Merlin simulations for loss maps calculation of the 2011 LHC machine run (preliminary results)

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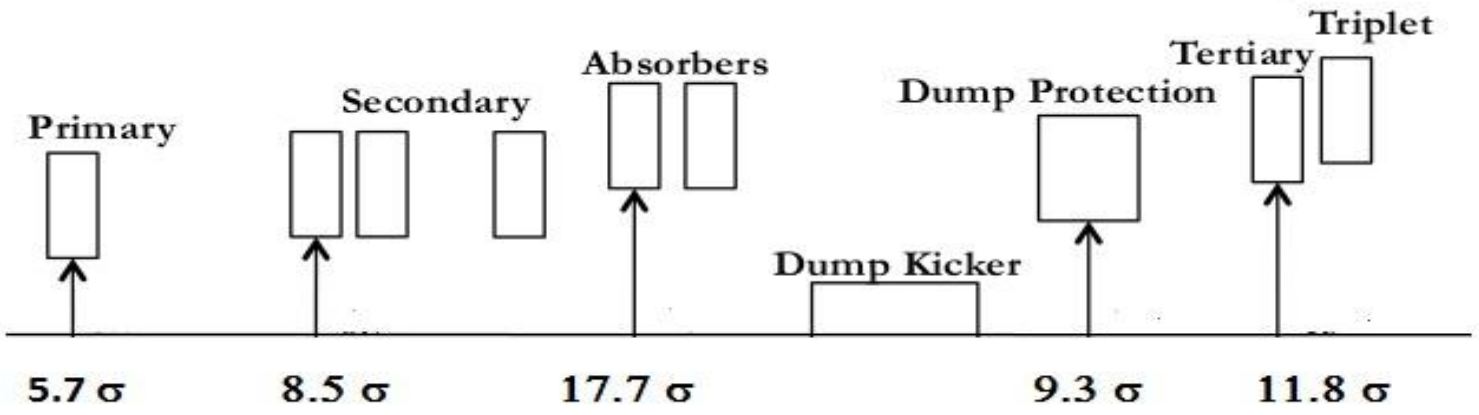
Introduction

- Machine setup at 3.5 TeV: optics and collimation system
- Comparison between MADX and Merlin optics results
- Halo beam input: flat beam in the horizontal plane
- Loss map with flat beam (Sixtrack physics)
- Loss maps comparison between Merlin and measurements
- Conclusions and work in progress

LHC Setup @ 3.5TeV

- Run 2011 machine setup at 3.5 TeV Beam1
- Collimation settings



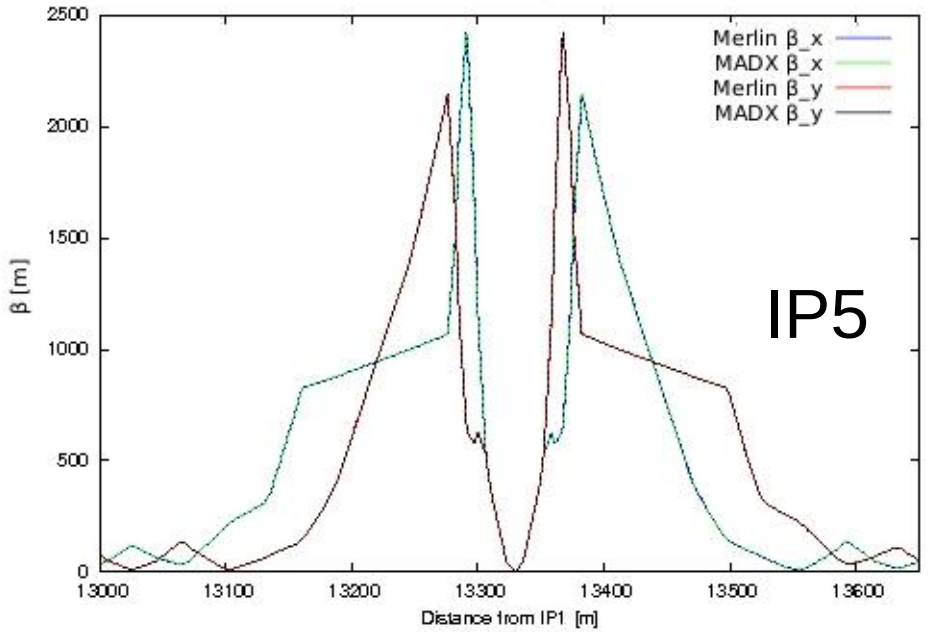
- Optics requirements at collision:

  β*=1.0m in IP1 and IP5, β*=3m in IP8 and β*=10.0m in IP2

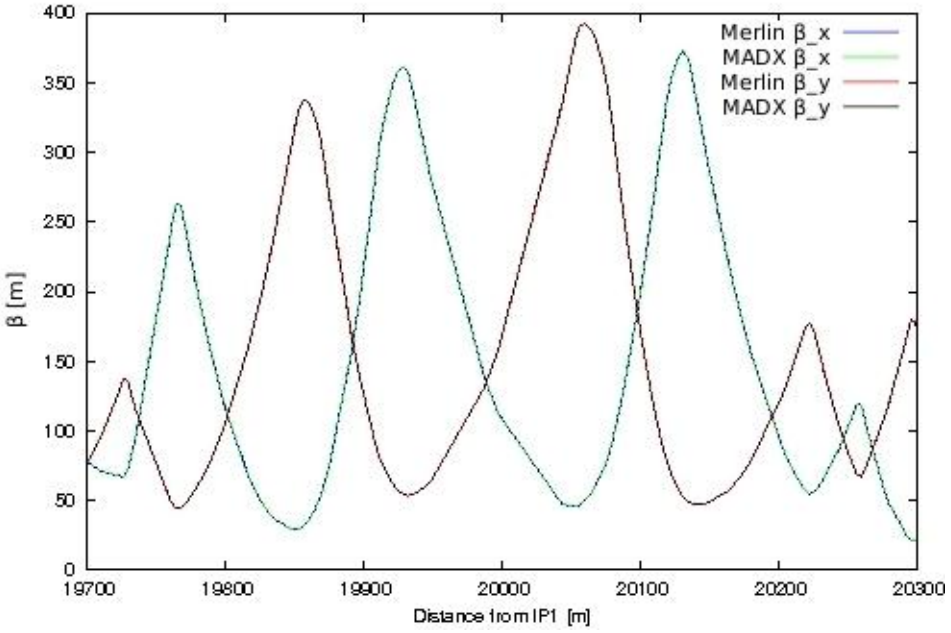
- Crossing angle ON, Separation OFF
- Alice and LHCb spectrometers ON
- ATLAS and CMS solenoids OFF

MADX and Merlin optics comparison

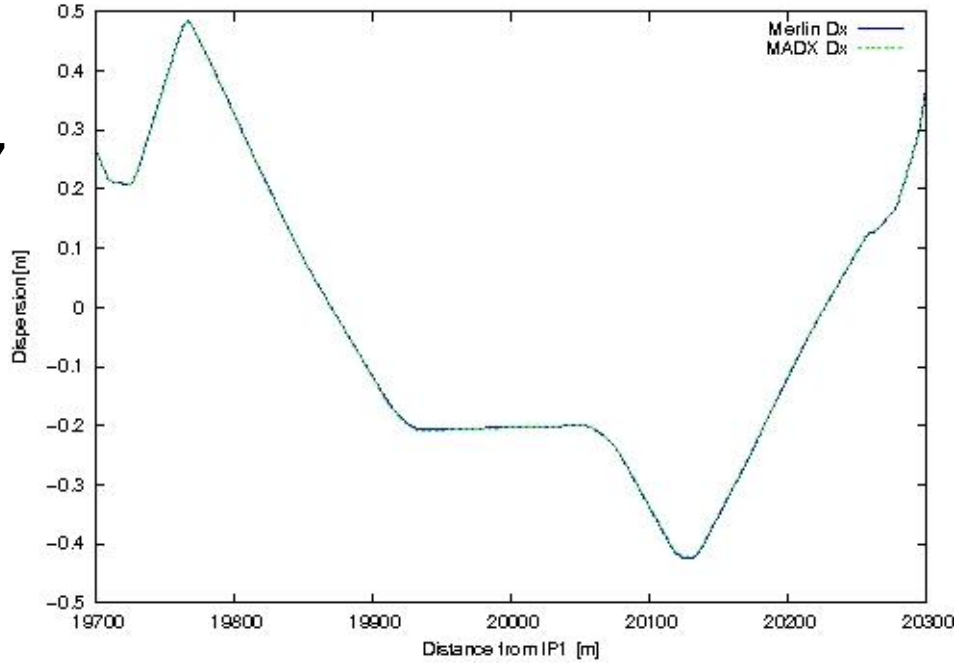
- MADX input V6.503 beam 1
- Both thick optics : there is a good agreement between the codes results



IP5



IP7



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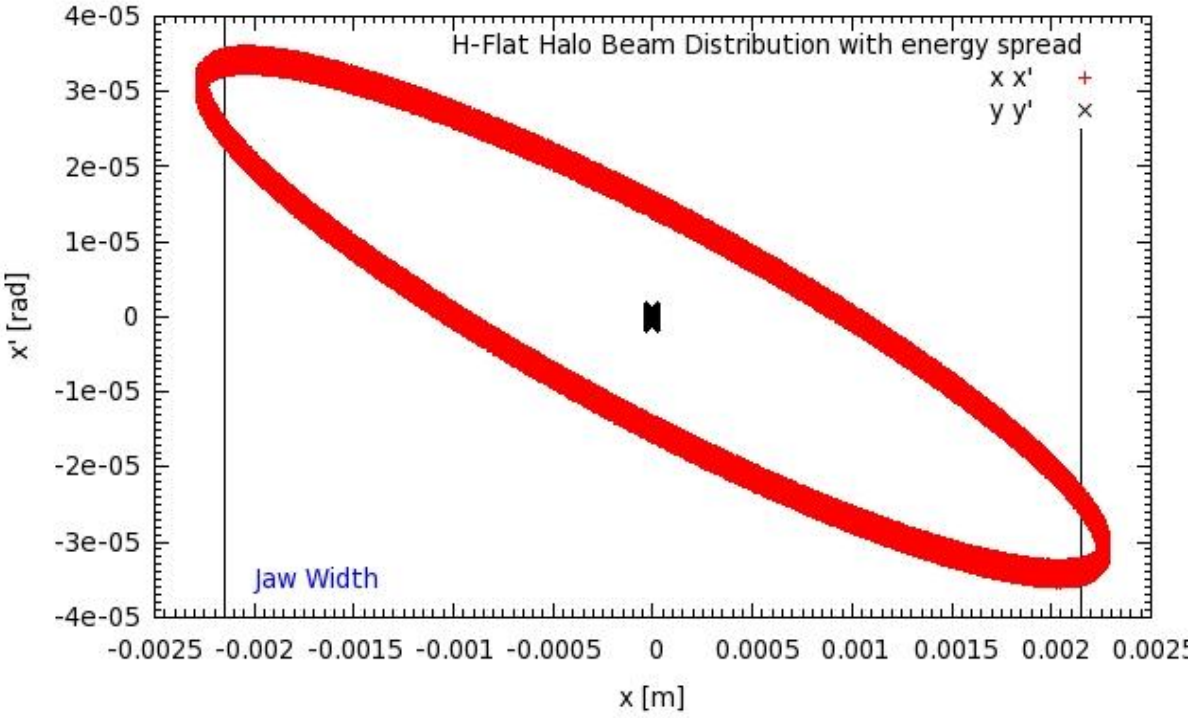
Merlin halo bunch constructor : Horizontal flat beam

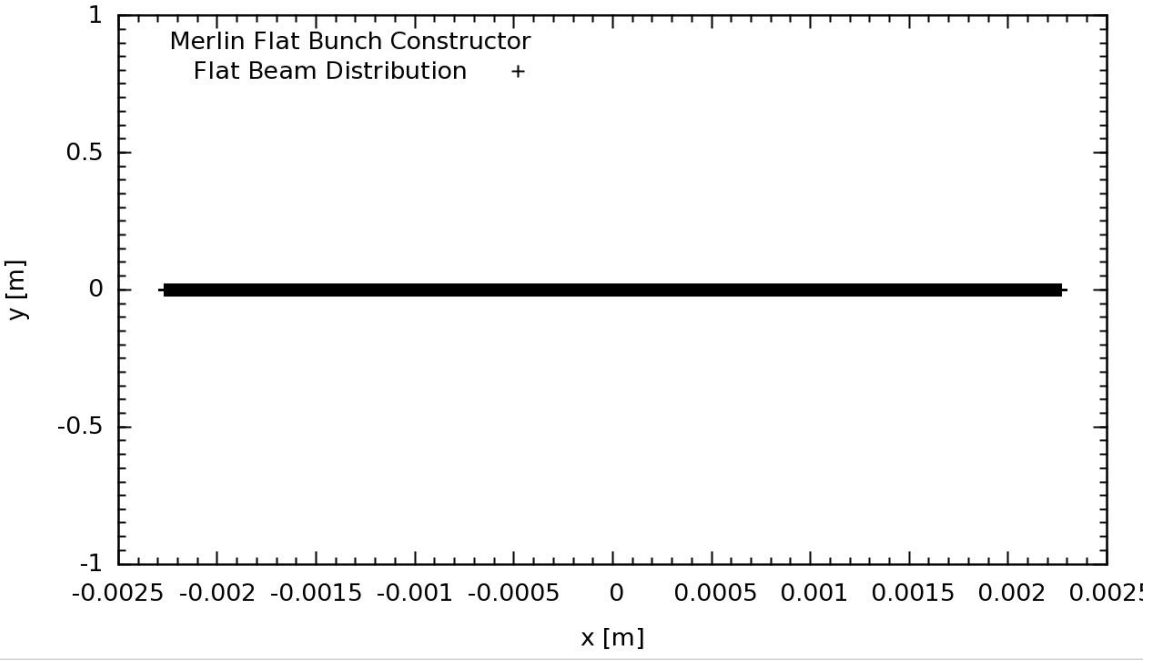
Energy=3.5 TeV
npart(real)=1.20e10
npart(simulated)=6.4e6
ε_{nx} = 3.5e-6 m rad
ε_{ny} =3.5e-6 m rad
σ_t = 0
σ_E= 0.000113%

Impact factor = 5.702 σ
Impact parameter = 1.0e-6 m

Start element:
TCP.C6L7.B1
using:
β_x = 151.7626 m
β_y = 82.0739 m
α_x = 2.0614
α_y = -1.1446
Dx = 0.007739 m
Dy = -0.002904 m

Jaw Width: 0.002151 m
Jaw Height: 0.037358 m





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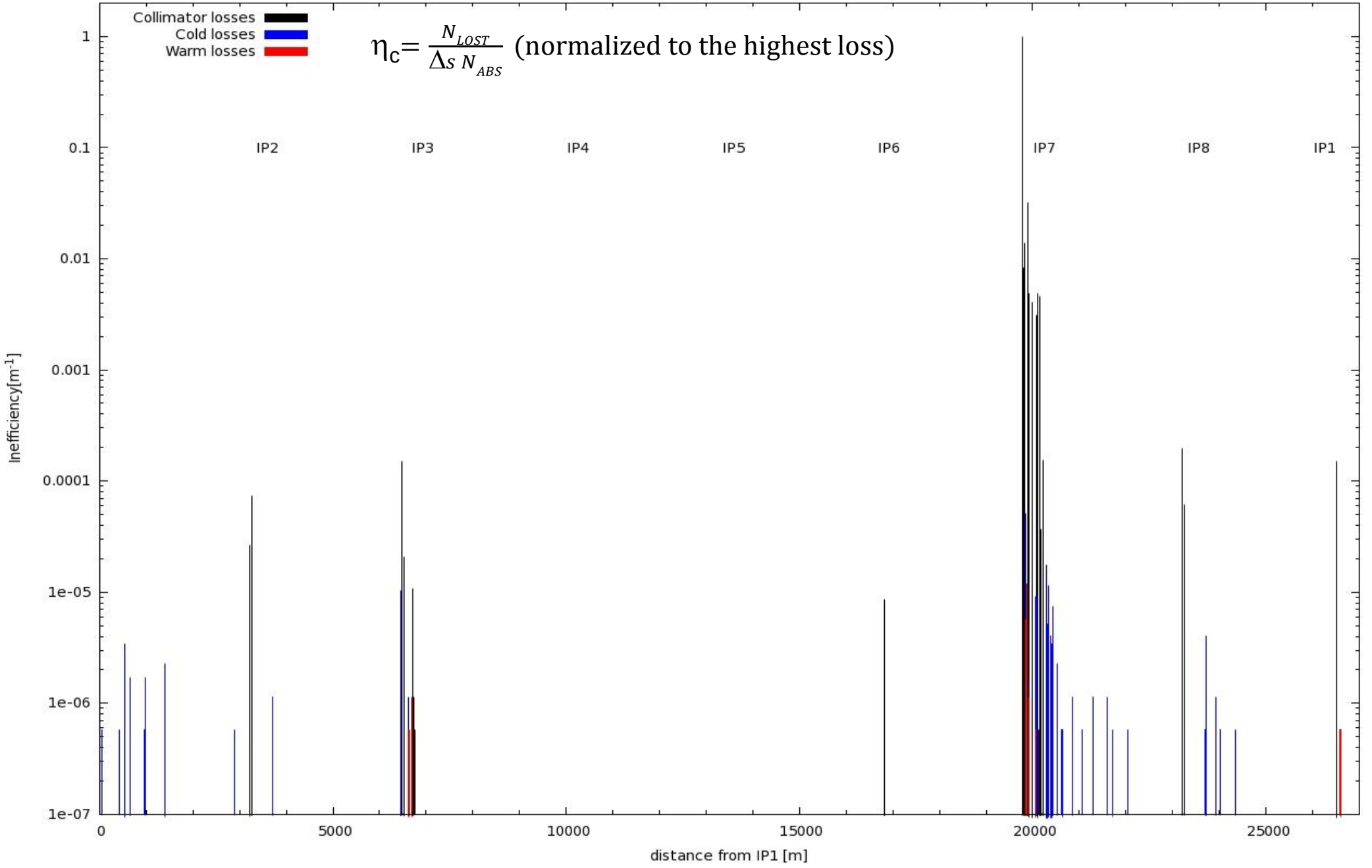
Merlin Horizontal loss map for flat beam

The results are almost the same also with different beams halo (sheet, pencil and ring)



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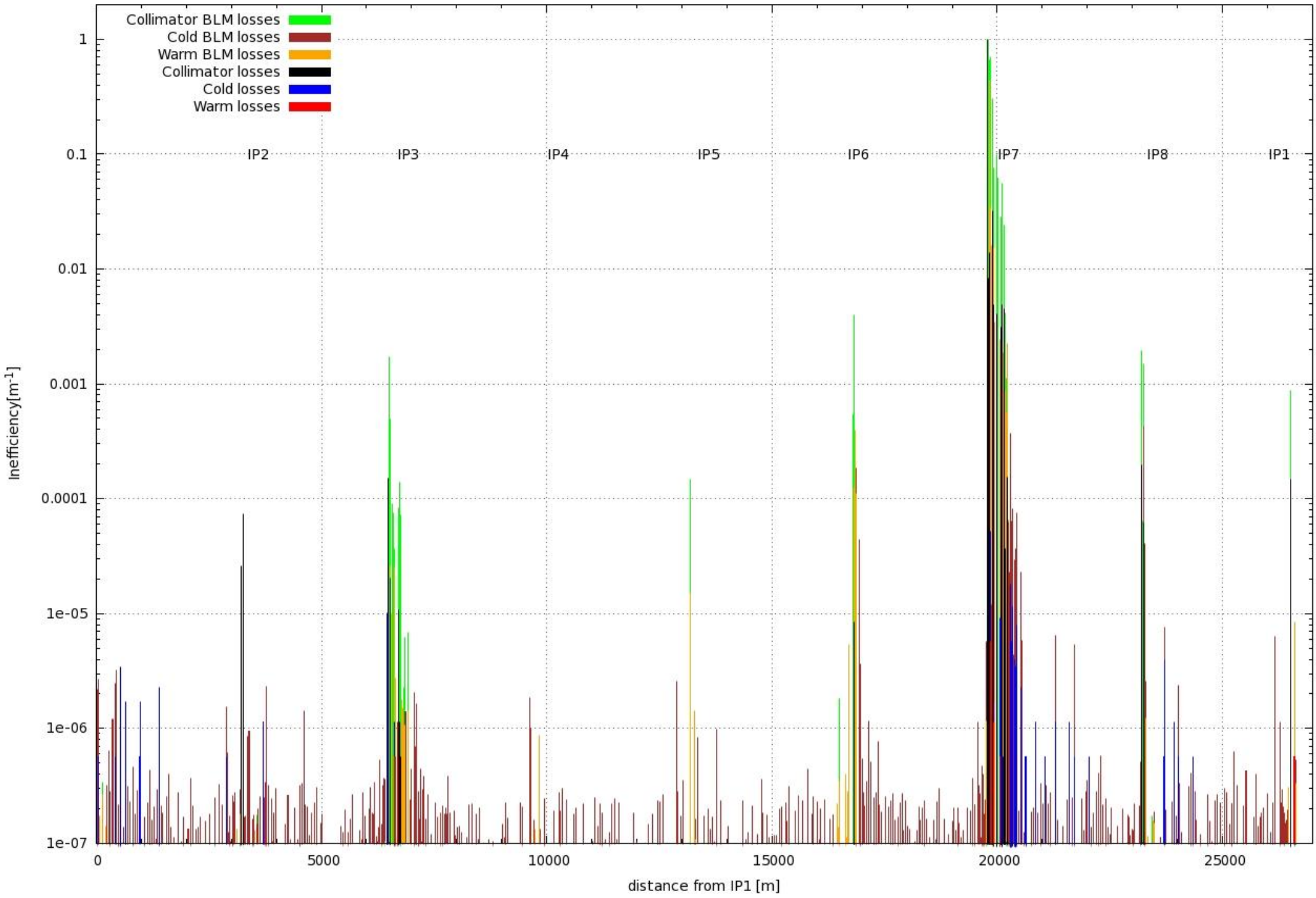
Merlin vs. Measurement loss map



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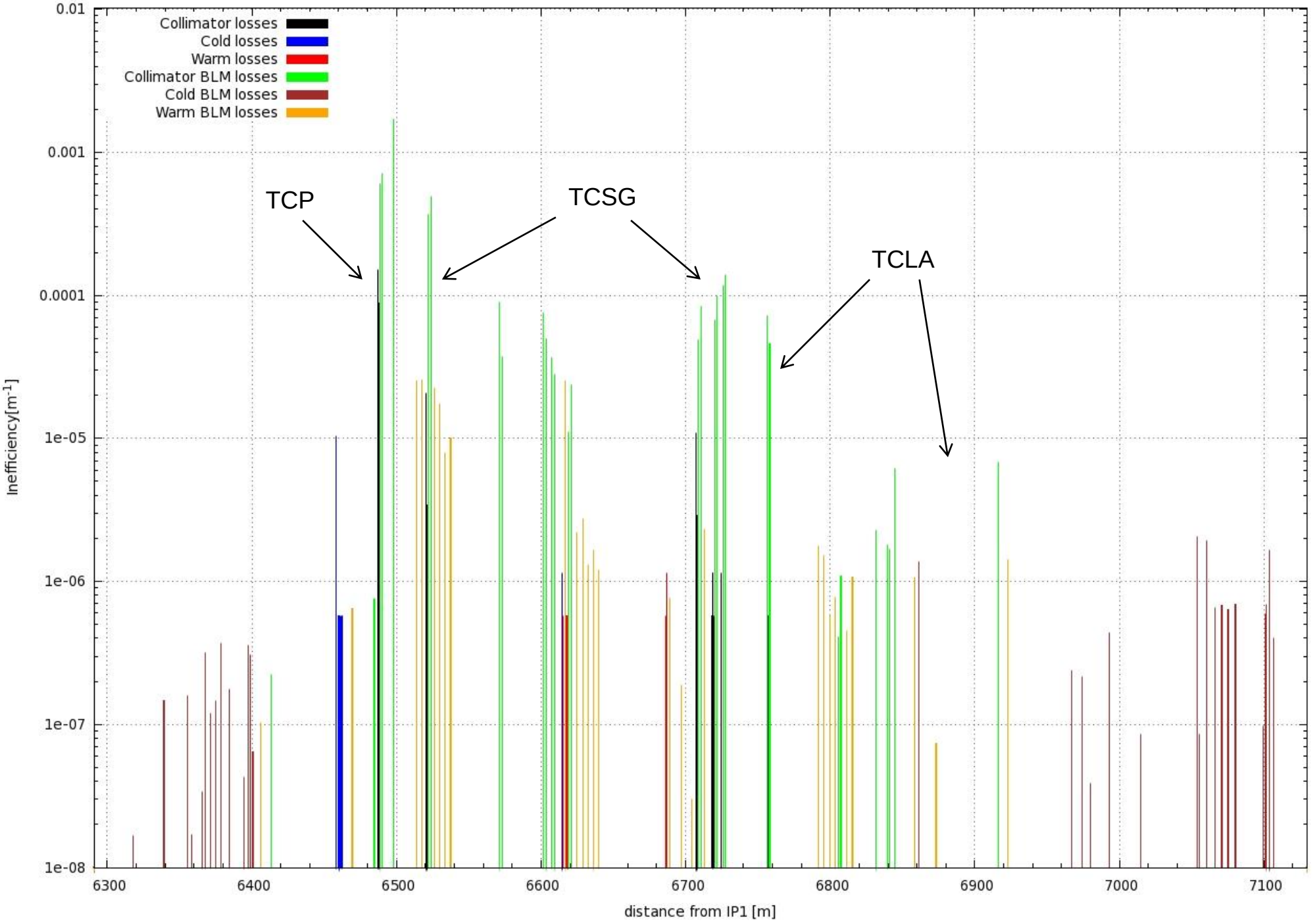
Merlin vs. Measurement loss map IP3



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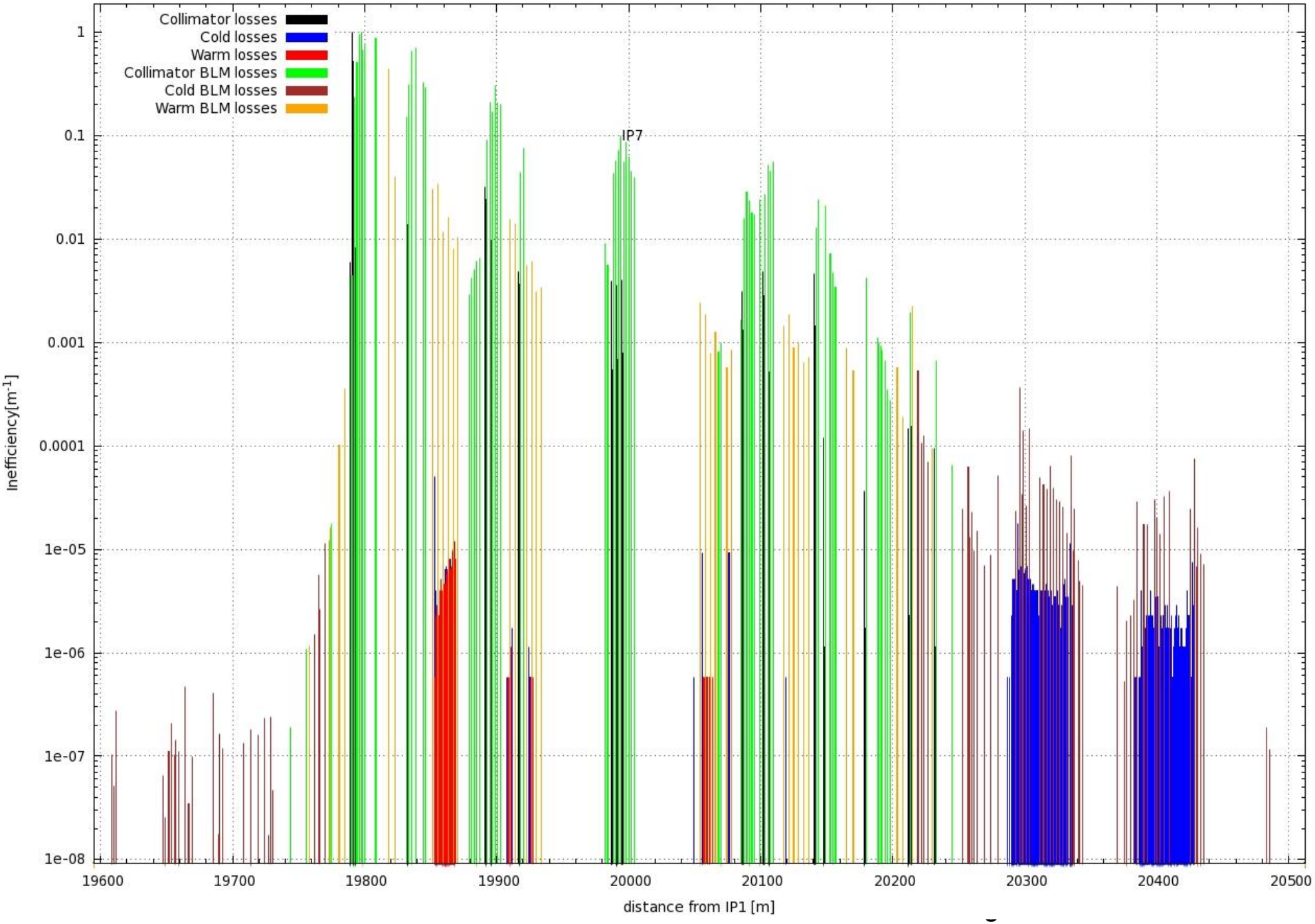
Merlin vs. Measurement loss map IP7



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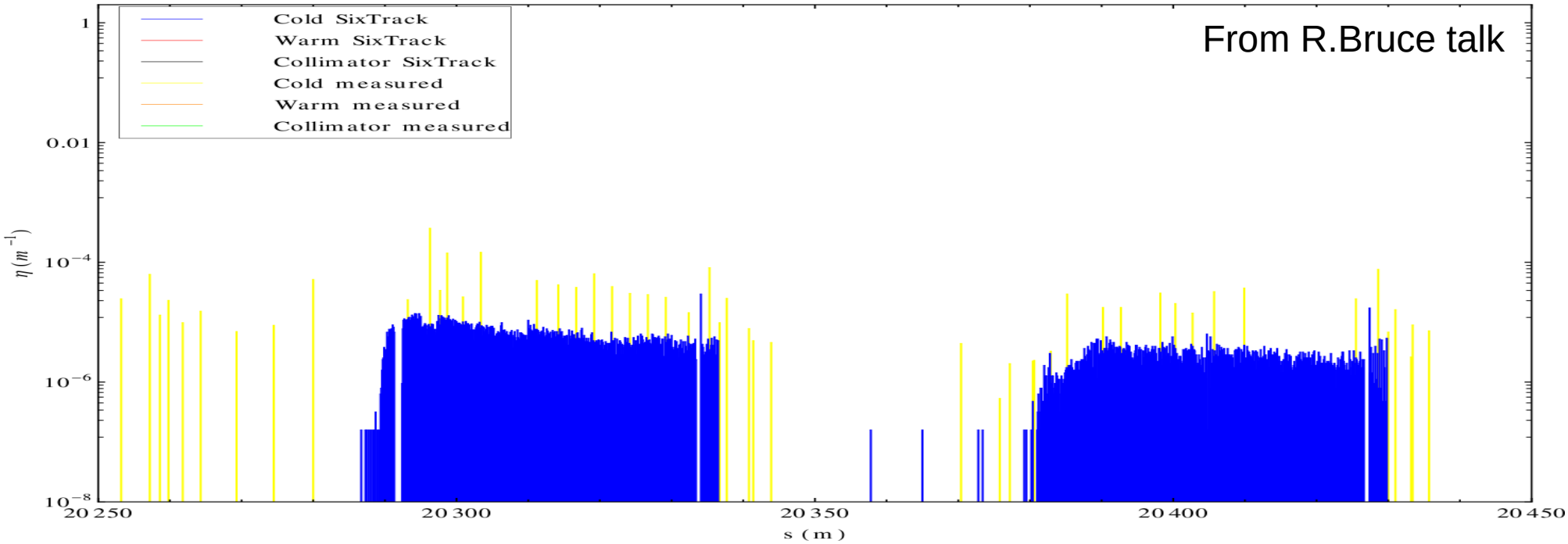
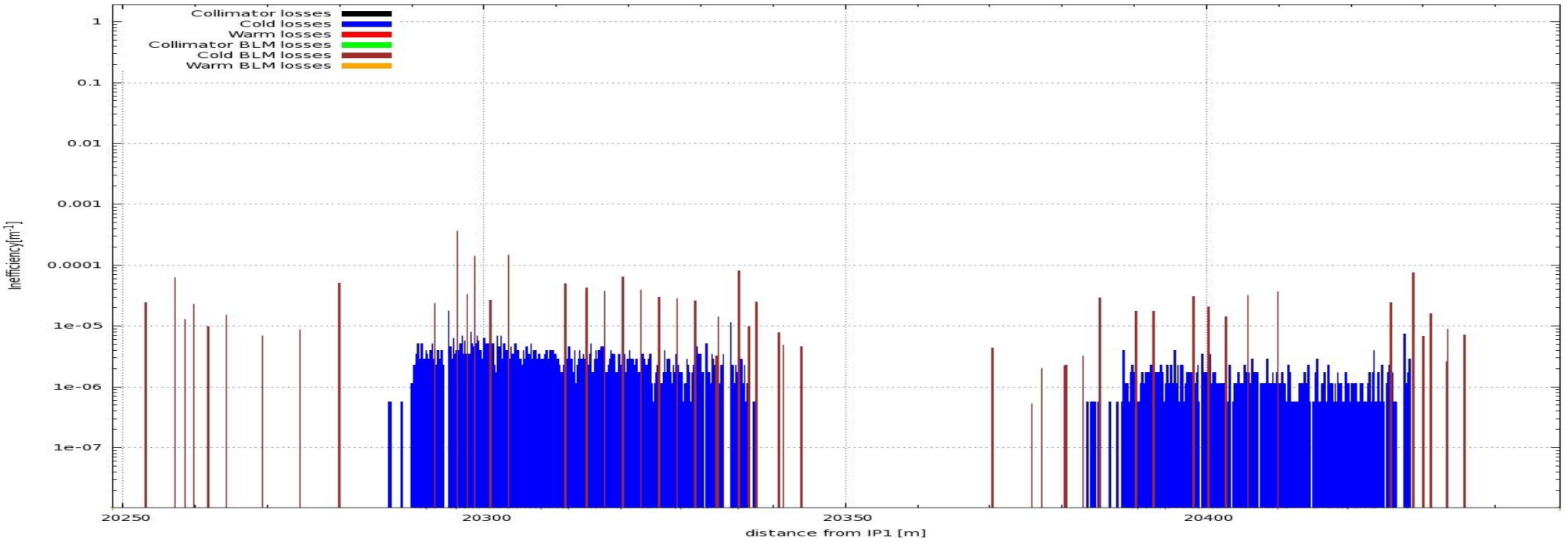
Merlin, Sixtrack and Measurement loss map IP7 zoom





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Conclusions

- We have full LHC collimation loss maps using a new approach: MERLIN
- We need to fix the collimators alignement in the main IPs in order to have reasonable results
- Check the results in deep detail for different initial beams distributions
- Check the results for β*=1.5m in IP1-IP5, i.e. the real value used in 2011 run (but sixtrack doesn't show relevant difference)
- **Work in progress**:
- Vertical loss maps
- Add the mechanical and field errors
- Improving the physics of scattering processes in collimators, beginning with elastic and single diffractive
- Add wakefield (already implemented in the code)
- Start to apply the future upgrated collimation schemes

Collimator list

TCL.5R1.B1	17.7	99	0.00000000000000	Cu	
TCTH.4L2.B1	11.8	99	0.00000000000000	W	
TCTVB.4L2	11.8	99	1.57079632679490	W	
TCP.6L3.B1	15	99	0.00000000000000	C	
TCSG.5L3.B1	18	99	0.00000000000000	C	
TCSG.4R3.B1	18	99	0.00000000000000	C	
TCSG.A5R3.B1	18	99	2.98000000000000	C	
TCSG.B5R3.B1	18	99	0.18900000000000	C	
TCLA.A5R3.B1	20	99	1.57079632679490	W	
TCLA.B5R3.B1	20	99	0.00000000000000	W	
TCLA.6R3.B1	20	99	0.00000000000000	W	
TCLA.7R3.B1	20	99	0.00000000000000	W	
TCTH.4L5.B1	11.8	99	0.00000000000000	W	
TCTVA.4L5.B1	11.8	99	1.57079632679490	W	
TCL.5R5.B1	17.7	99	0.00000000000000	Cu	
TCDQA.A4R6.B1	9.3	99	0.00000000000000	C	
TCDQA.B4R6.B1	9.3	99	0.00000000000000	C	
TCSG.4R6.B1	9.8	99	0.00000000000000	C	
TCP.D6L7.B1	5.7	99	1.57079632679490	C	
TCP.C6L7.B1	5.7	99	0.00000000000000	C	
TCP.B6L7.B1	5.7	99	2.22529479600000	C	
TCSG.A6L7.B1	8.5	99	2.46300000000000	C	
TCSG.B5L7.B1	8.5	99	2.50400000000000	C	
TCSG.A5L7.B1	8.5	99	0.71000000000000	C	
TCSG.D4L7.B1	8.5	99	1.57079632679490	C	
TCSG.B4L7.B1	8.5	99	0.00000000000000	C	
TCSG.A4L7.B1	8.5	99	2.34900000000000	C	
TCSG.A4R7.B1	8.5	99	0.80800000000000	C	
TCSG.B5R7.B1	8.5	99	2.47000000000000	C	
TCSG.D5R7.B1	8.5	99	0.89700000000000	C	
TCSG.E5R7.B1	8.5	99	2.27700000000000	C	
TCSG.6R7.B1	8.5	99	0.00900000000000	C	
TCLA.A6R7.B1	17.7	99	1.57079632679490	W	
TCLA.B6R7.B1	17.7	99	0.00000000000000	W	
TCLA.C6R7.B1	17.7	99	1.57079632679490	W	
TCLA.D6R7.B1	17.7	99	0.00000000000000	W	
TCLA.A7R7.B1	17.7	99	0.00000000000000	W	
TCTH.4L8.B1	11.8	99	0.00000000000000	W	
TCTVB.4L8	11.8	99	1.57079632679490	W	
TCTH.4L1.B1	11.8	99	0.00000000000000	W	
TCTVA.4L1.B1	11.8	99	1.57079632679490	W	
TCRYO.AR3.B1	10	99	0		W
TCRYO.BR3.B1	10	99	0		W