the preferred case

Summary

		for $\epsilon_{\perp}=240 \mu\text{m}$		for $\epsilon_{\perp}=150 \mu\text{m}$	
		ϵ_{\parallel}	Transm. %	ϵ_{\parallel}	Transm. %
0	RFOFO lattice with flips Transm.	2.1	47.3	2	45.6
4	Non-flip lattices for $\beta < 7$ cm	2	42.5		
5f	" with flips between stages	2.05	54	1.98	47.9
14	" starting Non-Flips earlier	2.56	45.9	2.38	38.5

Next

- Determine needed apertures and window diameters
- Design flips between stages
- Include rf windows