SuperB IR Design

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For

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Outline

- **IR design parameters**
- **Present design features**
- **SR power in the cryostat**
- **Vacuum pressure estimate**
- **Summary**

Parameters used in the IR designs

Parameter	HER	LER
Energy (GeV)	6.70	4.18
Current (A)	1.89	2.45
Beta X* (mm)	26	32
Beta Y* (mm)	0.253	0.205
Emittance X (nm-rad)	2.00	2.46
Emittance Y (pm-rad)	5.0	6.15
Sigma X (μm)	7.21	8.87
Sigma Y (nm)	36	36
Crossing angle (mrad)	+/- 30	

General IR Design Features

- Crossing angle is +/- 30 mrads
  - Tried 33 mrad – total crossing angle of 66 mrad – but found that SR backgrounds from large transverse (high sigma) orbits caused too much background on the detector beam pipe
- Cryostat has a complete warm bore
  - Both QD0 and QF1 are super-conducting
  - Also the extra focusing quadrupoles for the HER (QD0H and QF1H)

More general details

- PM in front of QD0
  - The magnet strength is as high as reasonable in order to get the most focusing in as close as possible to the IP
  - Maximum betas
    - HER β_x=330m β_y=1100m
    - LER β_x=290m β_y=1550m
- Soft upstream bend magnets
  - Reduce the SR power in IP area as much as possible. This applies especially to the inside walls of the cryostats.

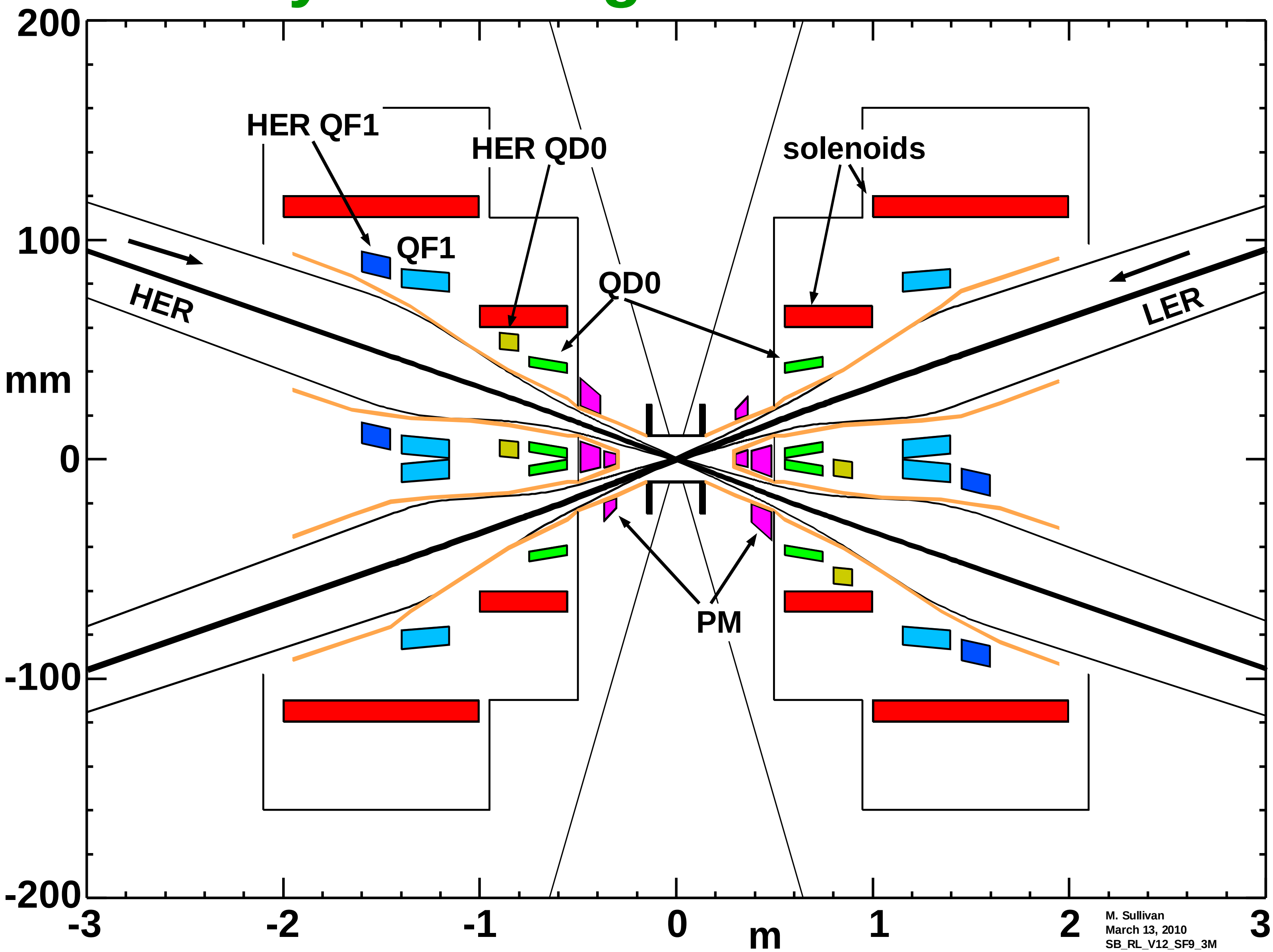
General details (3)

- **BSC to 30σ in X and 100σ in Y (7σ fully coupled)**
  - **This is as large as we could make it. Need at least 10-15 sigma for injection aperture and in this case larger is better especially since injection is continuous**
- **SR scanned to 20σ in X and 45σ in Y**
  - **There is a gap between the SR scanned area and the BSC. Presently assume that collimators will block most beam particles in this region (20 to 30 sigmas). This will need to be modeled further.**

Details of the permanent magnet slices

Name	Beam	Z from IP m	Len. cm	R1 mm	R2 mm	G T/cm
QDPA	LER	0.30	1	7.5	12.5	1.392
QDPB	LER	0.31	1	7.5	13.0	1.473
QDPC	LER	0.32	1	7.5	13.5	1.547
QDPD	LER	0.33	1	7.5	14.0	1.616
QDPE	LER	0.34	1	7.5	14.5	1.680
QDPF	LER	0.35	1	7.5	15.0	1.740
QDPG	LER	0.36	1	7.5	15.5	1.796
drift	drift	0.37	1			
QDPI	HER	0.38	1	7.5	16.5	1.899
QDPJ	HER	0.39	1	7.5	17.0	1.945
QDPK	HER	0.40	1	7.5	17.5	1.989
QDPL	HER	0.41	1	7.5	18.0	2.030
QDPM	HER	0.42	1	7.5	18.5	2.070
QDPN	HER	0.43	1	7.5	19.0	2.107
QDPO	HER	0.44	1	7.5	19.5	2.142
QDPP	HER	0.45	1	7.5	20.0	2.175
QDPQ	HER	0.46	1	7.5	20.5	2.207
QPDR	HER	0.47	1	7.5	21.0	2.238
QDPS	HER	0.48	1	7.5	21.5	2.266

Cryostat Magnets and PMs



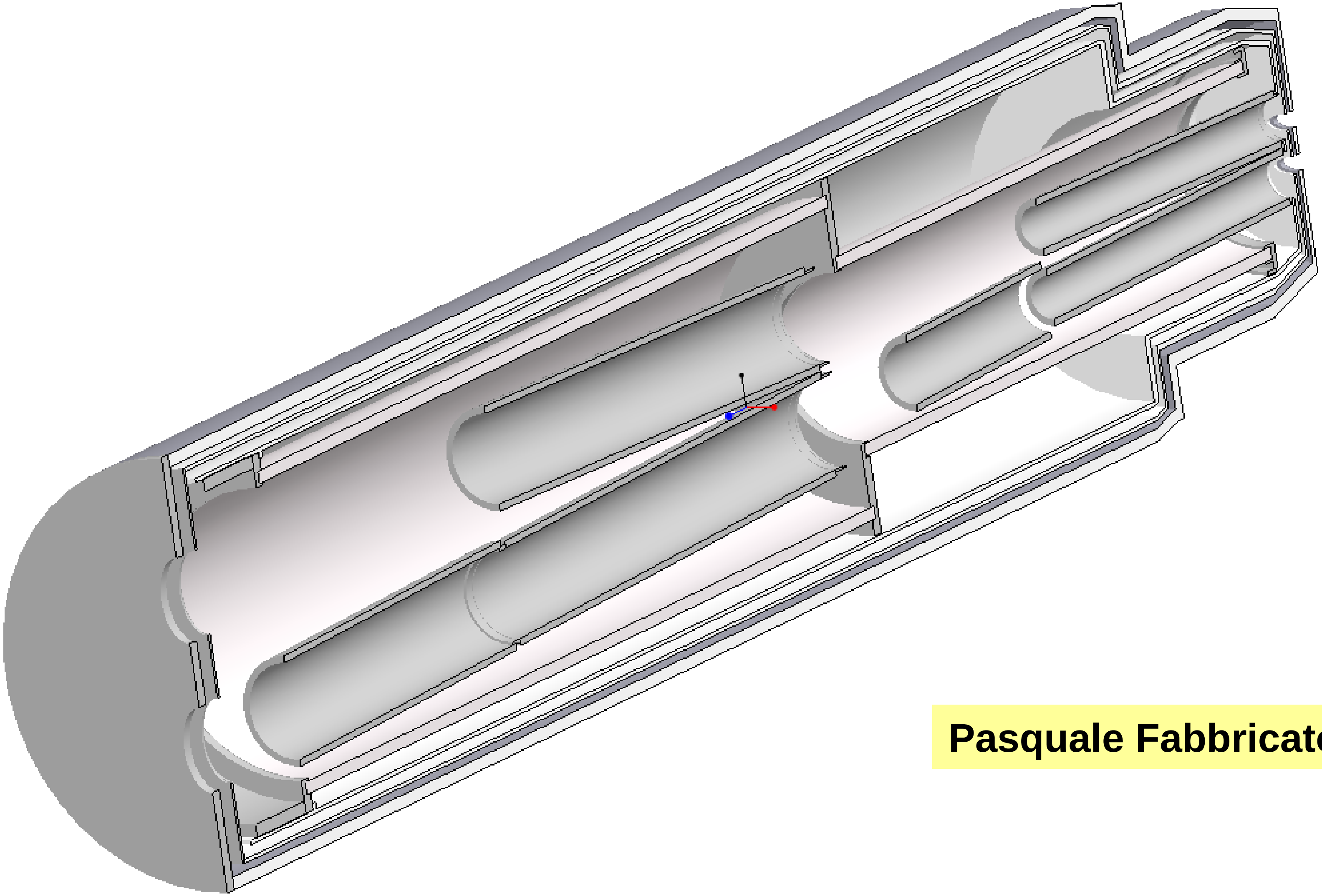
Magnet design details

- PM as described earlier

Pasquale Fabbricatore will talk more about this

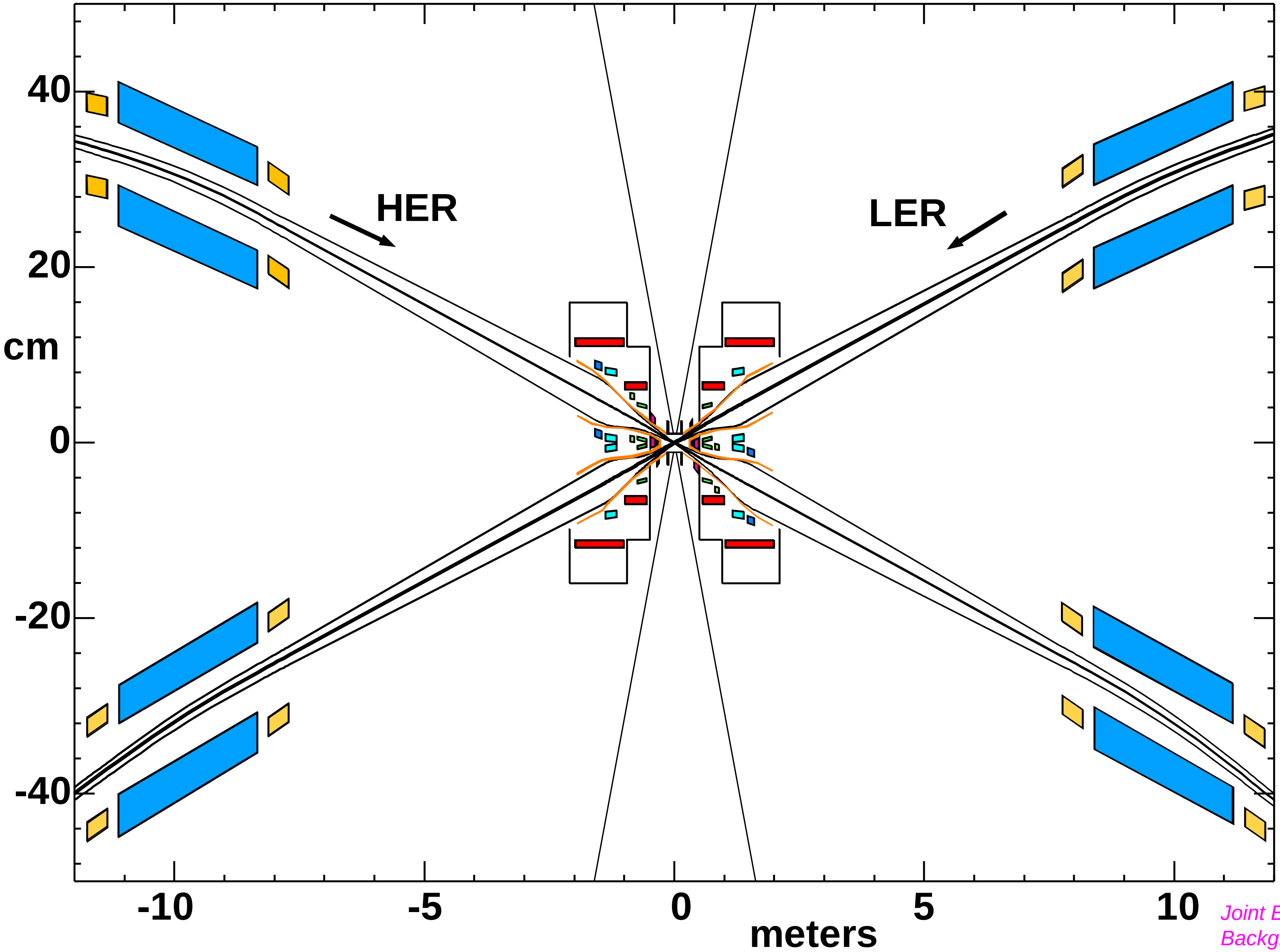
Magnet	QD0	QD0H	QF1	QF1H
IP face (m)	0.55	0.90	1.25	1.70
Length (m)	0.30	0.15	0.40	0.25
Axis offsets (mm)	0.5	---	4	---
Angle wrt beam (mrad)	30	0	27	1
G (T/cm)	0.956	0.706	0.408	0.381
Aperture (mm)	35	50	73	78
Max. Field (T)	1.67	1.77	1.49	1.49

Cryostat drawing

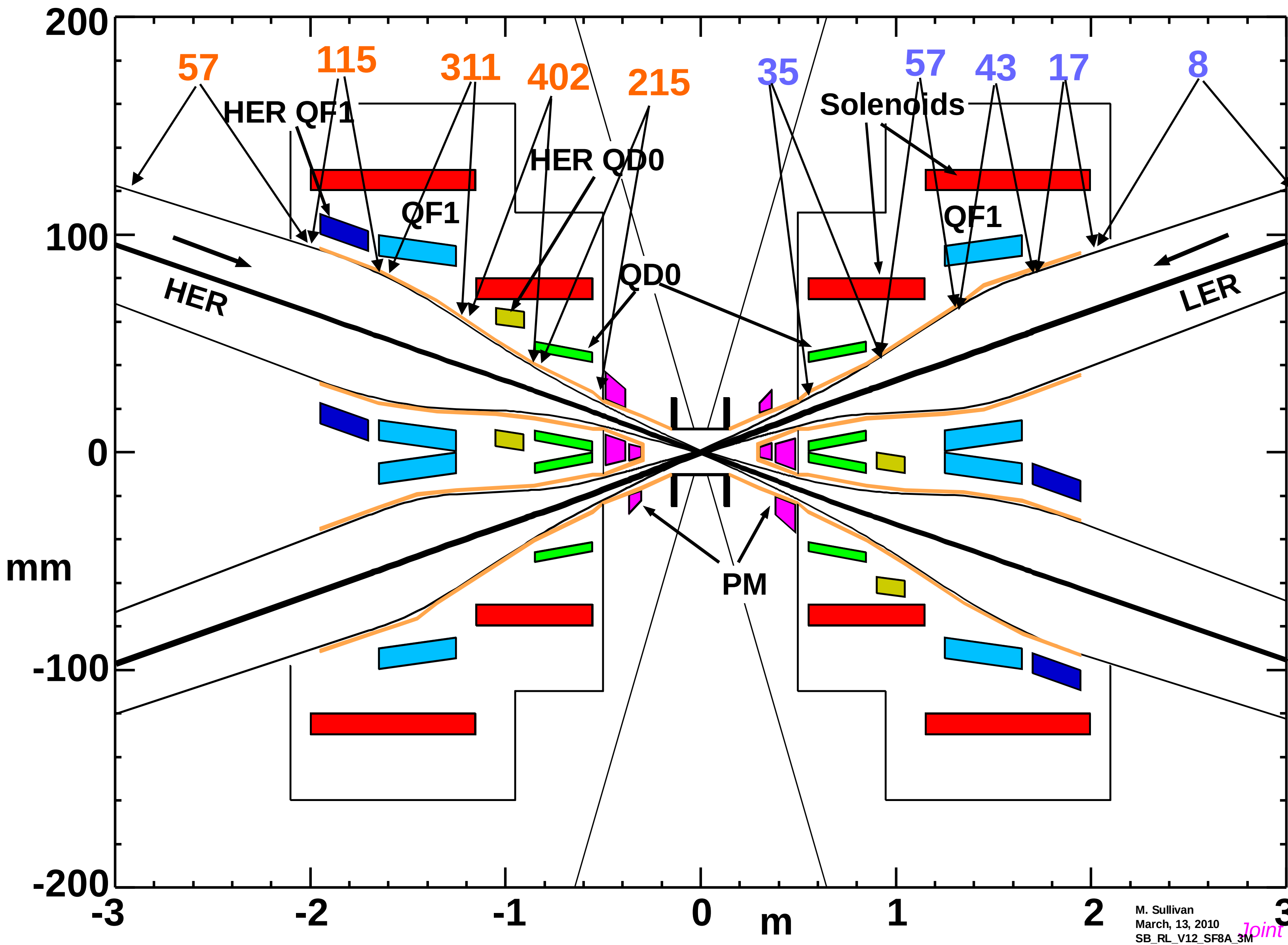


Pasquale Fabbricatore

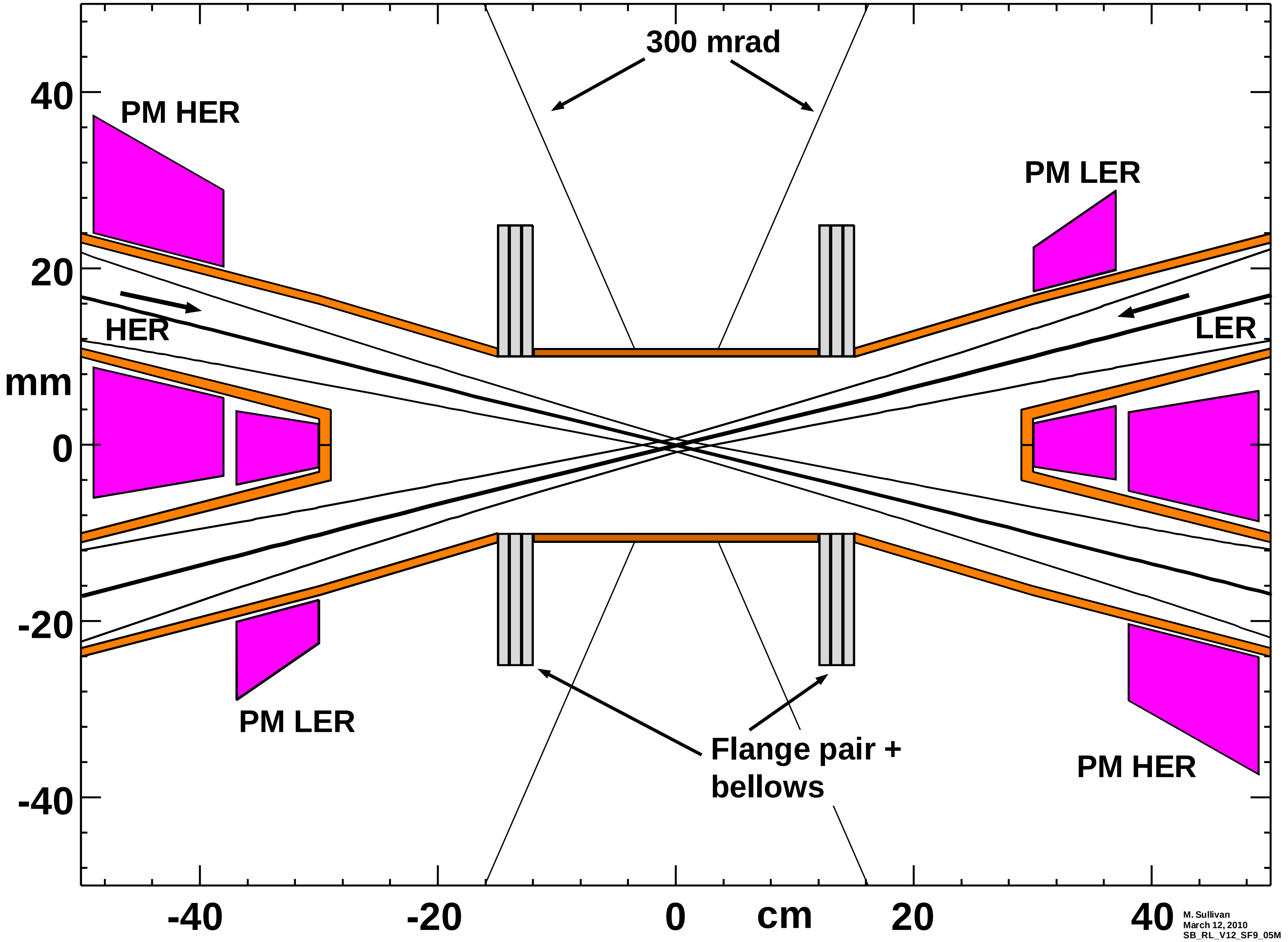
Larger view of IR



SR power inside the Cryostat

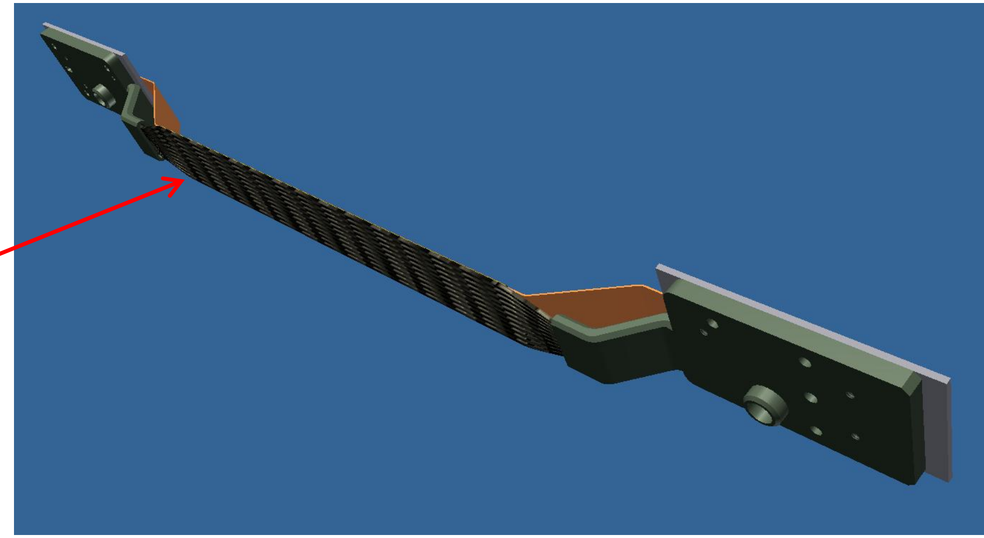


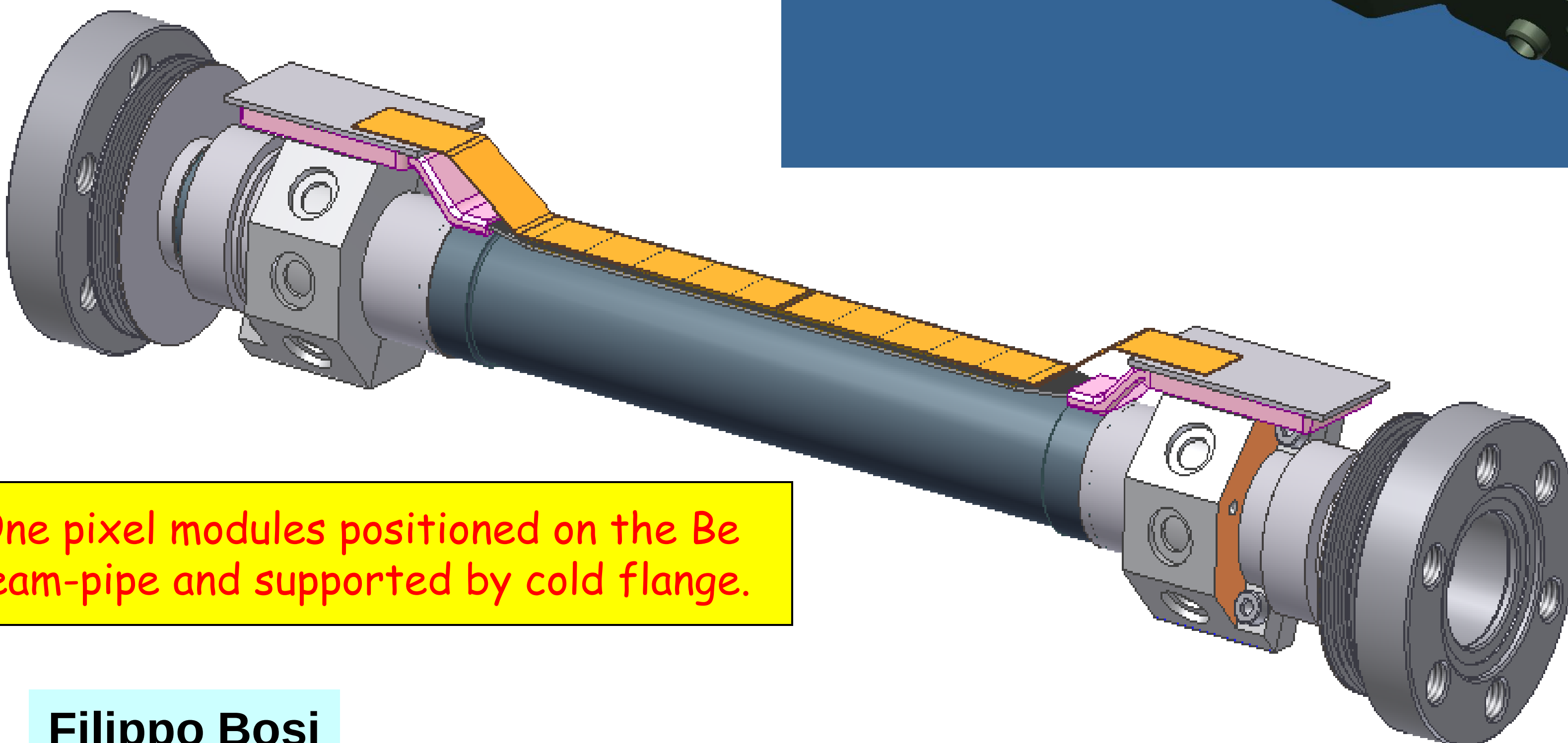
Central beam pipe



L0 on to the Beam Pipe

Microchannel support



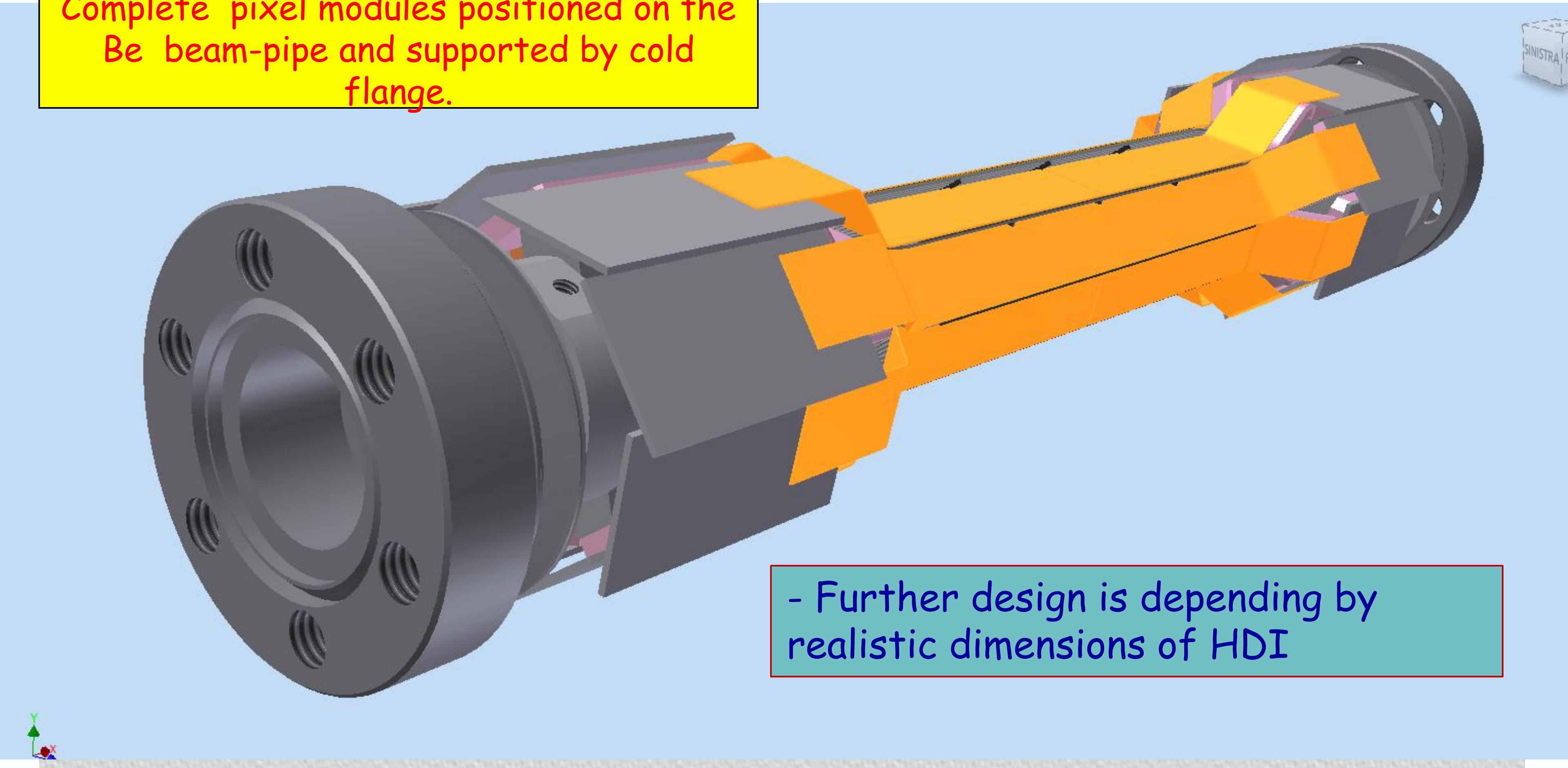


One pixel modules positioned on the Be beam-pipe and supported by cold flange.

Filippo Bosi

L0 on to the Beam Pipe

Complete pixel modules positioned on the Be beam-pipe and supported by cold flange.



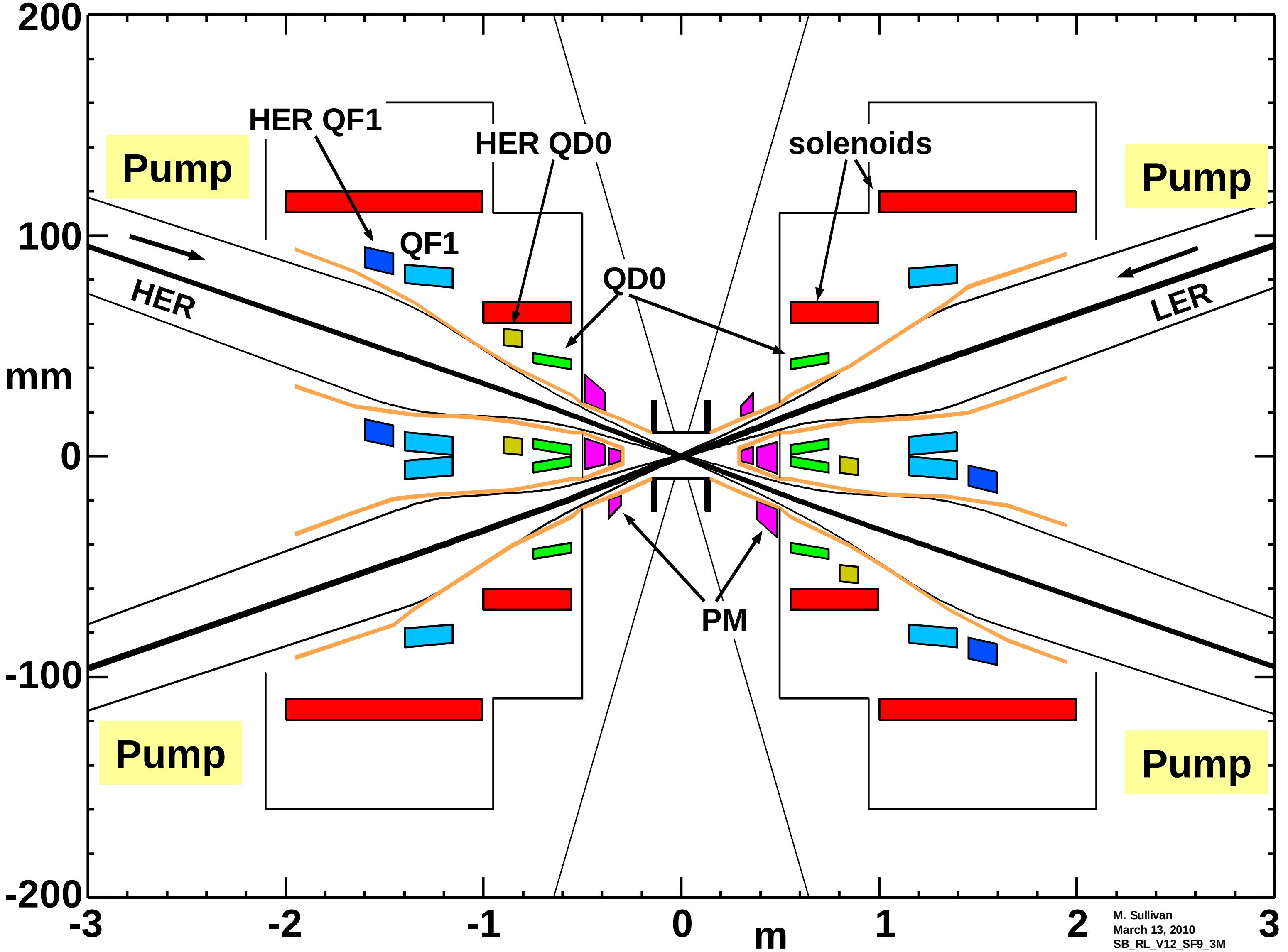
- Further design is depending by realistic dimensions of HDI

Filippo Bosi

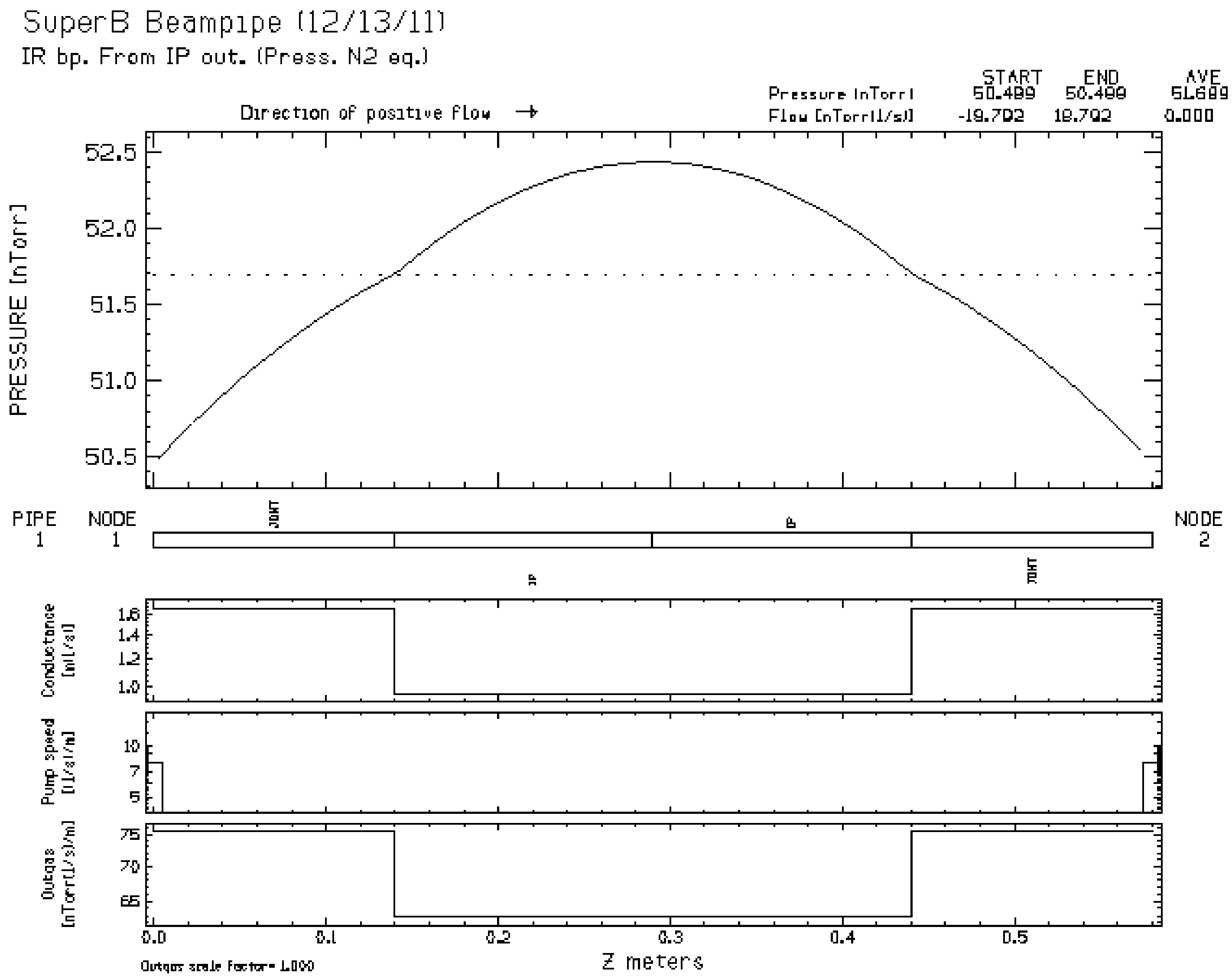
Initial Vacuum study

- Using a vacuum code called VACCALC
- This code was built for PEP-II
  - Derived from a program called VACTRAK made by Volker Ziemann to handle the problem of merging beam pipes
  - VACCALC has a similar construction but uses a different algorithm to find the pressure profile
  - Assume the first pumps are located just outside of the cryostats

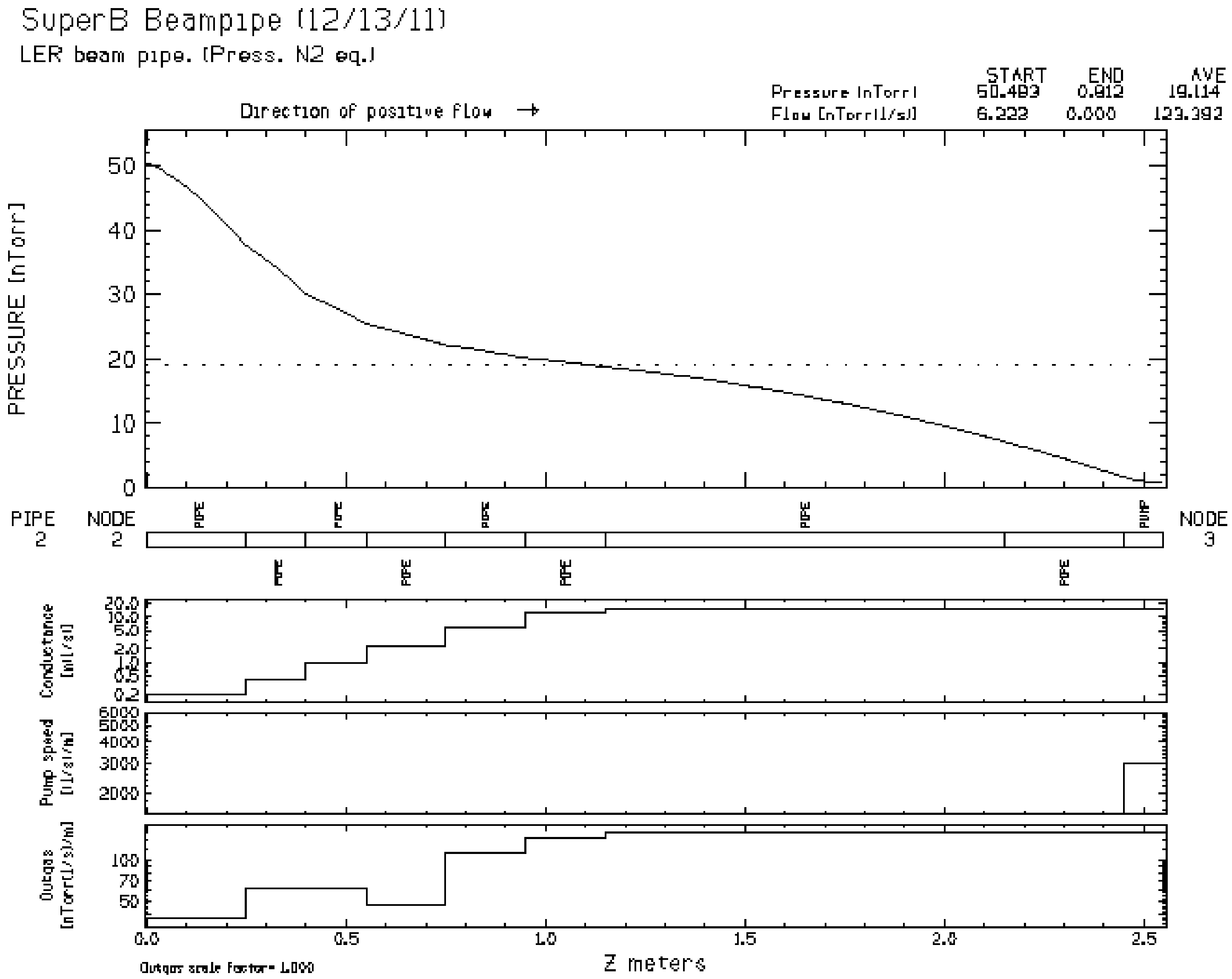
IR design is symmetric (except for SR)



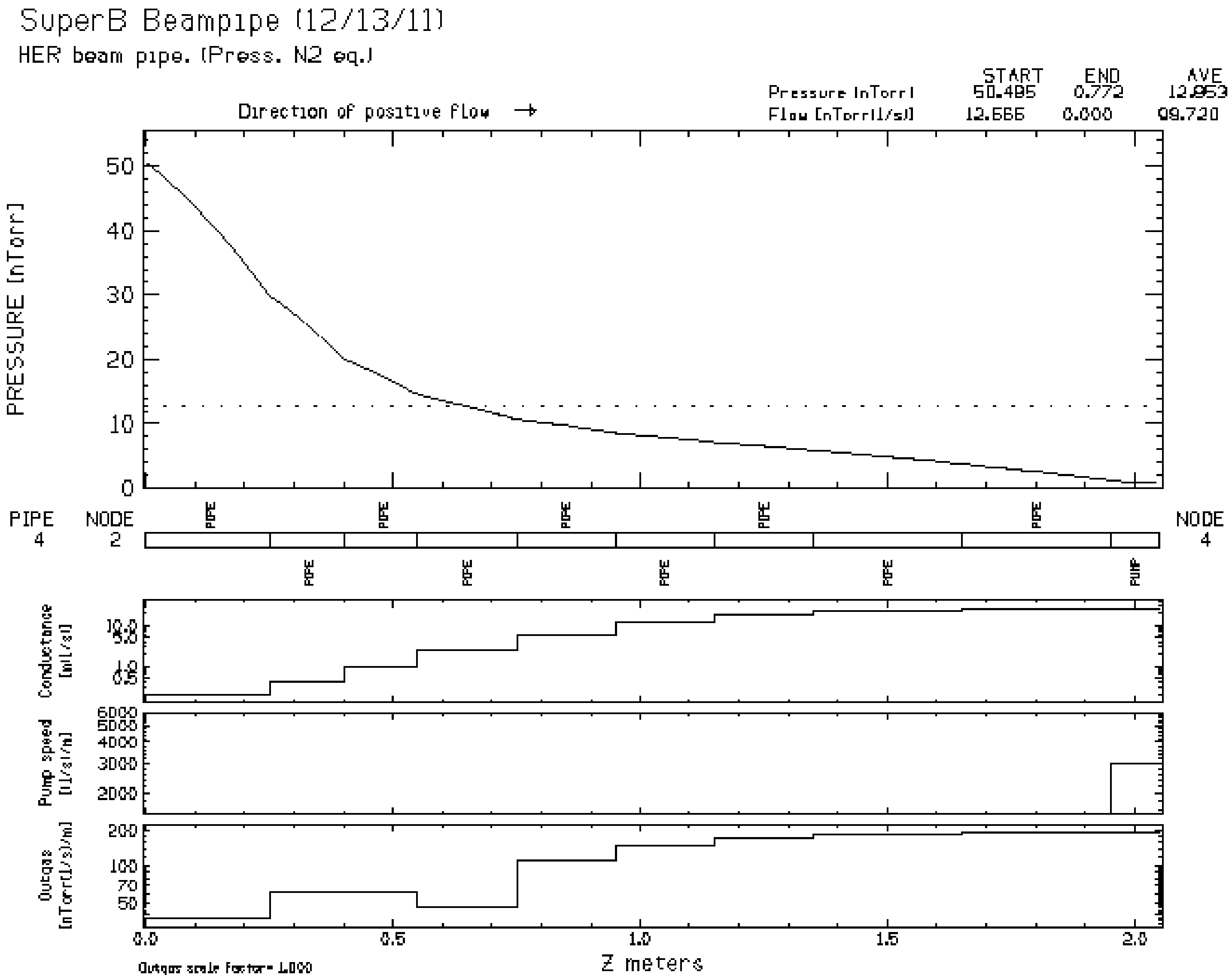
Central beampipe



LER beam pipe



HER beam pipe



Vacuum Summary

- Peak pressure at the IP is about 50 nTorr
- Pressure drops quickly after the narrow beam pipes under the permanent magnets
- This initial calculation is a reasonable first approximation
  - It is probably low compared to startup pressures
  - It is probably high after we have run for a while (after 100-200 A-hrs)
- This pressure profile looks quite reasonable
  - The PEP-II IP pressure was about 80 nTorr

Summary

- The IR design meets the SuperB requirements
- We have initial engineering for the cryostat and magnet windings inside the cryostat that looks very good
- We also have engineering for the center section of the beam pipe and how layer0 of the SVT can work with the beam pipe
- Both of these steps are very encouraging. The design has had to accommodate only small changes so far.
- As the engineering details for other aspects of the design come forward the design may have to change further however, the design looks to be robust enough to be able accommodate further engineering requirements