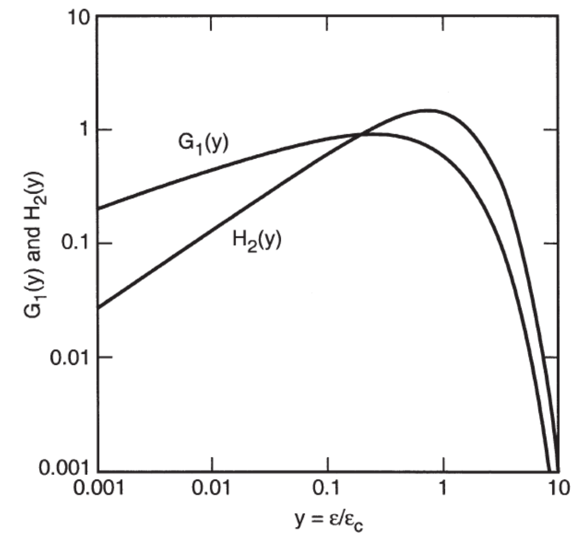
Question: Can the L3 vBSM measure the beam size of low bunch current 0.1mA at 300 MeV?

Photon flux:

In practical units [photons·s^{-1}·mr^{-2}·(0.1% bandwidth)$^{-1}$],

Horizontal: $$\left.\frac{d^2\mathcal{F}_B}{d\theta d\psi}\right|_{\psi=0} = 1.327\times10^{13} E^2[\text{GeV}] I[\text{A}] H_2(y).$$ ~ E^2

Vertical: $$\frac{d\mathcal{F}_B}{d\theta} = 2.457\times10^{13} E[\text{GeV}] I[\text{A}] G_1(y).$$ ~ E



Source bend: B48W

Bend radius: ρ=140.6289 m

Consider 500nm light

ph/s/0.1%bw/mr^2

E (GeV)	5.3	2.1	0.3	0.5
ε_c (KeV)	2.309	0.141	0.421E-3	1.95E-3
λ_c	0.531 nm	8.672 nm	2.911 μm	629 nm
$y=\varepsilon/\varepsilon_c$	1.074E-3	1.73E-2	5.82	1.258
H2(y)	0.0305	0.1932	0.0575	1.367
G1(y)	0.304	0.535	0.0100	0.542
H Flux	1.13E9	1.11E9	6.87E6	4.54E8
V Flux	3.95E9	2.74E9	7.37E6	6.66E8
Avg Flux	2.54E9	1.92E9	7.12E6	5.5E8

If 700nm light

y=4.1, H2(y)=0.231, G1(y)=0.048 @ 0.3 GeV

SRW calculated at x=0, y=0, 6.04 m distance from the source, with 1 mm2 area

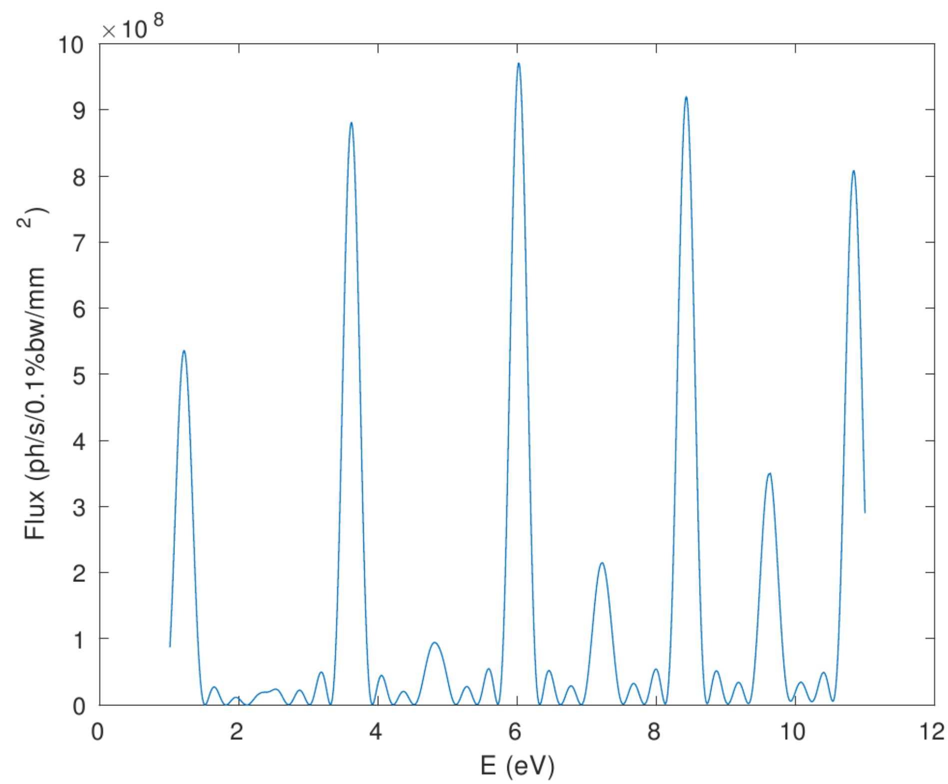
A factor of (1/6.04)^2=2.741E-2 needed for the conversion from ph/s/0.1%bw/mr^2 to ph/s/0.1%bw/mm^2

Ph/s/0.1%bw/mm^2	5.3GeV	2.1GeV	0.5GeV	0.3GeV
SRW	4.50E7	4.48E7	1.82E7	2.71E5
Analytical	6.96E7	5.26E7	1.51E7	1.95E5

OSC undulator

OSC und, λ_u=40 cm, B_0=0.075 T, K=2.8

0.5 GeV ph/s/0.1%bw/mm^2	1.21 eV (1.02 μm) n=1	2.48 eV (500 nm)
SRW	5.373E8	2.231E7
Analytical	2.13E9	



The radiation from the pickup undualtor

$$K = eB_0\lambda_u / 2\pi mc = 0.934\lambda_u\,[\text{cm}]\,B_0[\text{T}]$$

First harmonic peak:

$$\lambda_1 = \frac{(1 + K^2/2)}{2\gamma^2}\lambda_u$$

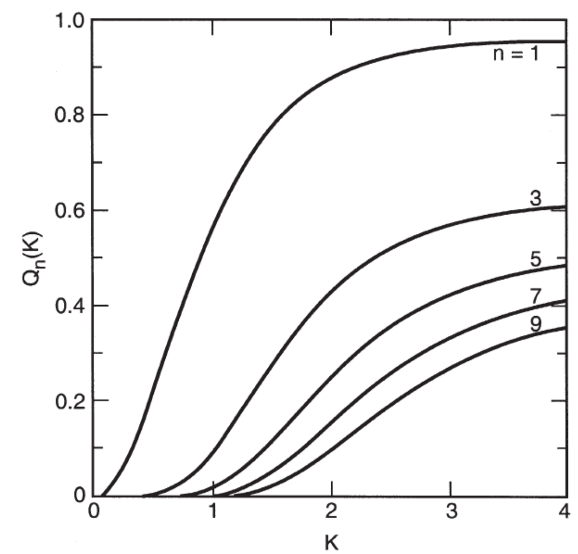
CCU, λ_u=2.8 cm, B_0=0.93 T, K=2.43

OSC und, λ_u=40 cm, B_0=0.075 T, K=2.8

$$\lambda_1[\text{Å}] = \frac{13.056\ \lambda_u[\text{cm}]}{E^2[\text{GeV}]}(1 + K^2/2)$$

$$\varepsilon_1[\text{keV}] = 0.950\frac{E^2[\text{GeV}]}{(1 + K^2/2)\lambda_u[\text{cm}]}$$

	CCU (5.3GeV)	OSC und (0.5GeV)	OSC und (0.3GeV)
λ_1	5.1 A	1.02 µm	2.85 µm
ε_1	2.4 keV	1.21E-3 keV	0.434E-3 keV
Q_1(K)	0.913	0.933	0.933



We are usually interested in the central cone. An approximate formula for the flux integrated over the central cone is

$$\mathcal{F}_n = \pi\alpha N\frac{\Delta\omega}{\omega}\frac{I}{e}Q_n(K), \quad (17)$$

or, in units of photons·s^{-1}·(0.1% bandwidth)$^{-1}$,

$$\mathcal{F}_n = 1.431\times10^{14} NQ_nI[\text{A}].$$

N=4, I=0.1 mA

Compare flux between Bend and Und

Bend (5.3Gev) @ 500nm	Bend (0.3Gev) @ 500nm	Bend (0.5Gev) @ 500nm	OSC Und (0.5GeV) @λ1
2.54E9	7.12E6	5.6E8	5.34E10

ph/s/0.1%bw/mr^2