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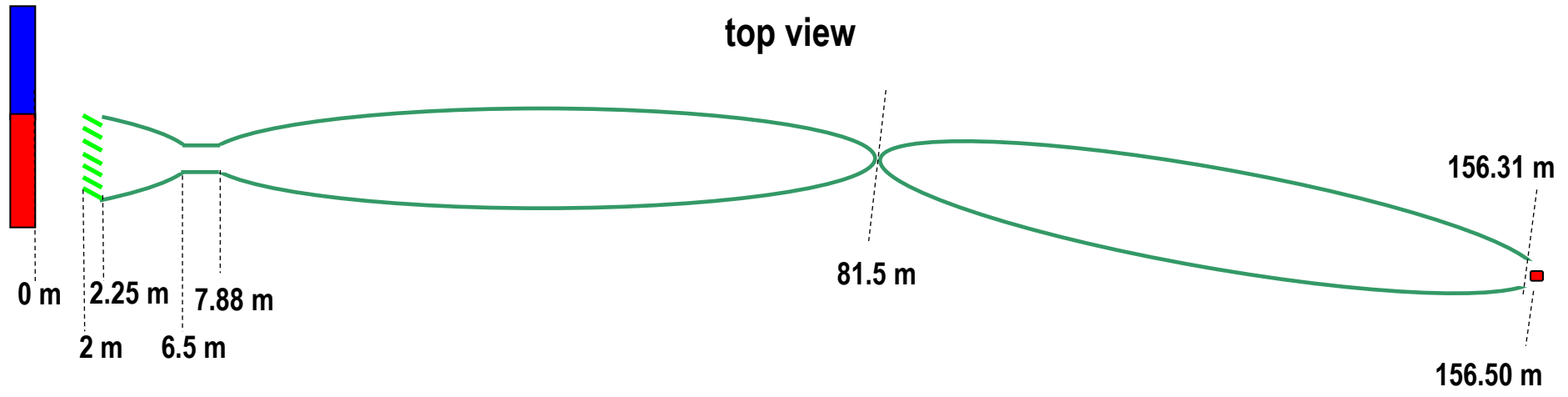
HZB Helmholtz
Zentrum Berlin

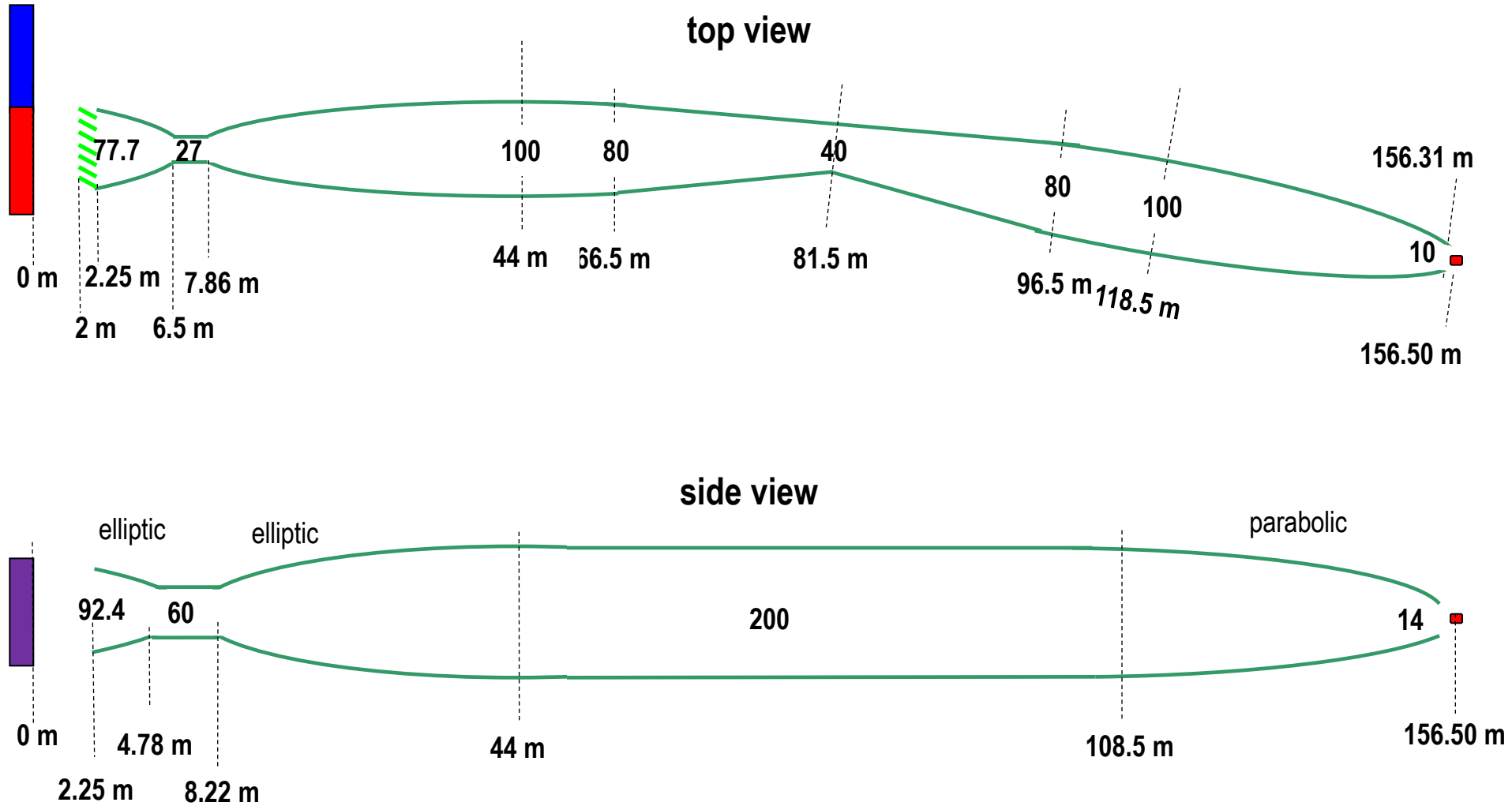
Simulations of the Extreme Environment Instrument for the ESS - ESSEX

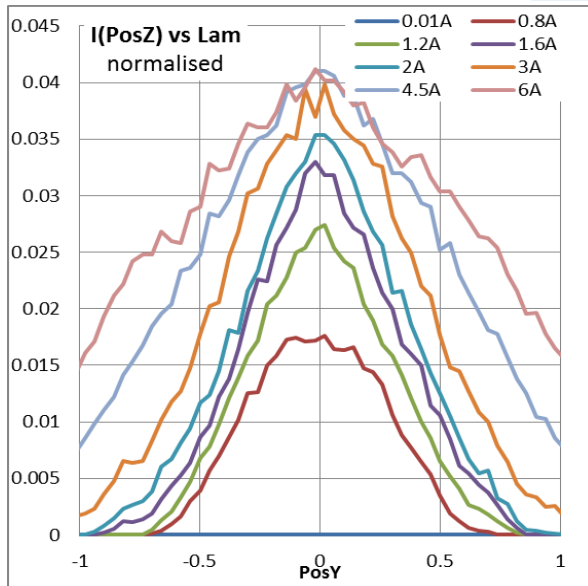
L. Cussen
K. Lieutenant
O. Prokhnenko
C. Zender



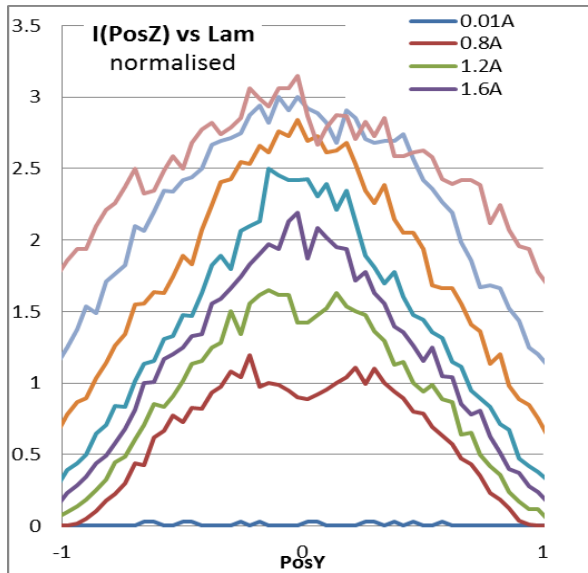
- ESSEX is an extreme environment instrument that shall work as
 - Diffractometer
 - Spectrometer
 - SANS instrument
- General Features
 - 150 m length (as a compromise)
 - Out of direct line of sight
- Requirements for the 3 options
 - Short wavelengths for diffraction
 - Long wavelengths for SANS
 - Symmetric divergence distribution (especially for diffraction)
 - High intensity = broad divergence distribution for spectrometry
 - Low divergence for SANS, intermediate divergence for diffraction



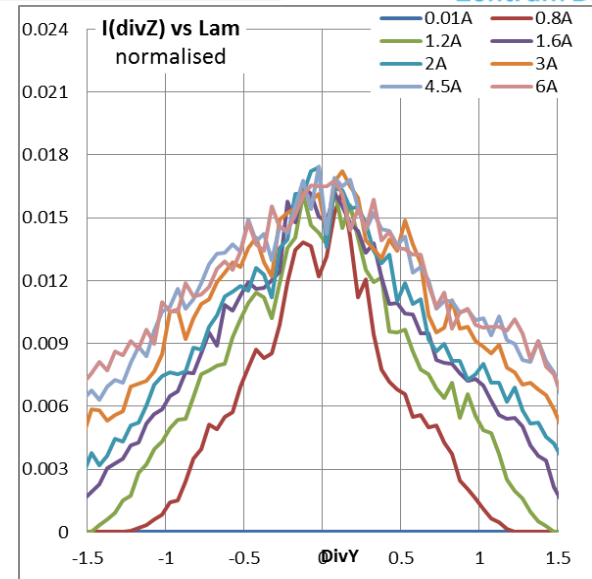




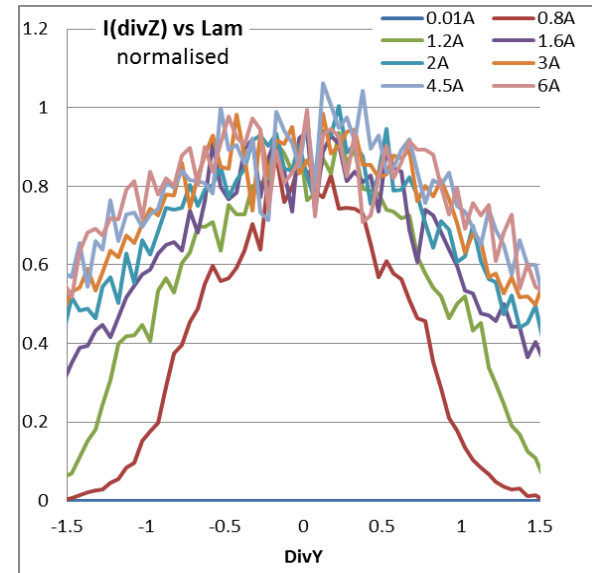
spatial distribution



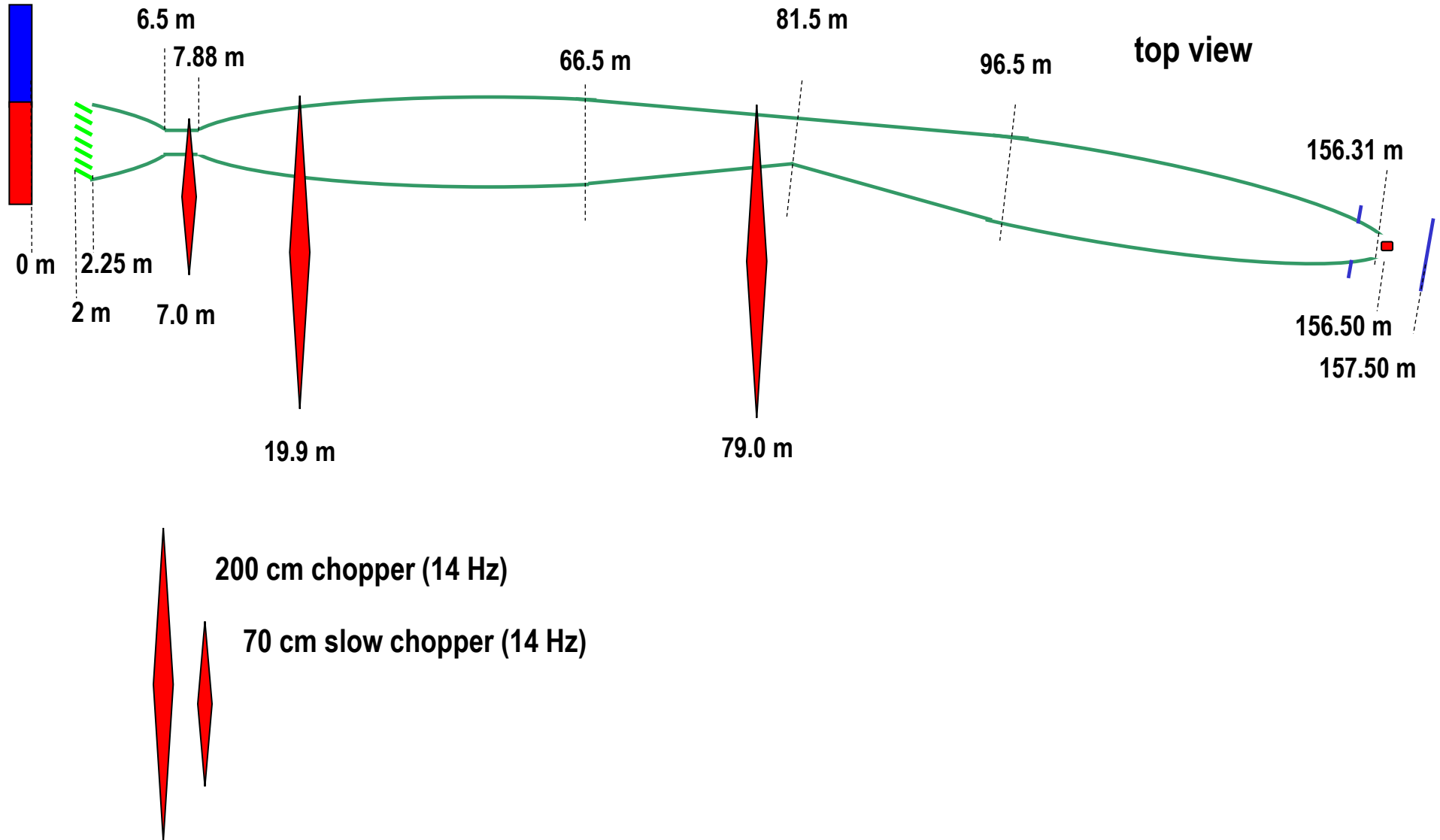
horizontal

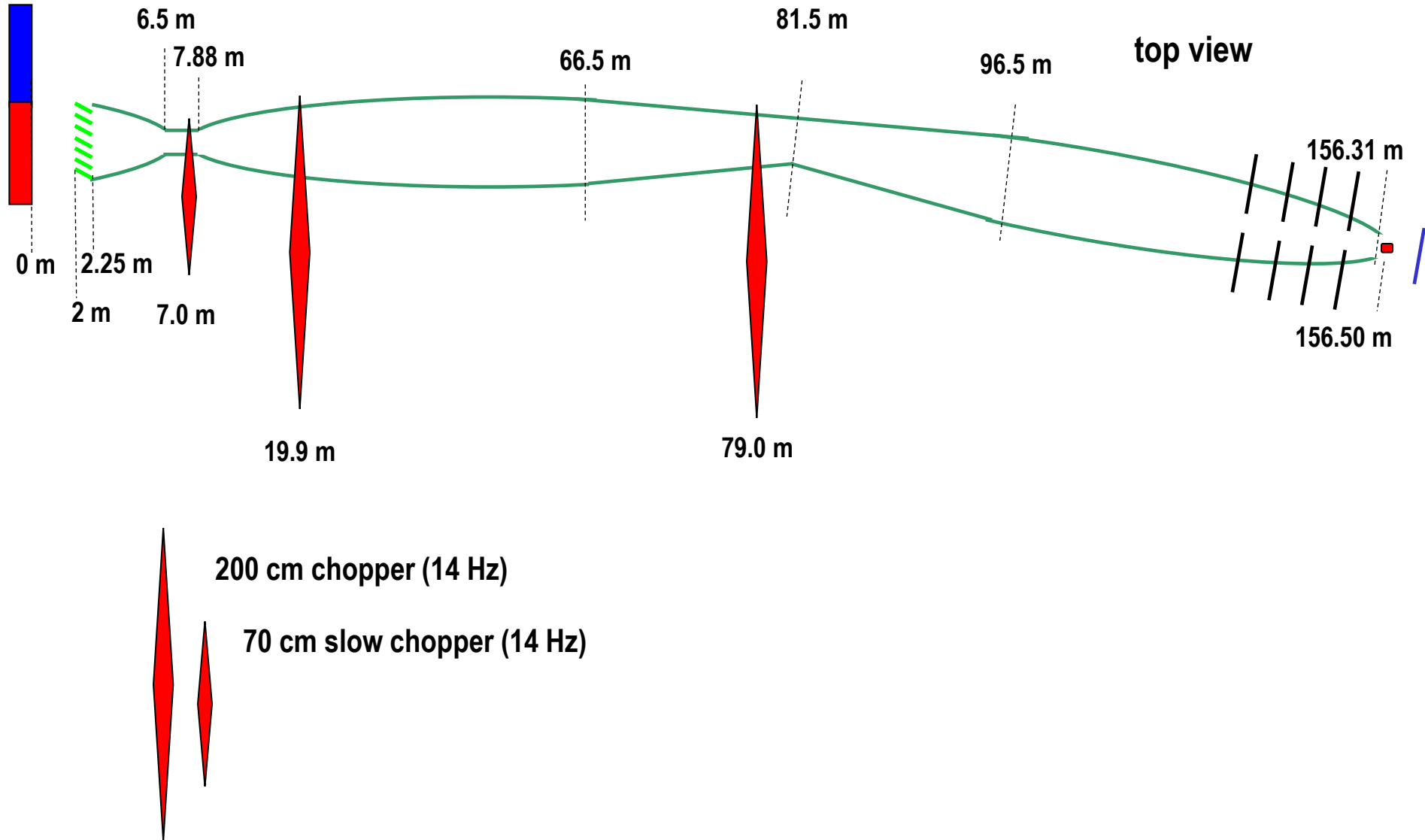


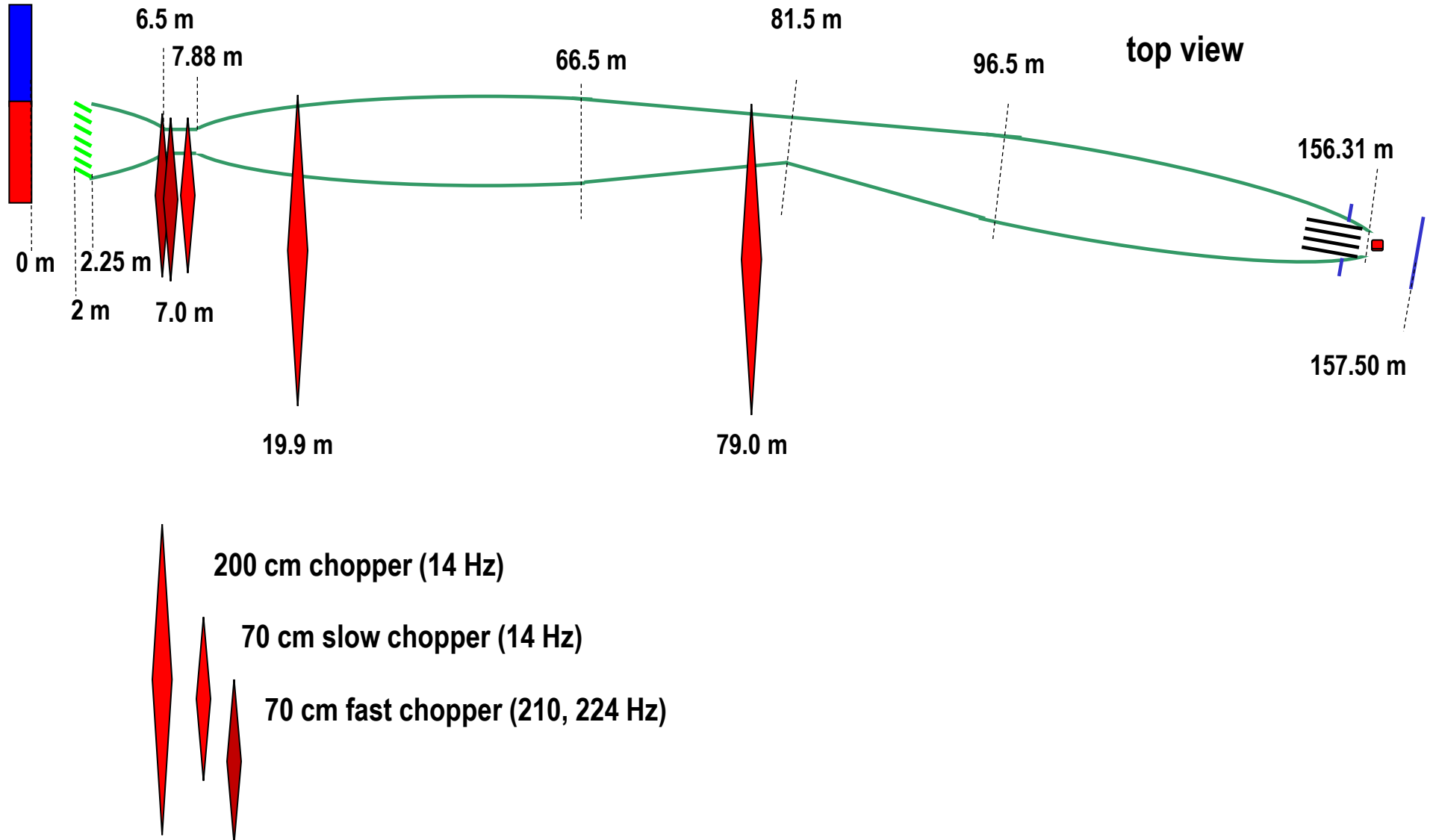
divergence distribution

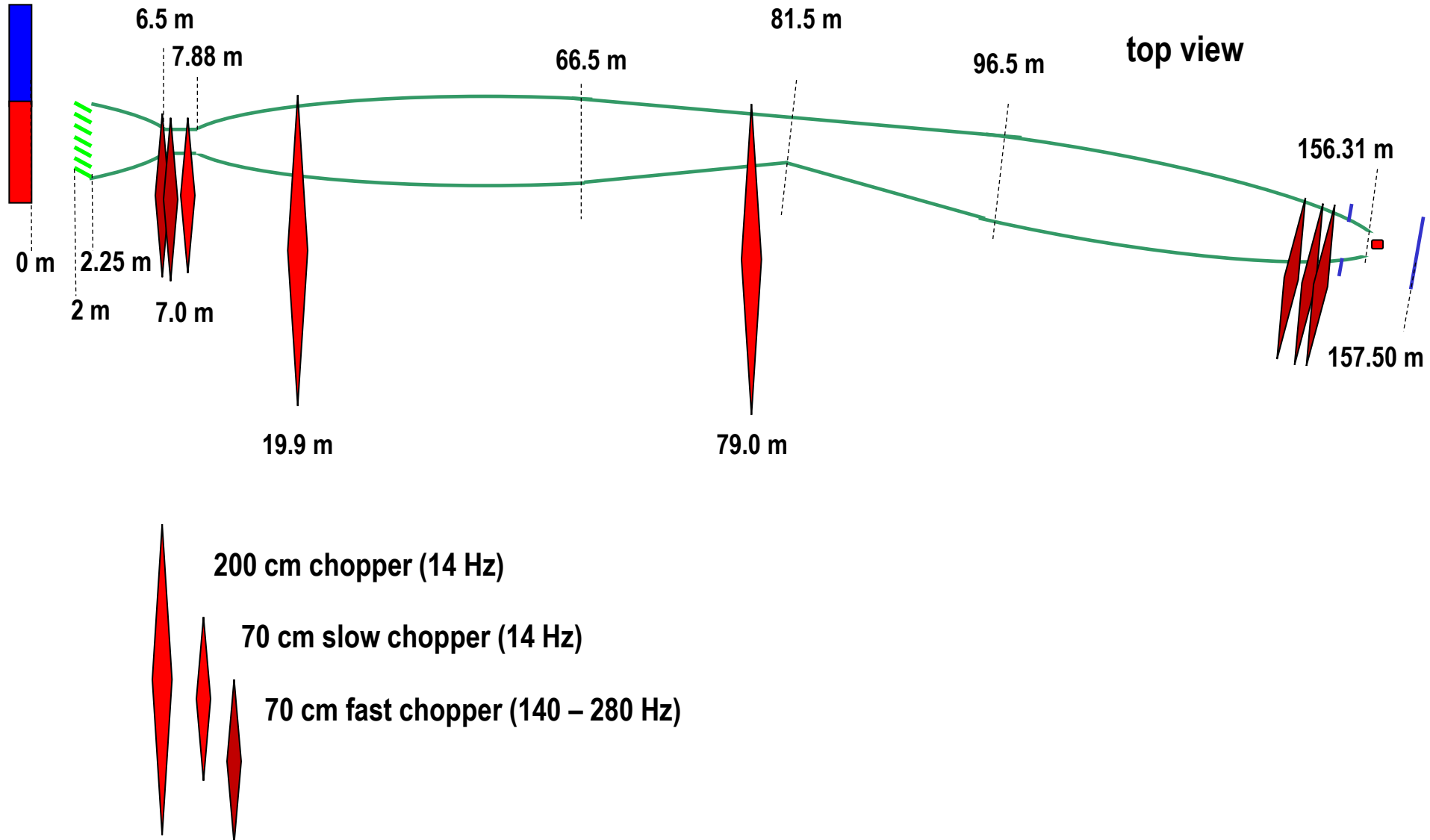


vertical





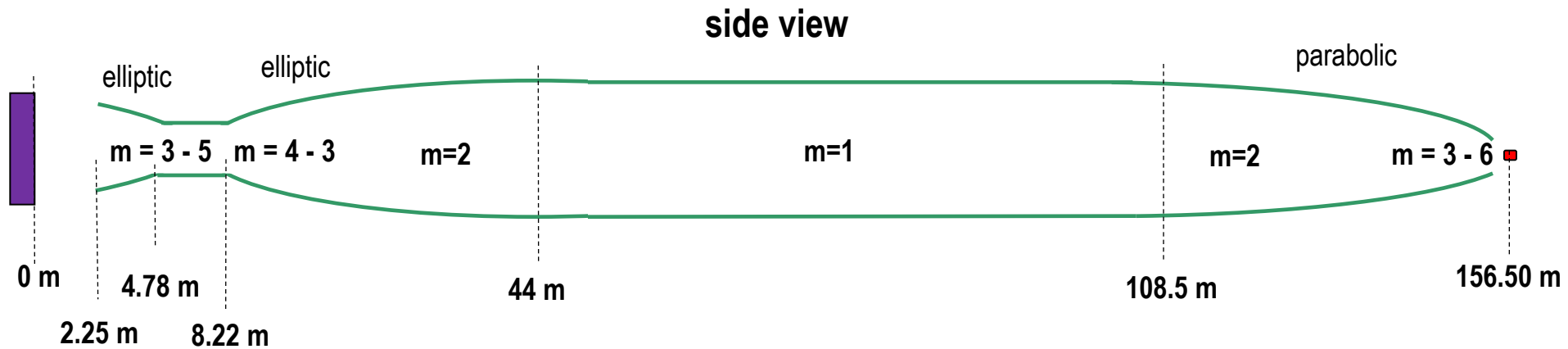
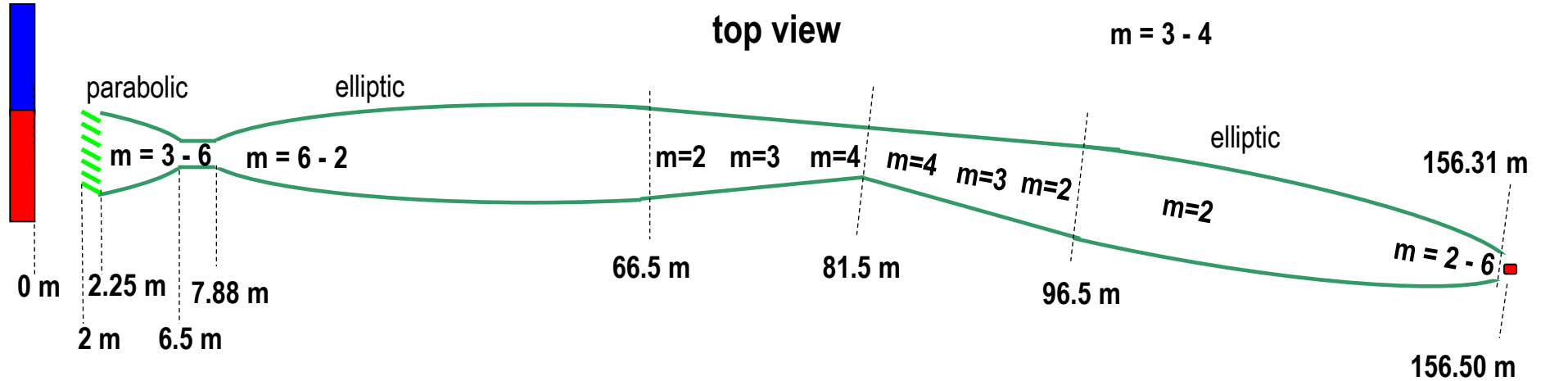




Chopper Data

Chopper	Pos [m]	Speed [1/min]	R [cm]	DelH [cm]	H_guide [cm]	H_wnd [cm]	AxisPos [cm]	Aperture [deg]
1a	6.474	13440	35.0	1.0	6.0	7.5	-31.0	8.0
1b	6.526	-12600	35.0	1.0	6.0	7.5	-31.0	8.0
2	7.000	840	35.0	1.0	6.0	7.5	-96.0	32.0
3	19.900	840	100.0	1.5	15.4	17.4	-90.8	59.0
4	79.000	840	100.0	2.0	20.0	22.5	-88.0	166.3
5a	153.300	8400	35.0	1.0	5.7	7.2	-31.2	14.0
5b	153.474	16800	35.0	1.0	5.7	7.2	-31.2	12.0
5c	153.526	-16800	35.0	1.0	5.7	7.2	-31.2	12.0

Reduction of Coating



	feeder				ellipse in					
range [m]	0-1	1-1.5	1.5-3.5	3.5-4.25	0-3	3-4	4-10	10-20	20-60	
global [m]	1	1.5	3.5	4.25	7.25	8.25	14.25	24.25	64.25	
m-number	3	4	5	6	6	5	4	3	2	

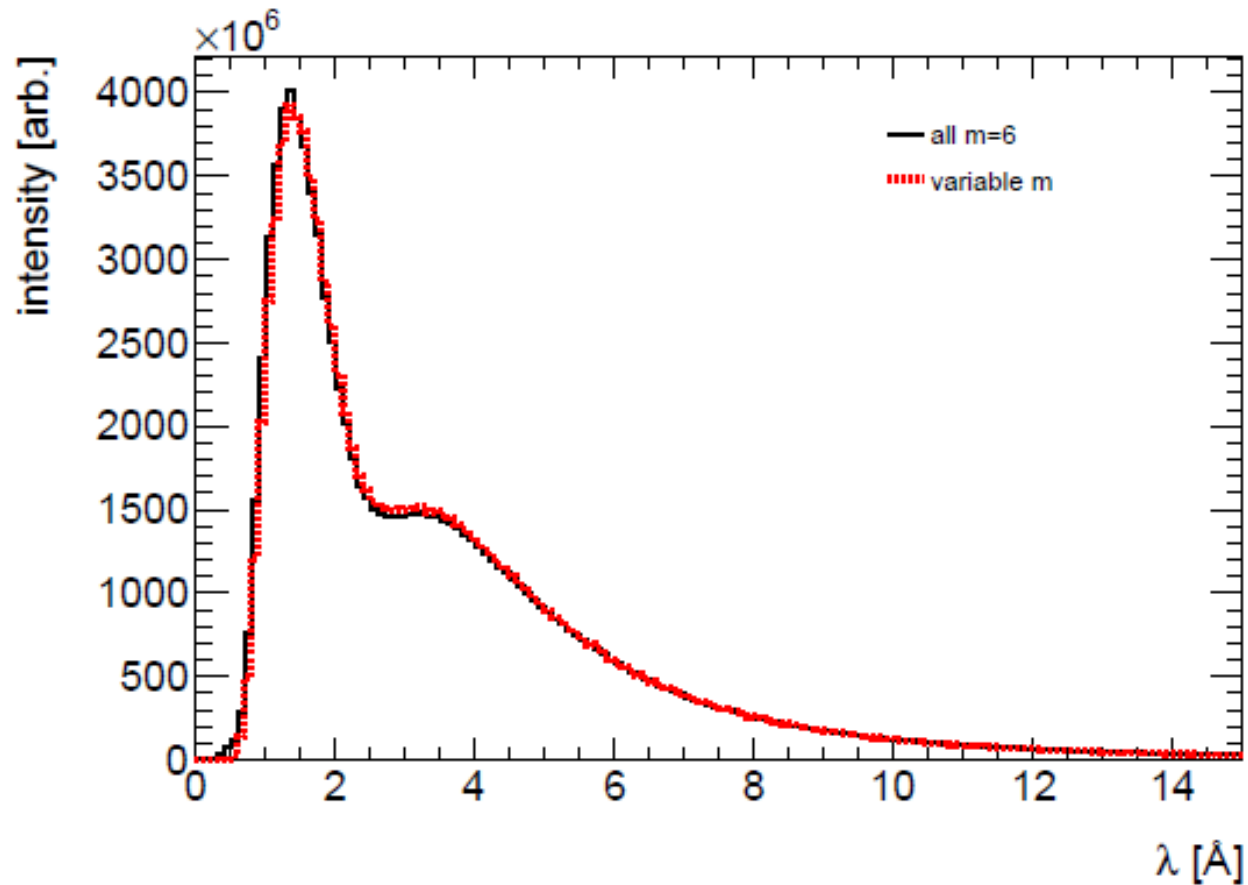
	tapered 1		tapered 2		ellipse out				tail	
range [m]	0-7	7-15	0-4	4-11	11-15	0-52	52-56	56-58	58-59.6	0-0.187
global [m]	71.25	79.25	83.25	90.25	94.25	136.25	150.25	152.25	153.875	154.062
m-number	3	4	4	3	2	2	3	4	6	6

(c) Horizontal guide segment coating

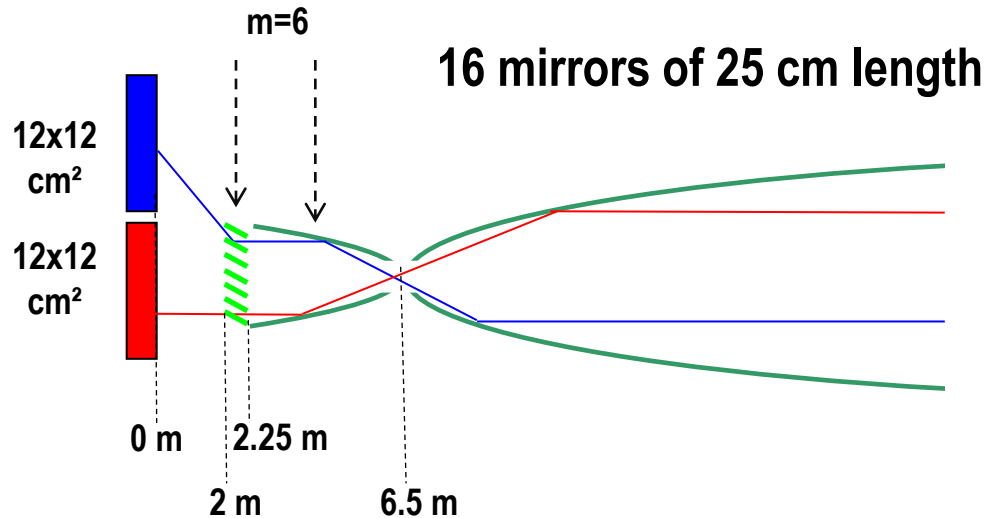
	feeder			ellipse in				
range [m]	0-1	1-2.5	2.5-4.25	0-2	2-10	10-30	30-60	
global [m]	1	2.5	4.25	6.25	14.25	34.25	64.25	
m-number	5	3	5	4	3	2	1	

	tapered 1		tapered 2	ellipse out				tail	
range [m]	0-5	5-15	0-15	0-12	12-52	52-56	56-58	58-59.6	0-0.187
global [m]	69.25	79.25	94.25	106.25	146.25	150.25	152.25	153.875	154.062
m-number	2	1	1	1	2	3	4	6	6

(d) Vertical guide segment coating



m-number	1	2	3	4	5	6
area [m ²]	10.71	46.84	11.01	6.76	0.70	0.71



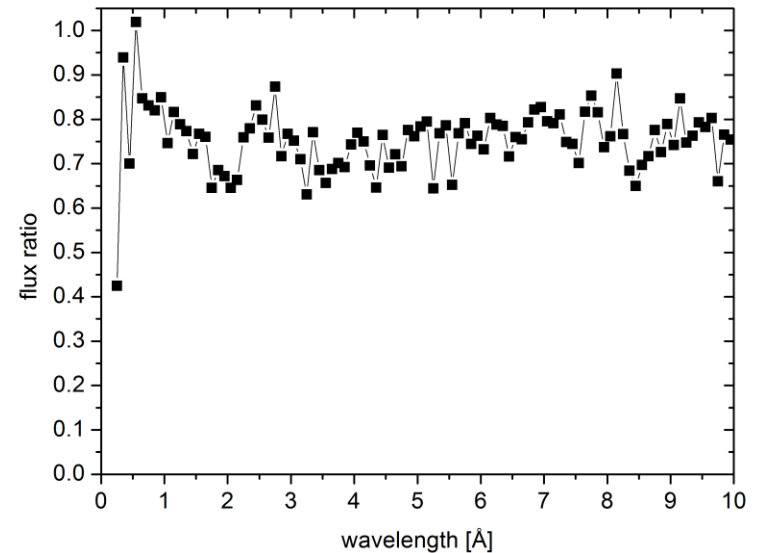
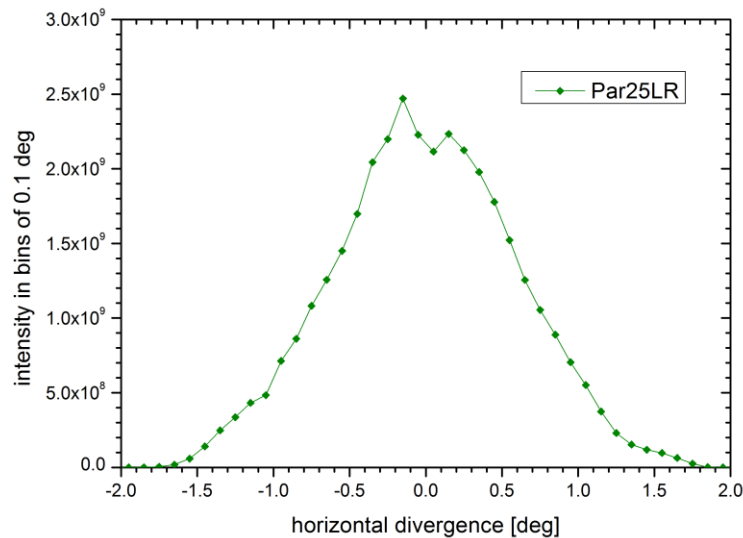
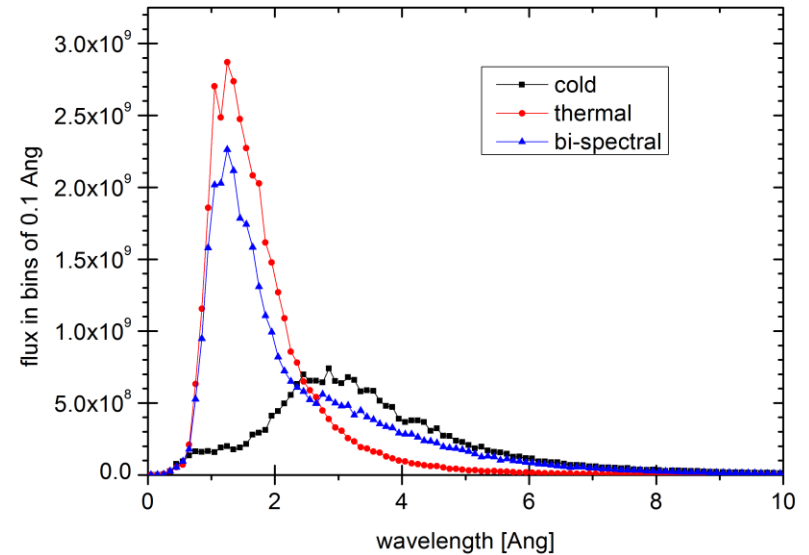
$$D_{\text{mirr}} = d / \tan(2 \cdot 0.1 \text{ m } \lambda_c)$$

Ideal distances for $d=0.12 \text{ m}$, $\lambda_c=2.35 \text{ \AA}$:

m	D_{mirr} [m]
7	2.110
6	2.462
5	2.955
4	3.695
3	4.928
2	7.392

- **Features**
 - 25 cm long parallel m=6 mirrors
 - Center of the beamline shifted by 1.5 cm from the center of the thermal moderator
- **Advantages:**
 - Feeder system is hardly influenced
 - Possibility to remove extraction system for some of the measurements
 - Easy to build, to align and to exchange

- Performance
 - Acceptable efficiency (> 75 %)
 - Good divergence distribution
- Variations
 - Longer mirrors (50 cm) yield same results
 - Focusing arrangement of the mirrors give lower intensity from cold moderator



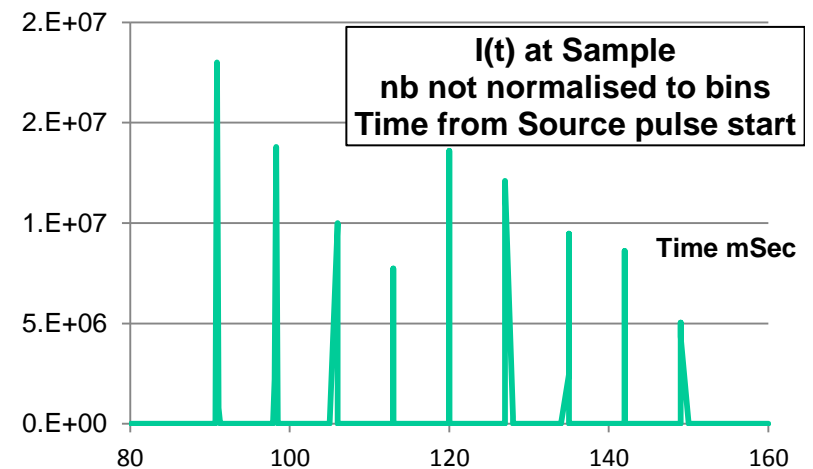
Flux at Sample

lambda [Ang]	total flux [n/cm ² s]	total flux [n/cm ² s]	total flux [n/cm ² s]
5.0 - 6.8	SANS - 6 m 9.07E+06	SANS - 2 m 8.19E+07	Reference 2.53E+09
1.0 - 2.8	Diffraction* (75 μs) 6.84E+08		Reference 2.43E+10
1.0 - 2.8	Spectrometry** 2.85E+08		
2.1 - 3.9	9.78E+08		
5.1 - 6.9	2.74E+07		

Spectrometer option
2.1 – 3.9 Å

* without collimation

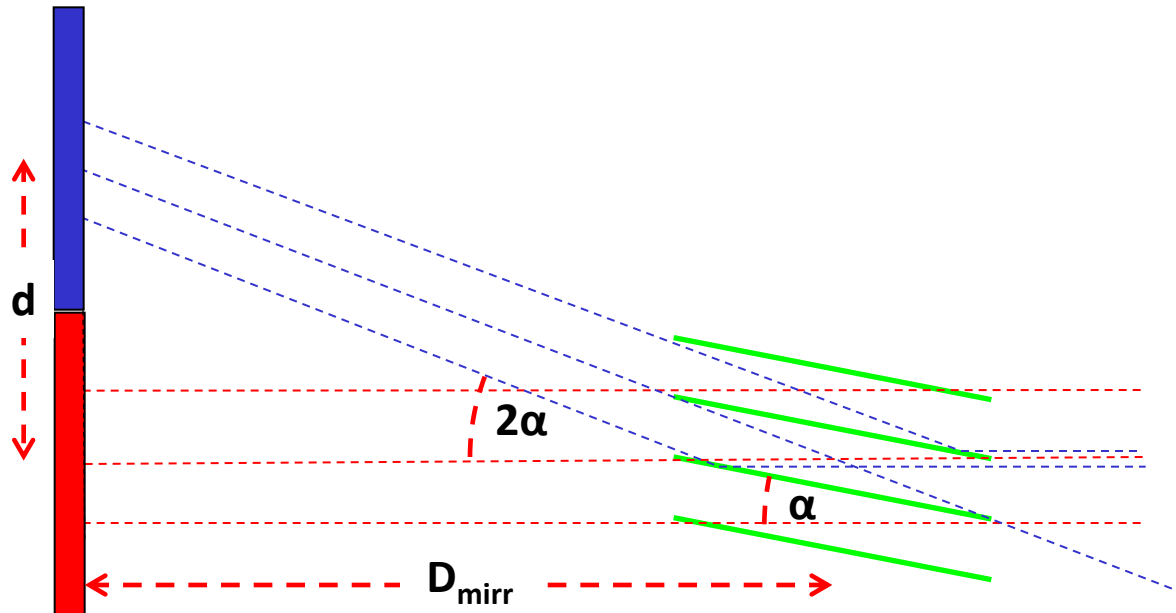
** integrated over 9 pulses



- Diffraction (NAC): simulation data not found
- SANS: not sufficiently good statistics yet
- Spectrometry: not yet finished

Thank you for your attention

**We like to thank the BMBF for their support through the contribution to the ESS update phase.
Work package K7: Simulationscode-Entwicklung, Helpdesk work package**



- Neutrons from the thermal source without divergence pass through exactly 1 mirror
- Neutrons from the cold source with divergence 2α are reflected exactly once