

FAILURE CASES

M. Eshraqi

on behalf of

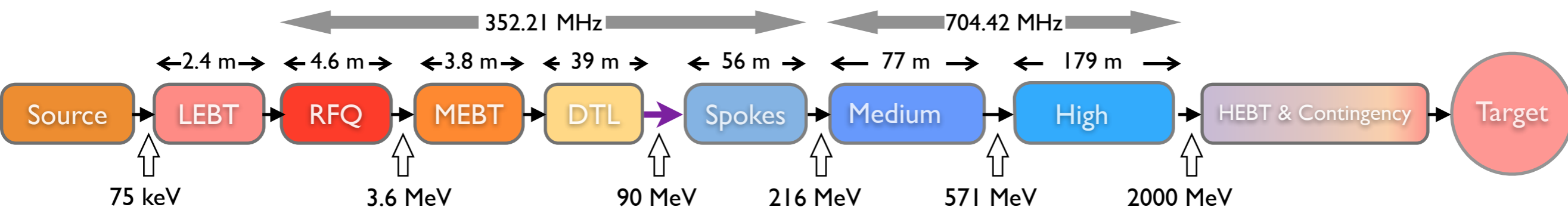
Renato De Prisco, Ryoichi Miyamoto, Yngve Levinsen

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Lund, MPS review

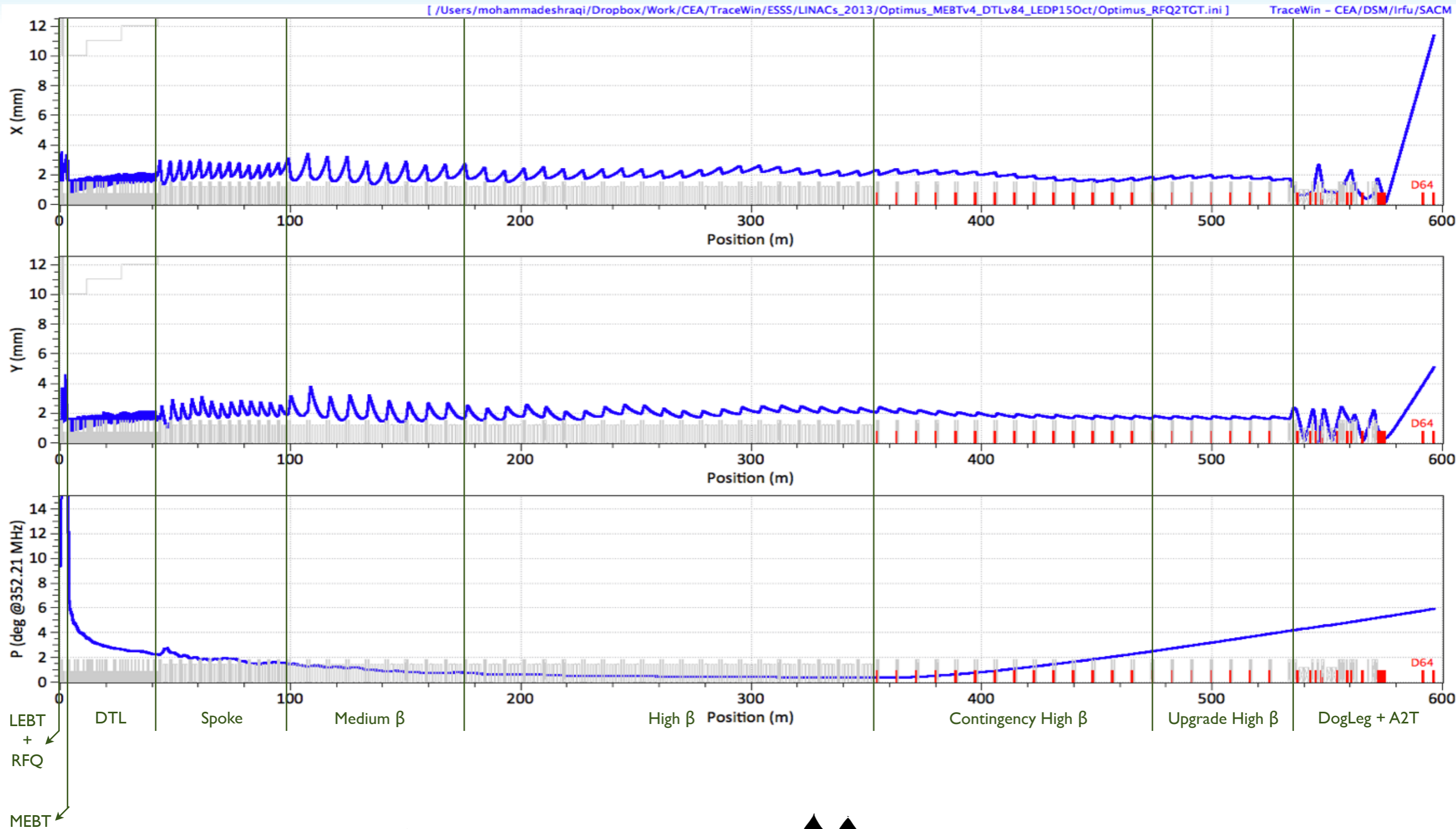


ESS LINAC



	Length	No. Magnet	No. Cavs	β Geometric	No. Sections	Power (kW)
LEBT	2.38	2 Solenoids	—	--	1	—
RFQ	4.6	—	1	--	1	1600
MEBT	3.83	11 Quads	3	--	1	15
DTL	38.9	—	5	--	5	2200
LEDP + Spoke	55.9	26 Quads	26	0.50	13	330
Medium Beta	76.7	18 Quads	36	0.67	9	870
High Beta	178.9	42 Quads	84	0.86	21	1100
Contingency + HEDP	130.4	32 Quads	—	(0.86)	15	—
DogLeg	66.2	12 Quads + 2	—	—	1	—
A2T	46.4	6 Quads + 8	—	—	1	—

BEAM ENVELOPES

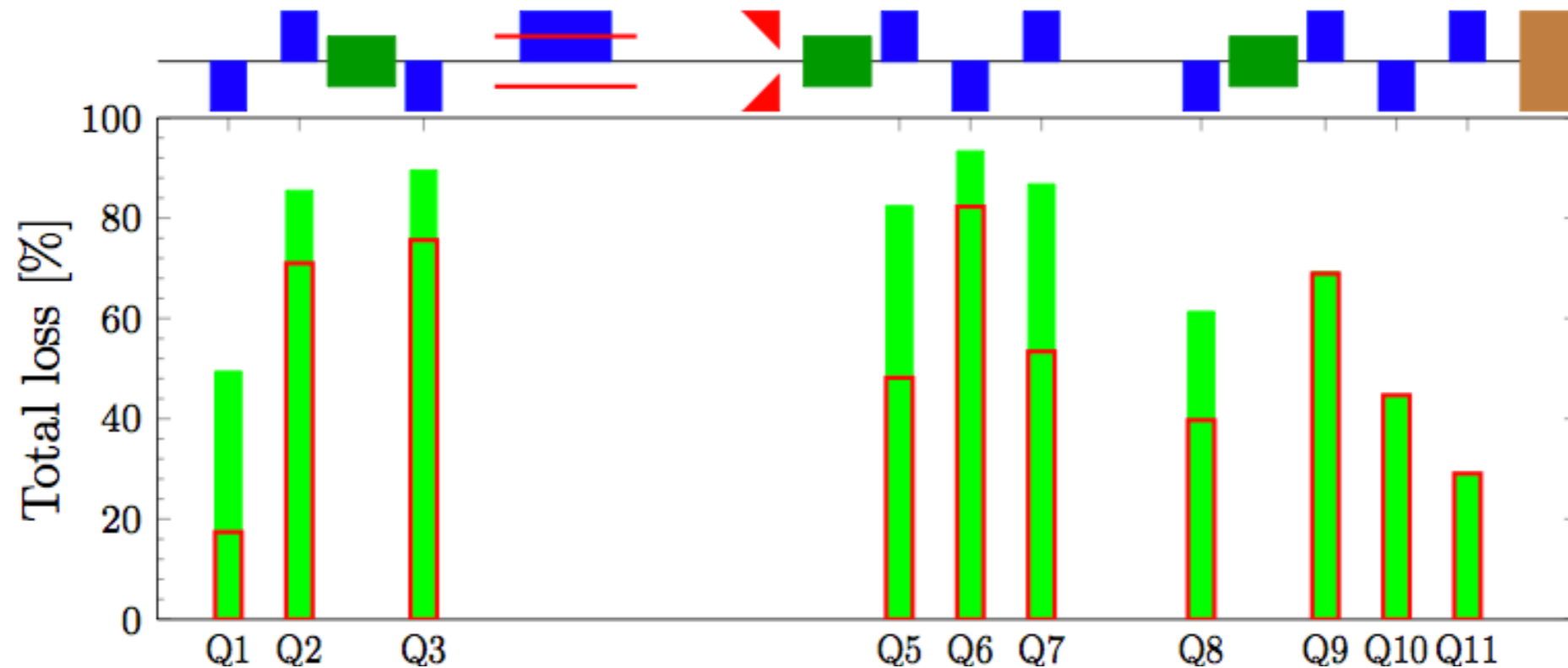




FAILURE CASES

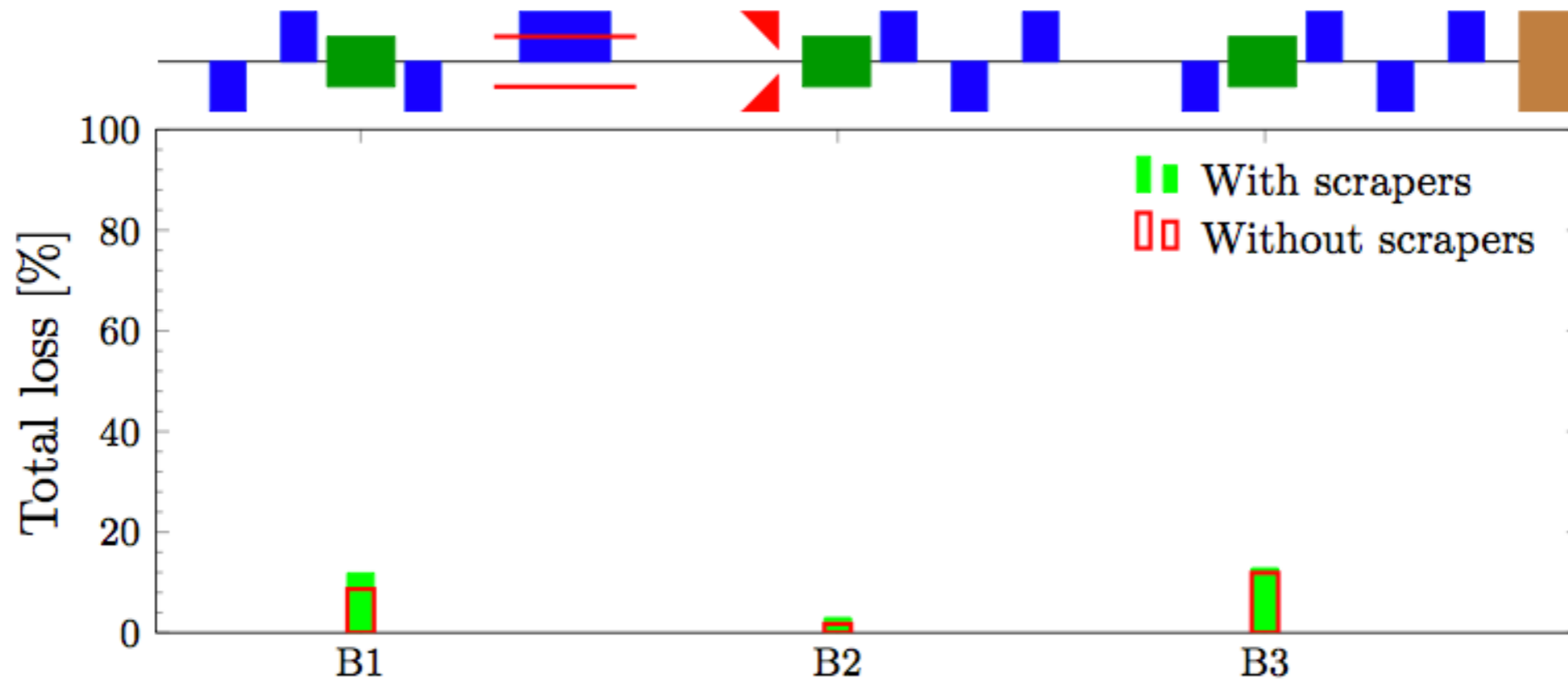
- Quadrupoles' loss of gradients,
 - Failure in power converter
 - Failure in quadrupole
 - Failure in control system
- Cavities' loss of field,
 - Failure in the chain of high power rf
 - Failure in cavity/environment
 - Failure in control system
- Please do **not** look at the magnitudes of the losses and focus on the distribution instead.

MEBT QUADS



- Total losses in the whole linac in number of particles due to a complete failure of each MEBT lattice element, comparing the cases **with** and **without** the three MEBT scrapers.

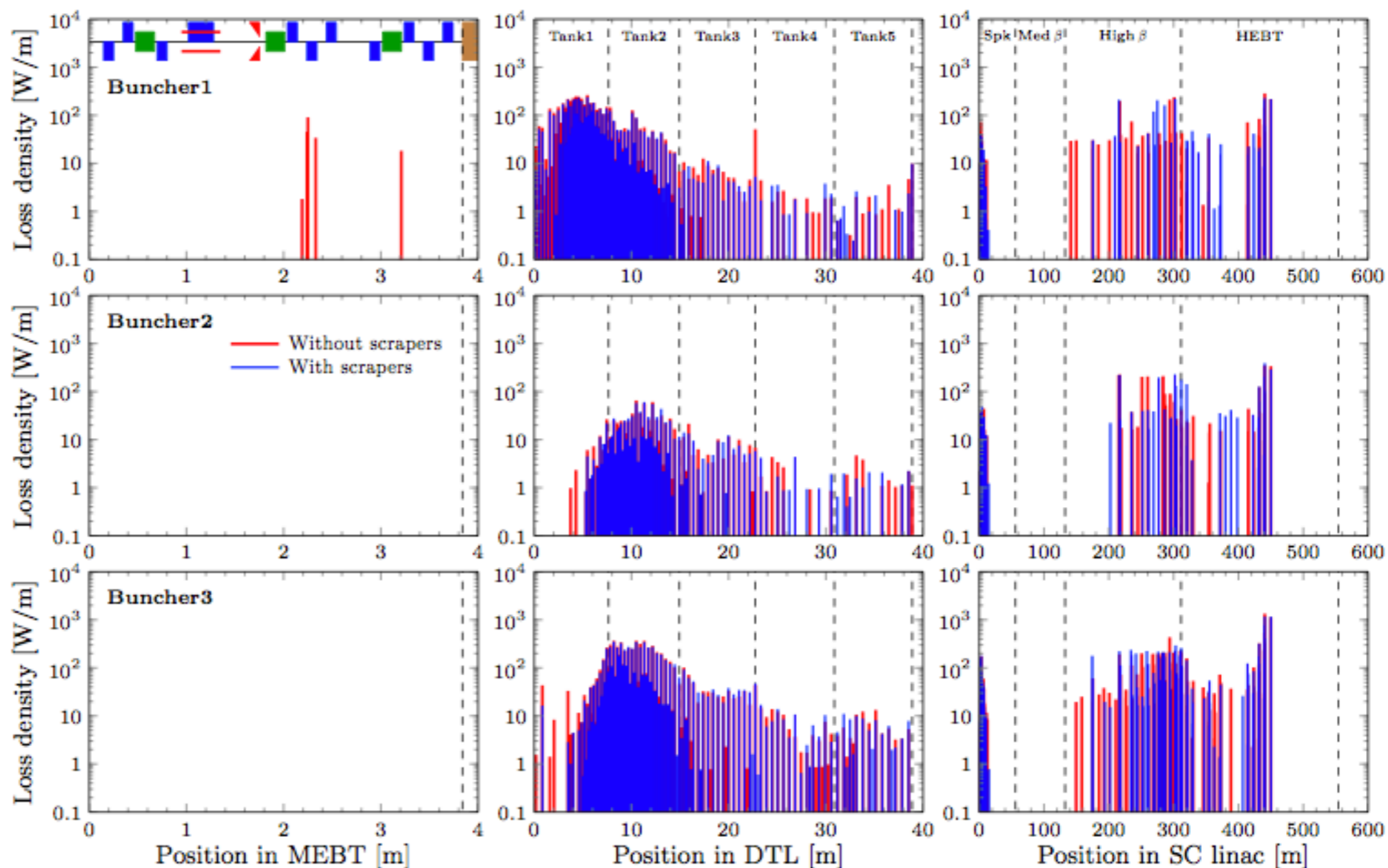
MEBT CAVITIES



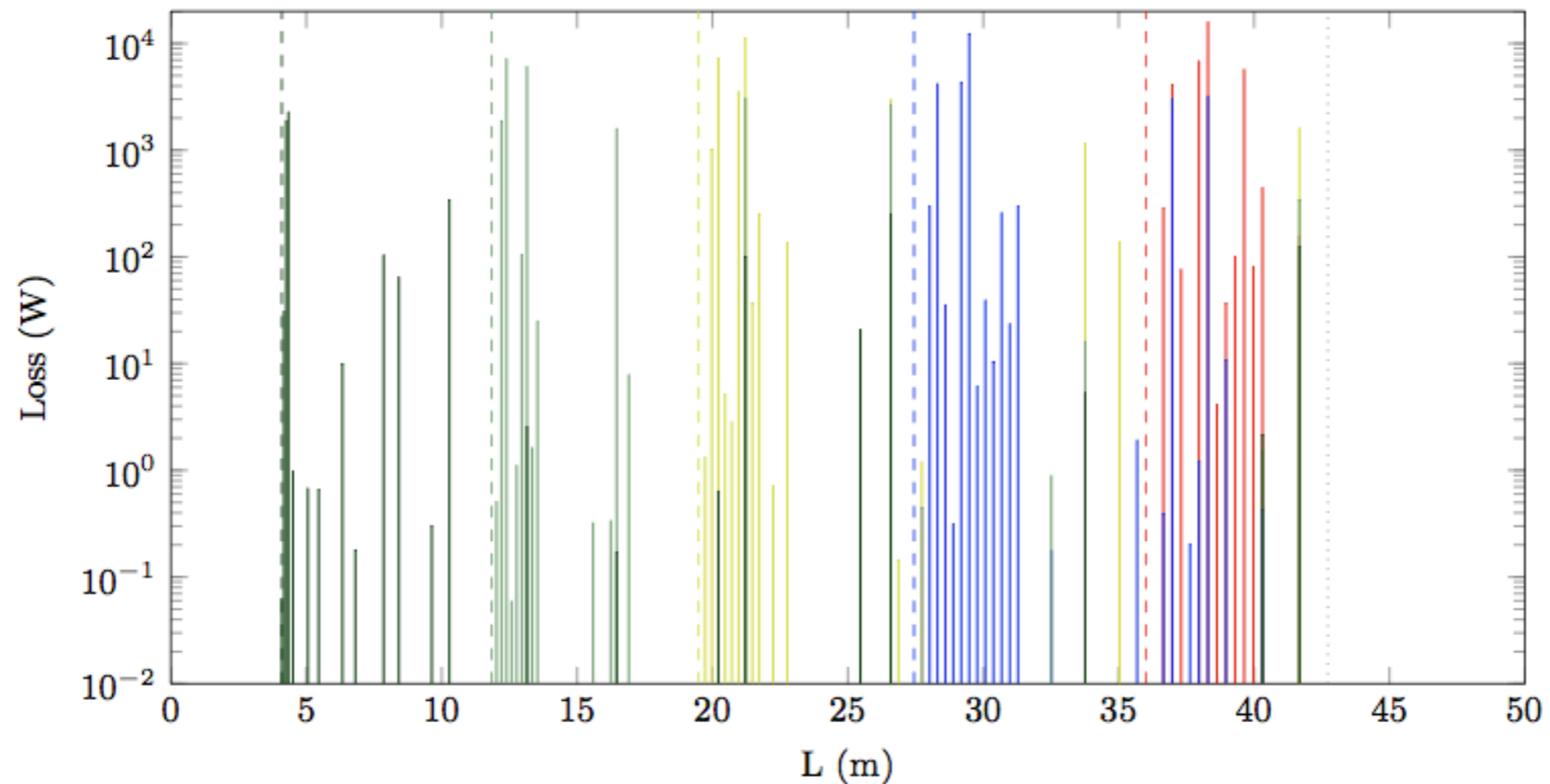
- Total losses in the whole linac in number of particles due to a complete failure of each MEBT lattice element, comparing the cases **with** and **without** the three MEBT scrapers.

MEBT CAVITIES

- Losses in linac due to complete failure of MEBT Bunchers. Losses into the three MEBT scrapers are not shown.

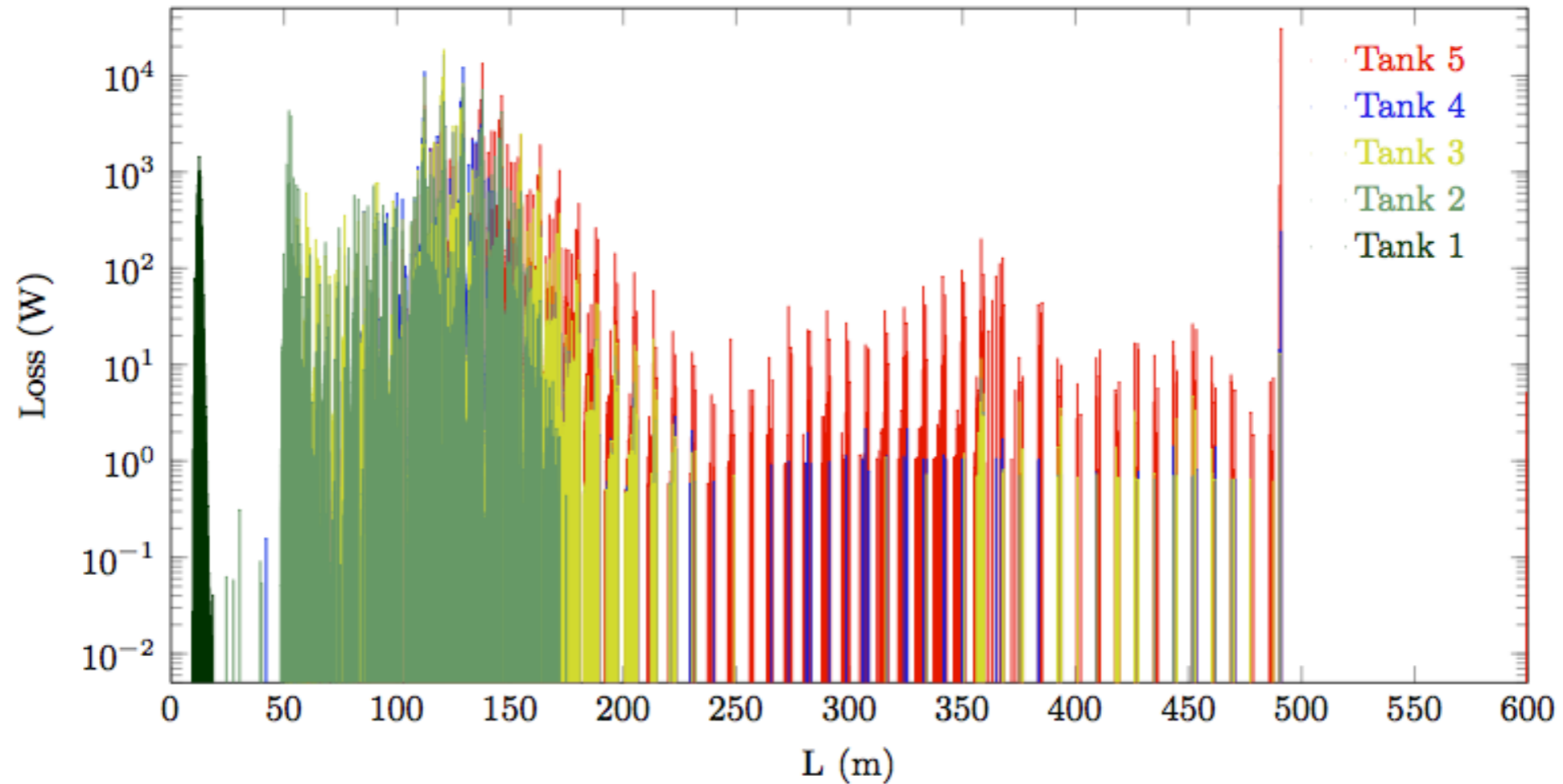


DTL PMQ



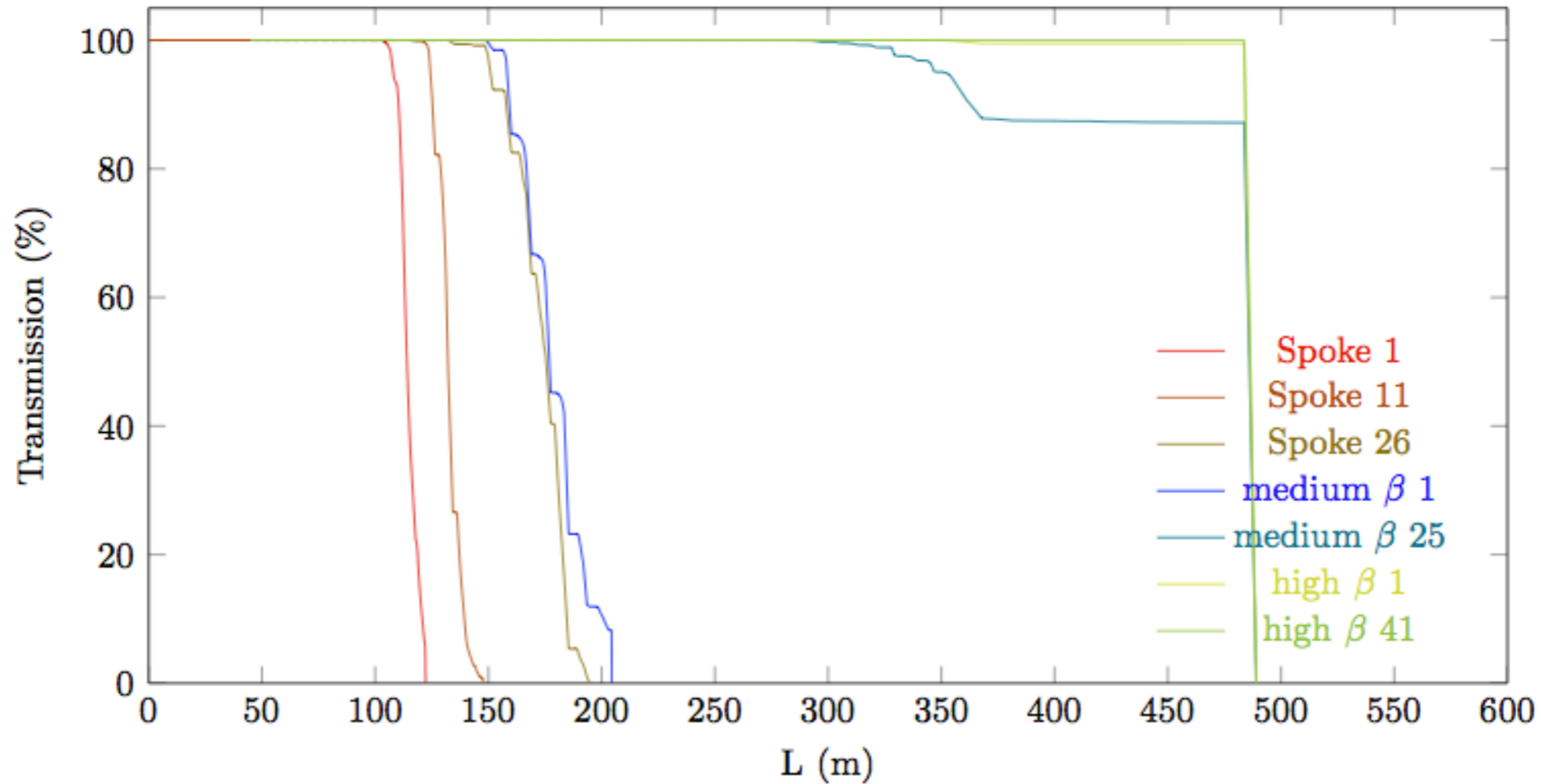
- Losses due to individual PMQ failure. Each failed quadrupole is marked with vertical dashed lines and the corresponding losses have the same color. The vertical dotted line at ~ 43 m indicated the end of DTL.

DTL RF



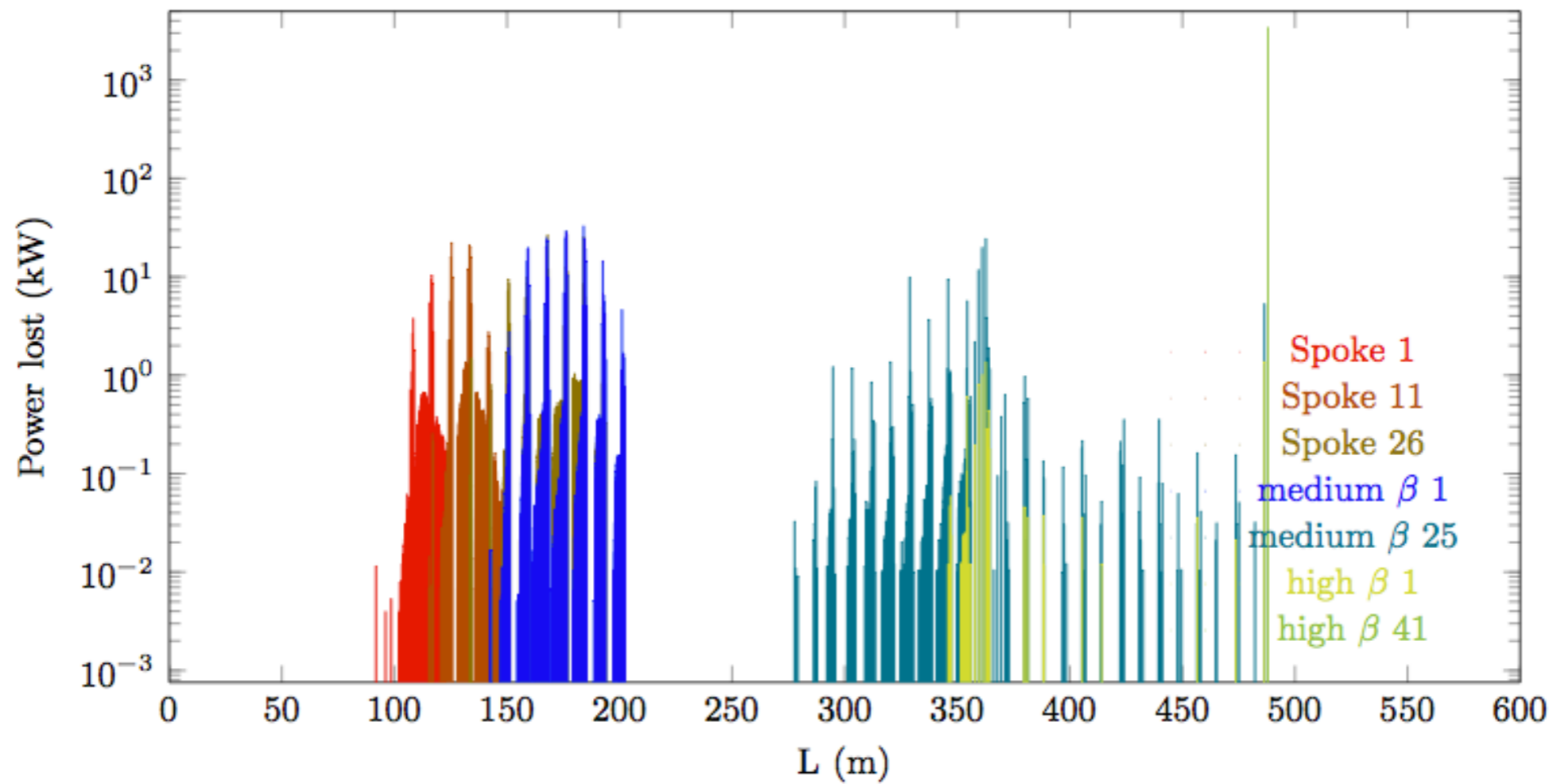
- Losses due to individual DTL tank RF failure

SCL CAVITY



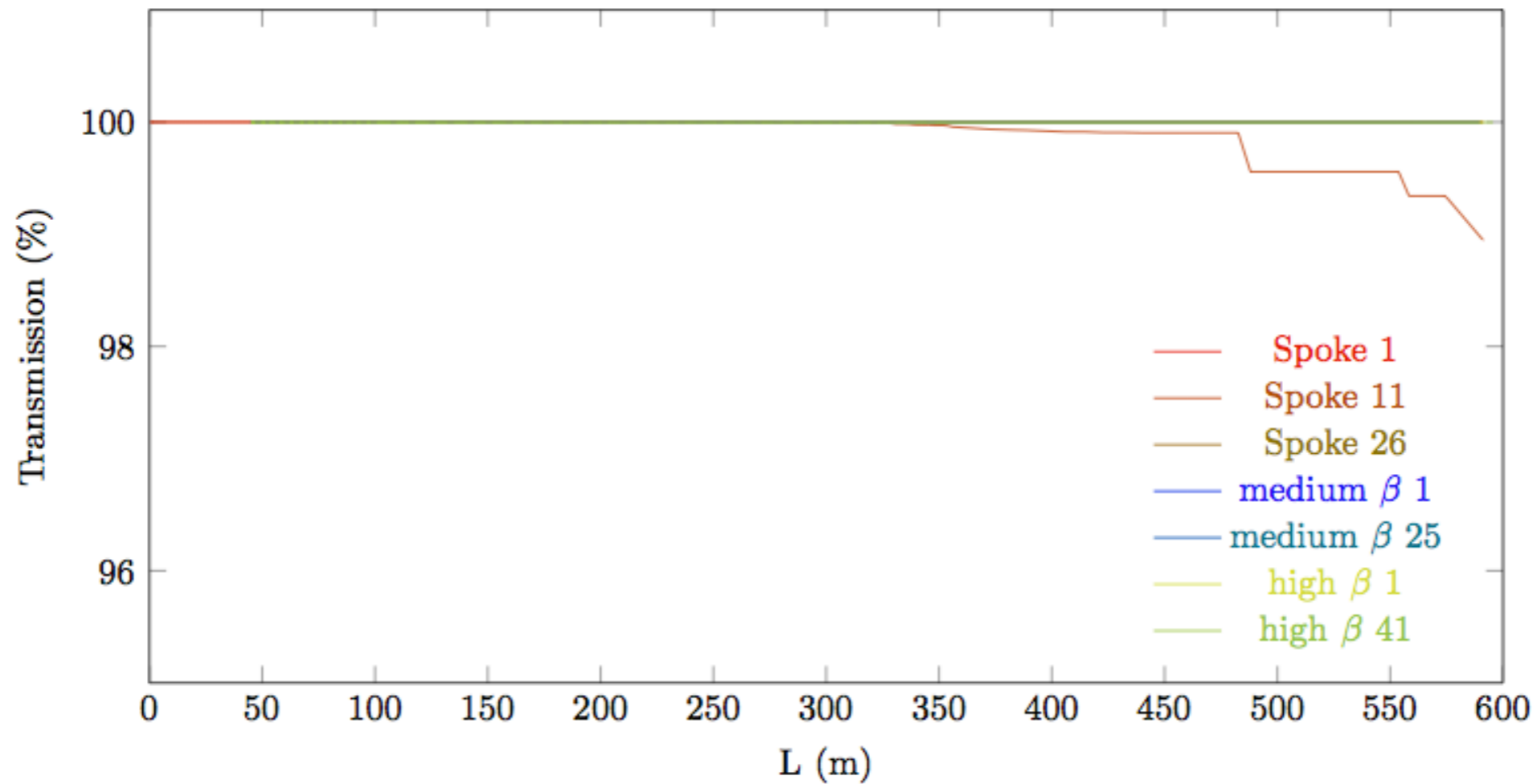
- Transmission for different cavity failure scenarios

SCL CAVITY



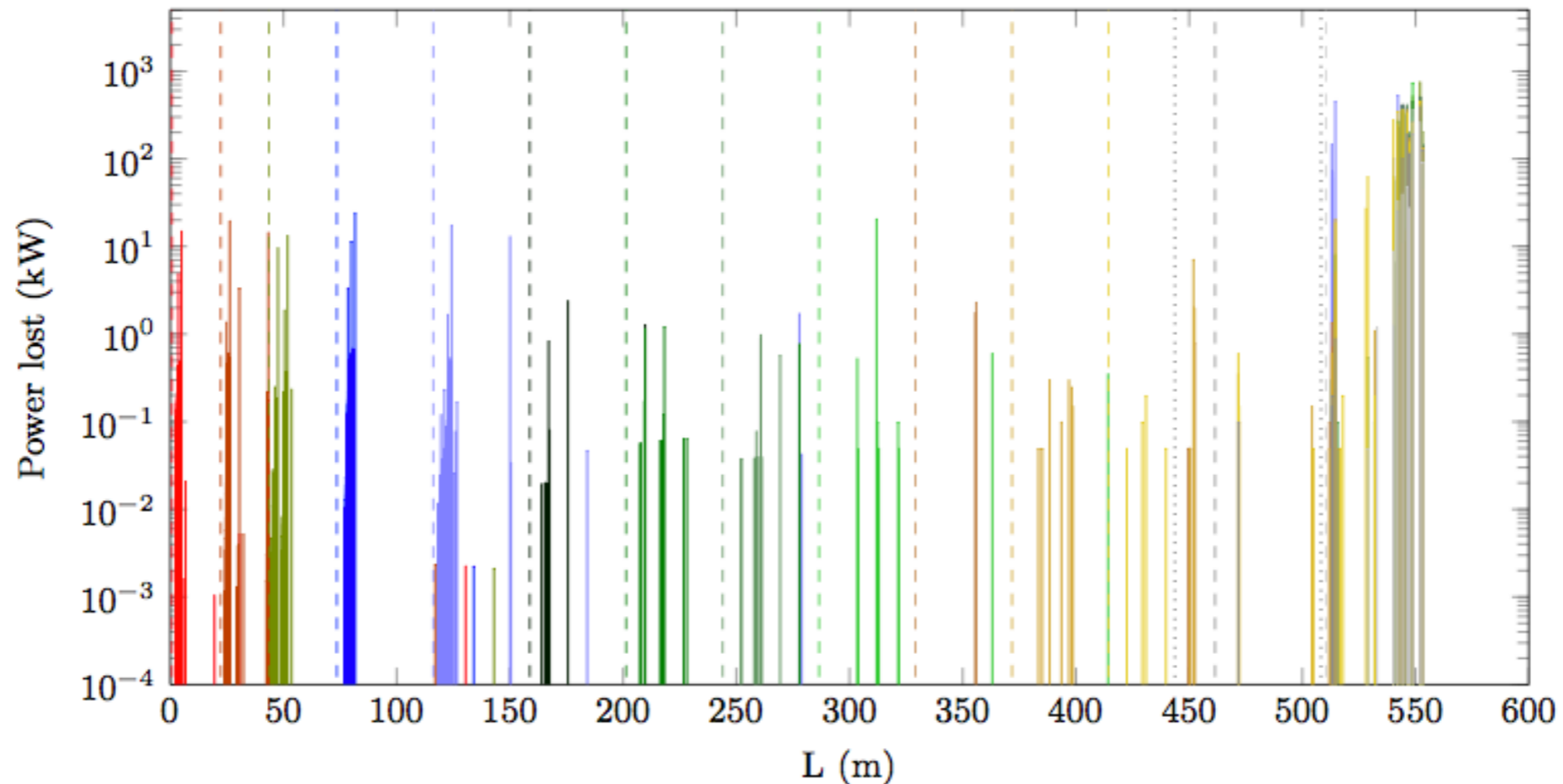
- Power lost for different cavity failure scenarios

FIXED SCL CAVITY



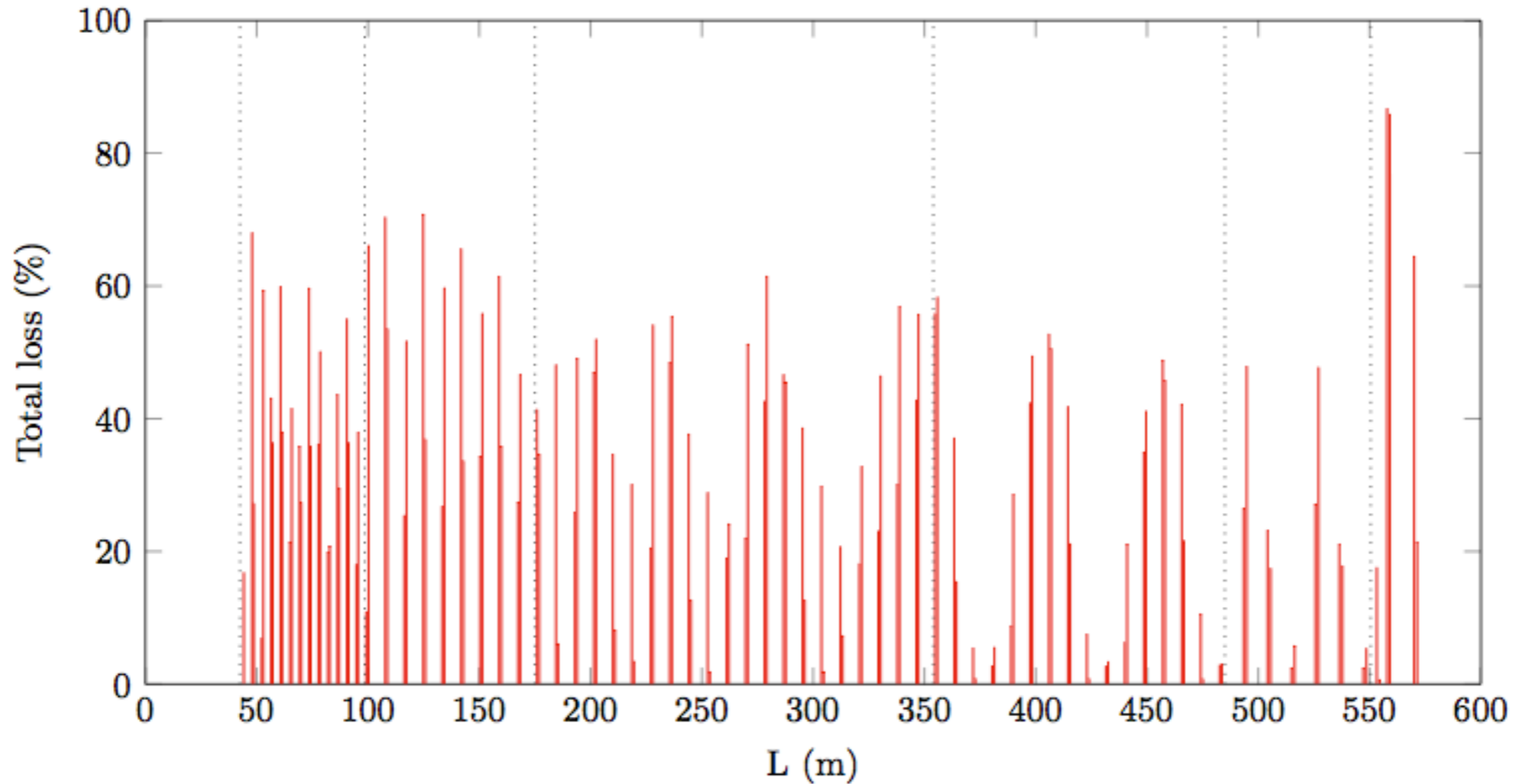
- Transmission after correction for the failed cavities. The reason Spoke 1 is not fully recovered is the “tools used” for the correction. Using more cavities one can recover the beam in that case too.

SCL AND HEBT QUADS



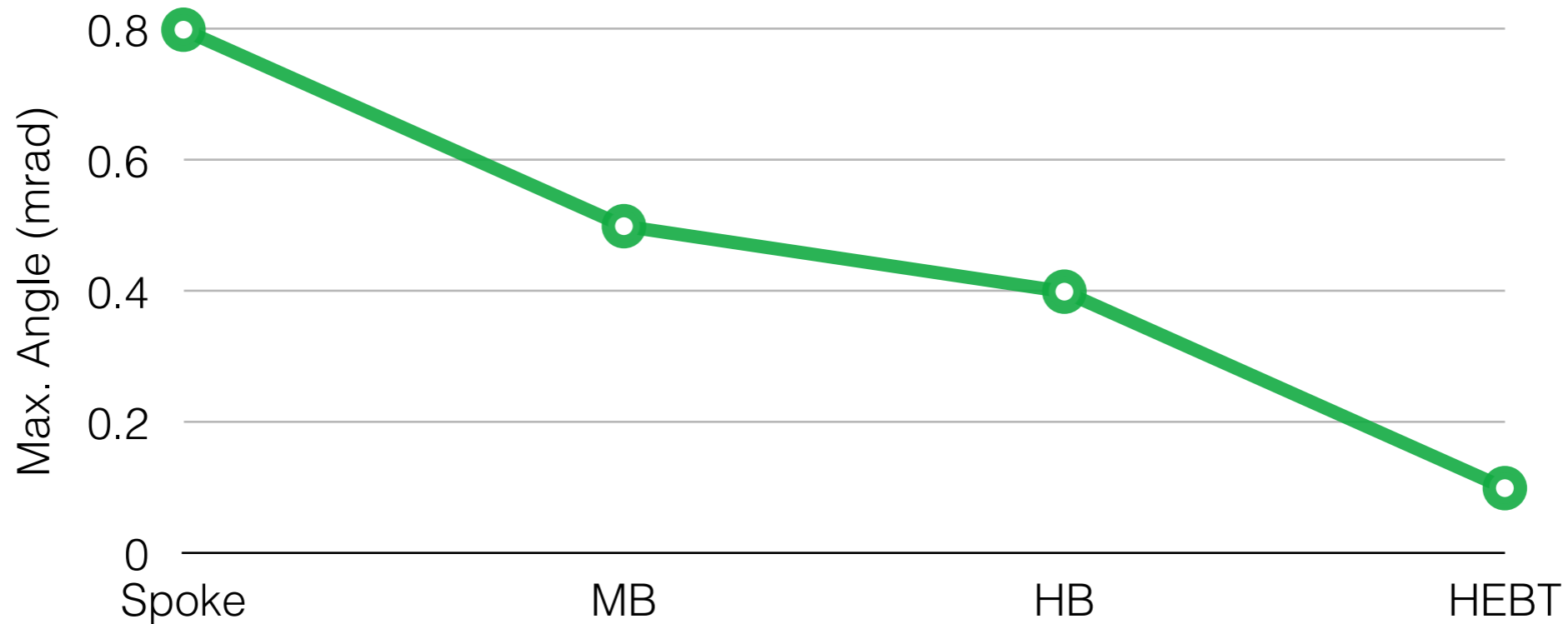
- Power lost due to QUAD failure. Vertical dashed lines indicate the position of failed quadrupoles and similar solid color bars indicate the losses associated to those. The two vertical dotted black lines represent the position of dipoles.

ALL QUADS



- Integrated power lost before target due to each quad failure in the SCL and HEBT. Vertical dotted lines indicate the start of Spoke, Medium- β , High- β , HEBT, DogLeg and A2T sections

STEERERS



- Failure of a corrector magnet could steer the beam by the maximum angle the corrector have steered the beam.



SUMMARY

- MEBT:
 - Bunchers: A large fraction of the beam actually reaches the target.
 - Quads: Immediate effects with losses in MEBT or DTL.
 - ▶ MEBT scrapers reduce the losses significantly.
- DTL:
 - RF: Considerable amount of losses inside Tanks 1 and 2 if Tank 1 is not at its nominal voltage.
 - PMQ: Downstream part of the DTL acts as scraper, particles leaving DTL will reach the target without causing any further losses.
- SCL:
 - RF: Depending on the energy at the failed cavity, the unaccelerated particles due failed cavities will be either lost locally or in the dogleg.
 - Quad: For low energy quads the losses happen locally, the quads in the high energy losses happen mainly in the A2T