Power Distribution on Masks in Undulator Section

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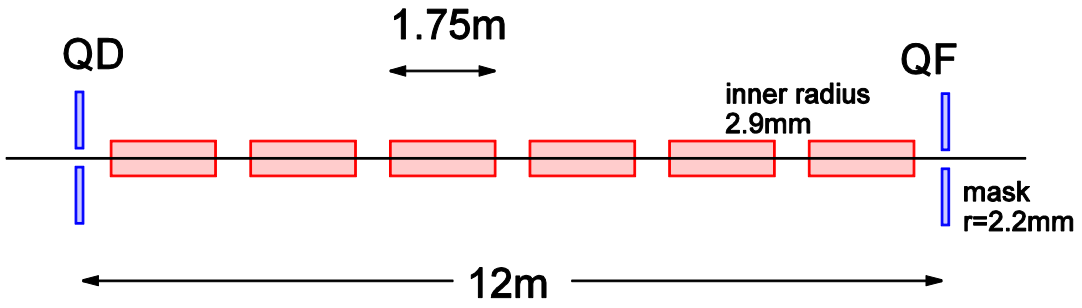
2017.6.1 Positron WG

Motivation

- How high is the power deposited at the masks in the undulator section?
  - Needed to see if the mask can be designed
- How high is the power deposited on the inner surface of the undulators?
- If further collimator is needed just in front of the target, how high is the deposit there as a function of the radius. (not actually done here)

Assumptions

- 1312 bunches, 5Hz
- E_e = 128→125GeV
- Undulator L=1.75m, n=132 (n*L=231m), K=0.85
- Optics
  - FODO
  - Distance between QF-QD (thin lens) = 12m
  - Phase advance = 90deg
  - 6 undulators between QF and QD
  - Distance between undulator section center to target = 401.1m (compact dogleg by Okugi san)
- Mask at every quad. r=2.2mm (TDR)
- In some cases, collimator (r=2.2mm or larger) just in front of target
- Normalized emittance ε_x=8μm, ε_y=40nm
- No alignment errors



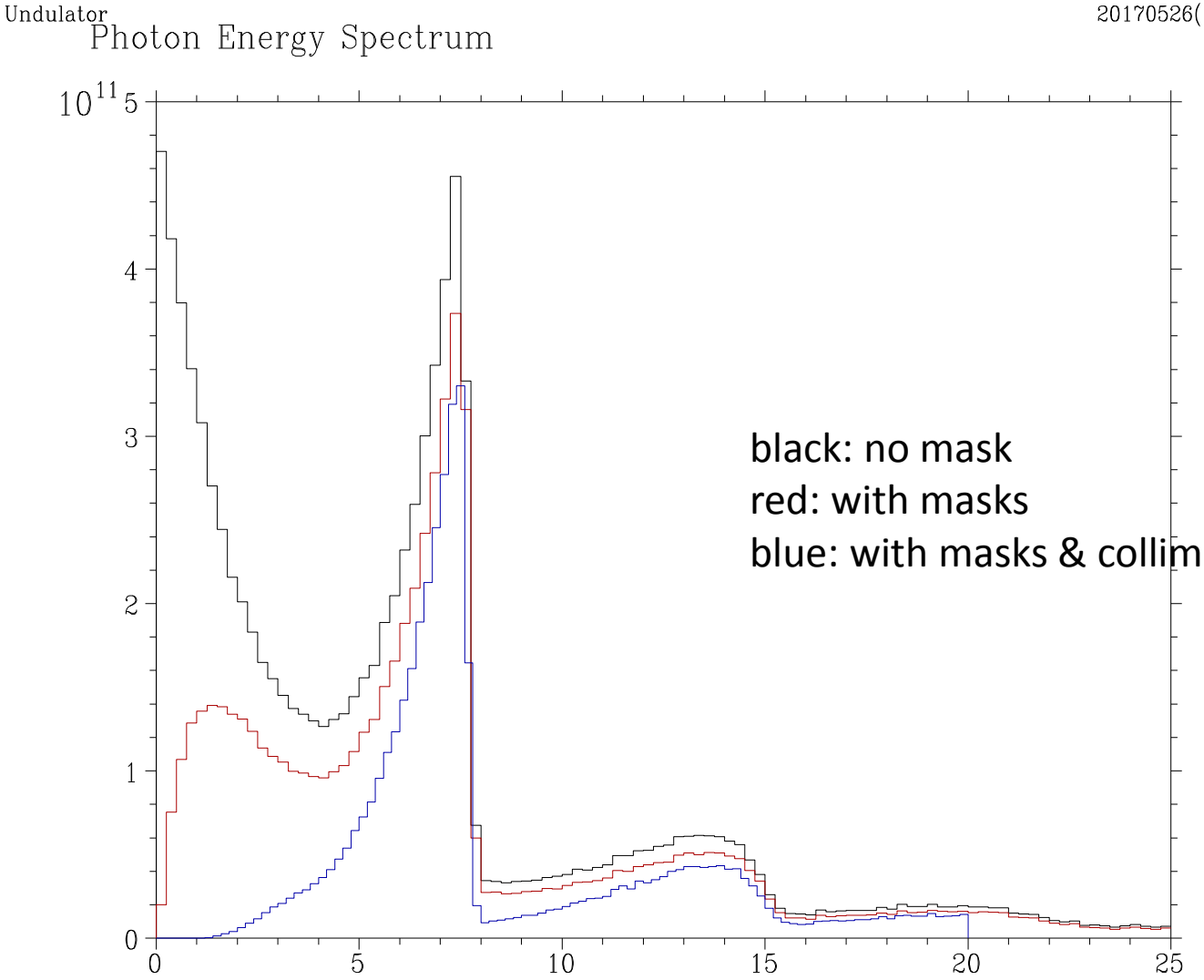
Photons on the Target

	No Mask	With Masks	Masks & Coll.
nγ / bunch	9.59×10^{12}	8.01×10^{12}	4.60×10^{12}
Average photon energy (MeV)	6.28	7.30	9.68
Power on target (kW)	63.4	61.5	46.7

- Total Photon Power
  - On masks 1.88 kW
- Average Electron Energy Loss 3.01GeV

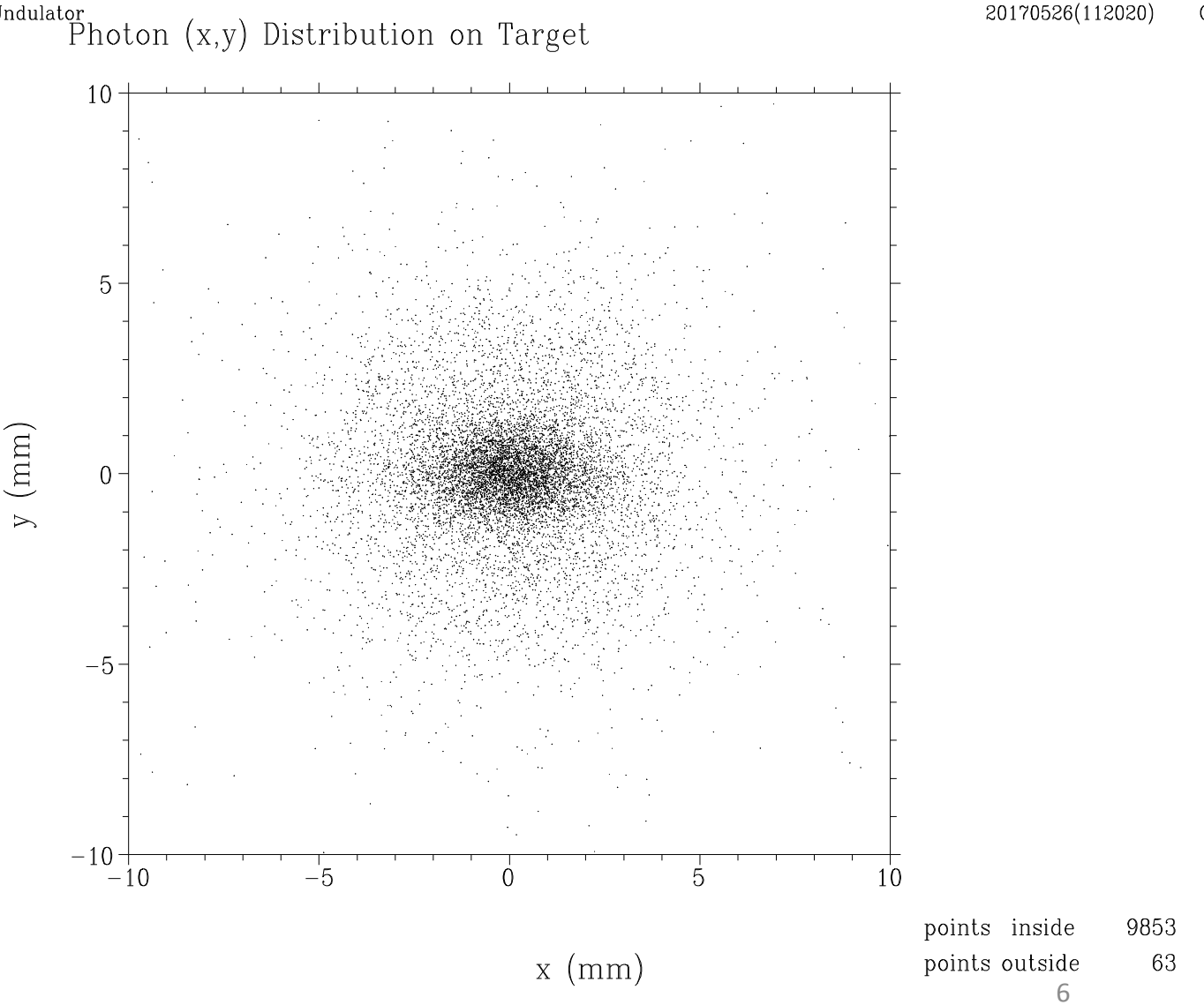
Photon Energy Distribution on Target

- x



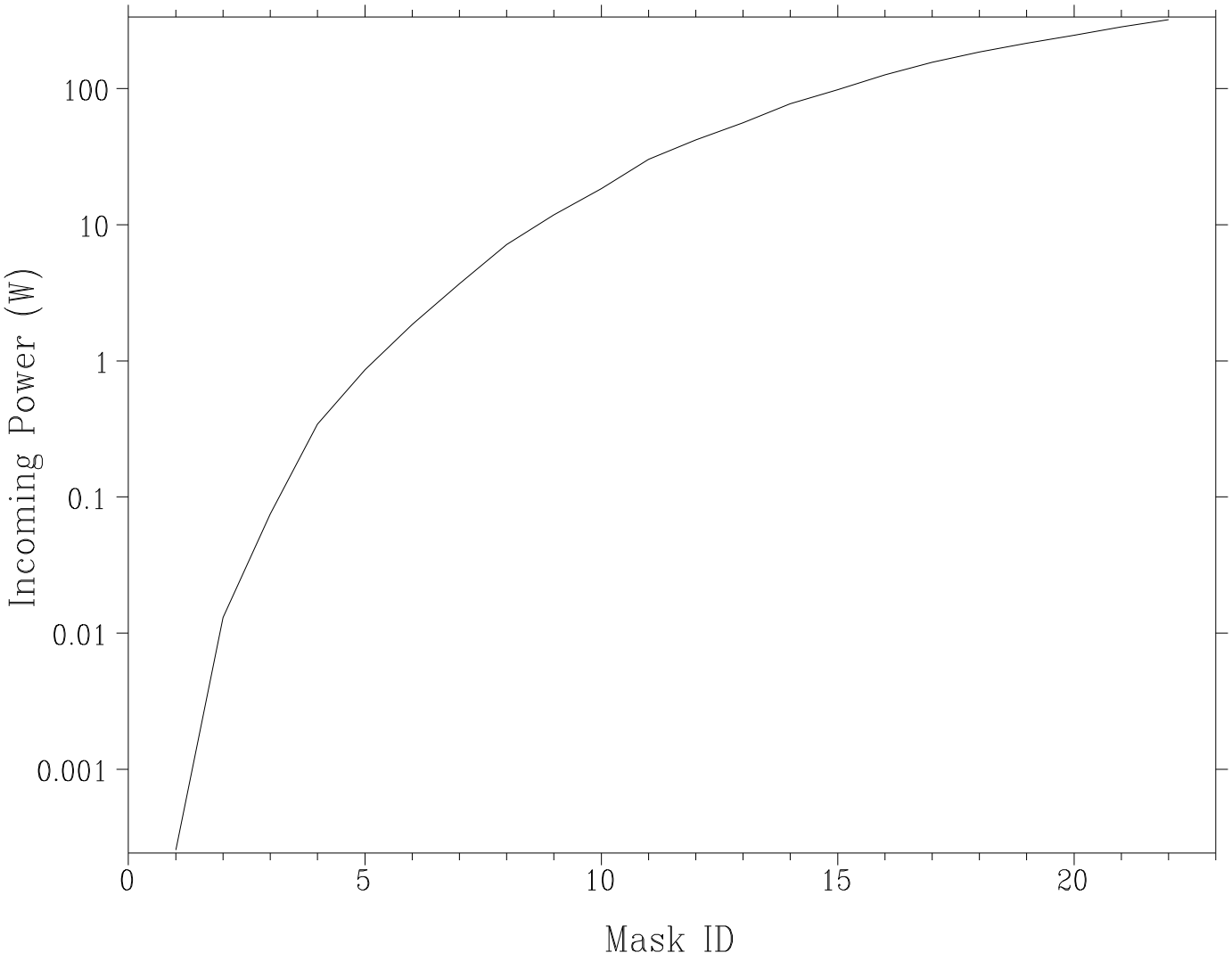
Photon (x-y) Distribution on Target

- With masks
- See slightly larger horizontal size due to horizontal emittance
- Only randomly selected particles are plotted here
- Total number of macro particles is ~400k



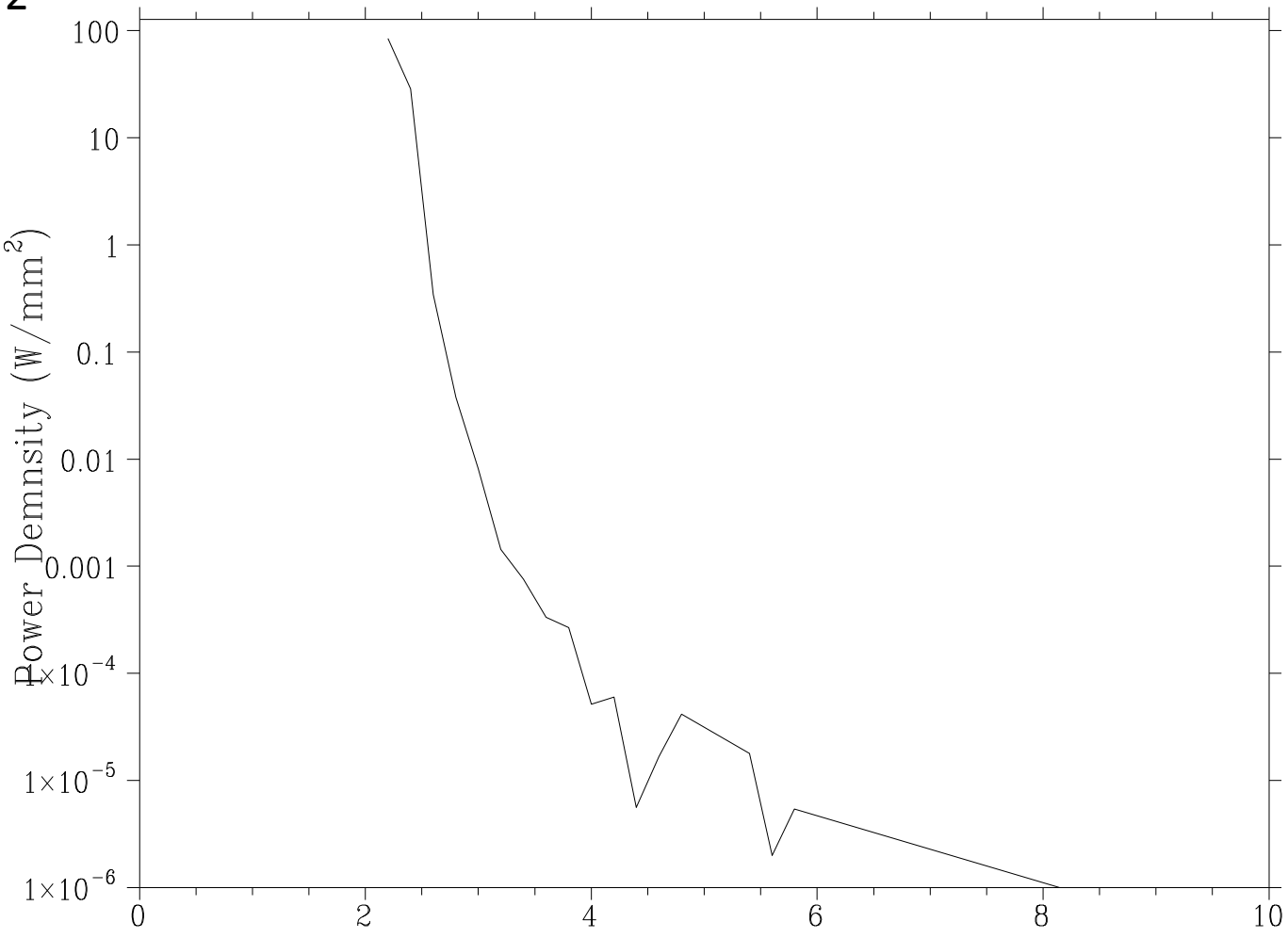
Power Distribution on Masks

- Maximum is at the last mask ~ 320 W



Radial Power Distribution on the Last Mask

- Maximum ~100 W/mm^2



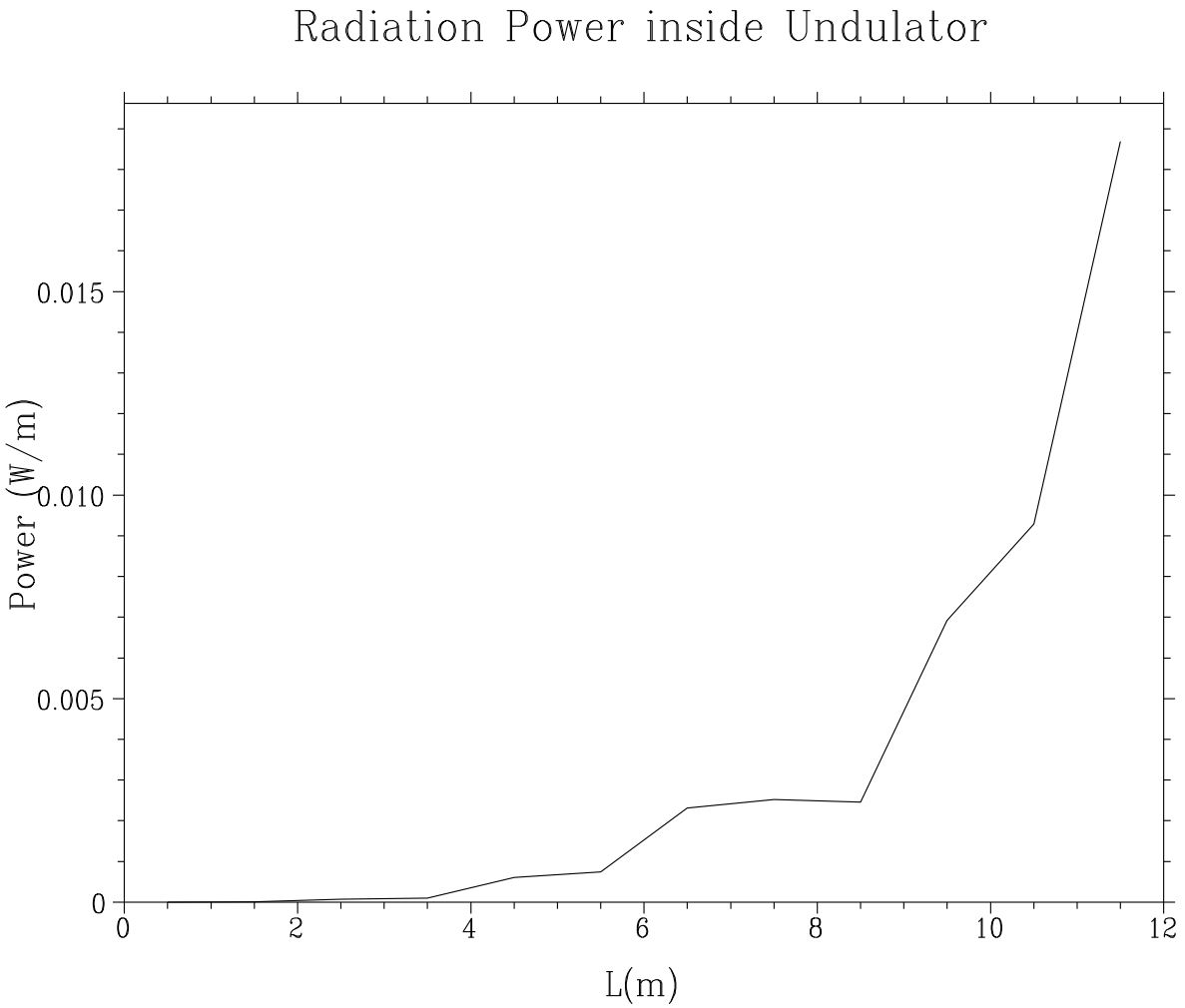
Photons Lost in Undulators

- Select photons lost at the last mask
- They might have been lost in undulators
  - Distance between masks is 12m
- Find distribution of lost position
  - r_{mask} = 2.2mm, $r_{undulator}$ = 2.9mm
- Plot the power distribution

	macro particle	n/bunch	<E> (MeV)	power
Photons lost in the whole undulator section	79459	158. x10^{10}	1.13	1884 W
Photons lost at the last mask	8266	16.5 x10^{10}	1.85	320 W
Photons lost between the last 2 masks	106	0.21 x10^{10}	0.020	0.044 W

Longitudinal Distribution of Photon Power Hitting the Undulator

- Maximum < 50 mW in one undulator
- Average photon energy ~20keV
- Statistics is a bit poor
- only ~100 particles



Photon Data

- Photon data are stored in
  - http://lcdev.kek.jp/~yokoya/temp/BeamOnTarget2017-0526.txt
    (survived photons on the target. no collimator. Contains some 400k photons)
  - http://lcdev.kek.jp/~yokoya/temp/LostPhotons2017-0531.txt
    (lost photons. Lost position preserved, Contains some 80k photons)
- Format
  - 1st line: title
  - Then I2, 11X, 12E20.12
  - I2: 1 for photon, 2 for electron
  - 12E20: w, t, x, y, s, E, p_x, p_y, p_s, ξ_1, ξ_2, ξ_3,
  - w: 1 macro-particle represents w real particles
  - ξ: Stokes parameters