January 3, 2023

First look at Udo's files for $n\bar{n}$ sensiticity

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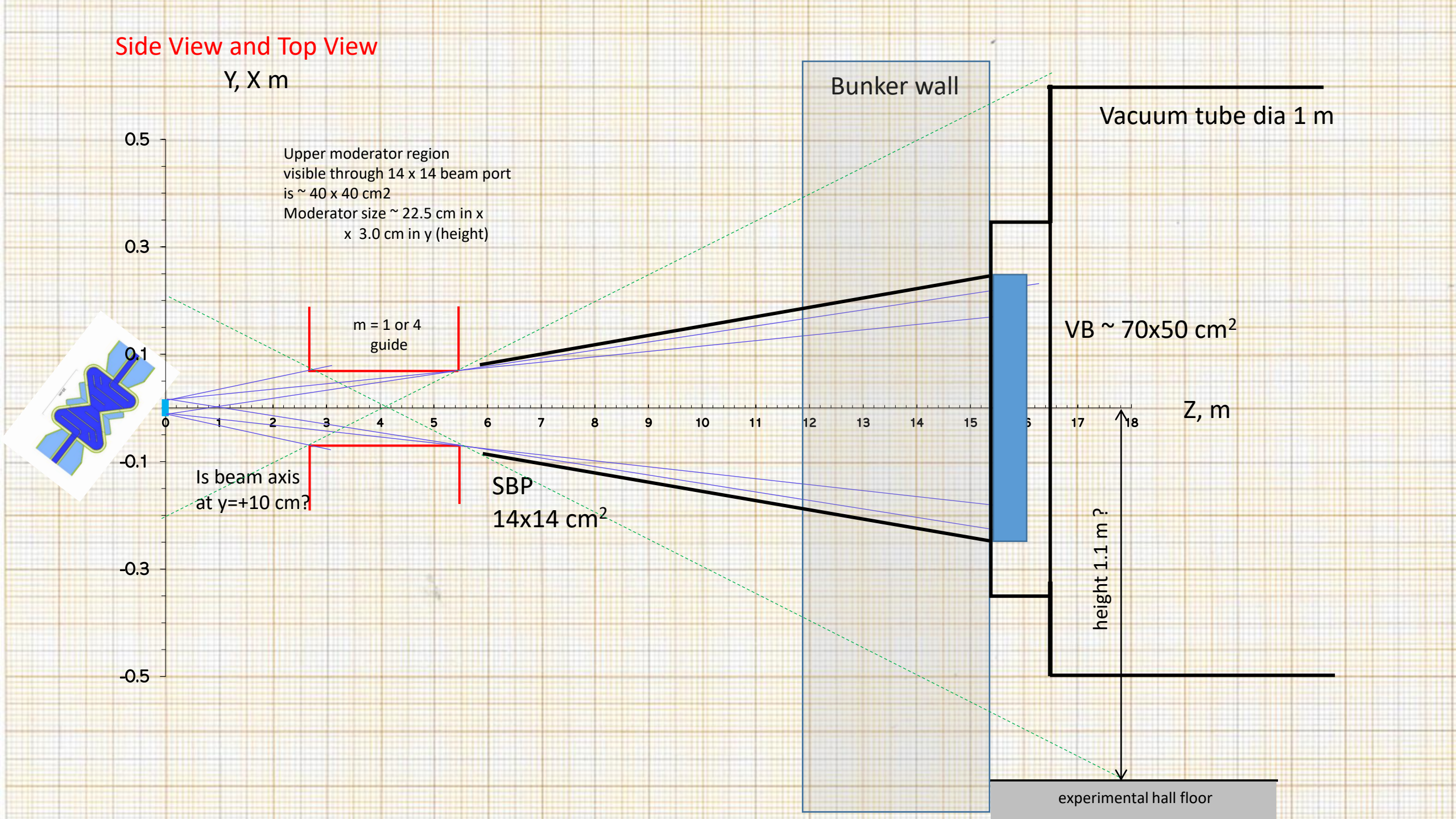
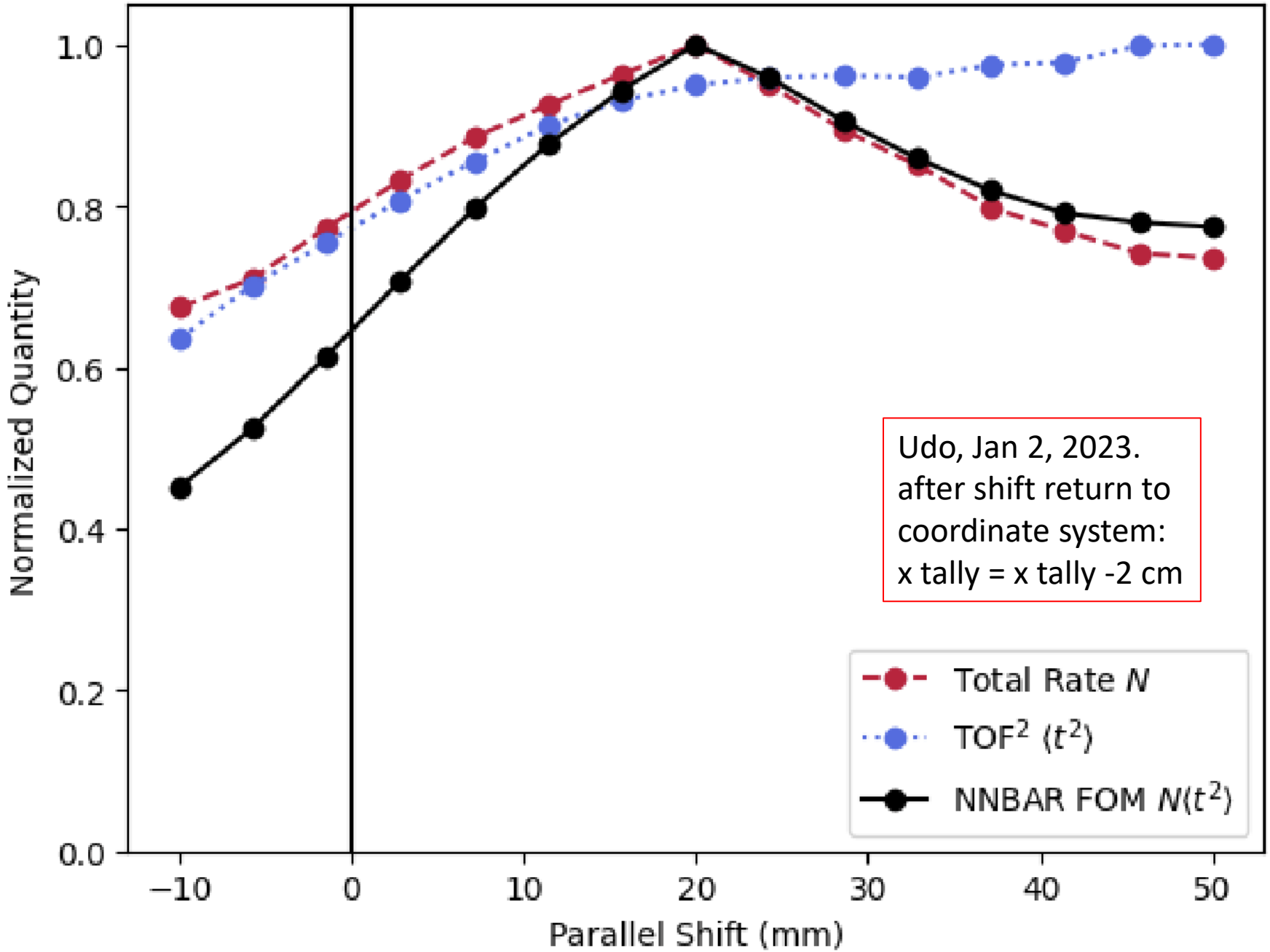
Total numbers in simulation files for 14 cm^2 guide tally

Range 1Å < λ < 10 Å(L) < 20 Å(H)

Configuration		File length	Events in file	Tot weight in file	NoReflEvnts	NoReflWeight
$Straight\ m = 1$	L H	69.7 MB 8.368 GB	549827	5.7264E+11	238452	5.5578E+11
$Straight\ m = 4$	L H	106.8 MB	841706	9.8089E+11	238112	5.5289E+11
$Elliptic\ m = 1$	L H	50.4 MB 5.668 GB	397803	5.3057E+11		
$Elliptic\ m = 4$	L H	60.5 MB 6.098 GB	477,255 48,495,250	8.1418E+11 9.3255E+11 •		

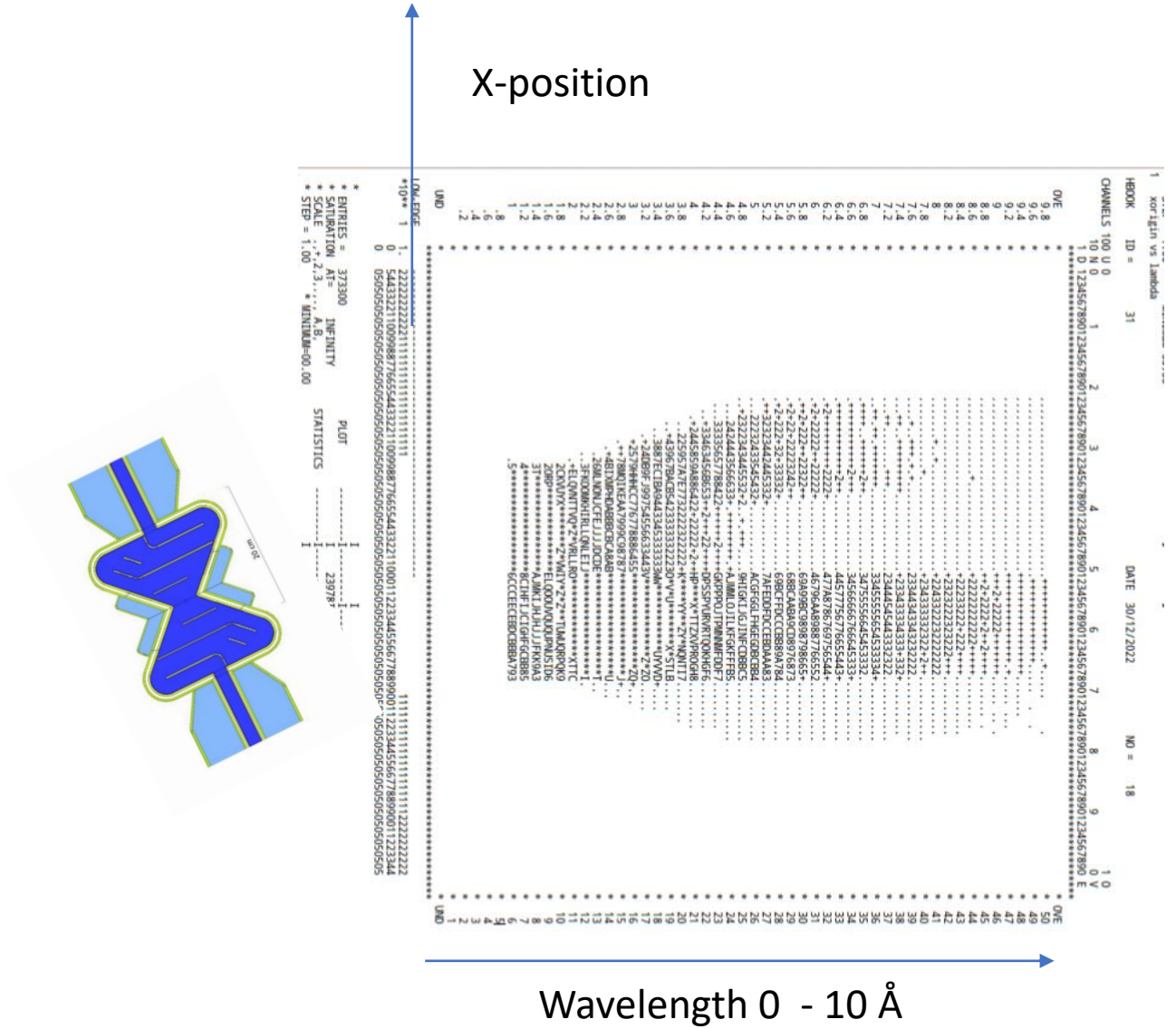
Side View and Top View



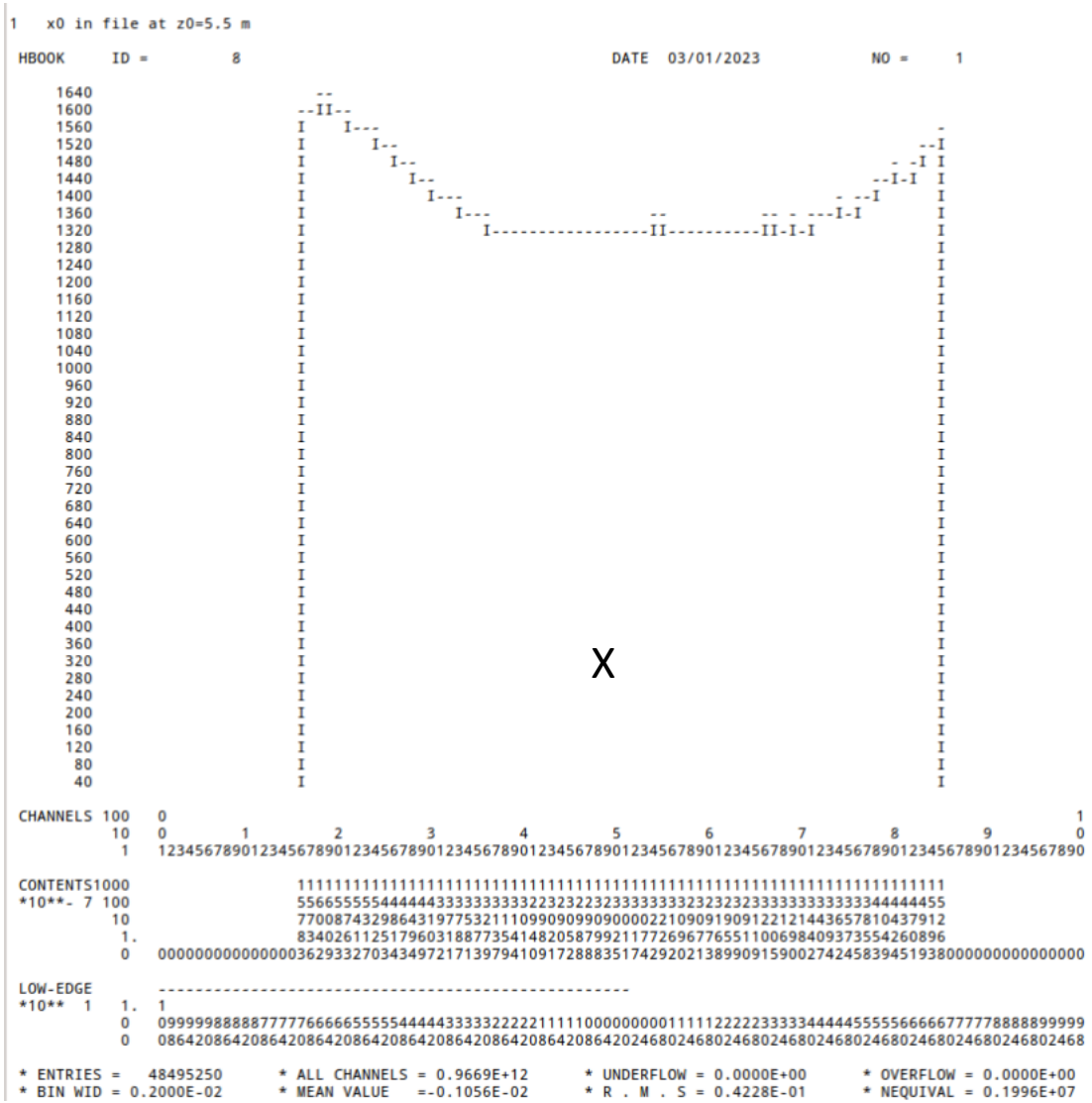

Normalized Quantity
1.0
0.8
0.6
0.4
0.2
0.0
−10
0
10
20
30
40
50
Parallel Shift (mm)
Udo, Jan 2, 2023.
after shift return to
coordinate system:
x tally = x tally -2 cm
Total Rate N
TOF² (t²)
NNBAR FOM N(t²)

File elliptic_m4_2MW

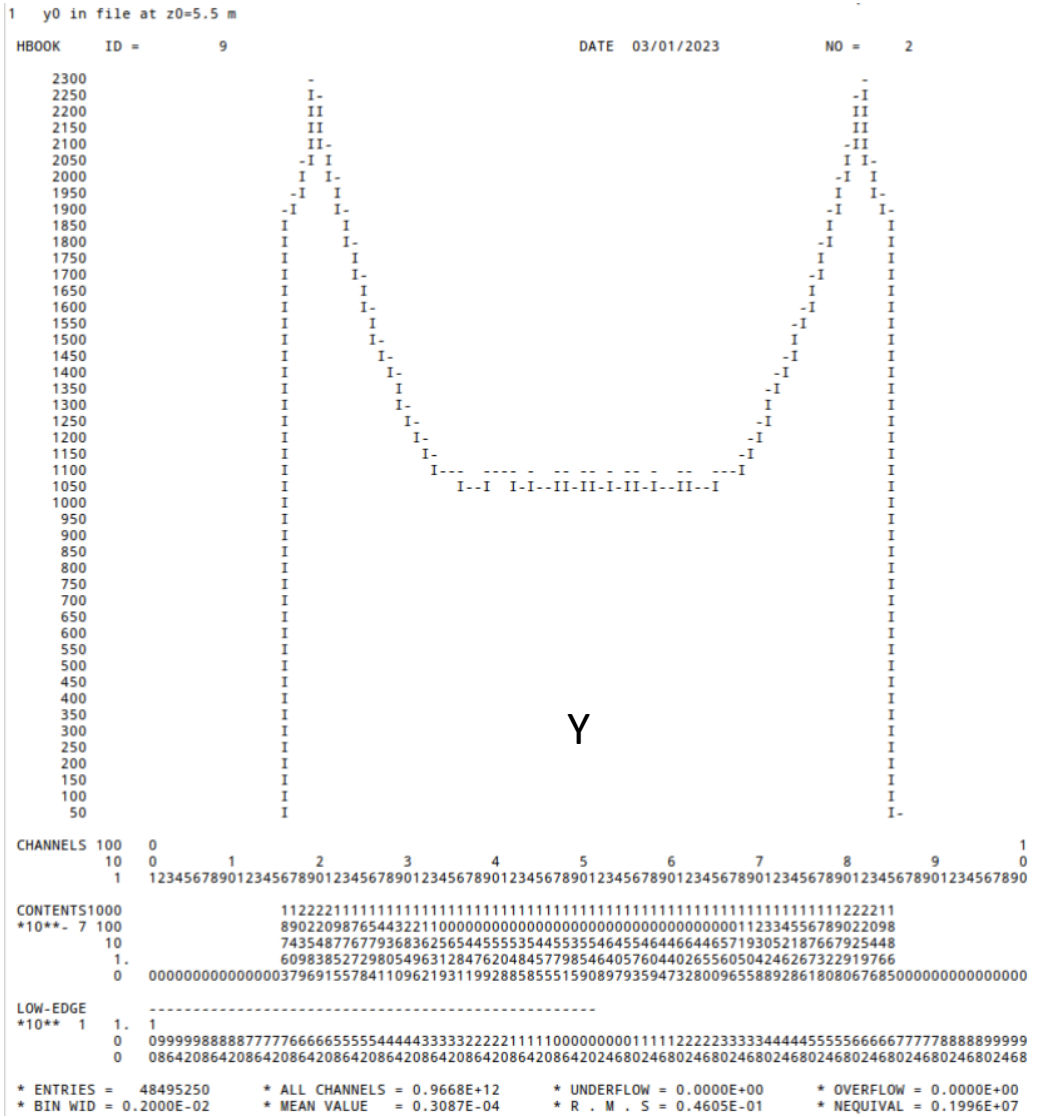
Temperature of moderator seen through beam port (reflections ~ removed)



Neutrons in 14 x 14 cm2 tally at 5.5 m

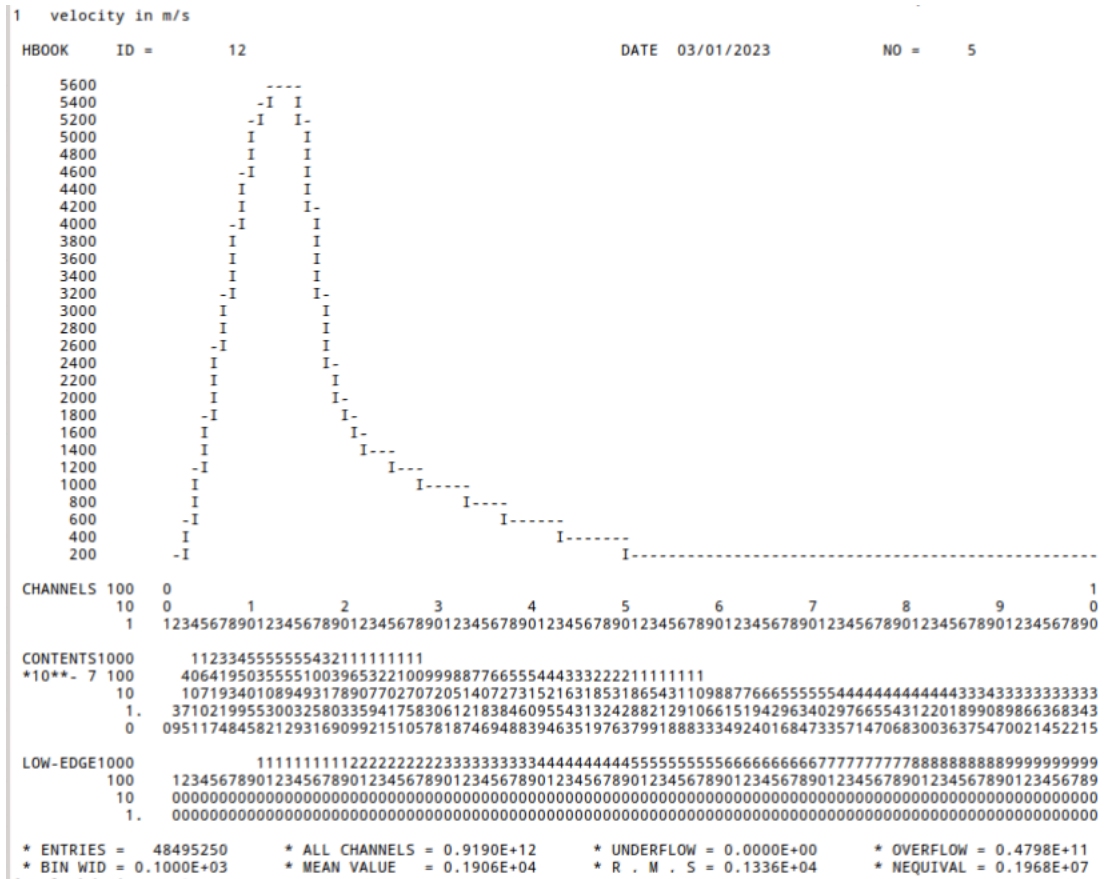


-0.07 < X < 0.07 m

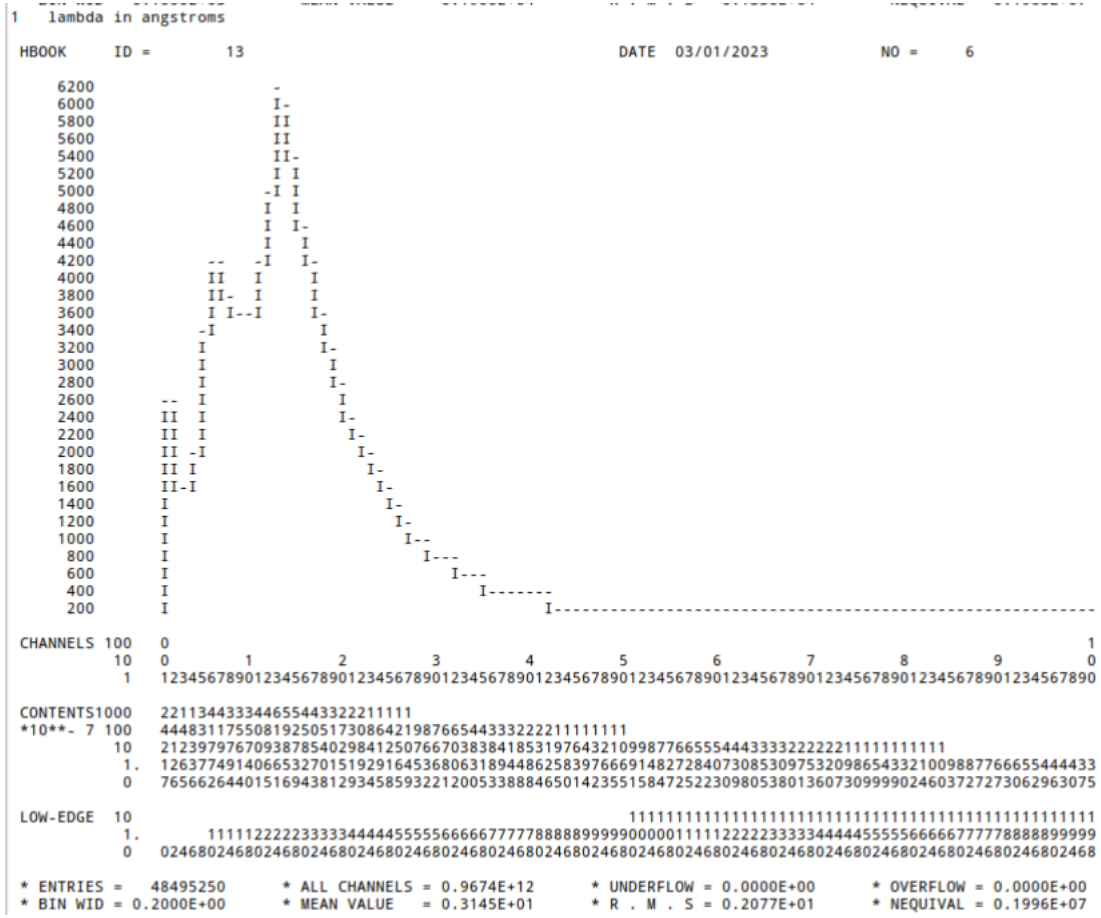


-0.07 < T < 0.07 m

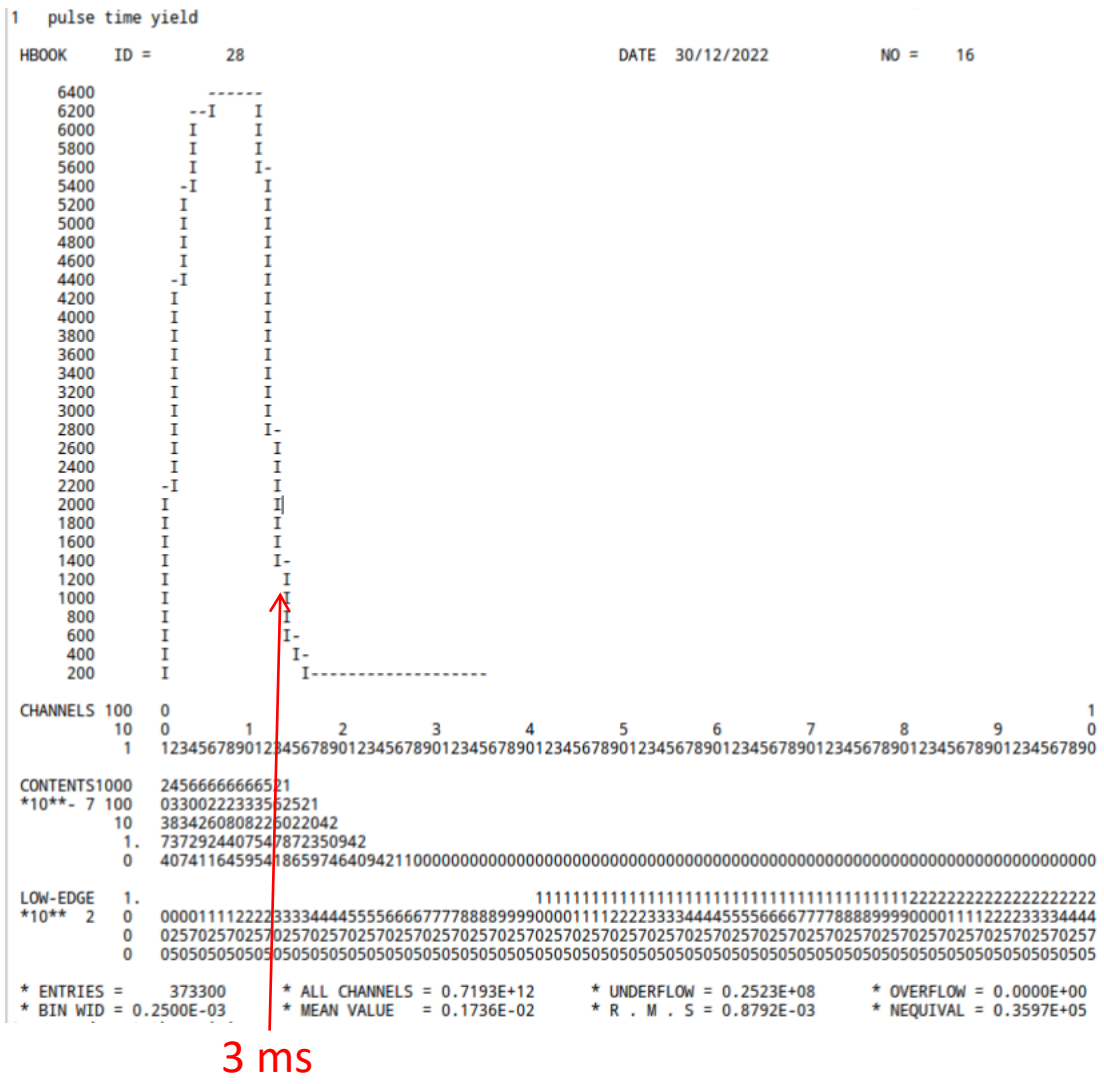
|Velocity| distribution in interval 0-10,000 m/s



Neutron wavelength distribution in interval 0-20 Å

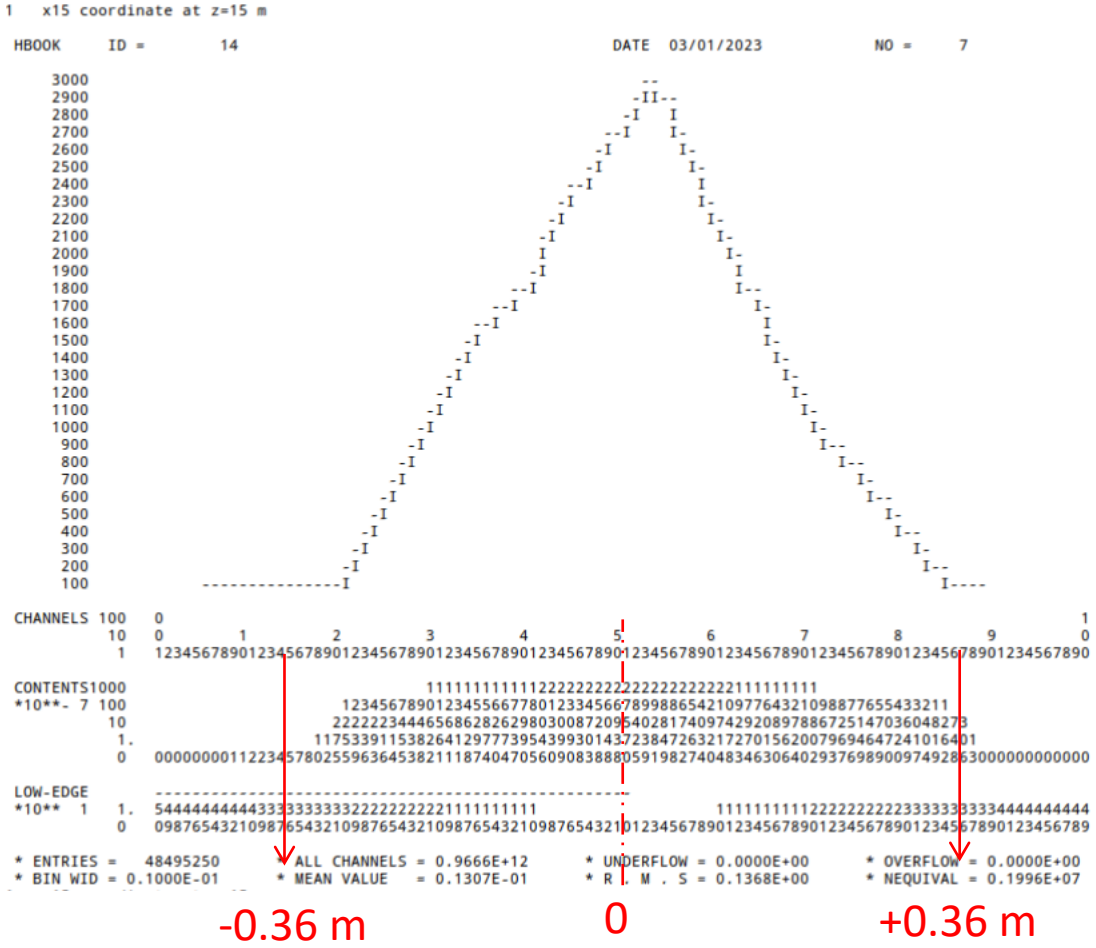


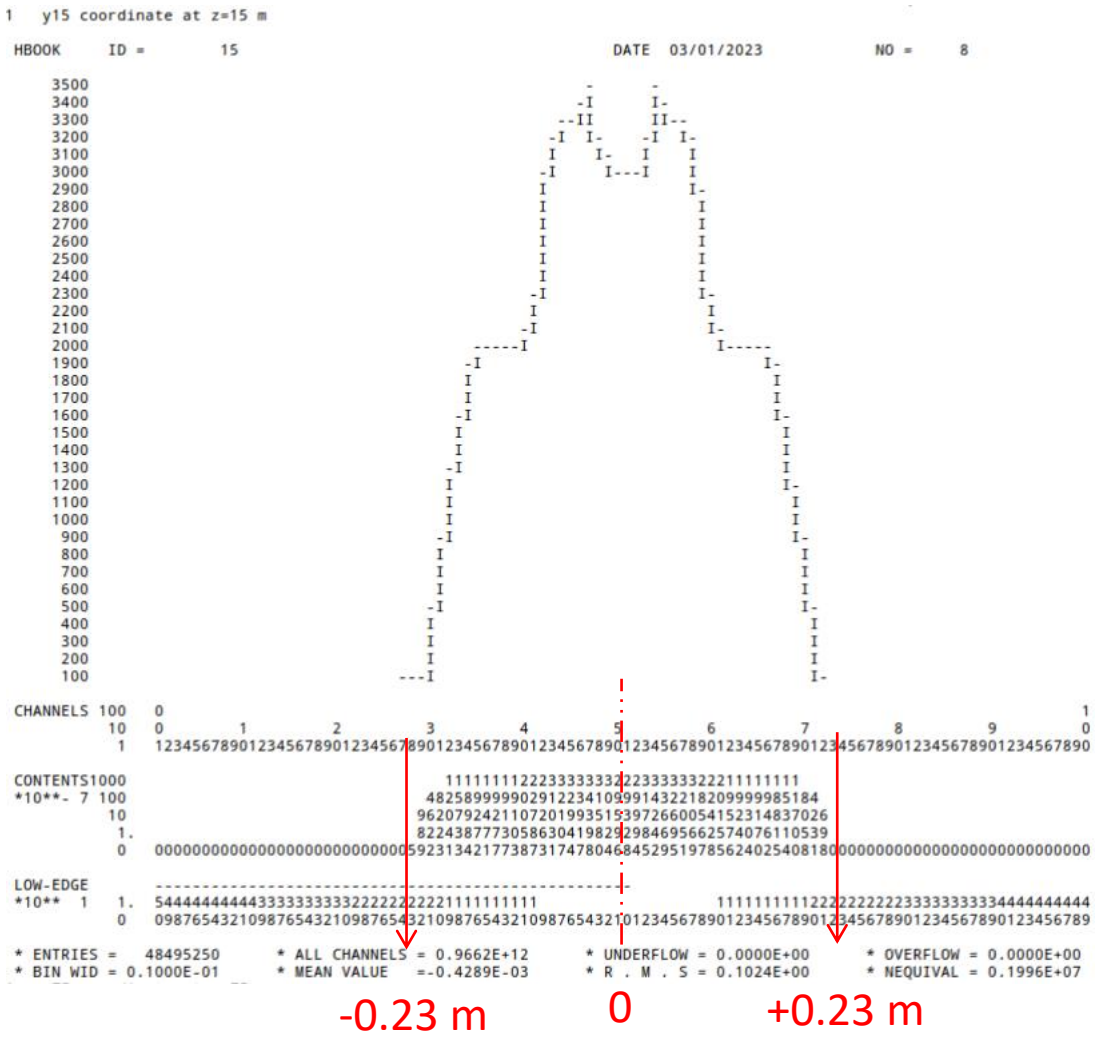
Proton beam pulse length



No selections!

X, Y distributions at z=15 m (bunker exit)





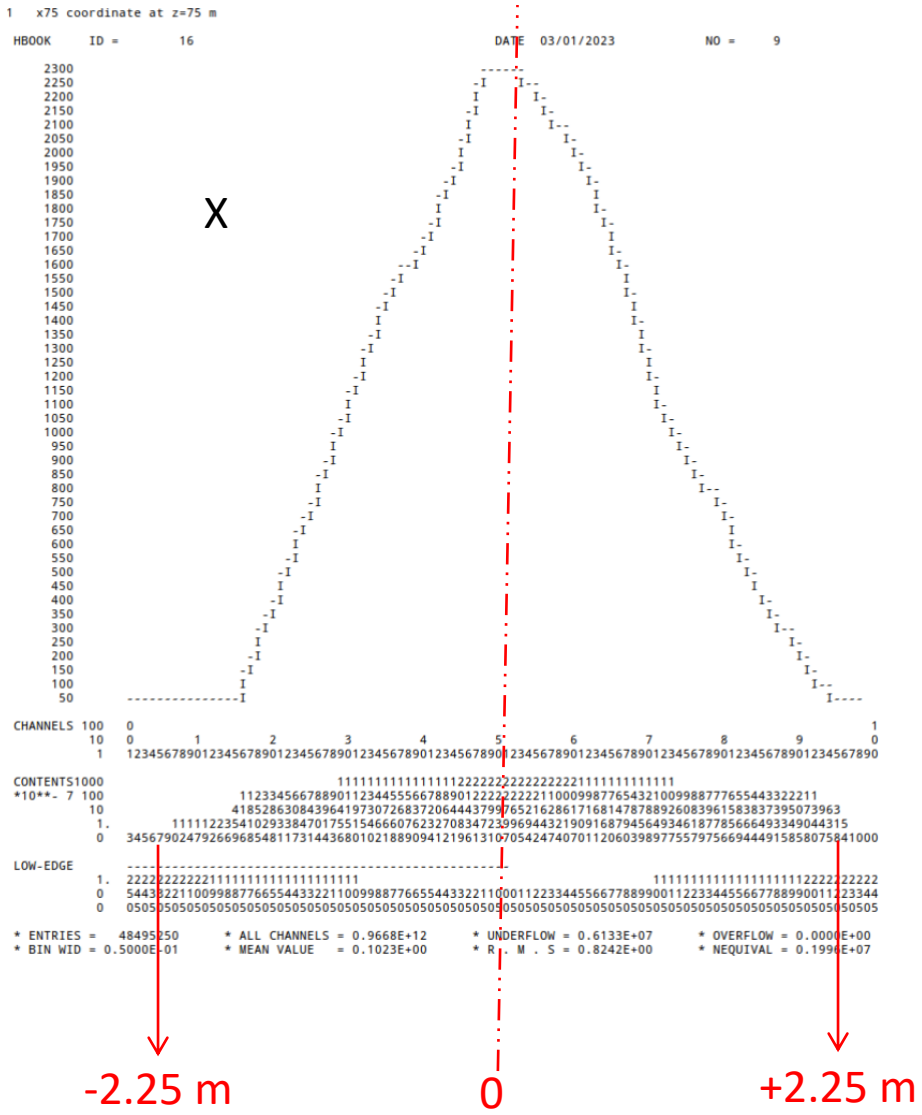
No selections!

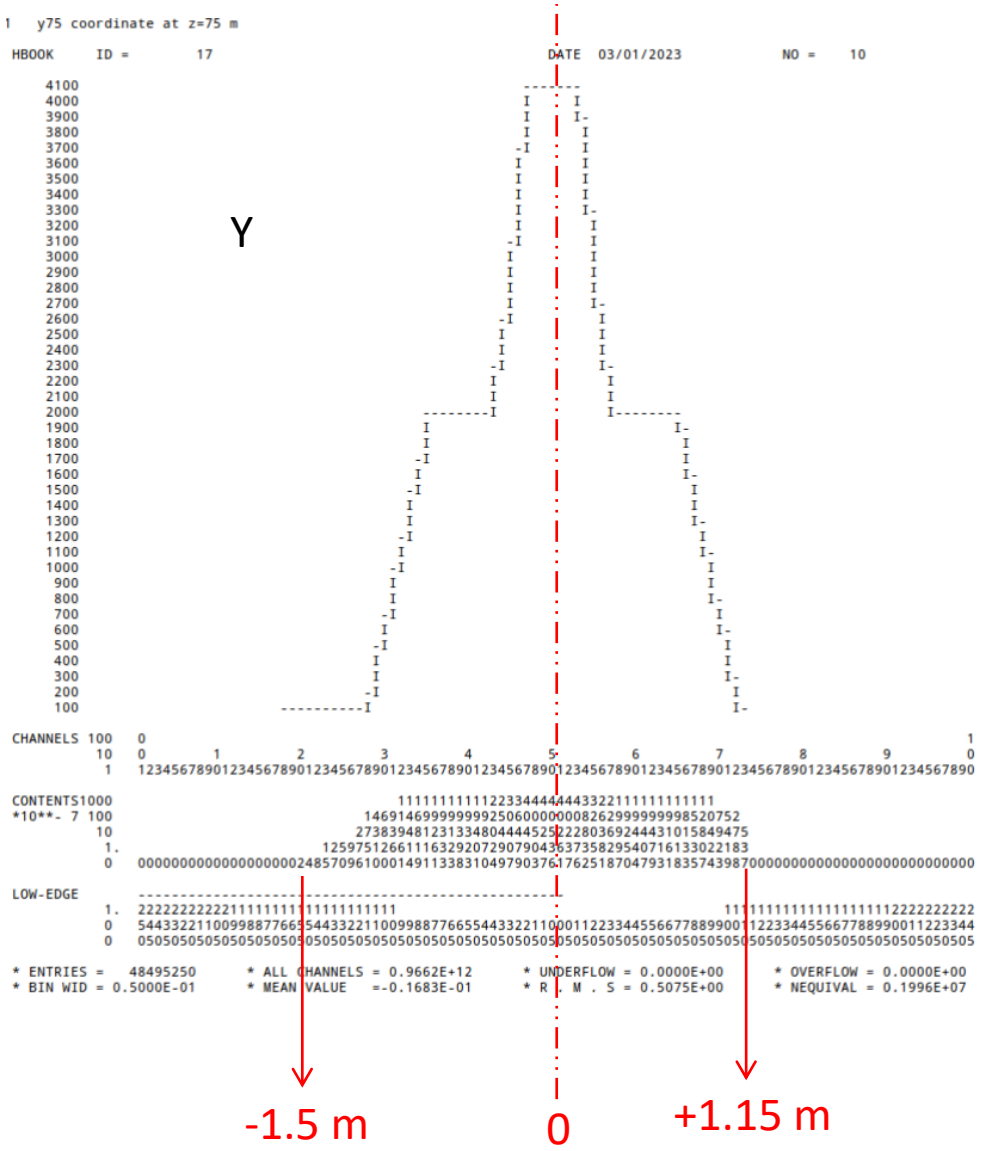
X, Y distributions at z=75 m (detector)

20Å ↔ 200 m/s

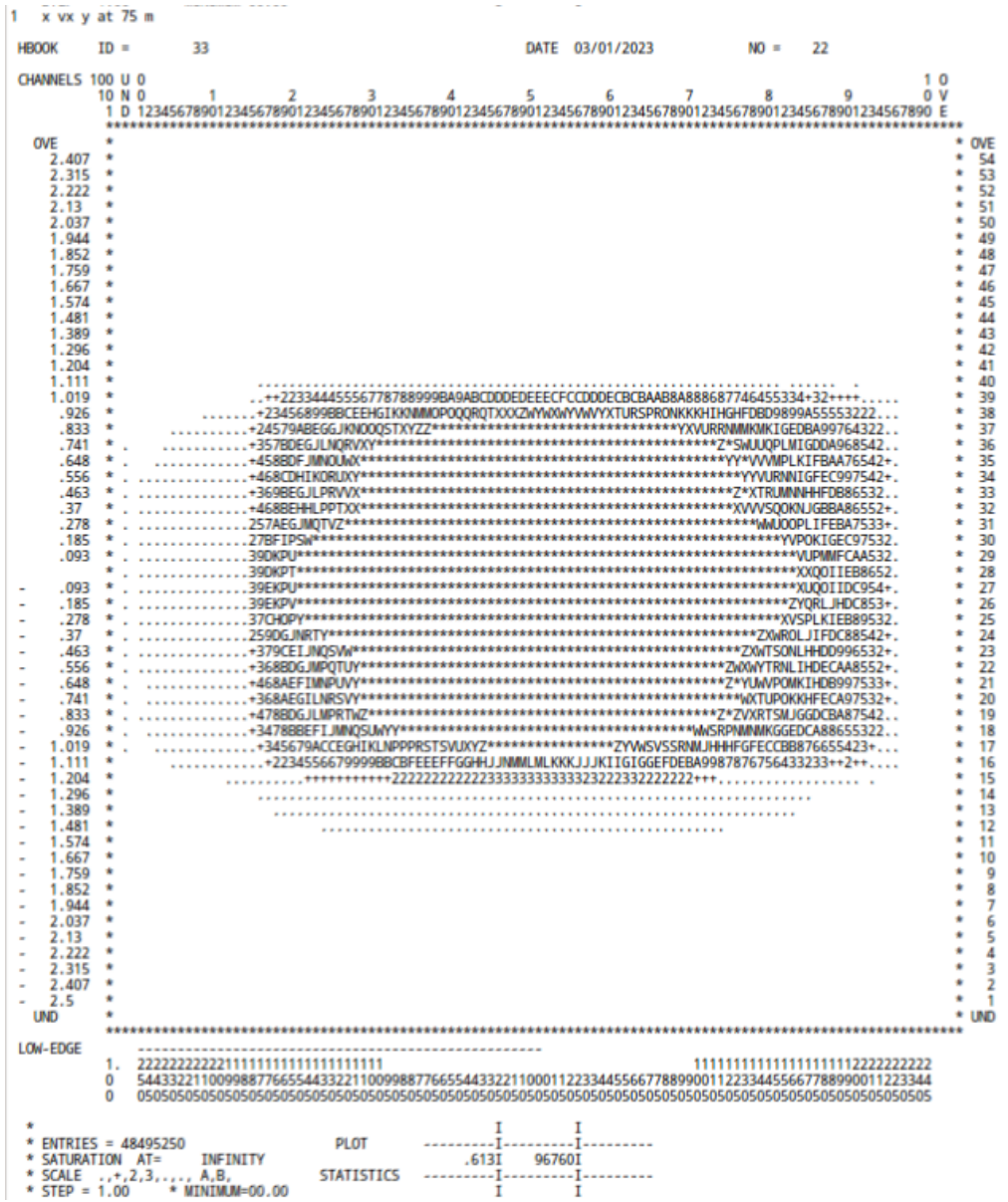
75 m for $\Delta t = 0.375\ s$

$\Delta y = -0.7\ m$





Detector area 4.5 m (x) × 2.7 m (y)



Task for focusing is
to reduce the beam size
to dia <1 m ? < 0.6 m ?

“Maximum” (non-realistic) HIBEAM sensitivity estimate for n-nbar

- BF upper ESS moderator, beam line E5 spectrum at 2 MW
- Use total beam intensity through guide ($0.1\text{Å} \leq \lambda \leq 20\text{Å}$)
- Maximum possible beam guide size 14 x 14 cm (from z = 2.7 to 5.5m)
- No reflection decoherence reset for maximum possible flight time of 75 m
- Perfect magnetic screening and vacuum assumed
- ILL unit (tuned to ESS availability time) = 2.0E+9 $n \cdot s$
- Detector efficiency 100%

For Udo’s configurations:
Elliptical $m = 4$ guide dia 10 to dia 14 cm, 2 MW

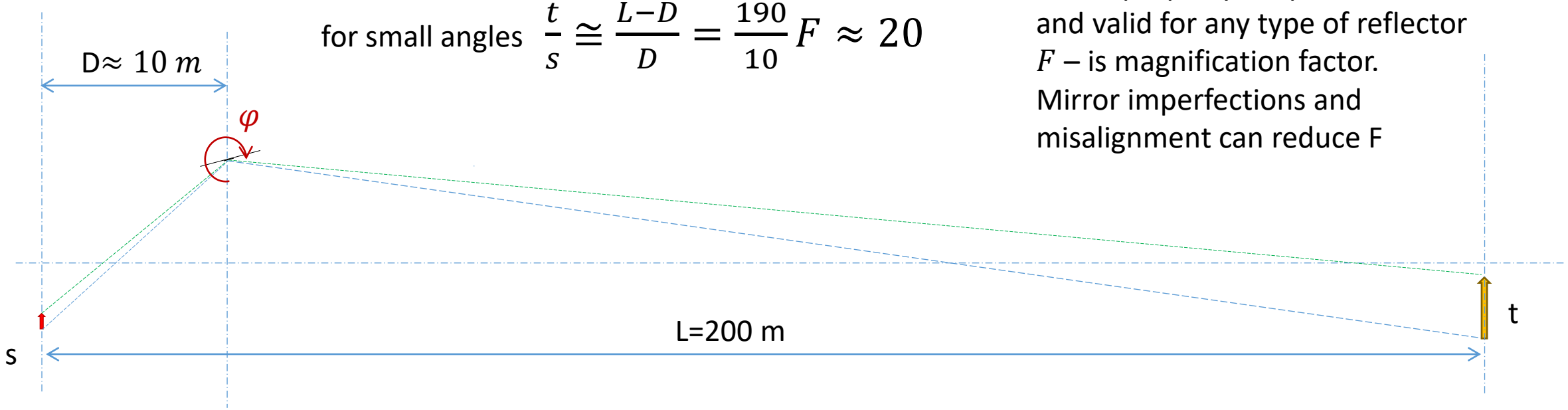
Config at 2 MW	Target m^2	n/s |max|	$\bar{t^2}$ |max|	ILL |max|	Tar ∅ m	n/s	$\bar{t^2}$, s^2	ILL units
Ellipse m=4 guide	4.5 x 2.7	9.325E+11	0.00511	2.38	2.0	6.302E+11	0.00525	1.68
					1.0	**2.330E+11**	**0.00542**	**0.63**
					0.6	**1.031E+11**	**0.00543**	**0.28**

Magnification factor F

Neglecting effect of gravity
if $\emptyset_t = 2\ m \rightarrow \emptyset_s \cong 10\ cm$

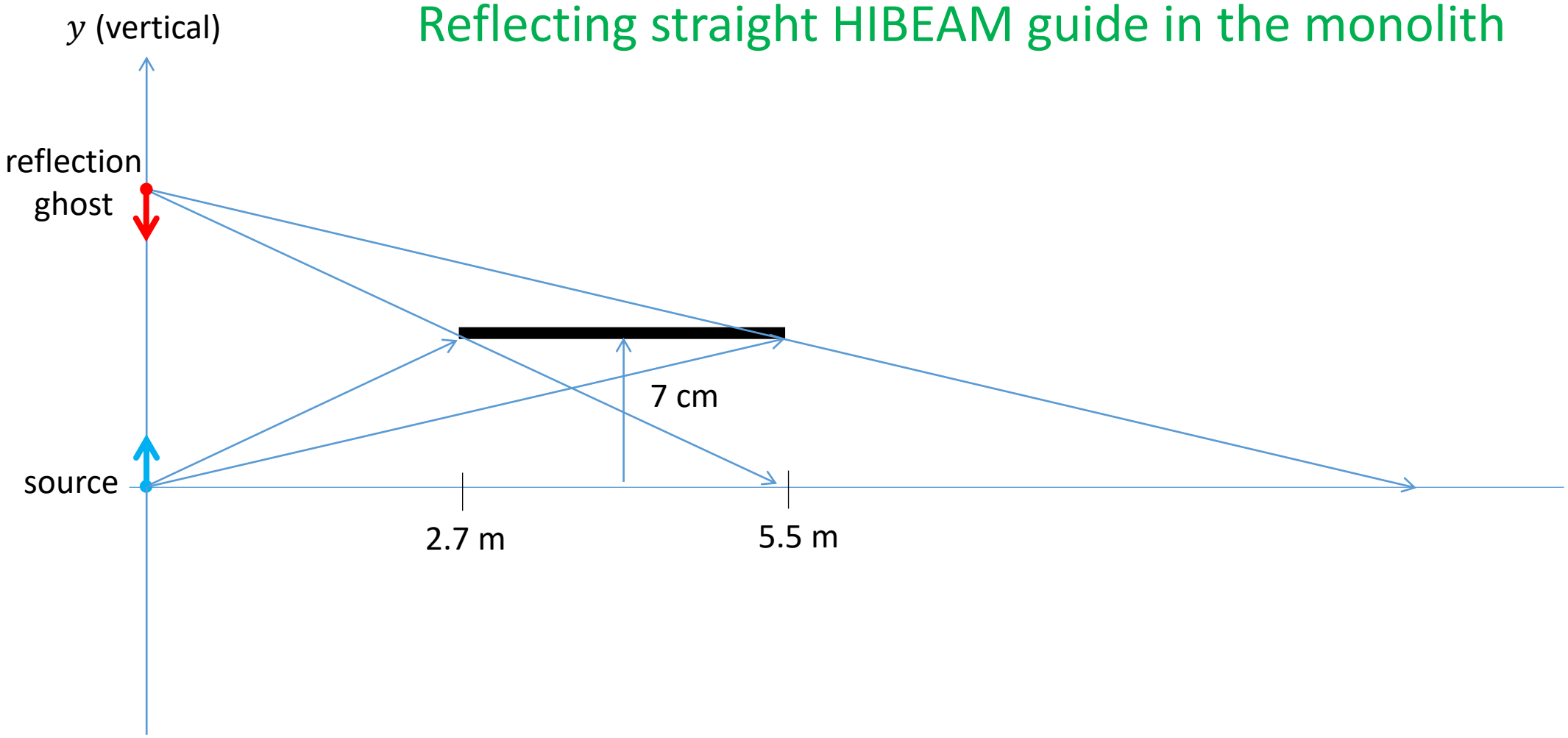
This is property of specular mirror and valid for any type of reflector
F – is magnification factor.
Mirror imperfections and misalignment can reduce F

for small angles $\frac{t}{s} \cong \frac{L-D}{D} = \frac{190}{10} F \approx 20$



Small rotation of the mirror element for angle φ efficiently moves the image, but doesn't change the magnification factor.

Reflecting straight HIBEAM guide in the monolith



Reflecting elliptic HIBEAM guide in the monolith