Transfer Line Linac4 to PSB: Injection Aperture Limitations

Outline

- Aperture at BIS and DIS
- Aperture in the PSB injection region:
  - Review of injected and circulating beam envelope
  - Foil
  - BSW
  - Valves

Linac4 to PSB: DIS and SMV

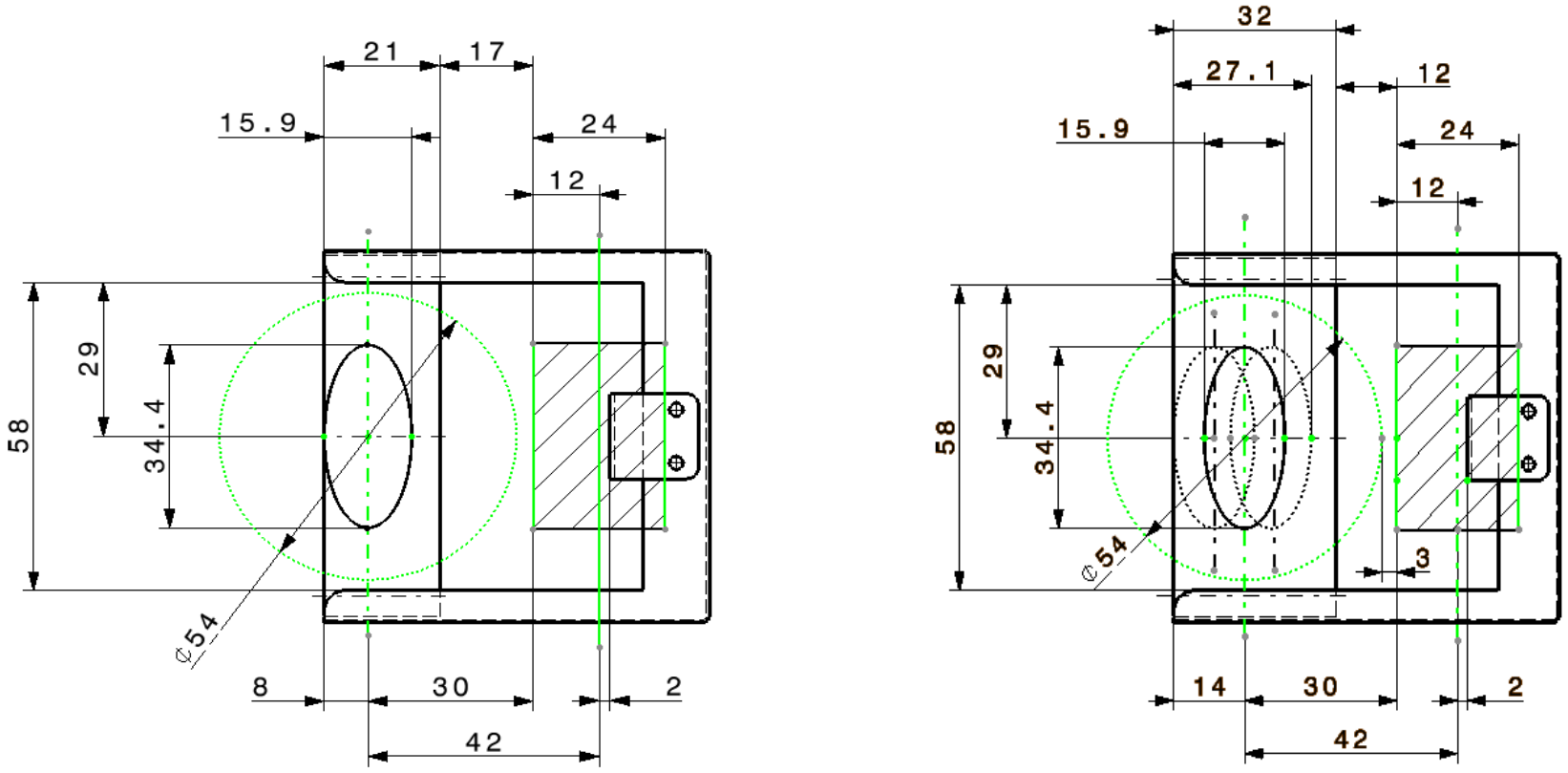
- Only “all matched” optics (β=5m, D=-1.4 m), beam envelope calculated from optics parameters, No tracking!

	BI.DIS Hor.	BI.DIS Vert.	BI.SMV Hor.	BI.SMV Vert.
Beam β max [m]	31.4	20.6	42.2	7.3
normalised ε [π mm mrad]	***0.5***	***0.5***	***0.5***	***0.5***
$\beta\gamma$	0.6	0.6	0.6	0.6
Betatron envelope [mm]	20.3	16.4	23.5	9.8
Beam Disp. [m]	0.1	1.5	0.1	1
Max $\Delta p/p$	0.0044	0.0044	0.0044	0.0044
Maximum mom. Displacement [mm]	0.4	6.0	0.4	4
r.m.s. orbit displacement [mm]	1.5	10	1.8	1
Mechanical tolerance [mm]	1	1	1	1
Max. beam envelope [mm]	±23.2	±34	±26.8	±15.9

Aperture OK: **50X100 mm** (H x V) for **DIS** and **70 X 32 mm** for **SMV** (specifications from A. Lombardi tracking studies for different optics)

W. Weterings

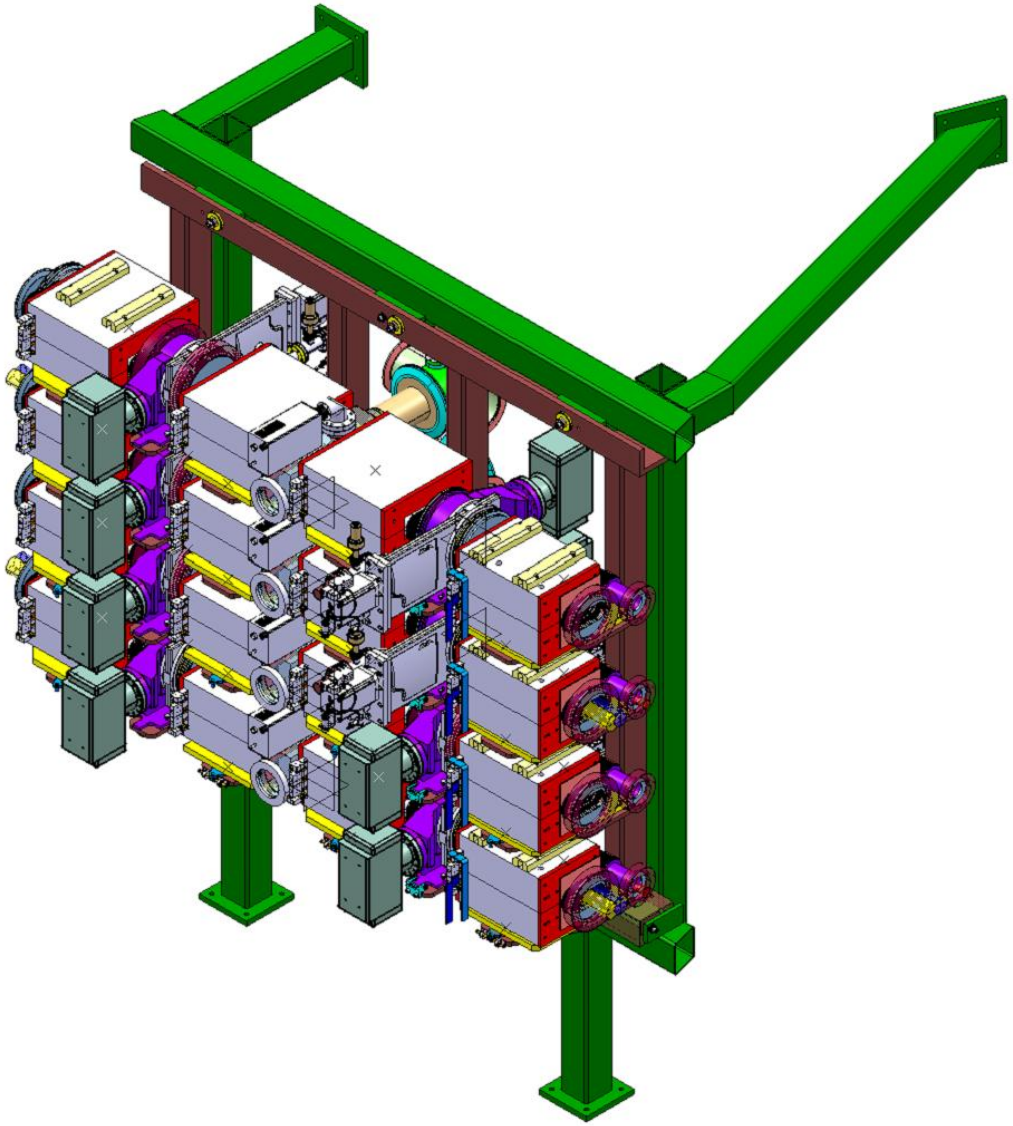
Foil and Support



Estimated beam size on the foil for zero dispersion (left) and matched (-1.4 m) dispersion (right) at injection point. PSB beam envelope (Ø54mm) during injection is also shown. (L4-T-EP-0005, EDMS 1108941)

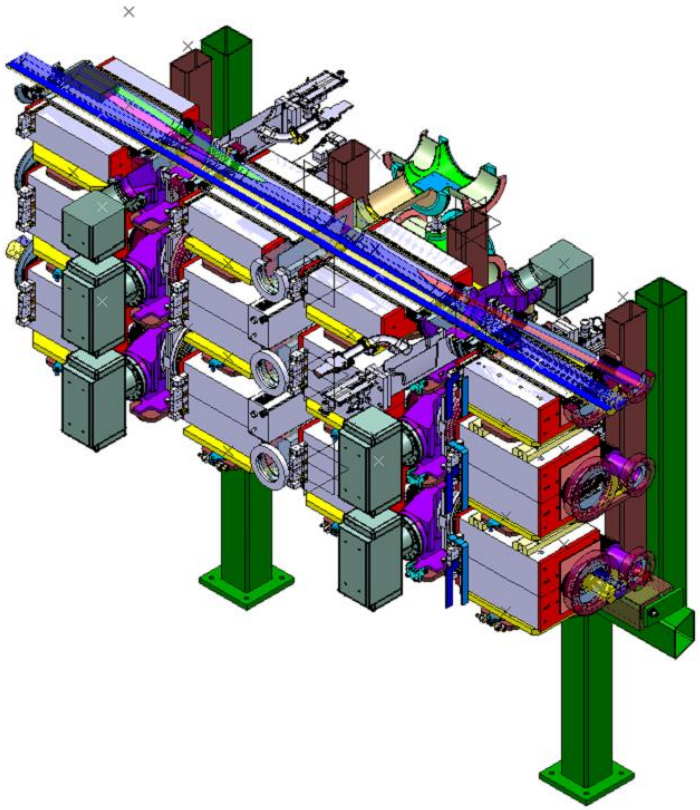
W. Weterings

Injection Region



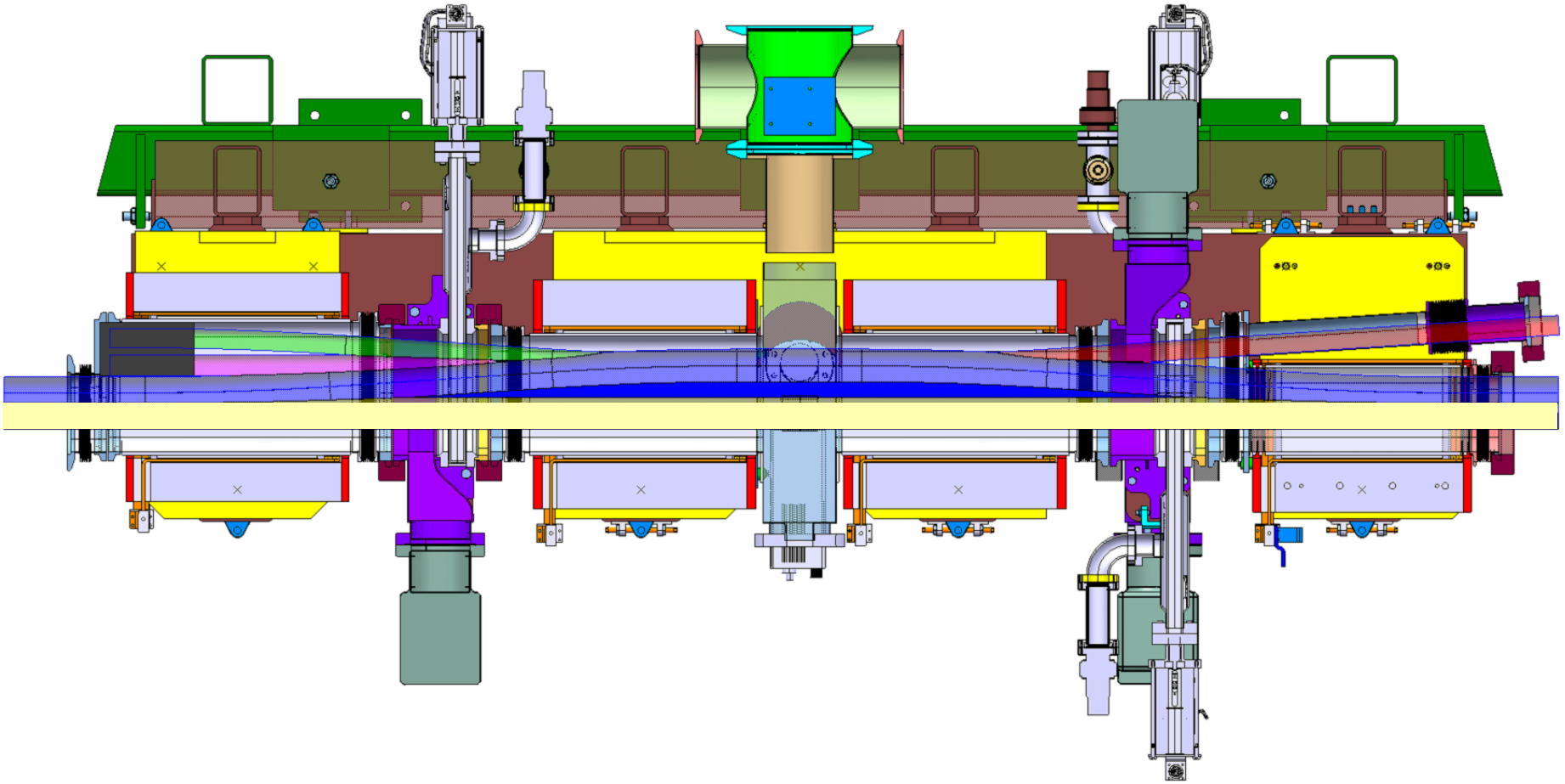
W. Weterings

Injection Region



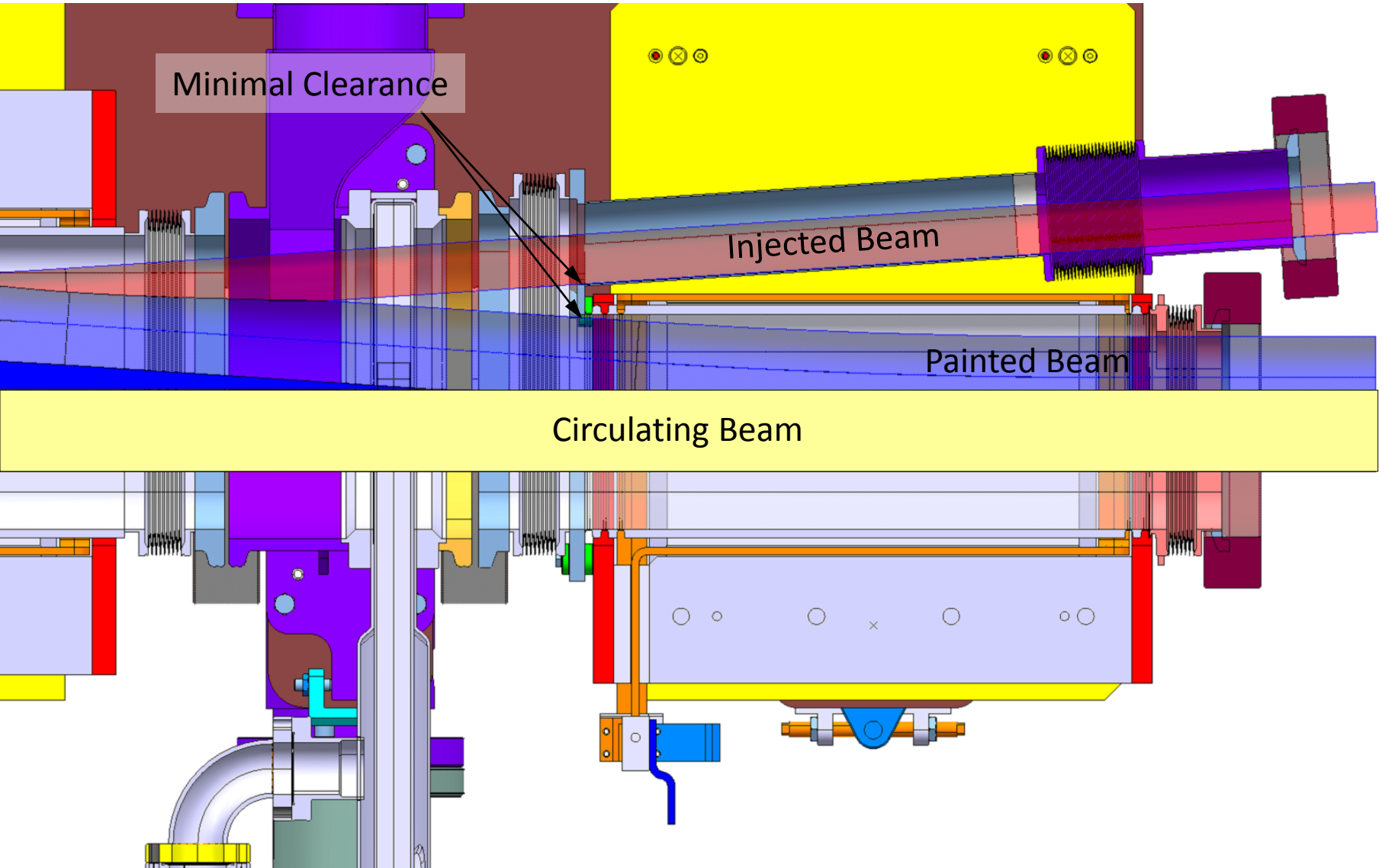
W. Weterings

Injection Region



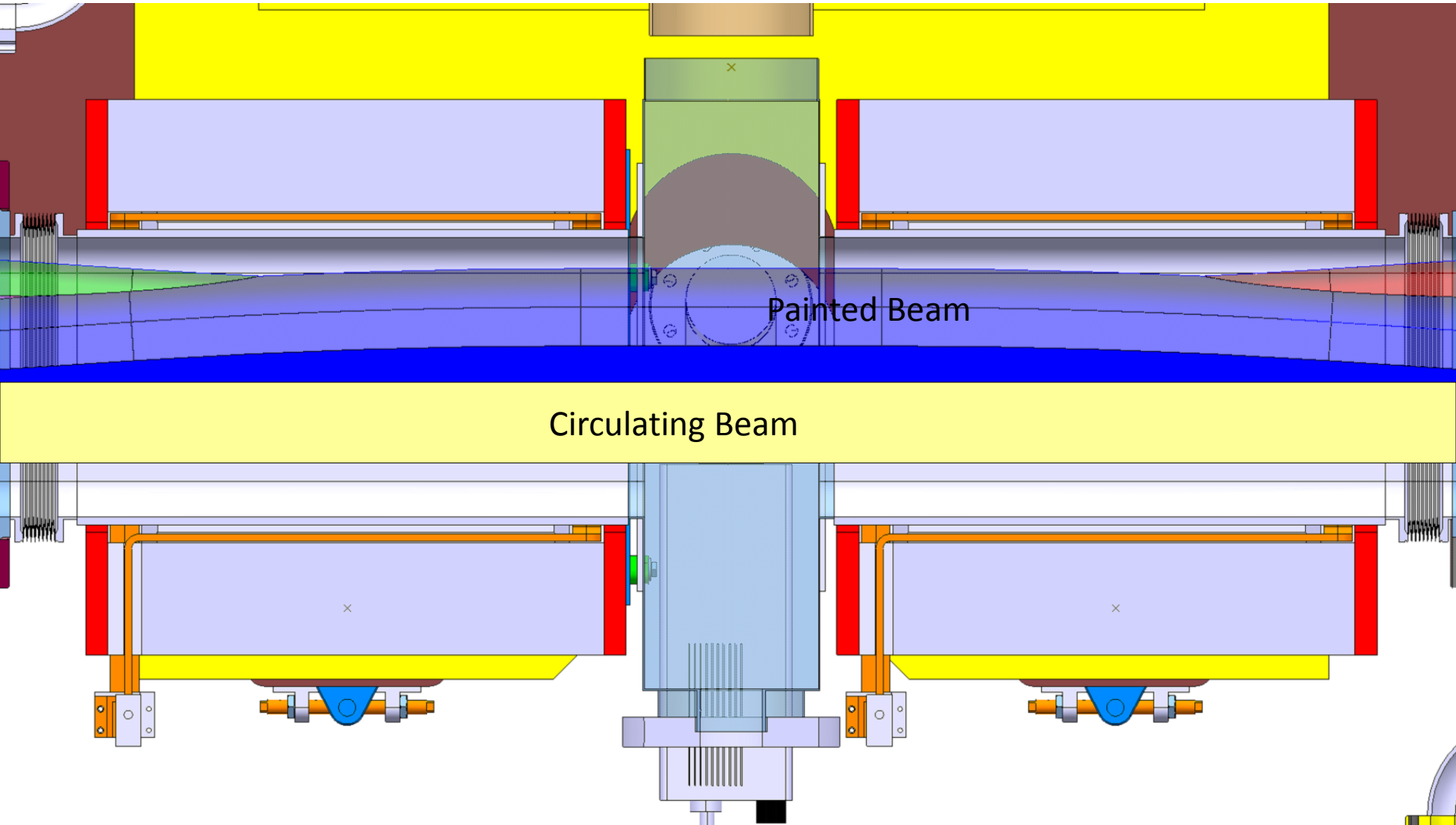
W. Weterings

BSW1



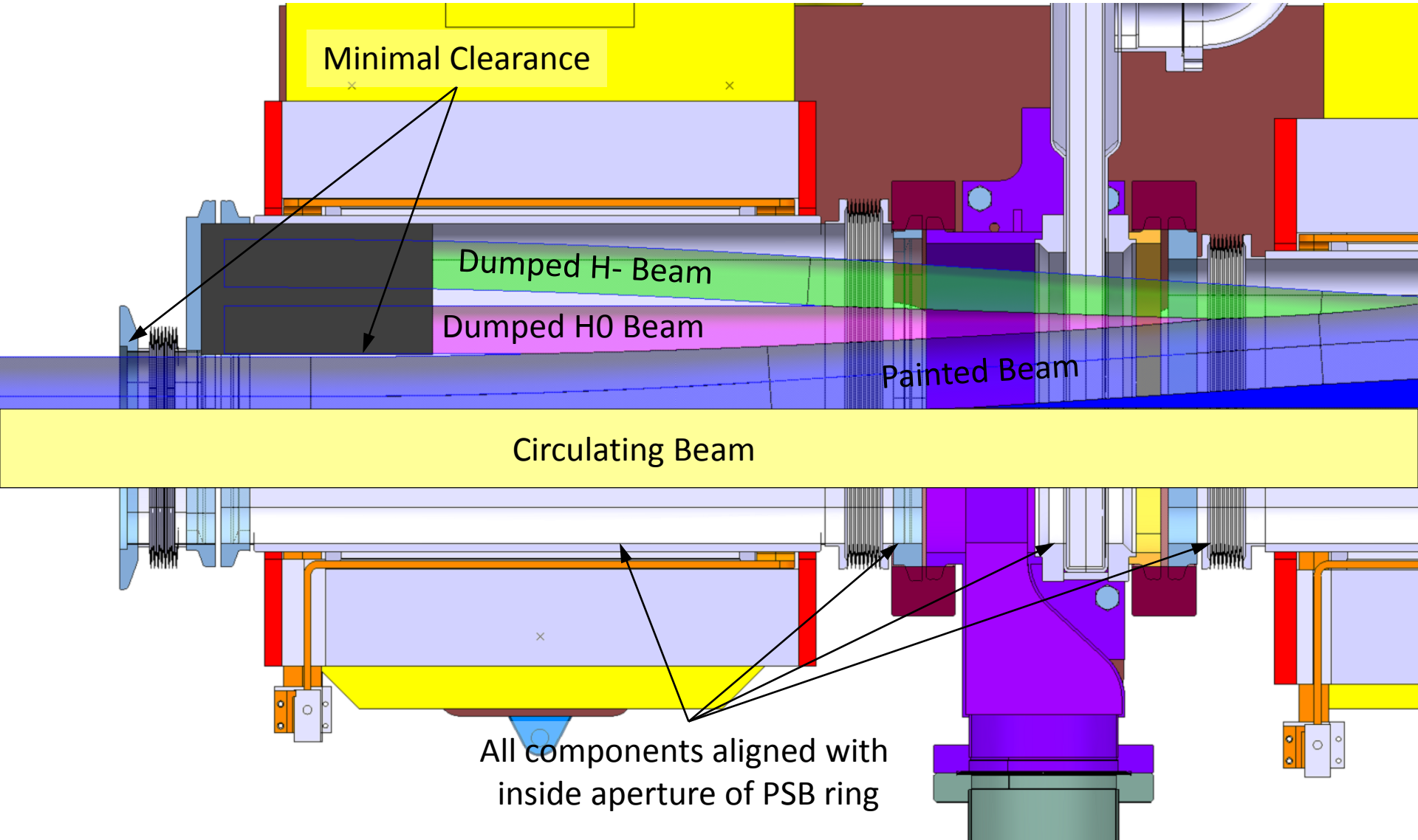
W. Weterings

BSW2-3



W. Weterings

BSW4



Beam Envelope at the BSW

B. Goddard

C. Bracco

Circulating beam size

Circulating beam beta H nominal	m	5.6
Max. H beta beat	%	25
Max. H beta function at injection	m	7.0
Normalised injected emittance	pi.mm.mrad	0.5
Betagamma		0.61
Number of sigma for envelope		4
Injection mismatch factor on sigma		1.55
Betatron envelope	±mm	14.8
Circ. beam |Dx|	m	1.6
Max dp/p		0.004
Max momentum displacement	±mm	6.4
Orbit	±mm	4
Max H offset for painting	±mm	2
Max. circulating beam envelope at injection start	±mm	**27.2**

Circulating beam beta H nominal	m	5.6
Max. H beta beat	%	25
Max. H beta function at injection	m	7.0
Normalised injected emittance	pi.mm. mrad	0.5
Mismatch		1.55
Betatron envelope 4sigma	±mm	14.8
Circ. Beam Dispersion	m	1.4
Max $\Delta p/p$		0.0044
Max. momentum displacement	±mm	6.16
Mech. Tol.	±mm	1
Orbit	±mm	4
Max. H offset for painting	±mm	2
Max. circulating beam envelope at injection start	±mm	**28.0**

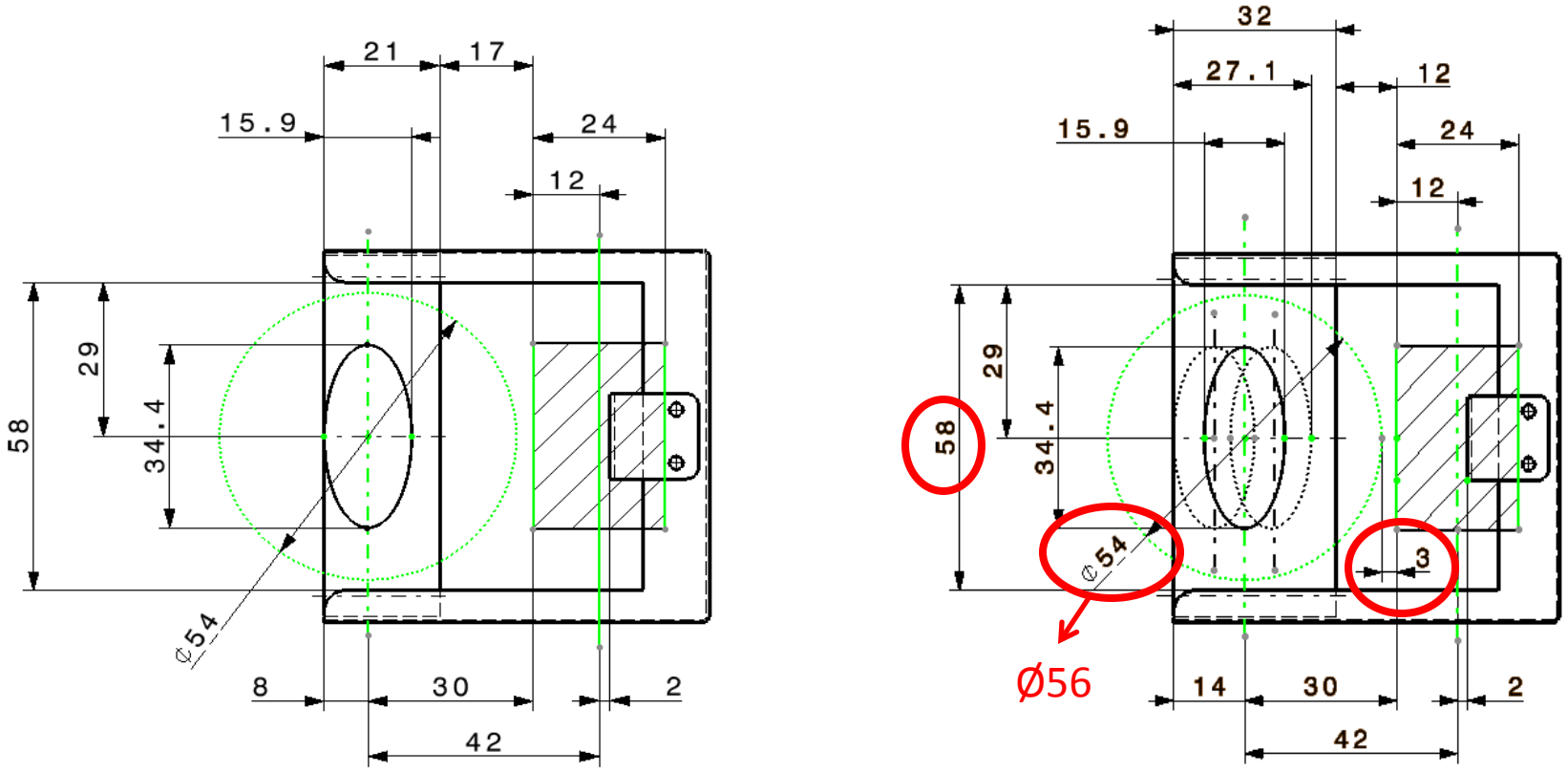
Injected beam size

Injected beam beta H max	m	10
98% normalised H emittance	pi.mm.mrad	3.2
betagamma		0.61
98% beam size	±mm	7.2
Injected beam |Dx| max	m	1.6
Max dp/p		0.004
Max momentum displacement	±mm	6.4
Delivery precision H	±mm	1
Maximum H offset for painting	±mm	2
Max. injected beam envelope	±mm	**16.6**

Injected beam beta H max	m	10
Betatron env. 98%	±mm	7.3
Dispersion	m	1.4
Max. $\Delta p/p$		0.0044
Max. momentum displacement	mm	6.16
Mech. Tol.	±mm	1
Delivery precision	±mm	1
Max. H offset for painting	±mm	2
Max. Beam env.	±mm	**17.4**

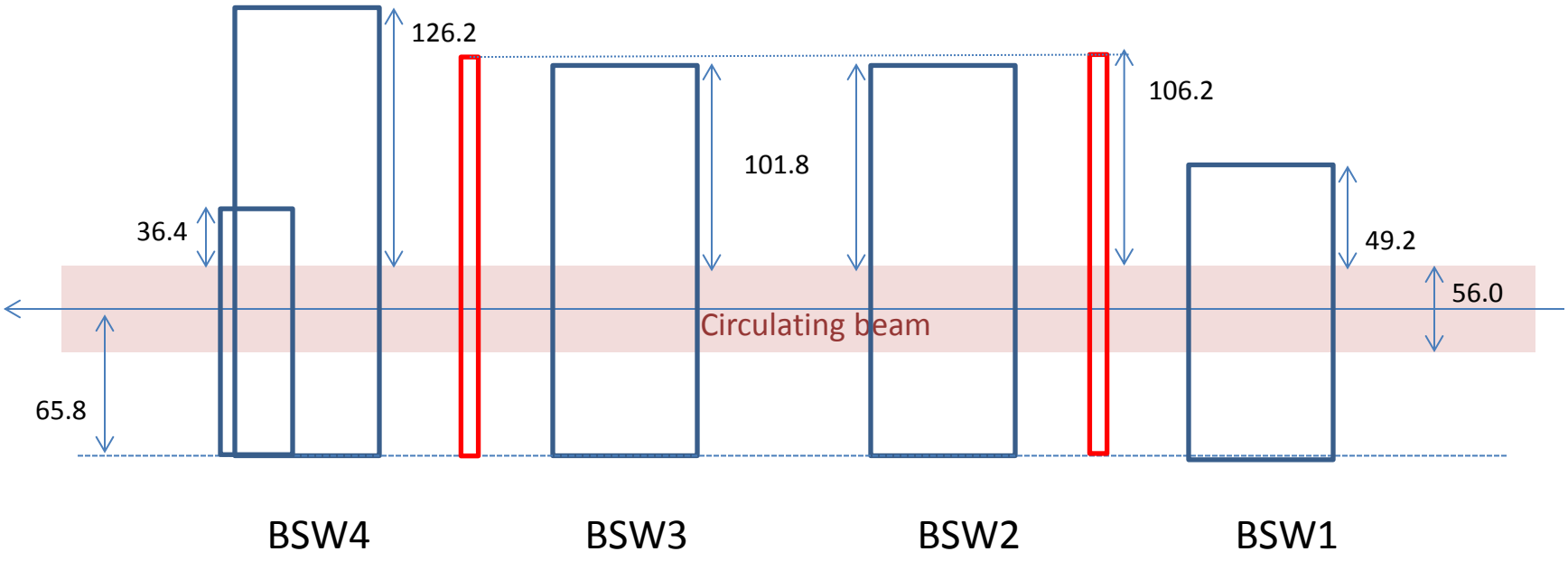
W. Weterings

Foil and Support



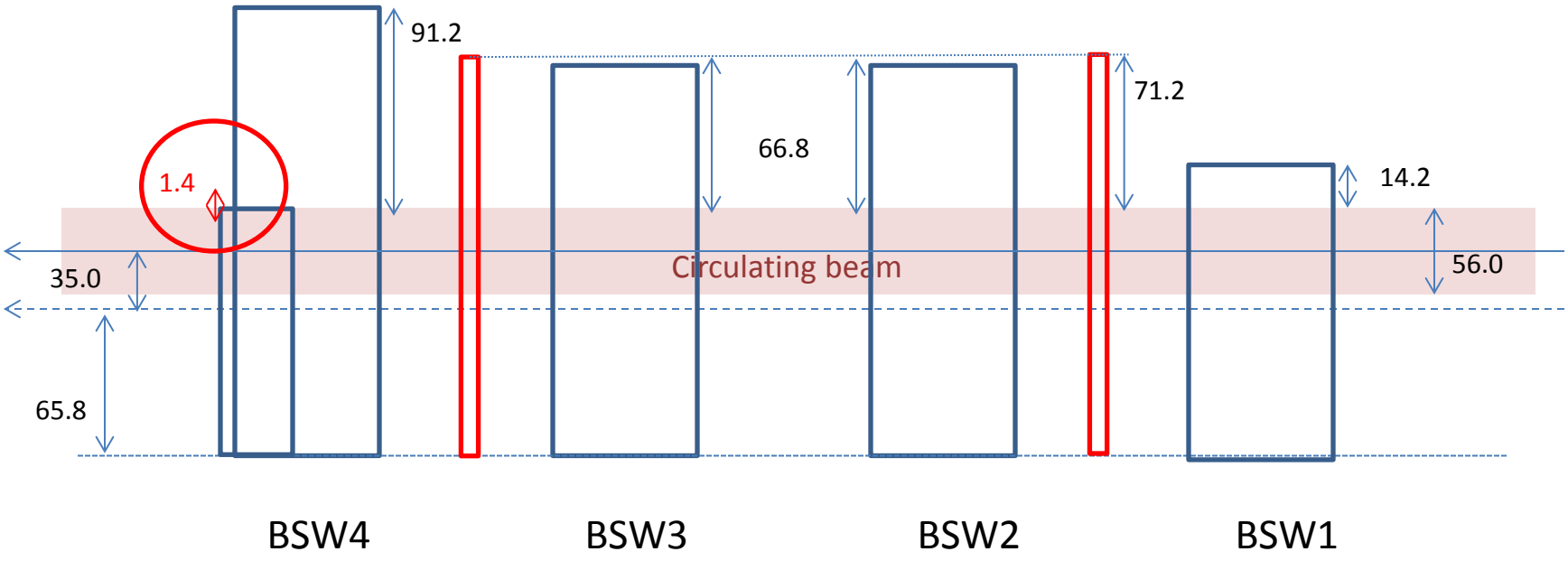
Estimated beam size on the foil for zero dispersion (left) and matched (-1.4 m) dispersion (right) at injection point. PSB beam envelope (Ø56mm) during injection is also shown. (L4-T-EP-0005, EDMS 1108941)

Aperture Scheme



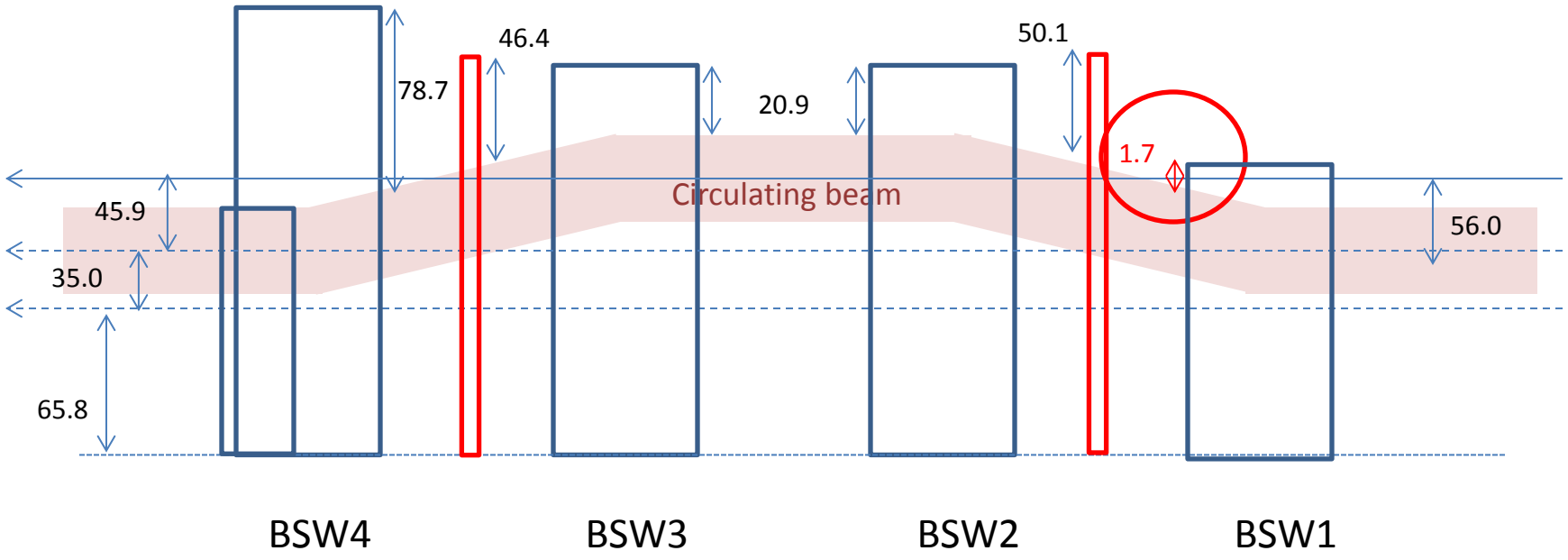
Aperture Scheme

35 mm from KSW for horizontal painting



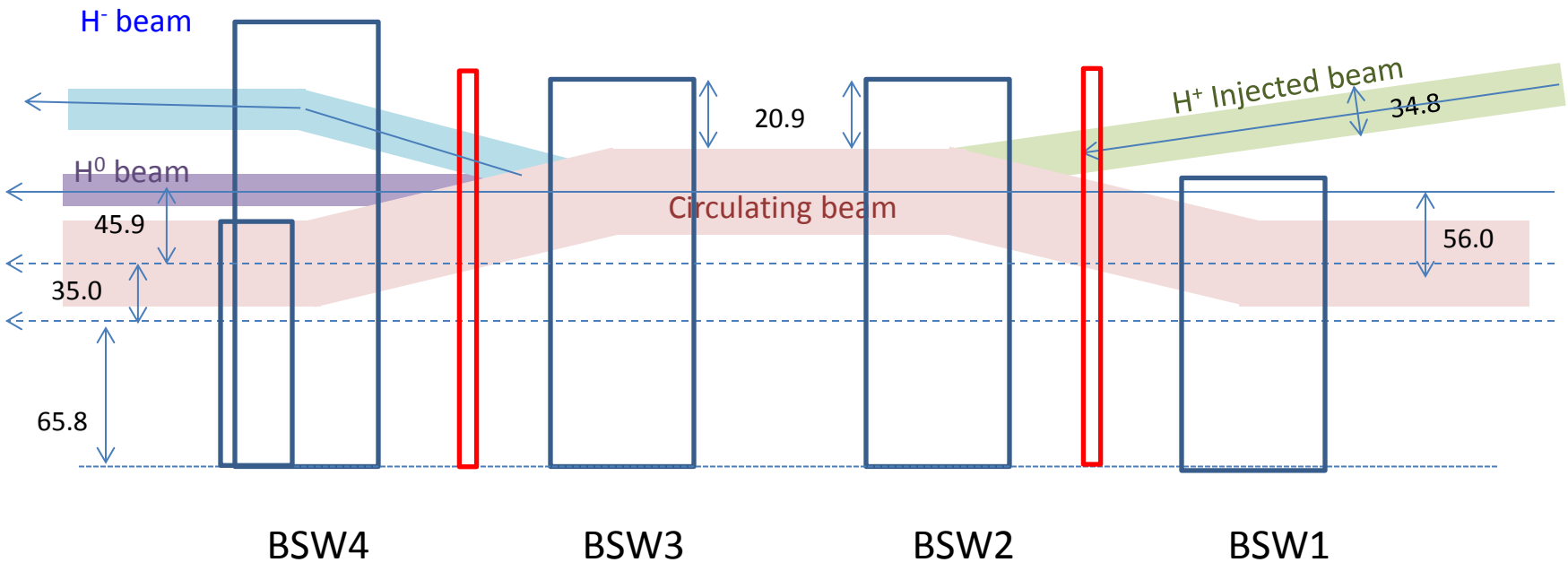
Aperture Scheme

35 mm from KSW for horizontal painting
45.9 mm from BSW chicane bump

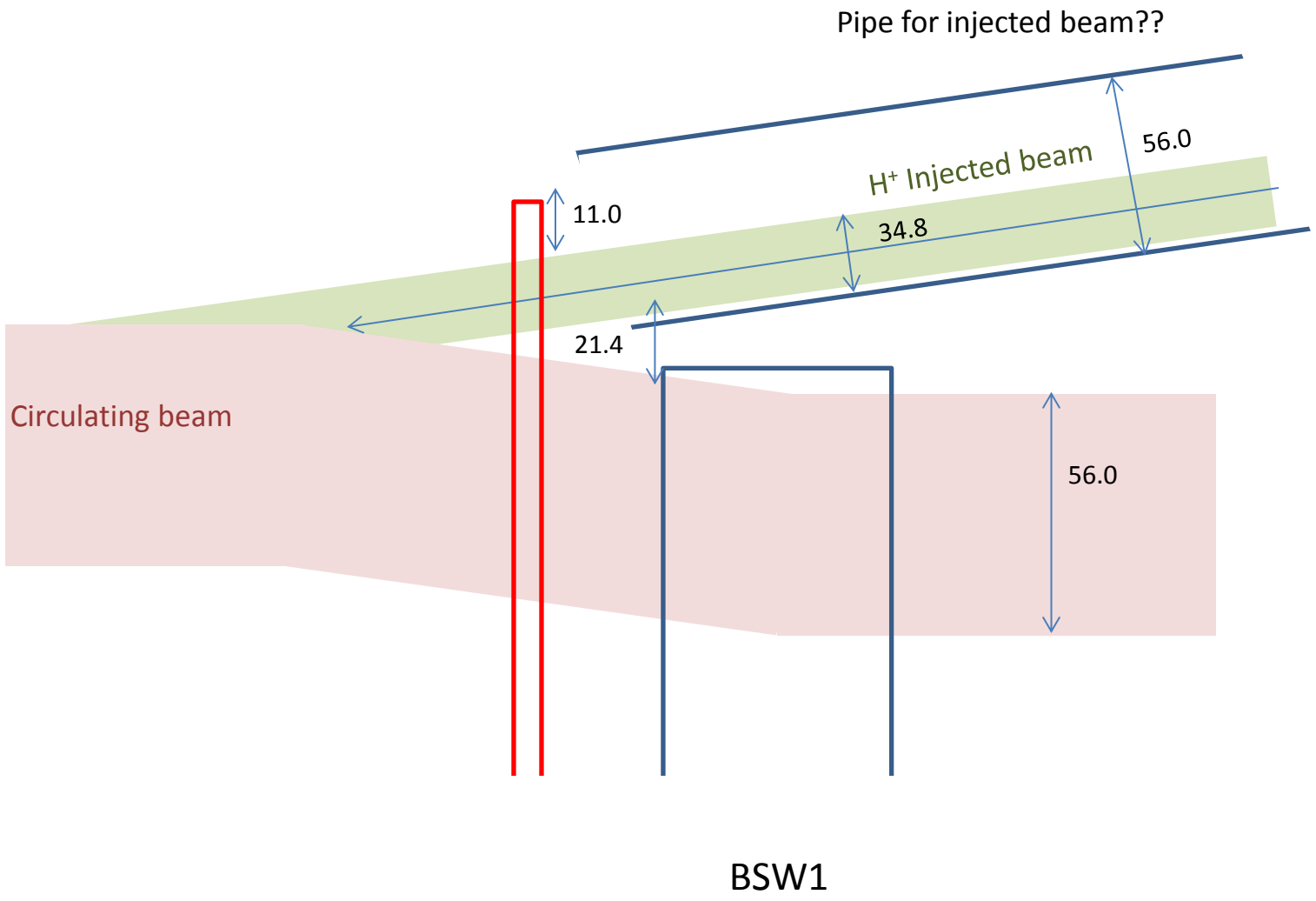


Aperture Scheme

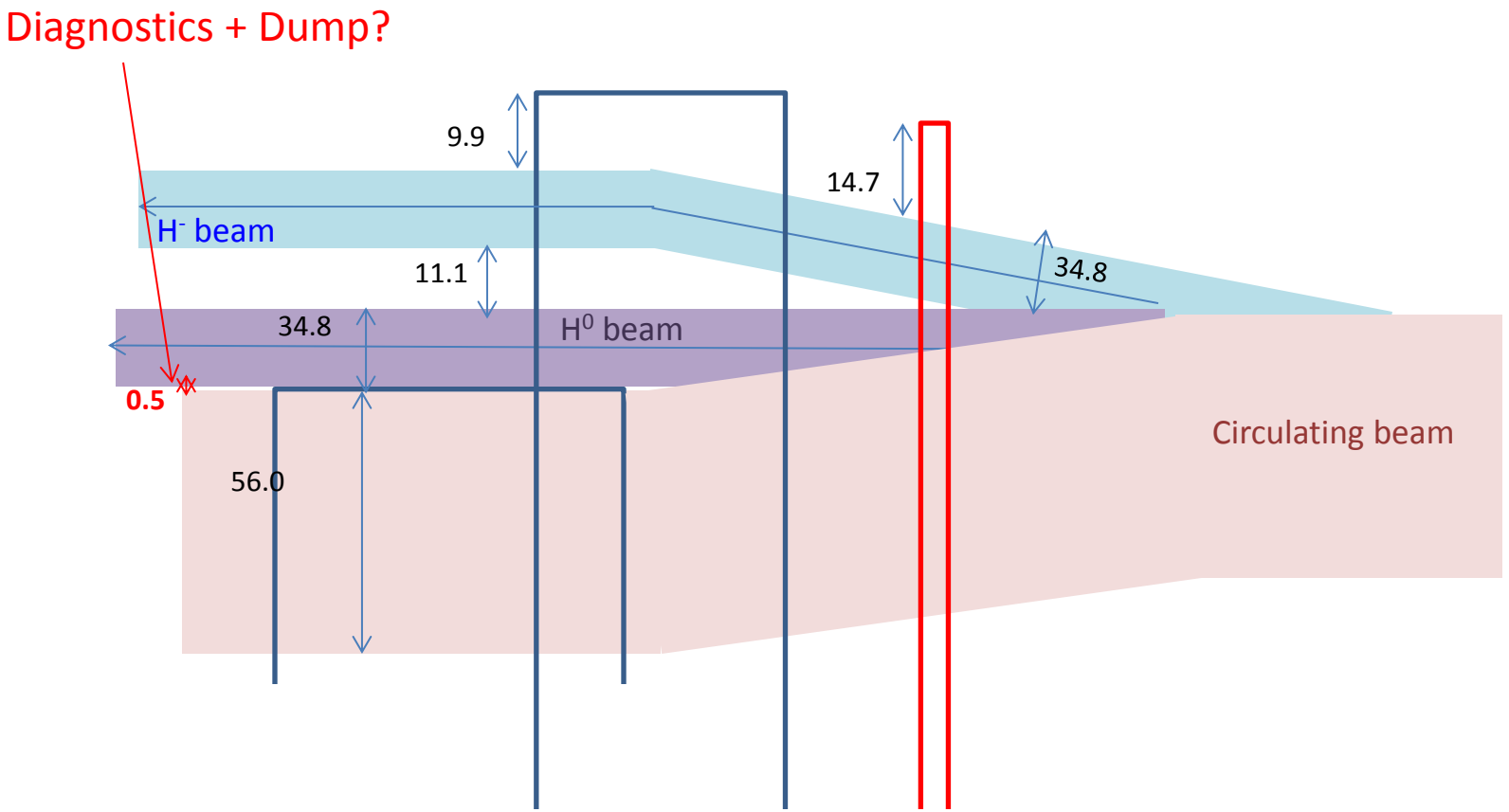
35 mm from KSW for horizontal painting
45.9 mm from BSW chicane bump



Zoom at BSW1


Pipe for injected beam??
H+ Injected beam
56.0
11.0
34.8
21.4
Circulating beam
56.0
BSW1

Zoom at BSW4



BSW4

Conclusions

- Spec for BIS and DIS as from previous studies
- Injected (±17.4 mm) and circulating (±28 mm) beam envelope calculated for -1.4 m dispersion and considering mechanical offset
- Bottlenecks:
  - Foil still ok but 1 mm lost on each side of the foil
  - BSW1 for circulating beam when painting and chicane on (1.7 mm clearance)
  - Beam pipe for injected beam
  - Separation H^0-proton beam: 0.5 mm not enough for dump and diagnostics