SPECKLES @ NCD

NCD source characterization

```
def getUndK(gap_um):
    min_valid_K=0.5
    a_0=-178.683137165;a_1=101031.437305031;a_2=-268554.955894147
    a_3=333043.58574148;a_4=-223412.253880588;a_5=78201.083309632
    a_6=-11222.656555176
    r=np.roots(np.flipud([a_0-gap_um,a_1,a_2,a_3,a_4,a_5,a_6]))
    r=r[np.isreal(r)];r=r[r>=min_valid_K]
    return r.real[0]
ALBA_Energy=2.98
ALBA_gamma=1+ALBA_Energy*1e3/0.511
harm=11
Gap_um=6.05e3
ALBA_und_Period=0.0216
ALBA_und_numPer=92
ALBA_und_K=getUndK(Gap_um)
ALBA_und_B= ALBA_und_K/(0.934*ALBA_und_Period*1e2)
ALBA_und_LambdaPeak_nm=(1+ALBA_und_K**2/2)/(2*ALBA_gamma**2)*ALBA_und_Period*1e9
wl_nm= ALBA_und_LambdaPeak_nm/harm   # on peak und radiatition
```

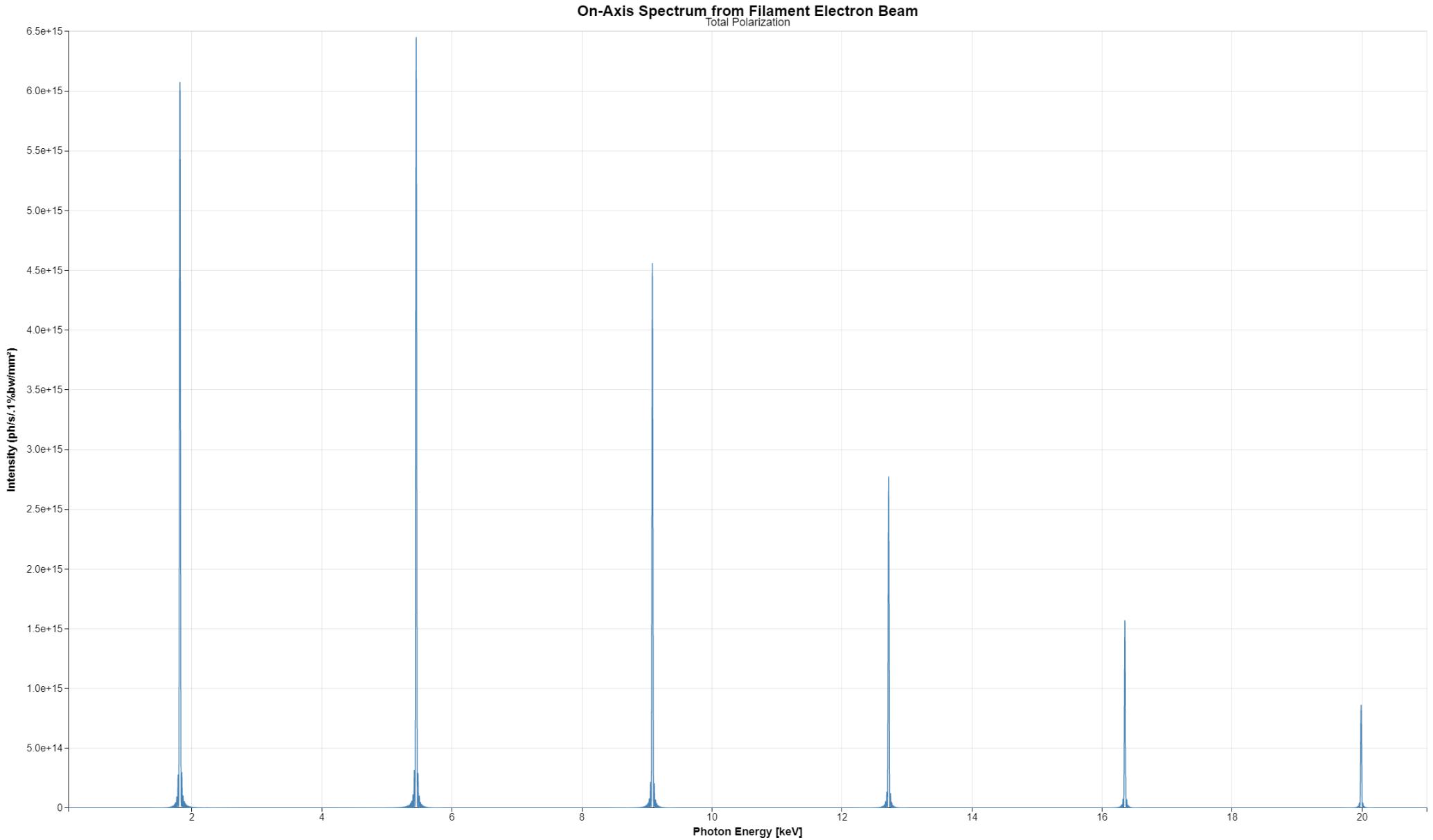
Misalignment

$$g = \sum_{i=1}^{6} a_i K^i + 31.25$$

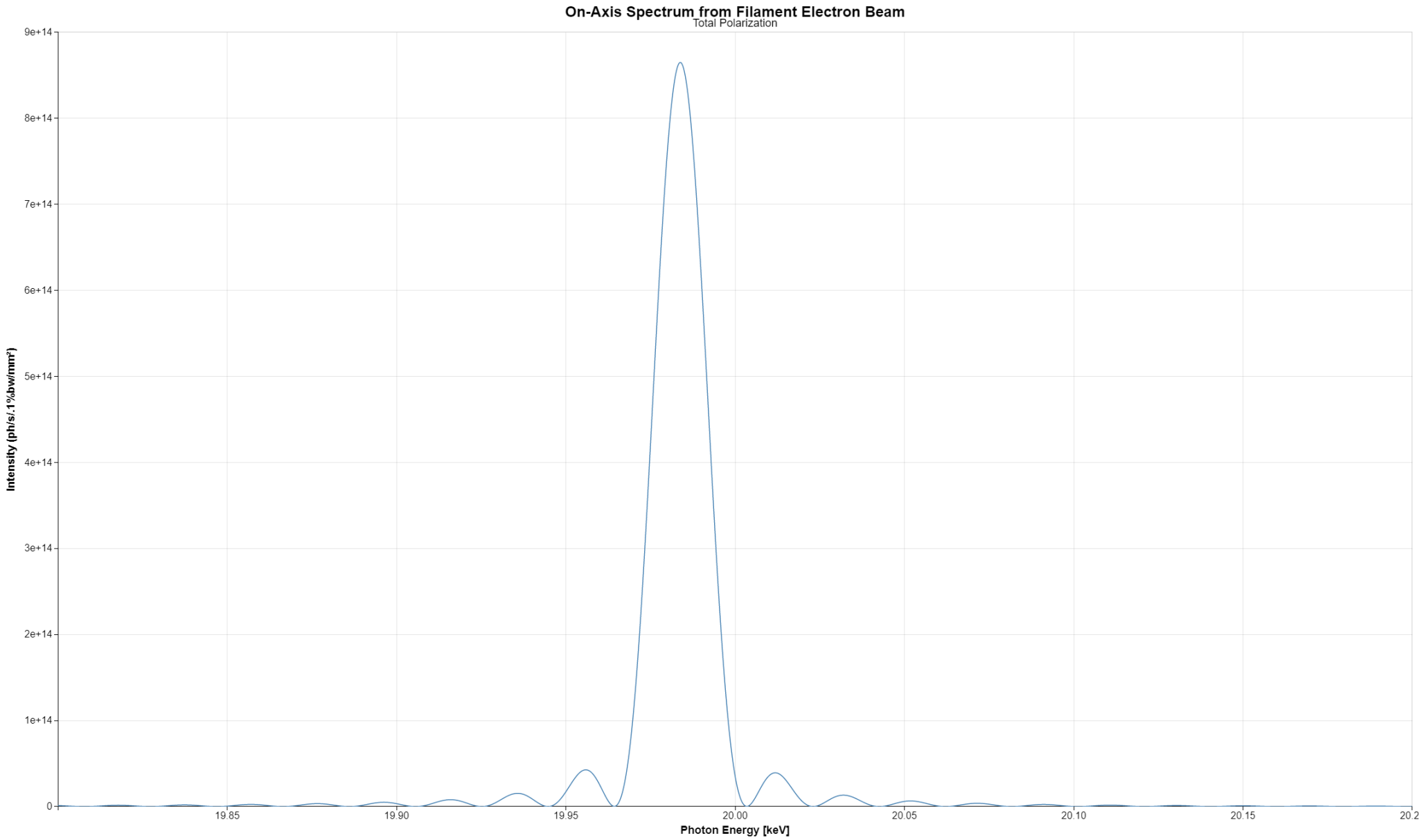
a_0	-178.683137165
a_1	101031.437305031
a_2	-268554.955894147
a_3	333043.58574148
a_4	-223412.253880588
a_5	78201.083309632
a_6	-11222.656555176

New model

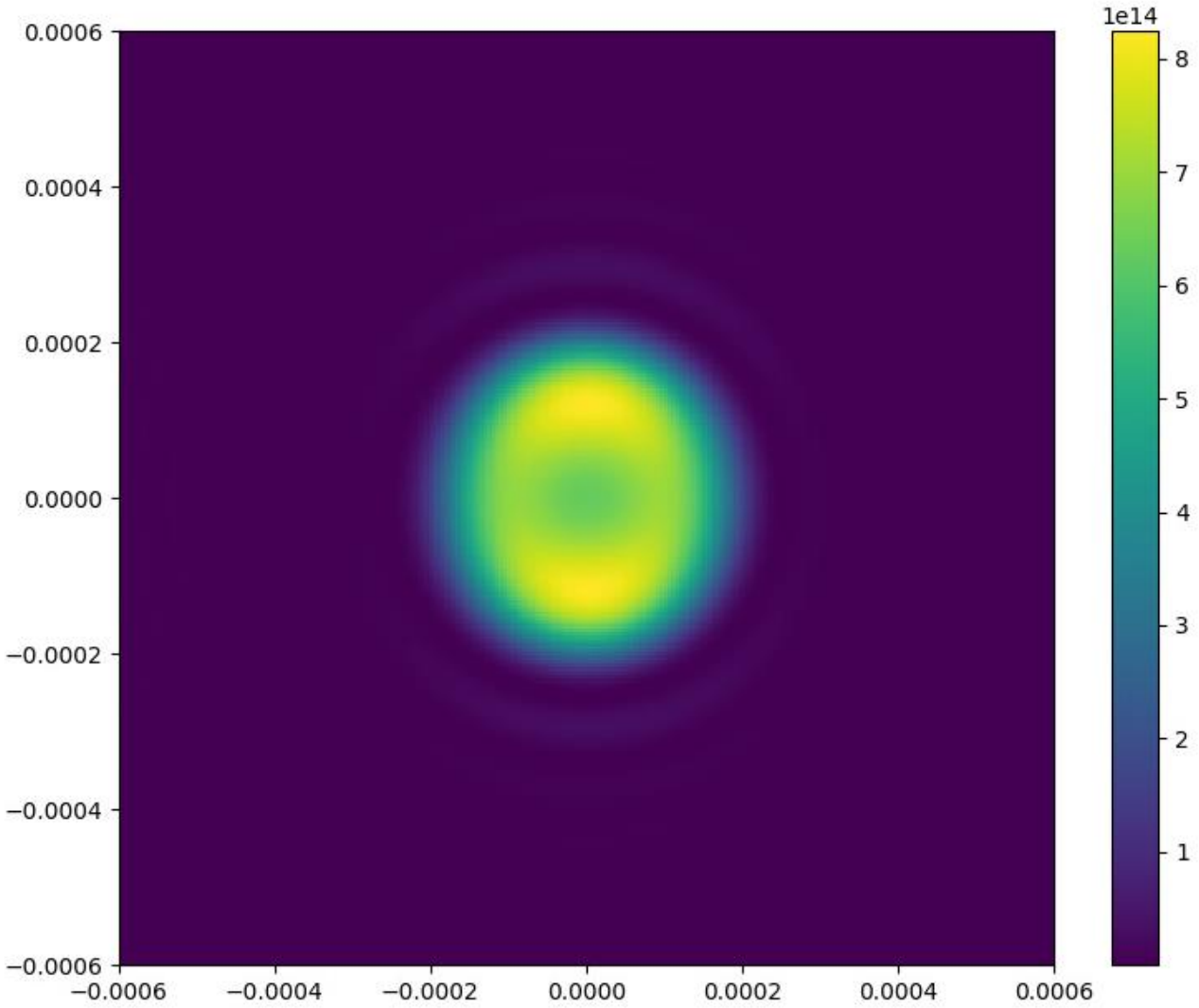
NCD source characterization



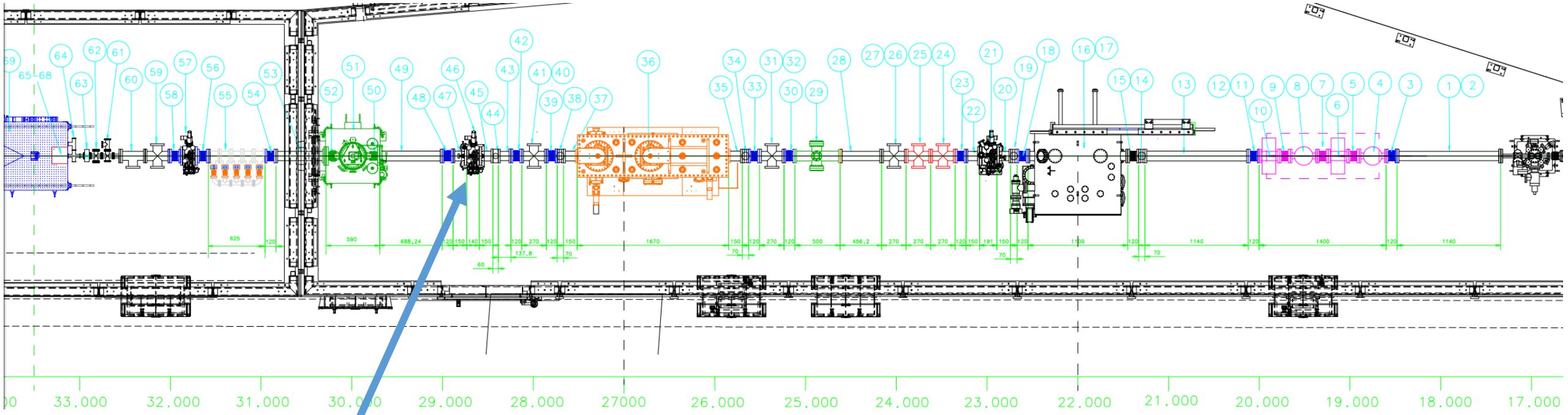
NCD source characterization



NCD source characterization



Beam divergence and Slits

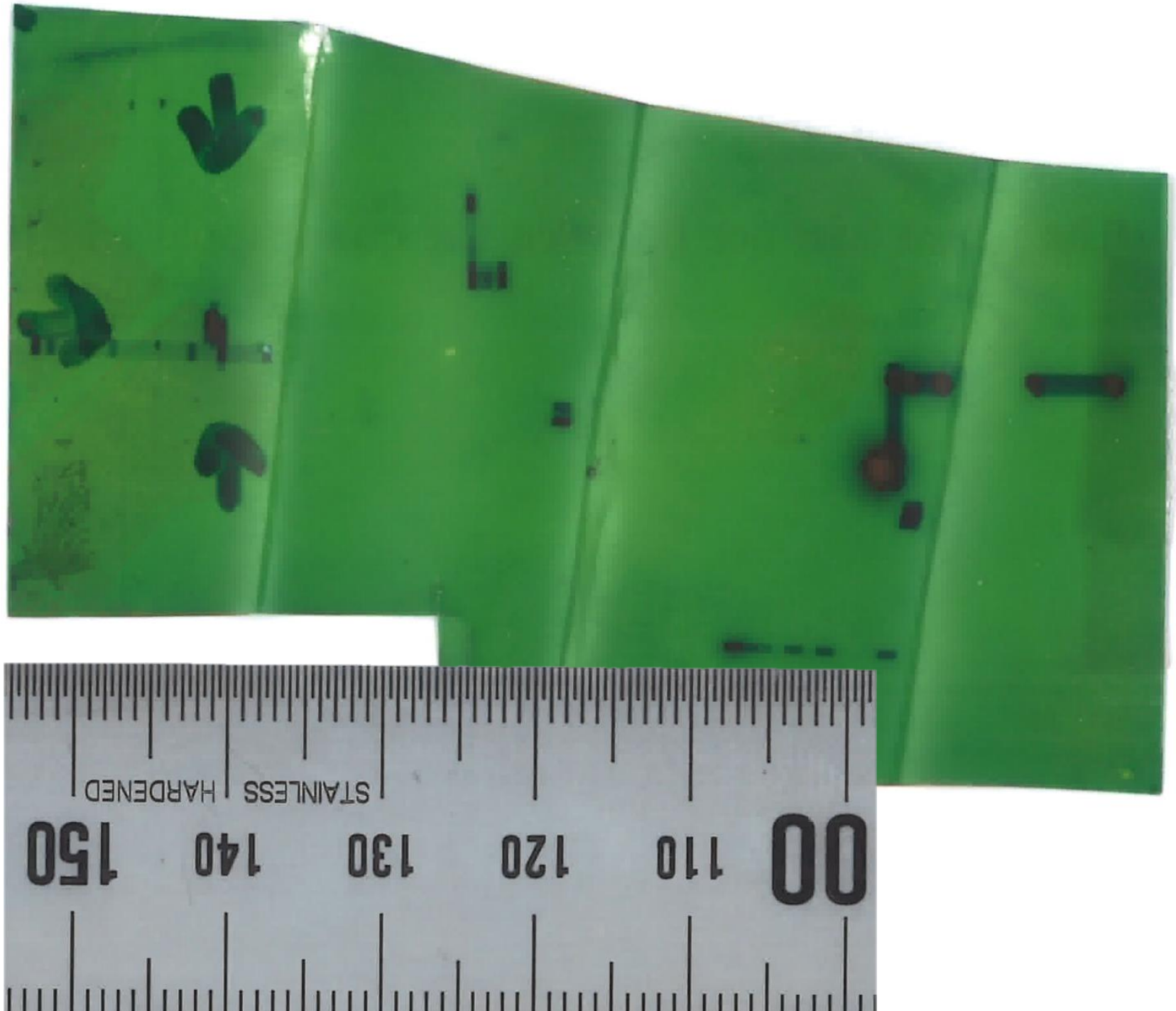


JJ X-RAY slit
Closed to 1mm x 1mm ?

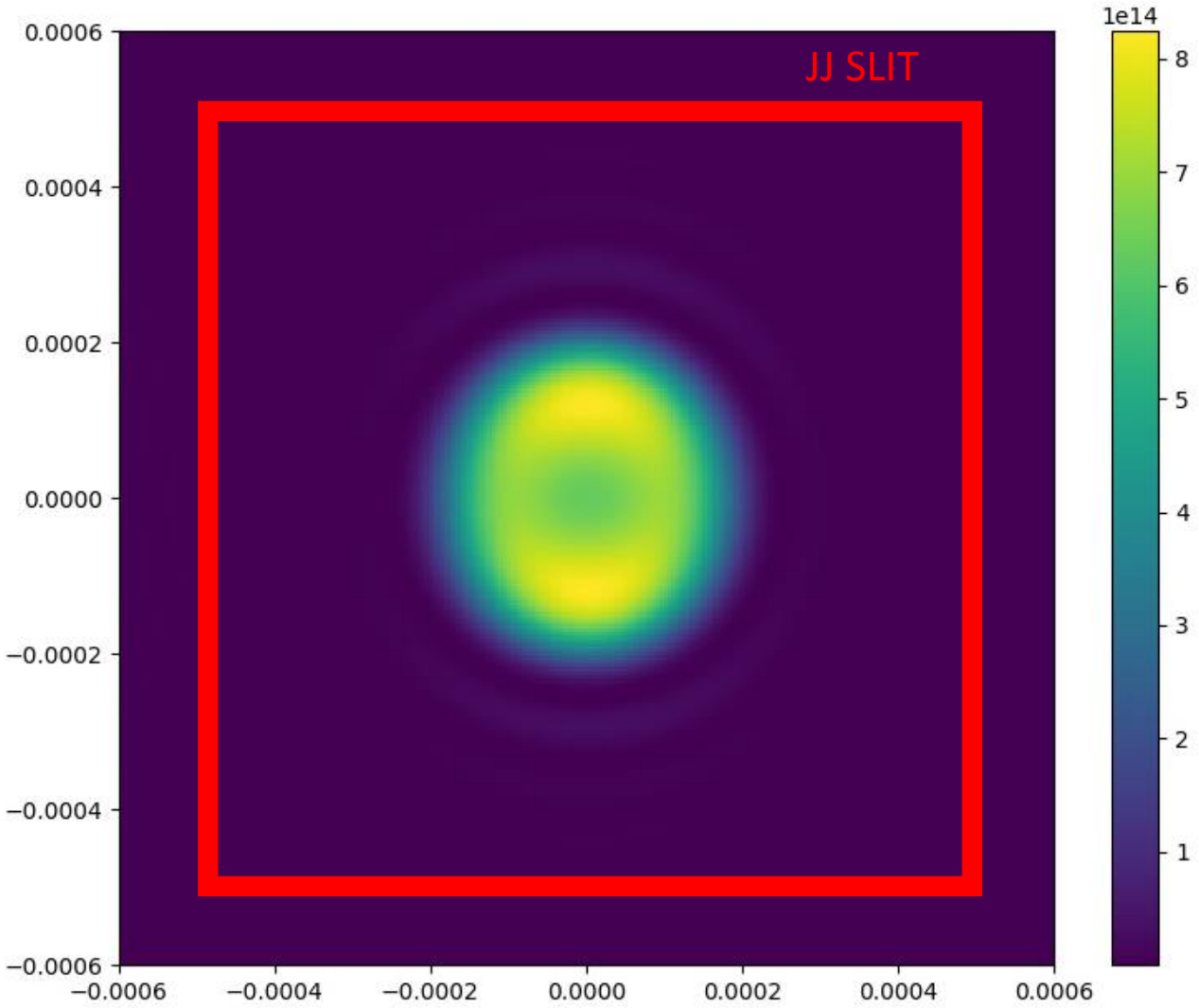
ALBA BEAM (nominal k)

sigX = 130e-6
sigXp = 46e-6
sigY = 5e-6
sigYp = 4e-6

Simulated 800 particles
(estimated output 1 TB)



NCD source characterization



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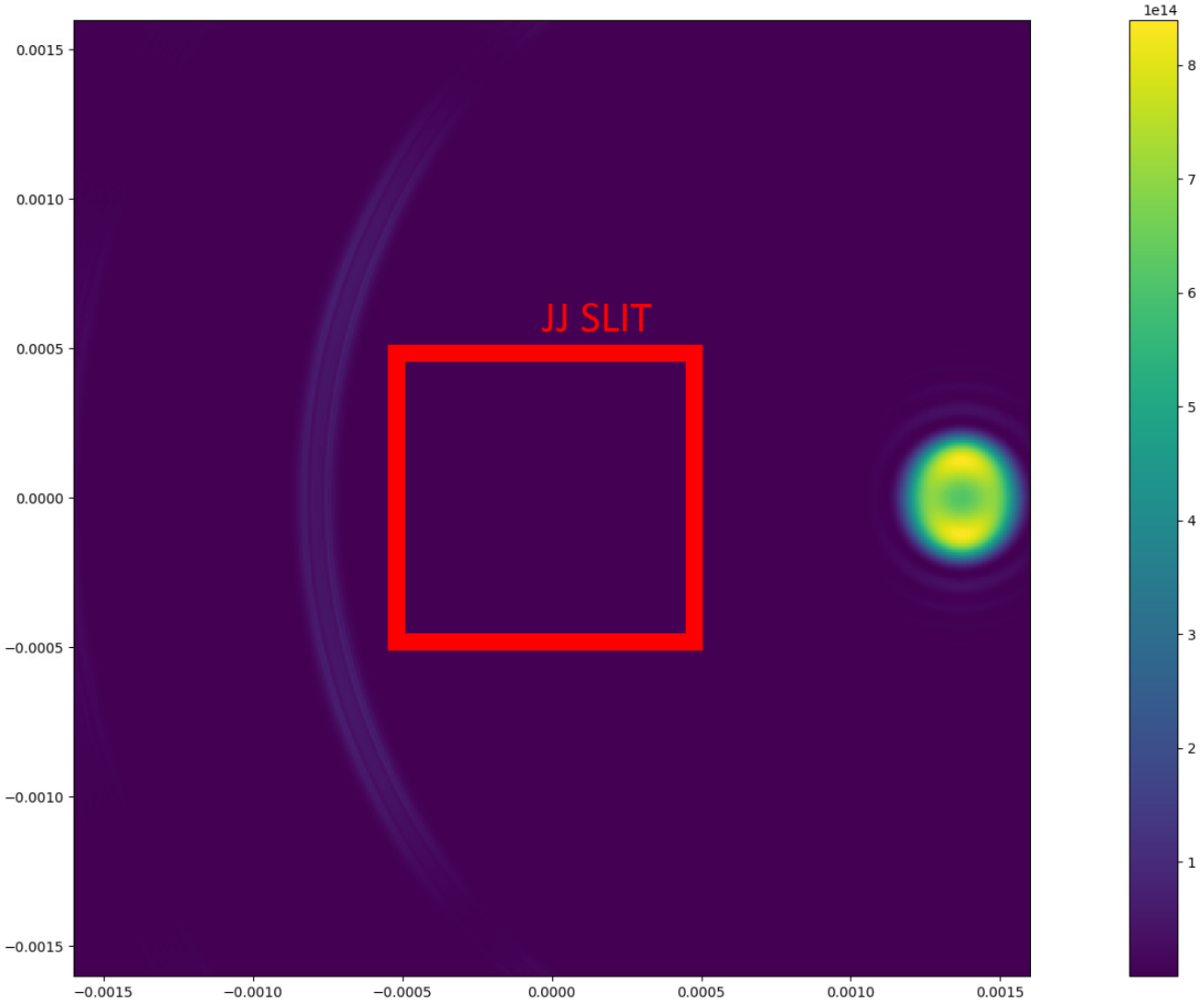

Particle at 1sigma in H divergence!

ALBA BEAM (nominal k)

sigX = 130e-6
sigXp = 46e-6
sigY = 5e-6
sigYp = 4e-6

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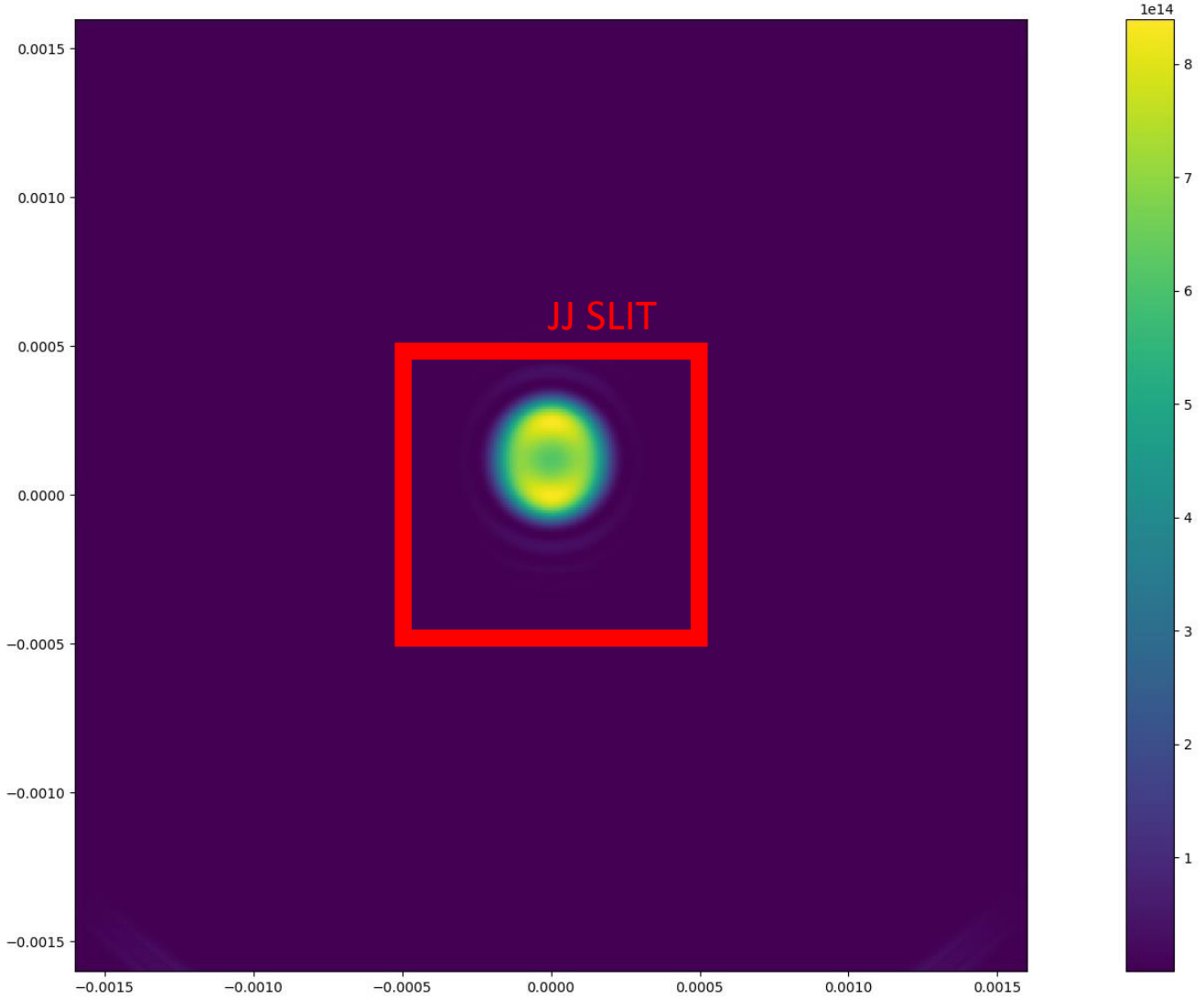
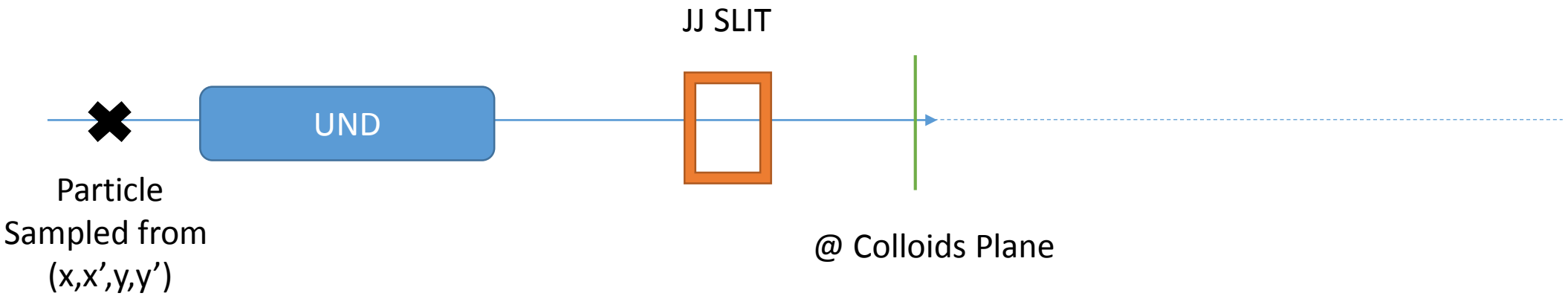
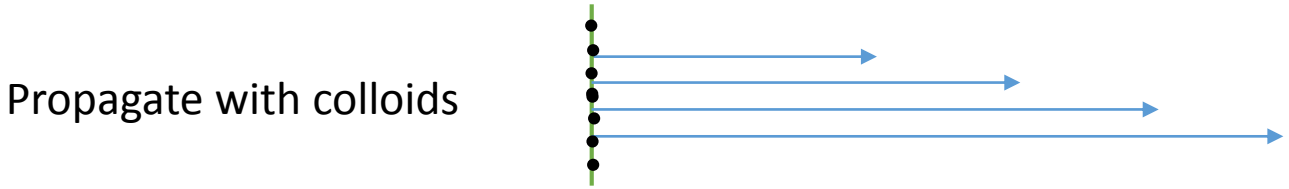


Particle at 1sigma in V divergence!

Simulation


JJ SLIT
UND
Particle
Sampled from
(x,x',y,y')
@ Colloids Plane


Propagate without colloids

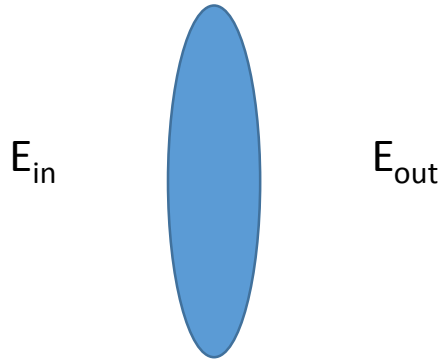

Propagate with colloids

Colloids

sensorSize=4e-3 #m
MAG=23
holder_thickness=1e-3 #m
Rcoll=250e-9 #m
Concentration=0.15 #W/W
ro_coll=2650 #kg/m3
ro_water=1000 #kg/m3

N_coll = 25e6
If we slice it longitudinally in slices
Each slice: Ncoll=1e4-1e5 (in 170 $um^{2)}$
Filling ratio of ~2-10%

COLLOID
Modifies E field



$E_{out}=k.E_{in}e^{jphi}$

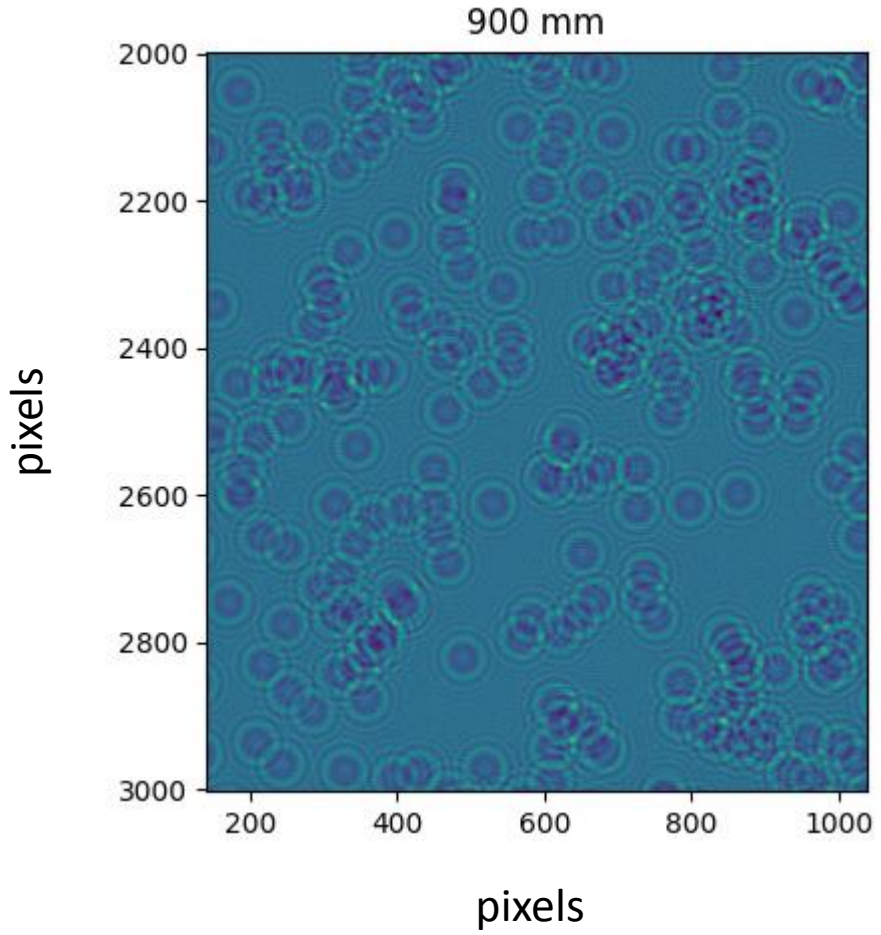
Amplitude reduction
Phase delay
Both dependent on n @ 20 keV

Could be estimated from the experimental ratio between water and colloids samples.
For the rest of this simulation k=0 (for simplicity)
Both k=0.999 and phi=1° with 1e5 colloids were simulated and speckles were observed

Colloids

Achievement:

Speckles observed
Talbot in FFT observed
S(q) quantified
C(q)=1 by definition
(Single particle)



Colloids

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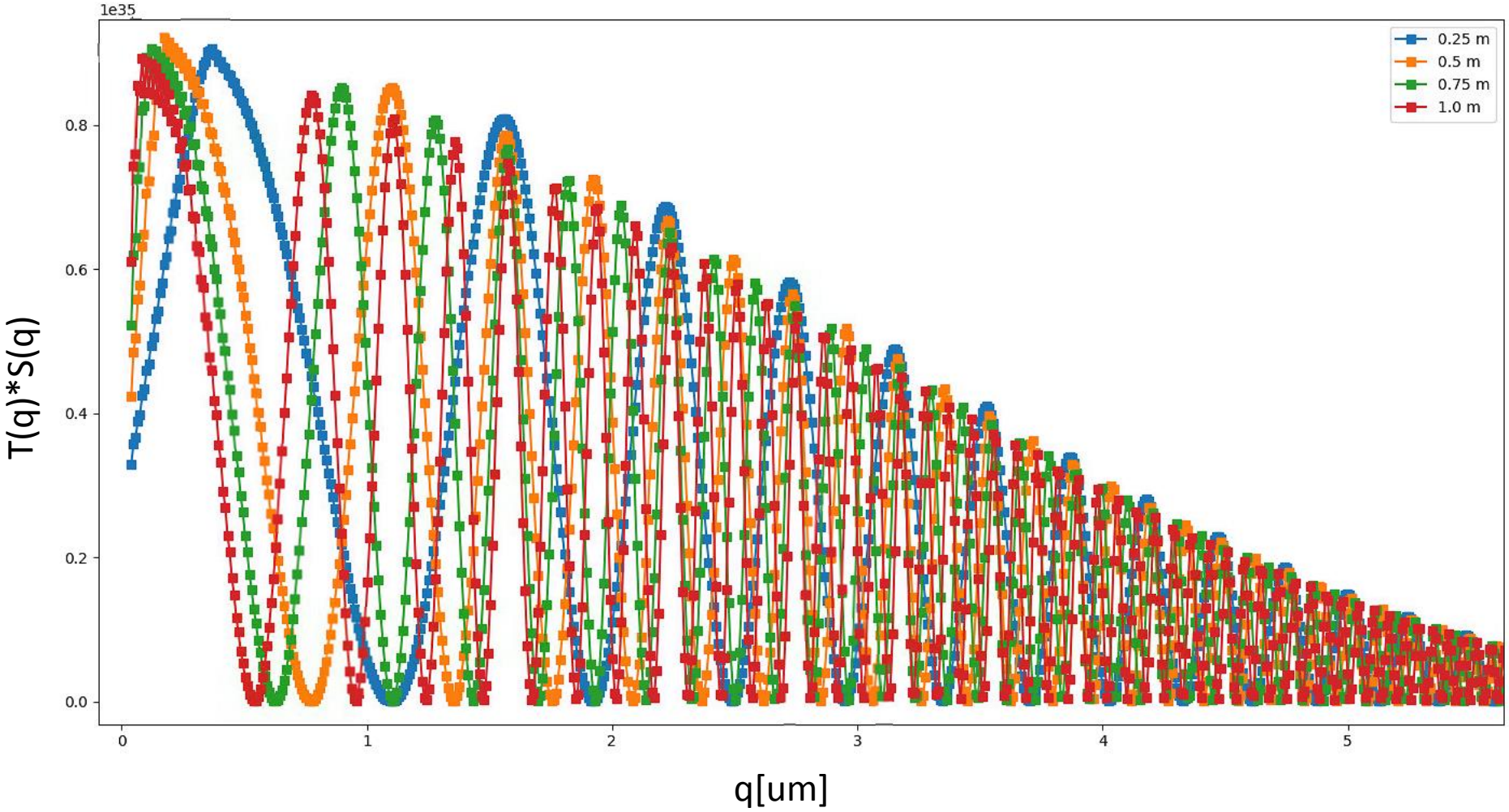
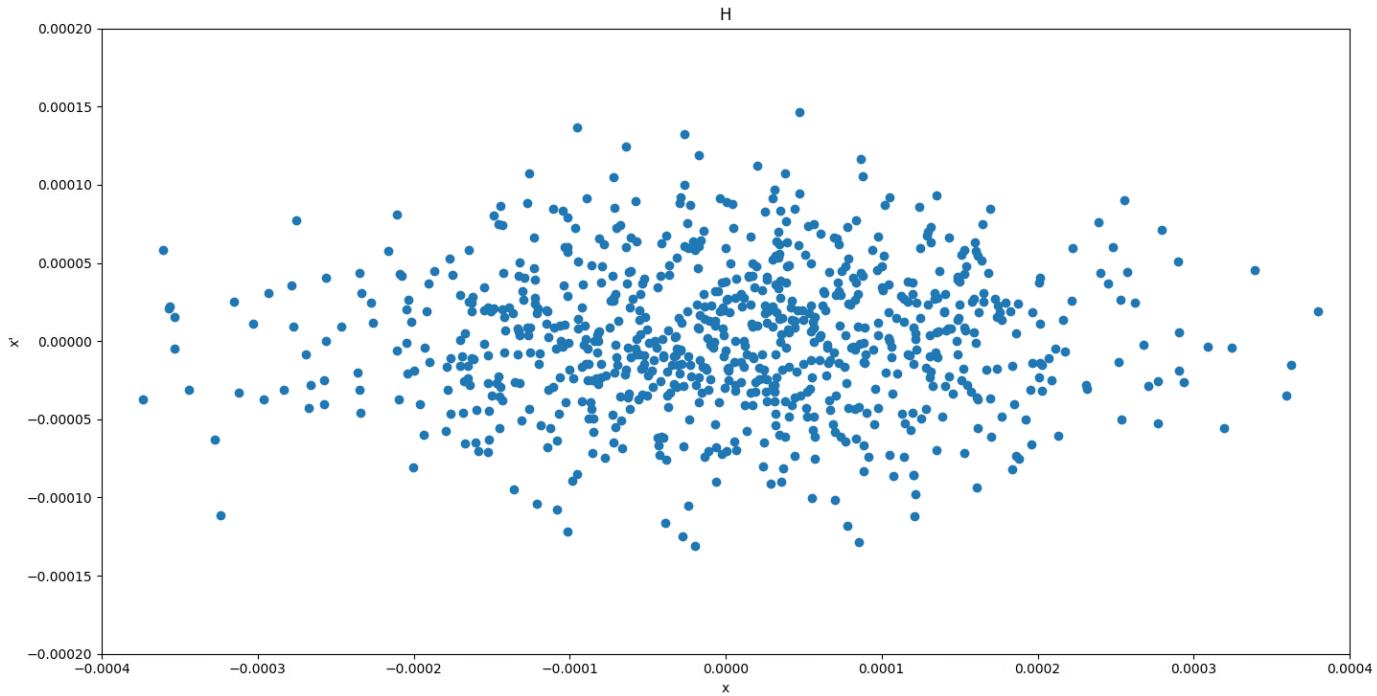
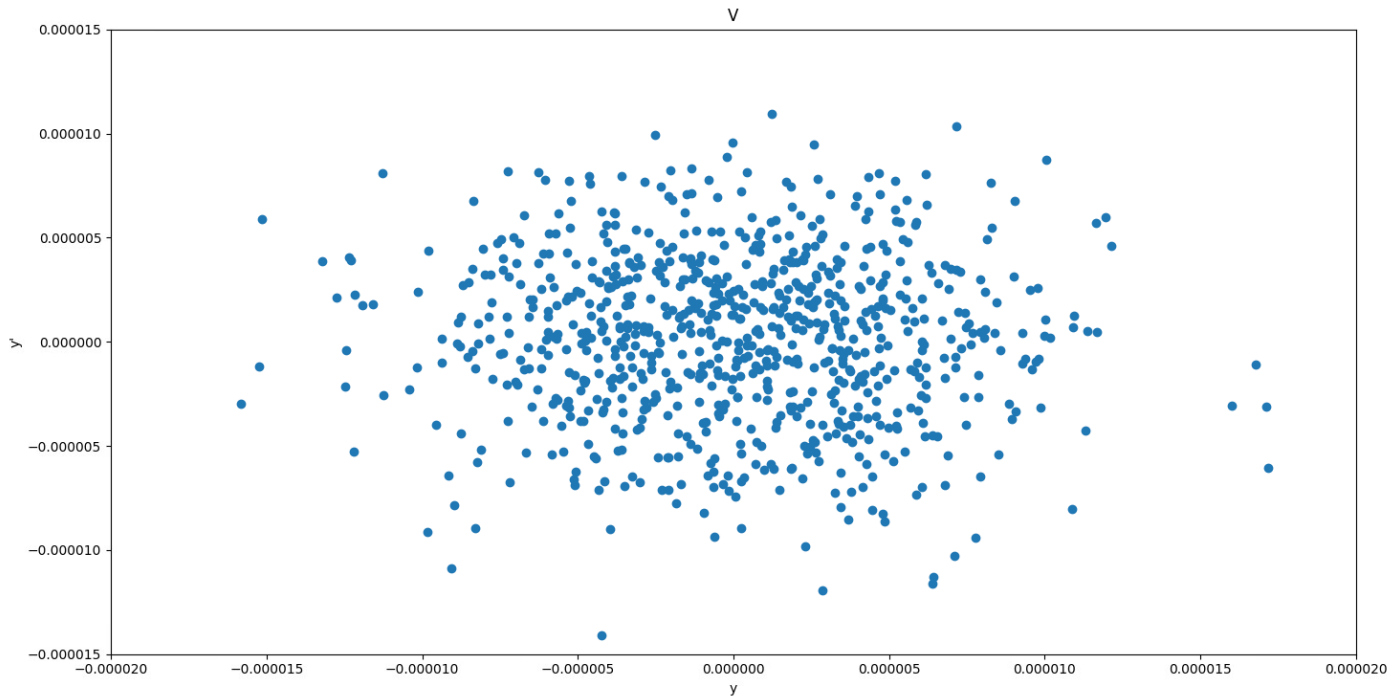


Simulated T(q)*S(q) at different distances for 20 KeV SR and 1 um colloid diameter

What is ALBA ‘beam size’?

4 D Phase space



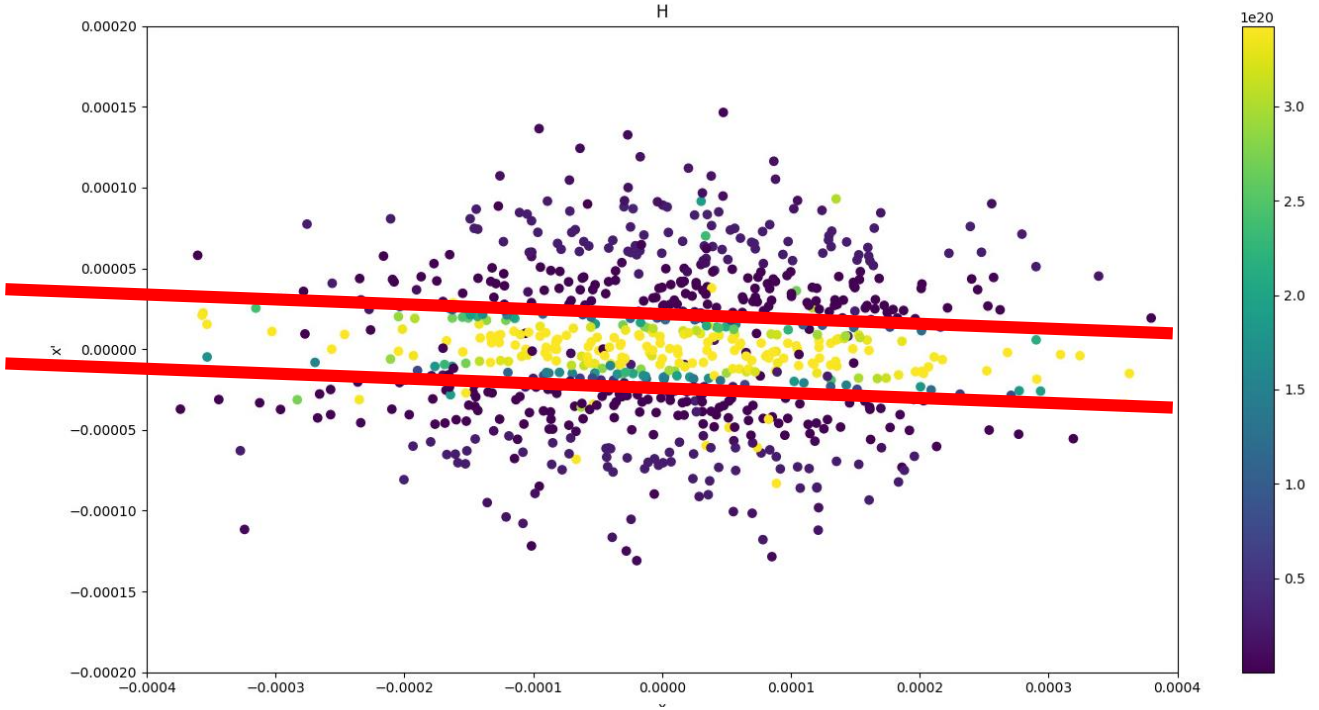


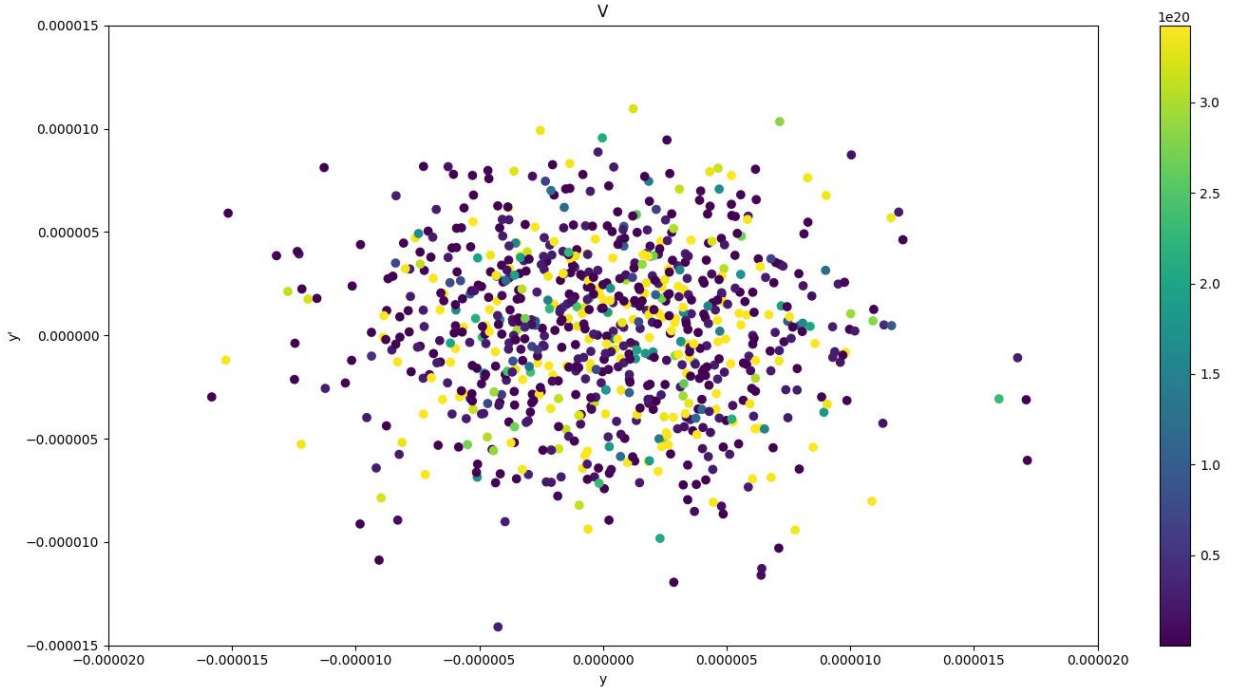
What is ALBA ‘beam size’?

4 D Phase space

Color coded:

SR on the colloids plane after crossing the slit



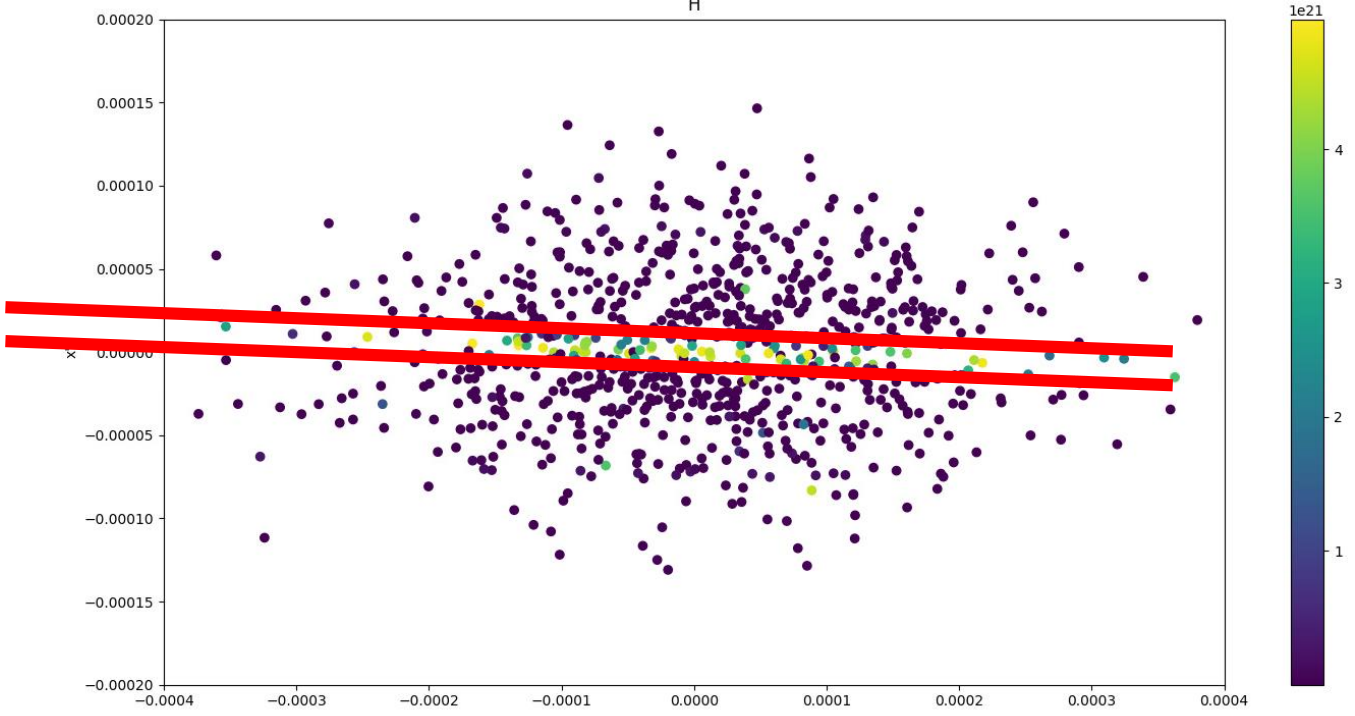


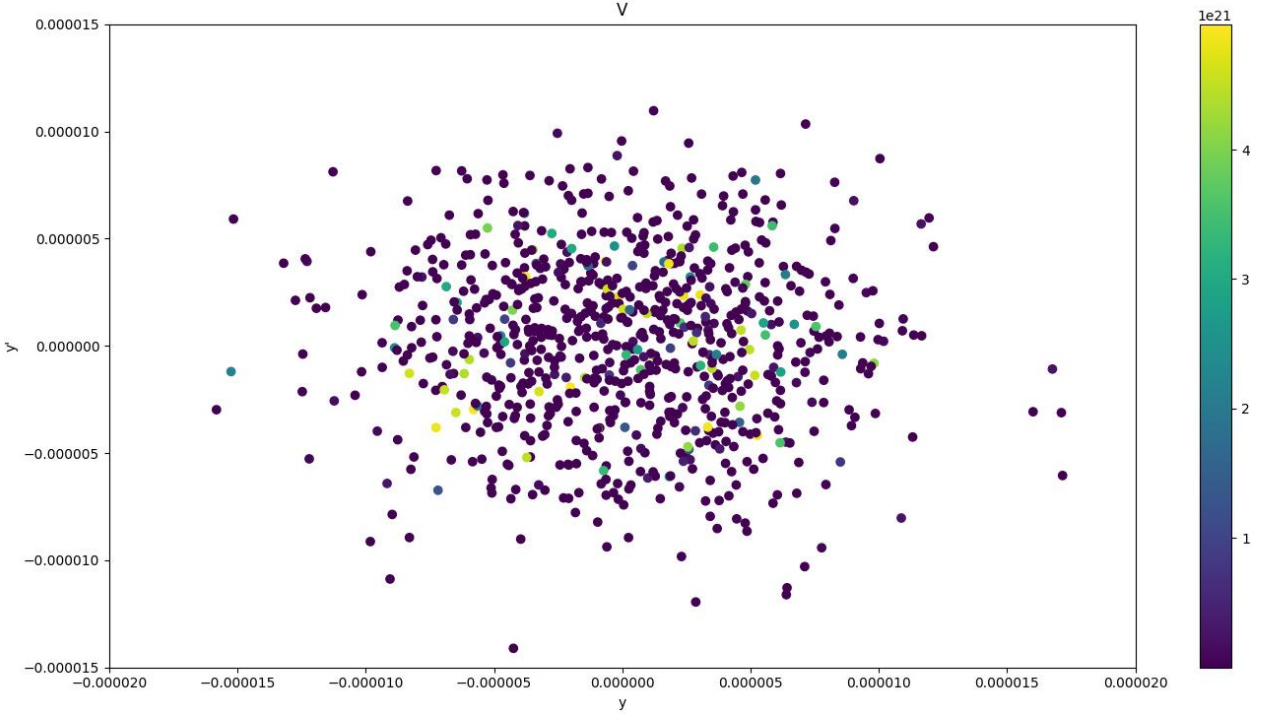
What is ALBA ‘beam size’?

4 D Phase space

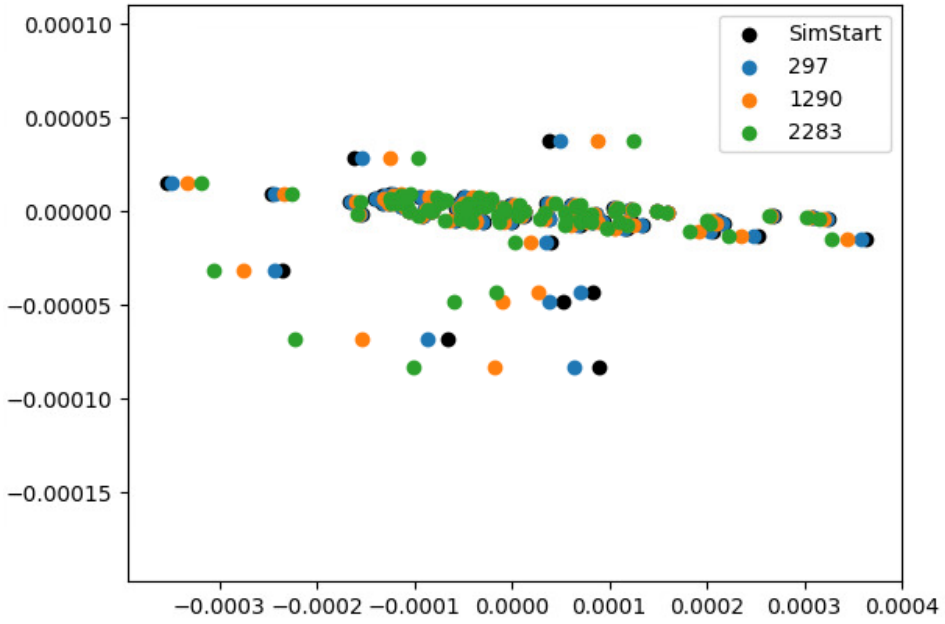
Color coded:

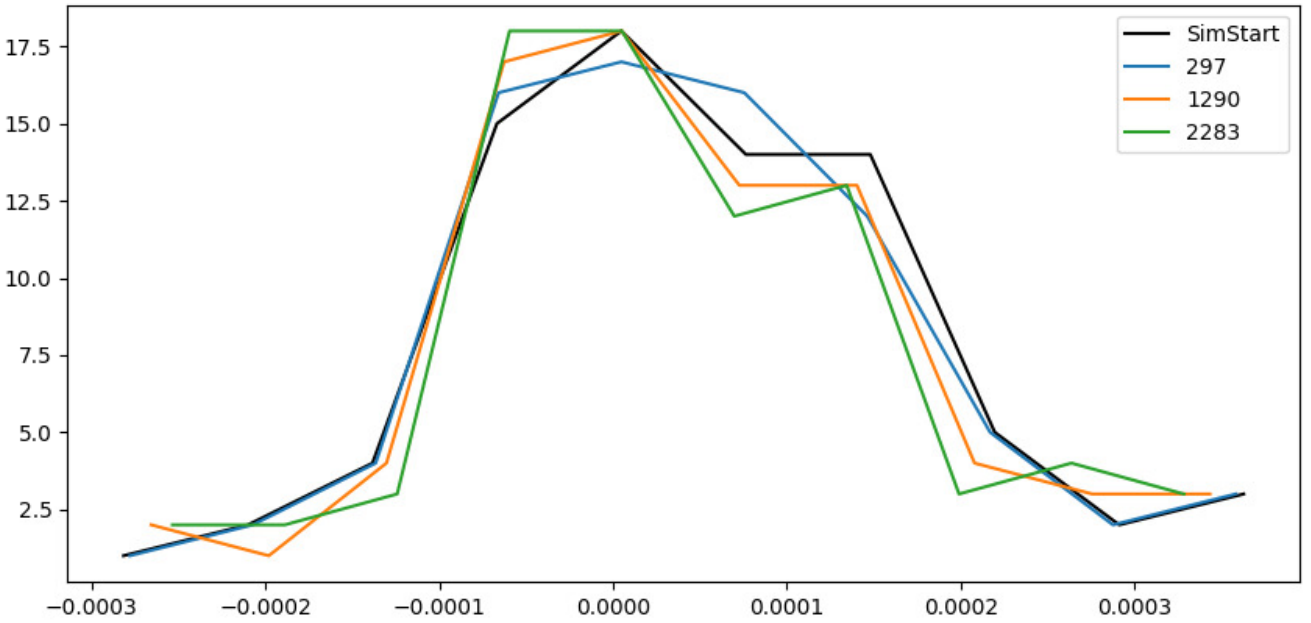
SR on the detector plane only inside the FOV

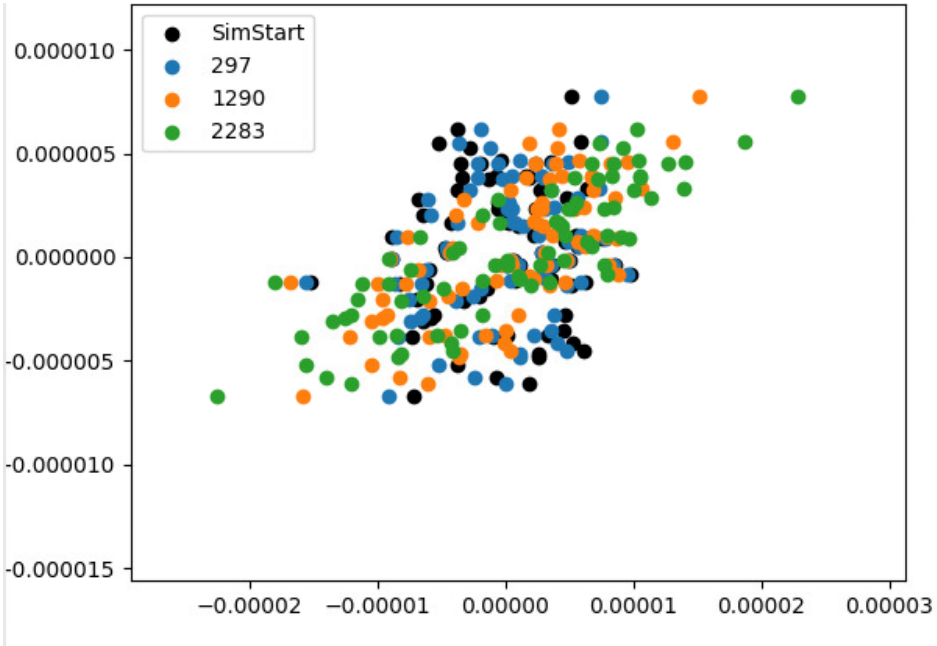


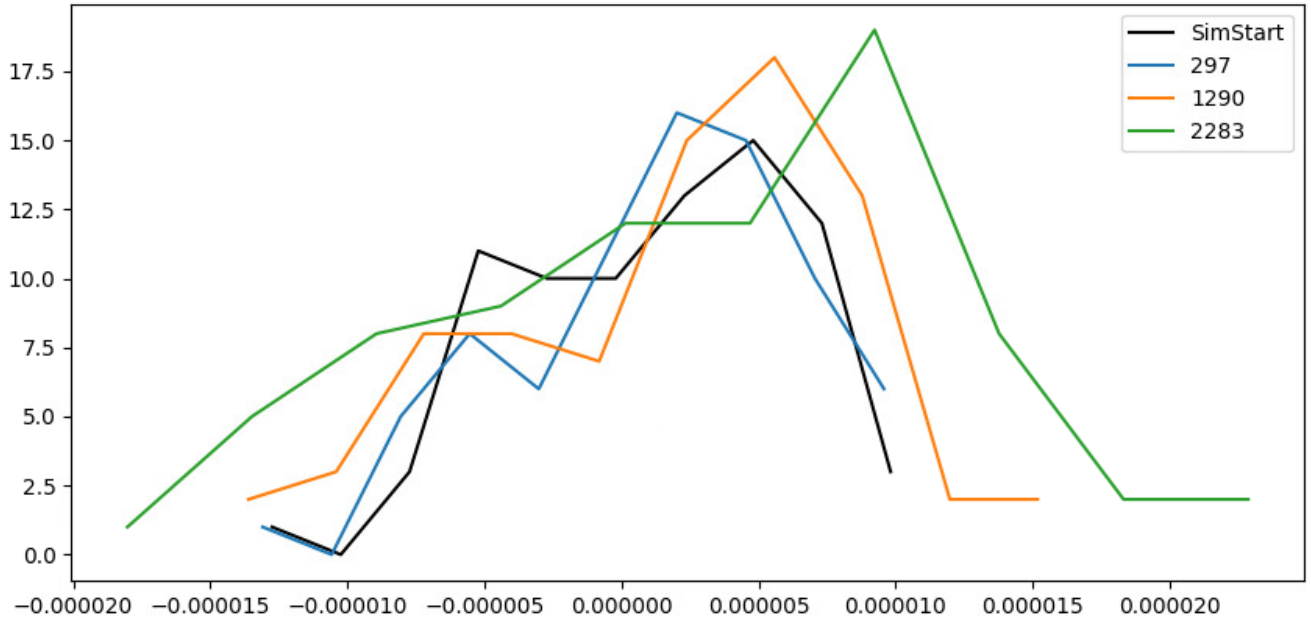


What is ALBA ‘beam size’?

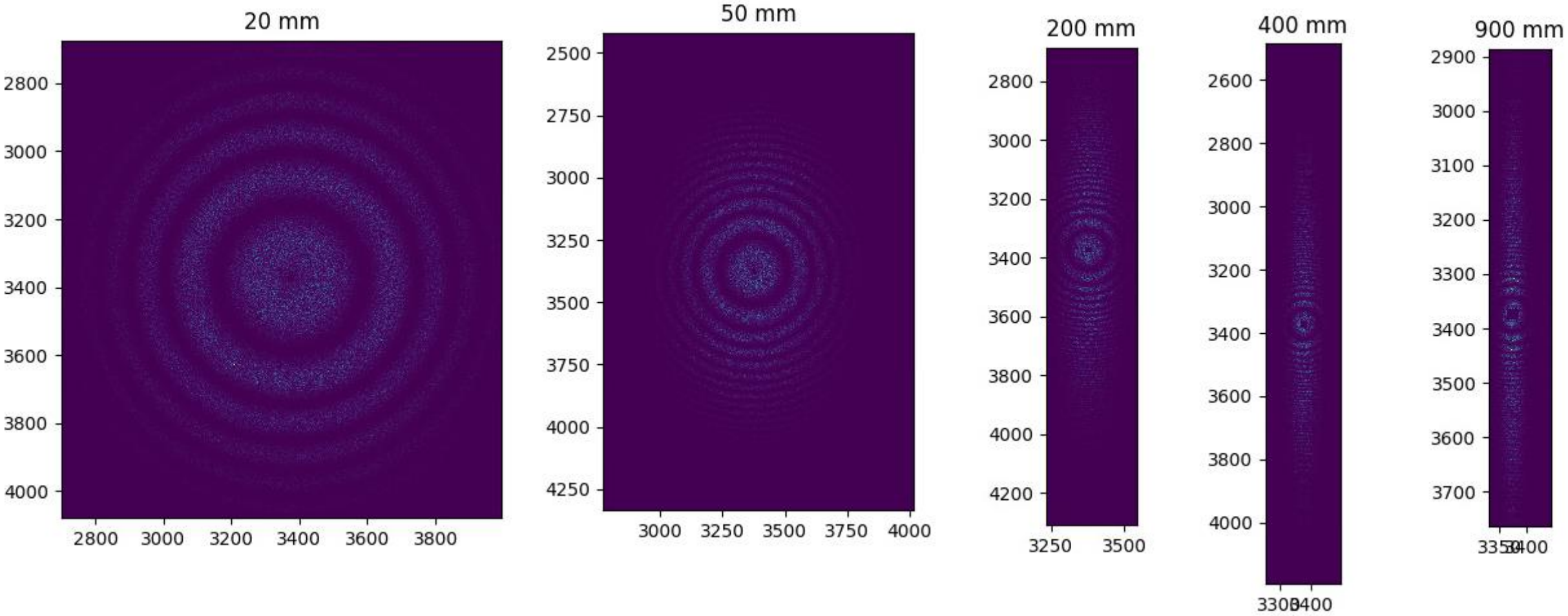






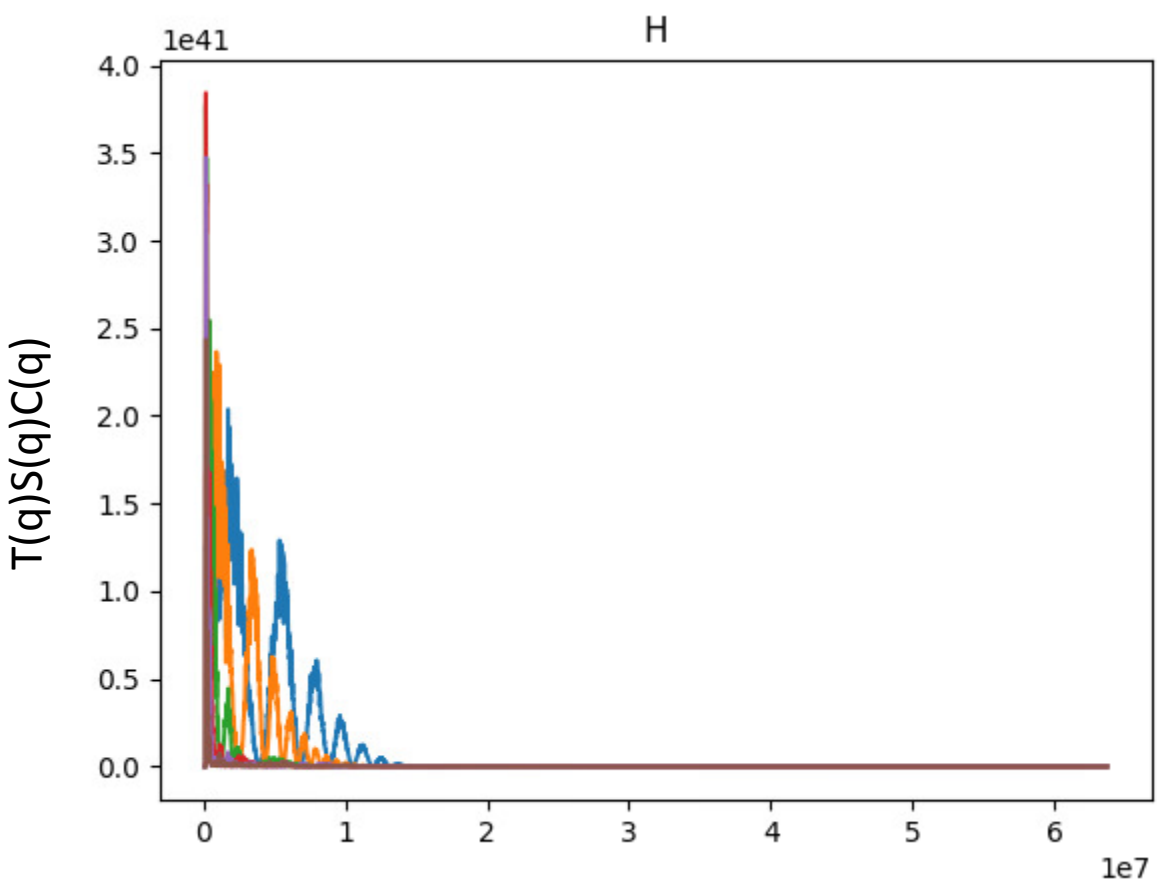


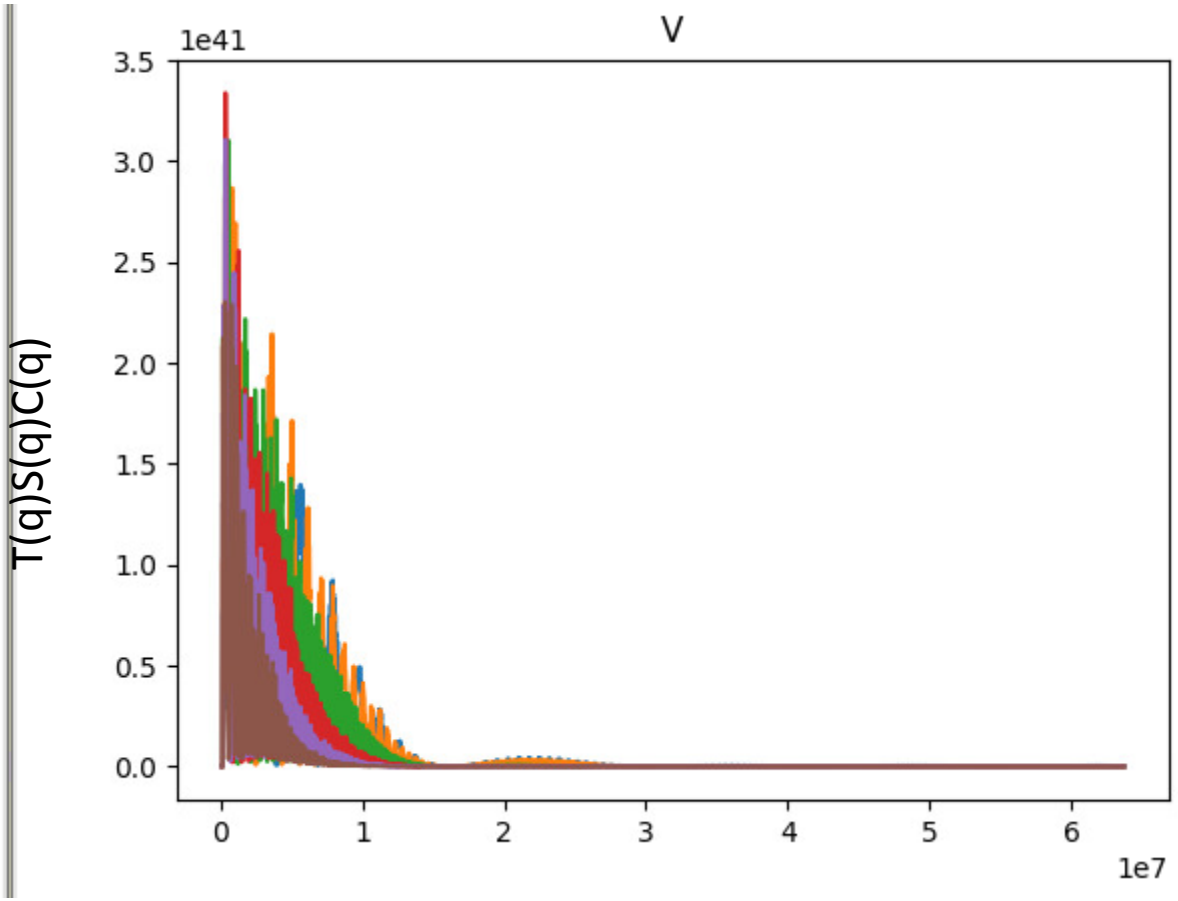
Distance scan



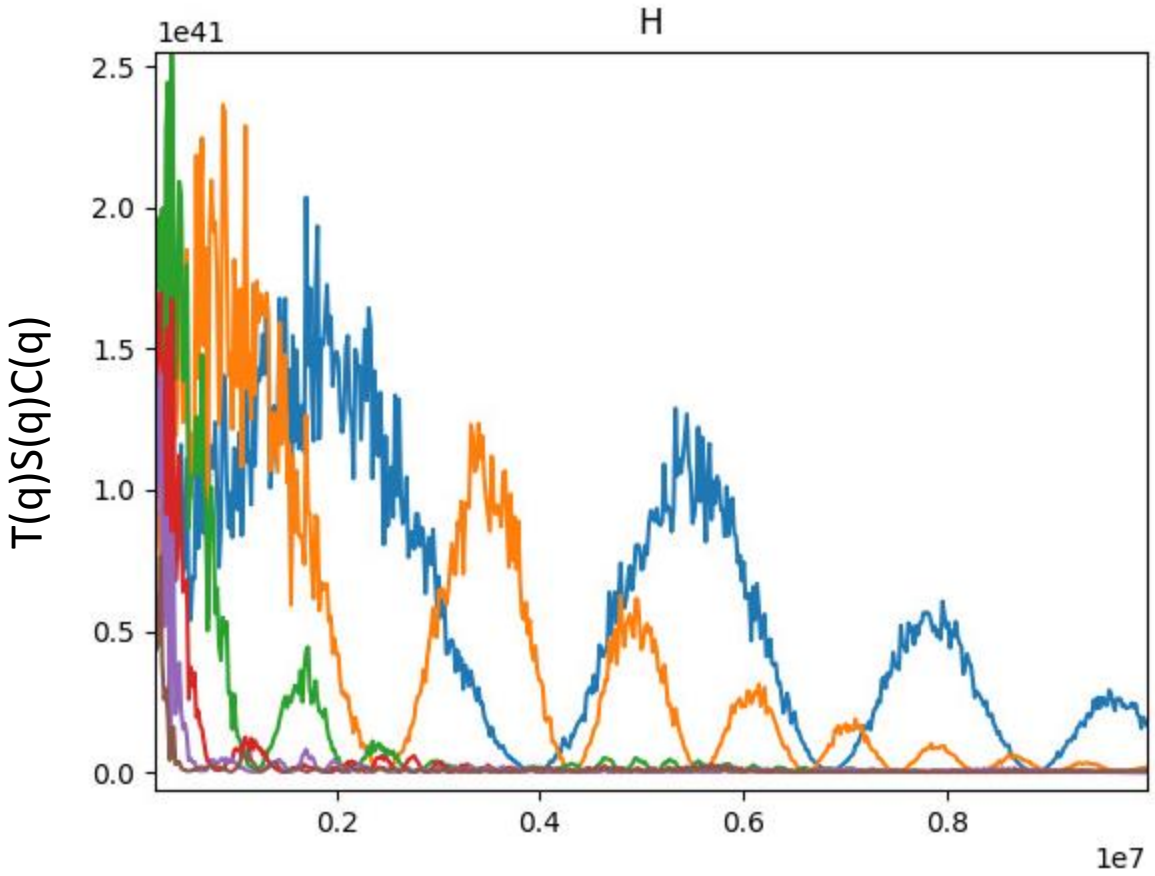
C(q) effect is more appreciated

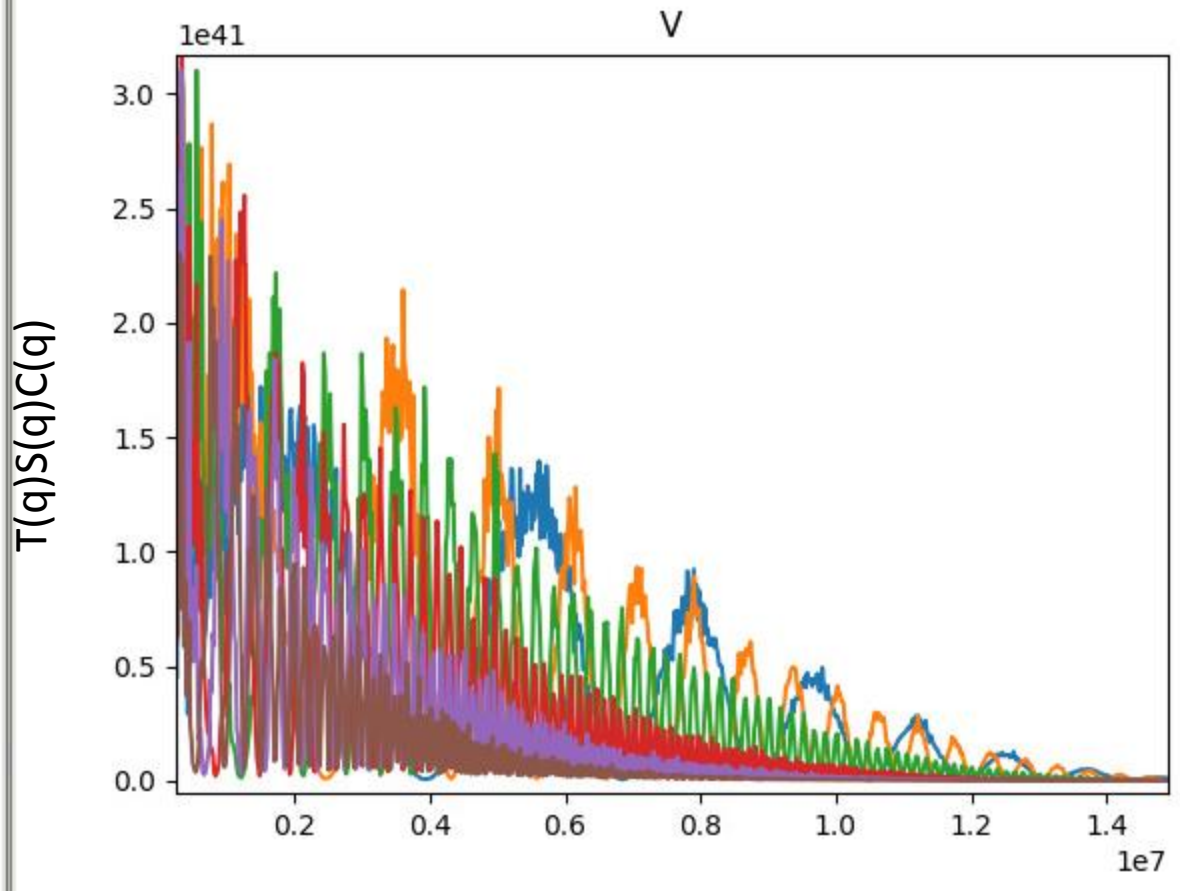
Distance scan



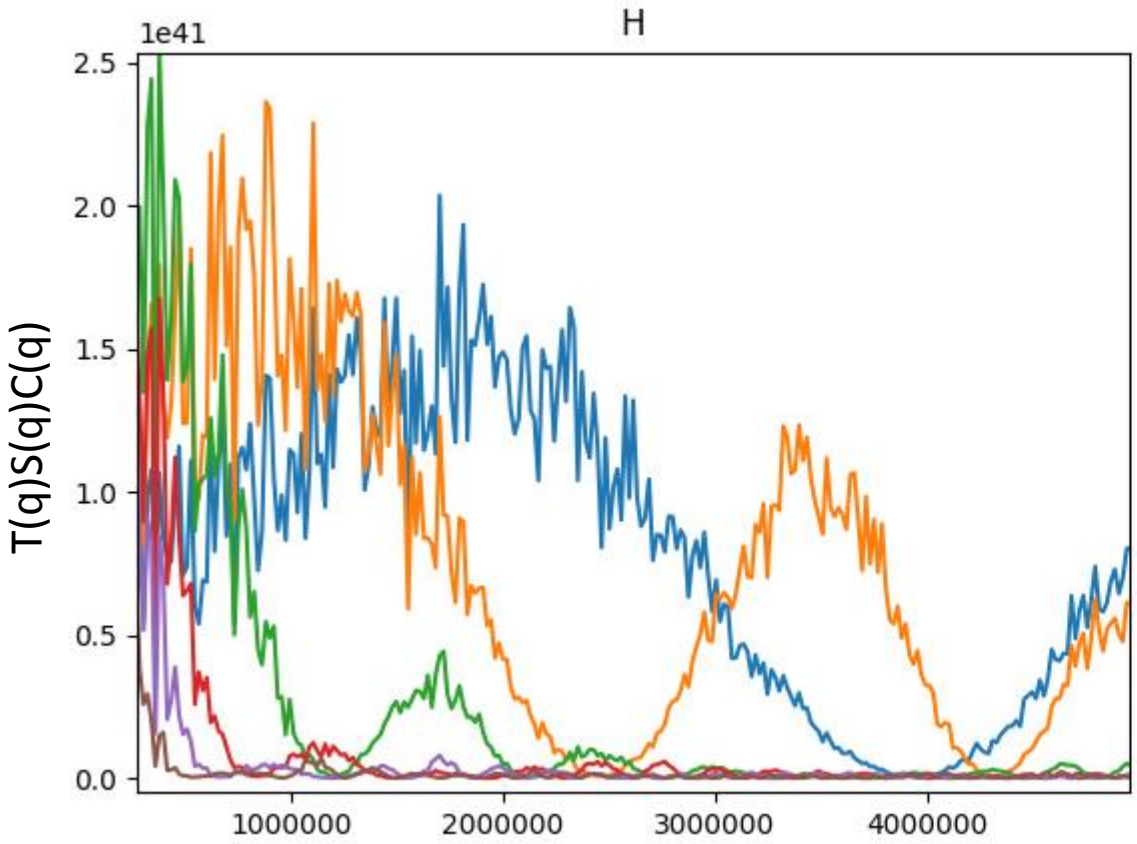


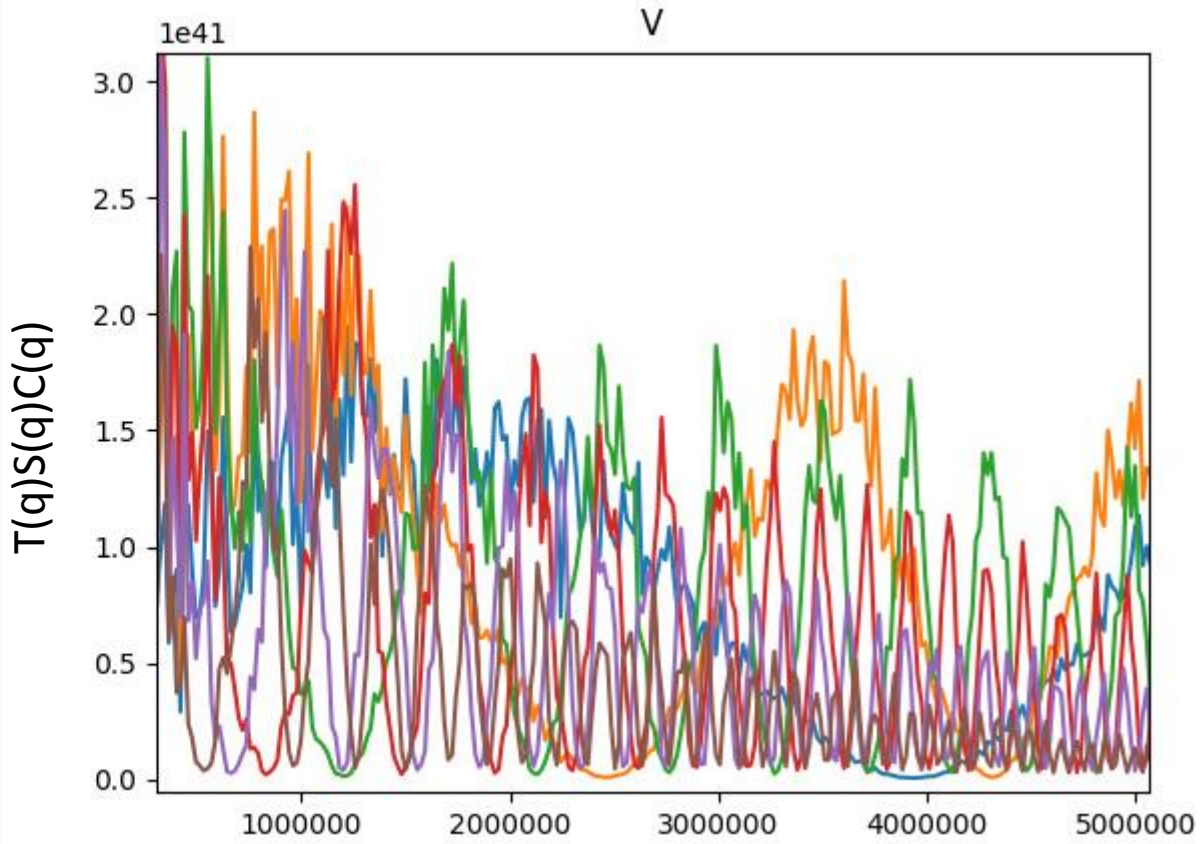
Distance scan



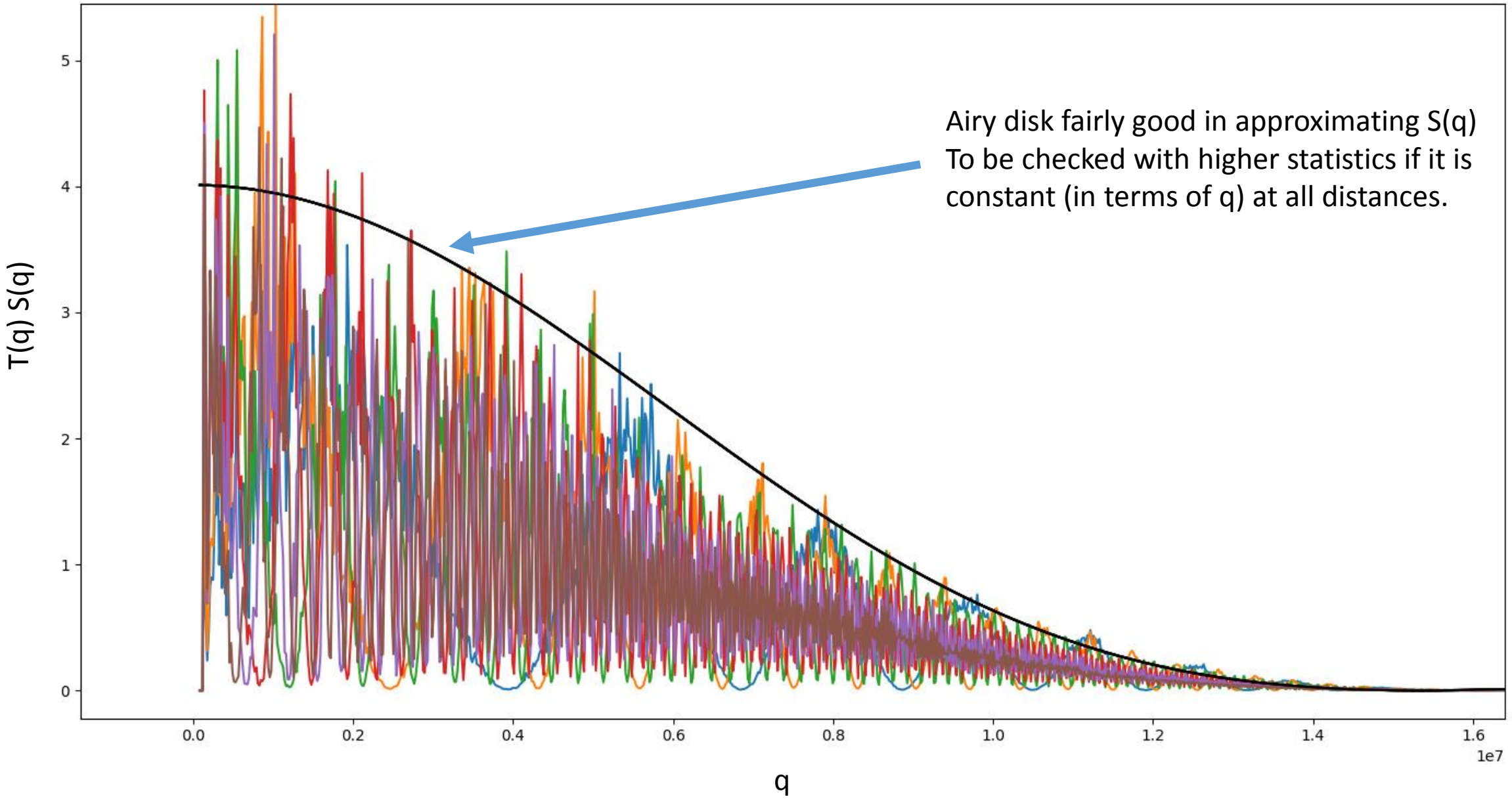


Distance scan



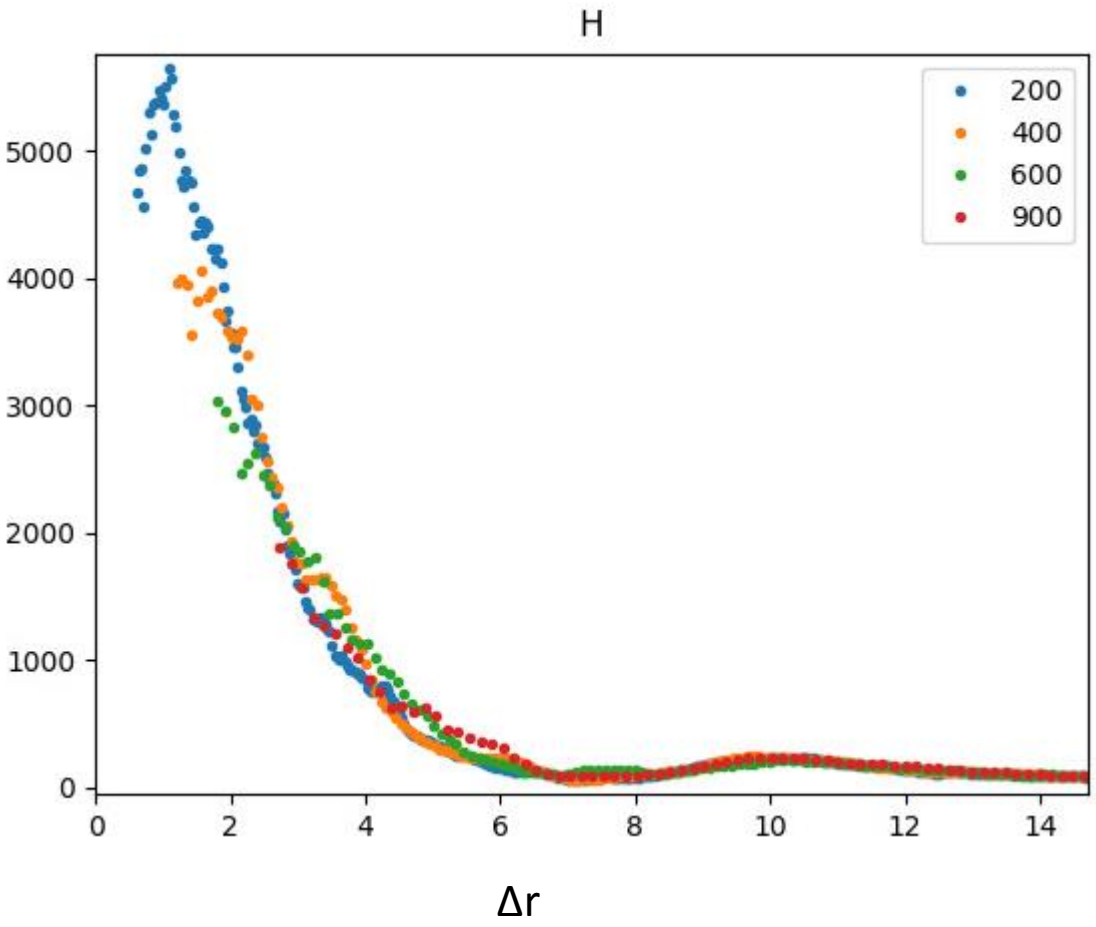


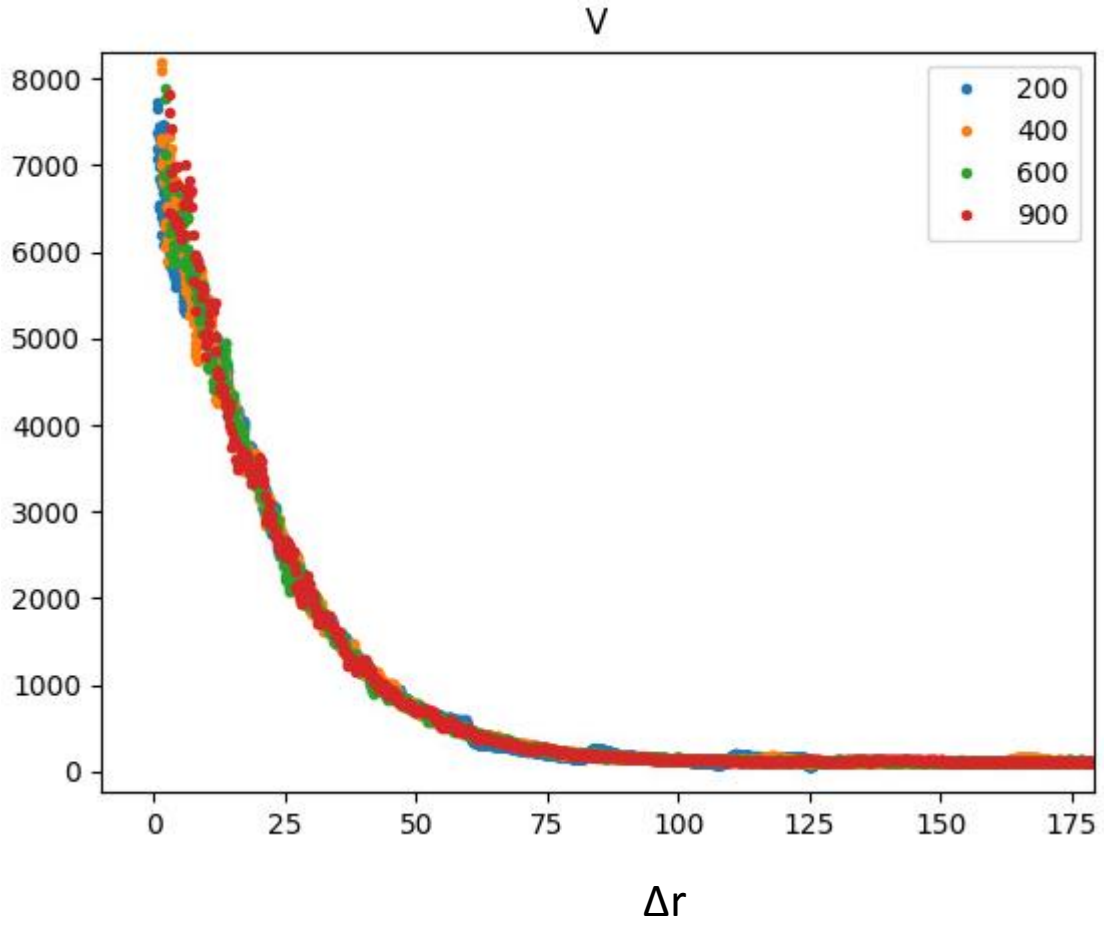
Decay for single particle taken as a reference



Closing the loop

$$C(q) = [T(q)*S(q)*c(q)]_{BEAM} / [T(q)*S(q)]_{refParticle}$$





Curves from all distances collapse!

Closing the loop

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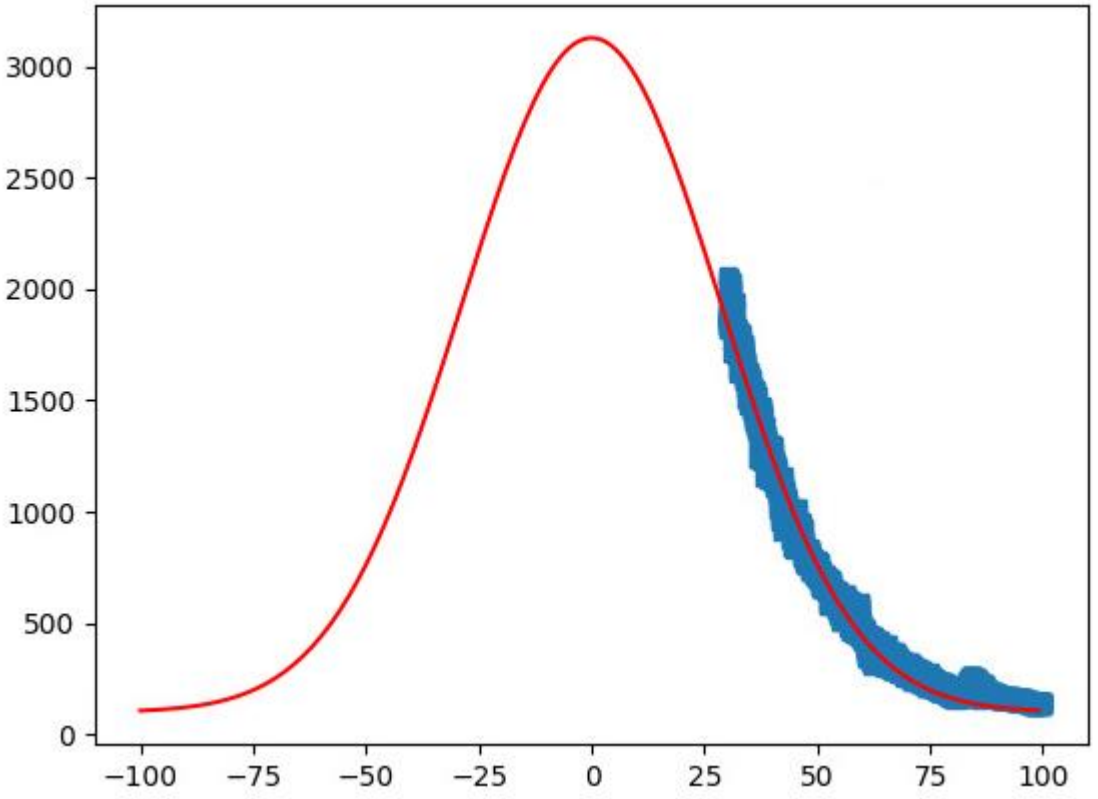
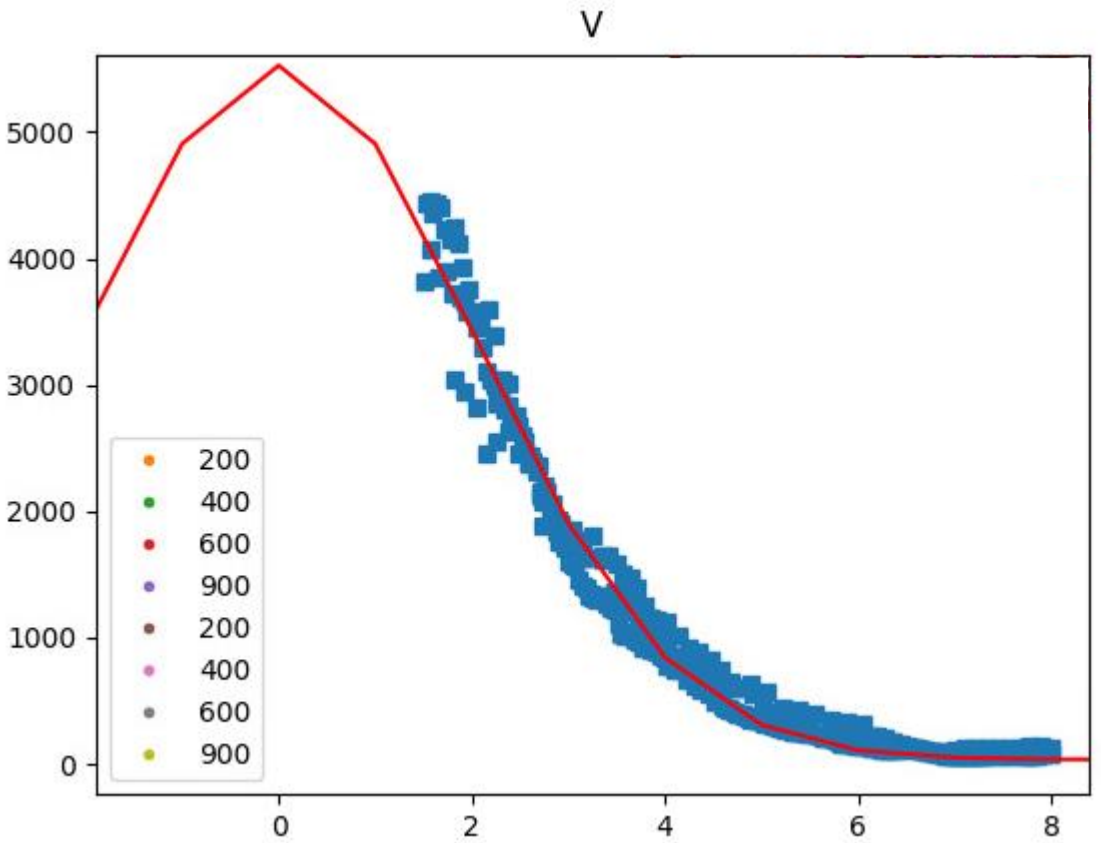


Δr



Δr

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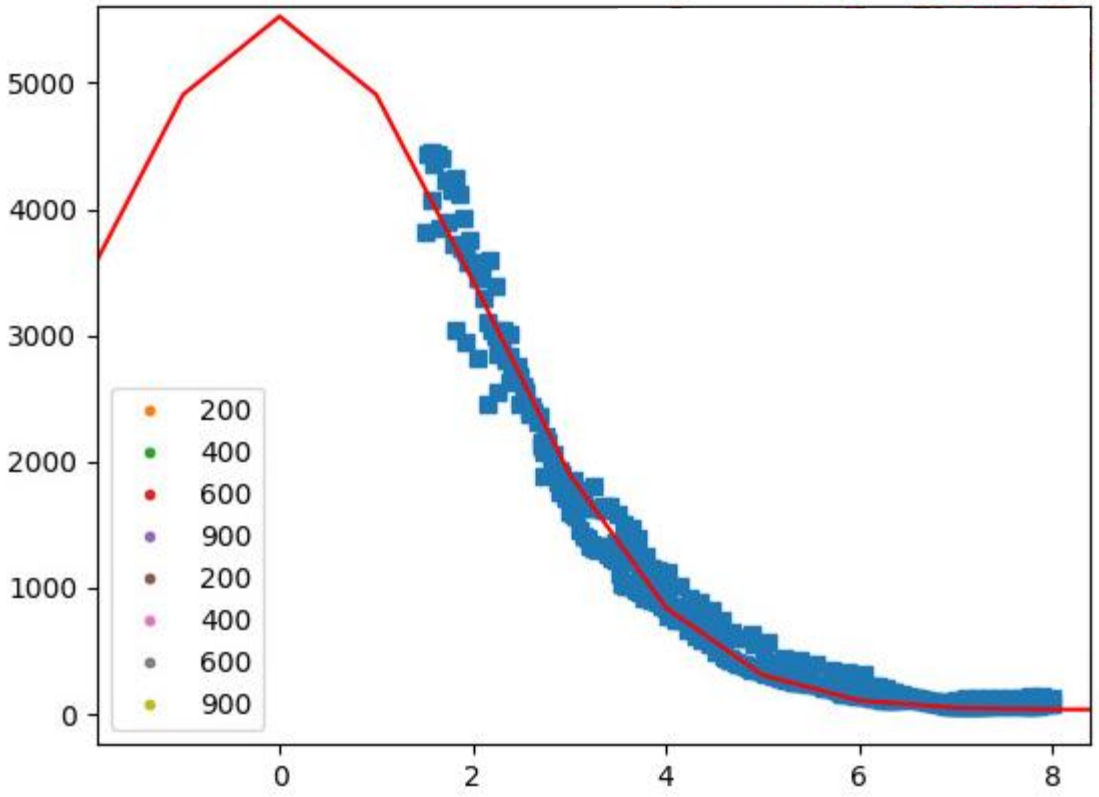
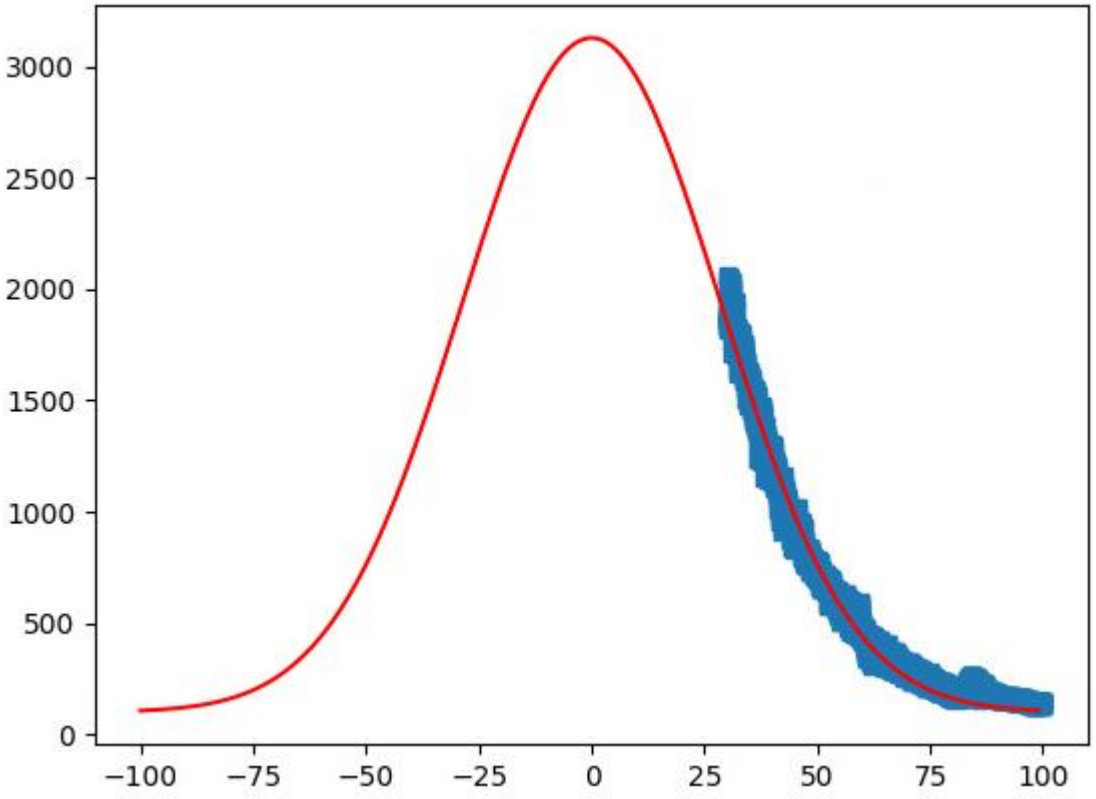


Δr



Δr

Will not enter in beam size reconstruction
(depends on lower cut in q), however:
H: 157 um if q_{min} 2
V: 9.4 um if q_{min} 25

Calibration

$$C(q) = [T(q)*S(q)*c(q)]_{BEAM} \,/\, [T(q)*S(q)]_{refParticle}$$

Is it really 1, at which distance?