



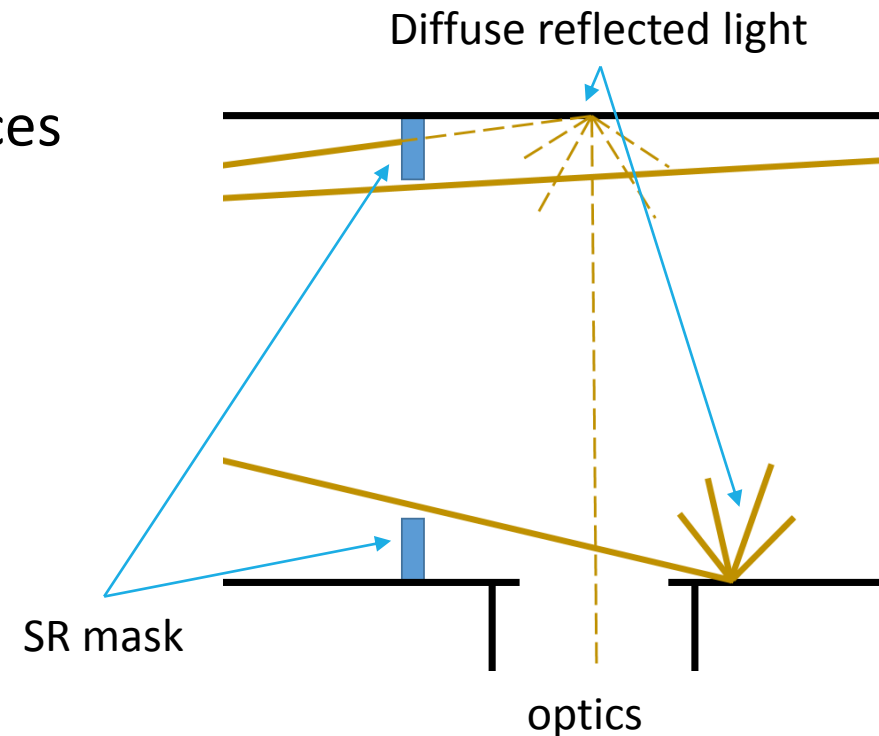
# Synchrotron Radiation: Simulation, Stoppers and Blackening

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BGC Collaboration Meeting – 27.11.2018

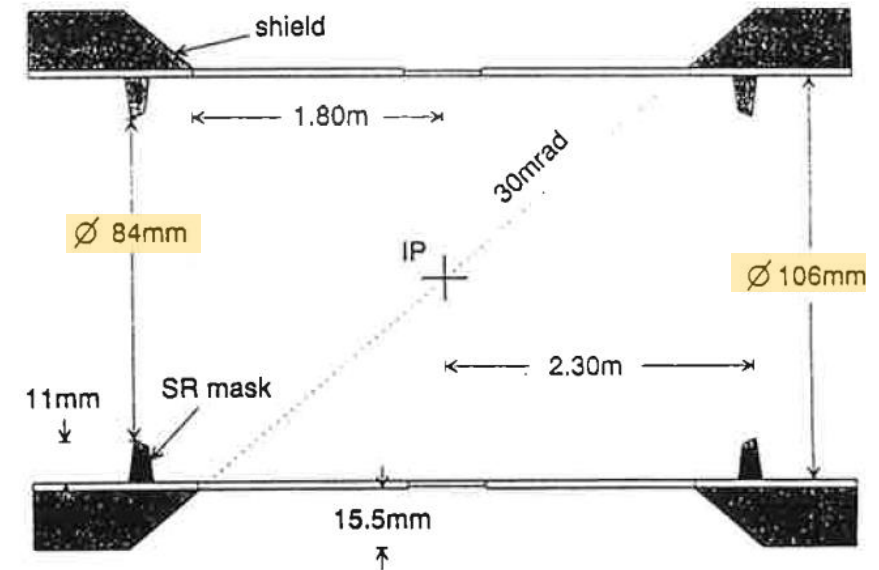
# Principle of SR Masks/Stoppers

- The SR masks should stop SR and prevent it from reflecting on surfaces in the optical path



# Experience from the LEP

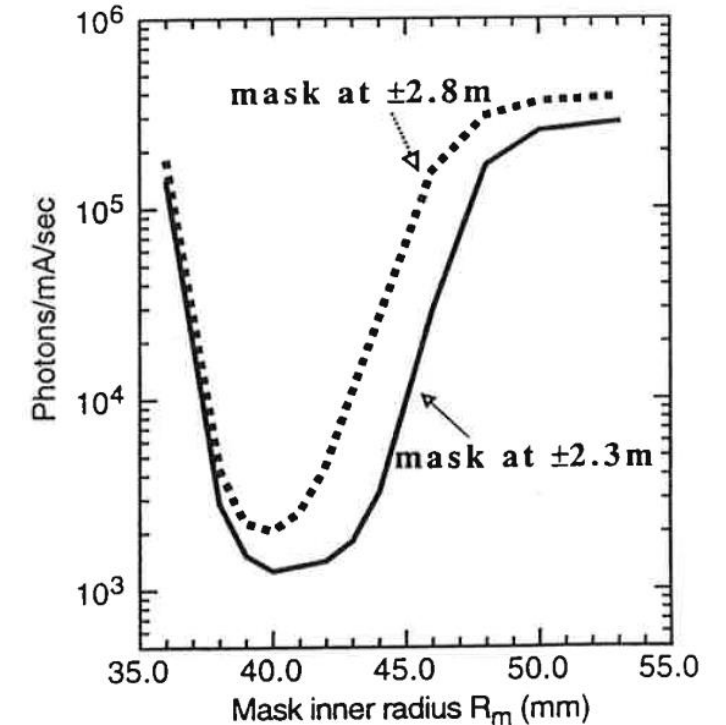
- Purpose: Decrease of the photon background in the detectors at the interaction points
- The photon rates at a detector without SR masks was 25-30 times higher than at the detector with SR mask



Synchrotron Radiation Mask for LEP2 – CERN – SL/Note 93-23 (EA)  
Test of Synchrotron Radiation Masks in LEP – CERN – SL-MD Note 144

# Experience from the LEP Simulations

- Simulation of different aperture diameters and distances
- Masks could lower the photon rates by 2 orders of magnitude (in the simulation)



Synchrotron Radiation Mask for LEP2 – CERN – SL/Note 93-23 (EA)  
Test of Synchrotron Radiation Masks in LEP – CERN – SL-MD Note 144

# Synchrotron Radiation (SR) Sources

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- Bending Magnets (D3 and D4)
- The HEL? (not relevant for demonstrator)
- The wiggler is on the outer beam (not relevant)

# Basis of Simulations

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- List of apertures in the beam pipe
  - Source is the layout data base
- MADX survey for the magnetic elements
  - Synchrotron radiation sources

MadX SEQ/DISP/TWISS file import Manual table input From LHC layout database Export result to Synrad format

	Name	length (m)	DIPOLE: Bending angle [rad]	DIPOLE: Field (T)	QUADRUPOLE: Gradient (T/m)	QUADRUPOLE: K1L	Twiss s [m]	start s [m]	start X (m)	start Theta [rad]
▶	LMD4	9.75656061					1184.272149	-774.5930431	1.519153208	0.0029861
	QMD11	2.8			38.98374071	0.17223427	1187.072149	-764.8364825	1.490013494	0.0029861
	LMD5	5.942814728					1193.014964	-762.0364825	1.481650793	0.0029861
	QMD12	2.8			-29.62253566	-0.1308754807	1195.814964	-756.0936678	1.463901514	0.0029861
	LMD6	10.08					1205.894964	-753.2936678	1.455538813	0.0029861
	QMD13	2.8			27.28412775	0.1205441484	1208.694964	-743.2136678	1.42543309	0.0029861
	LMD7	10.08					1218.774964	-740.4136678	1.417070389	0.0029861
	QMD14	2.8			-17.86233932	-0.07891769536	1221.574964	-730.3336678	1.386964666	0.0029861
	LMD8	9.66644					1231.241404	-727.5336678	1.378601965	0.0029861
	QF8	2.77368			-2.713854765	-0.01187738912	1234.015084	-717.8672278	1.349731413	0.0029861
	FFIN	0					1234.015084	-715.0935478	1.341447321	0.0029861
	D8	12.8016					1246.816684	-715.0935478	1.341447321	0.0029861
	QD7	2.77368			-1.998821473	-0.008747992235	1249.590364	-702.2919478	1.303213052	0.0029861
	LX0	0.42672					1250.017084	-699.5182678	1.29492896	0.0029861
	SFFB4	2.944368	1.276131017E-05	-0.002746788041			1252.961452	-699.0915478	1.293654484	0.0029861
	MBFFB4	0					1252.961452	-696.1471798	1.284841815	0.0029999
	SFFB4	2.944368	1.276131017E-05	-0.002746788041			1255.90582	-696.1471798	1.284841815	0.0029999

Reference element row:  
 Ref. X [m]: 
 Ref. Z [m]: 
 Ref. theta [rad]:

Search text:   
 Found at row 300

Emittance\_X (m) 
 pMass(GeV/c<sup>2</sup>) 
 current (mA)

Emittance\_Y (m) 
 energy spread (%) 
 Beam E (GeV)

step length (cm) 
 Start row:

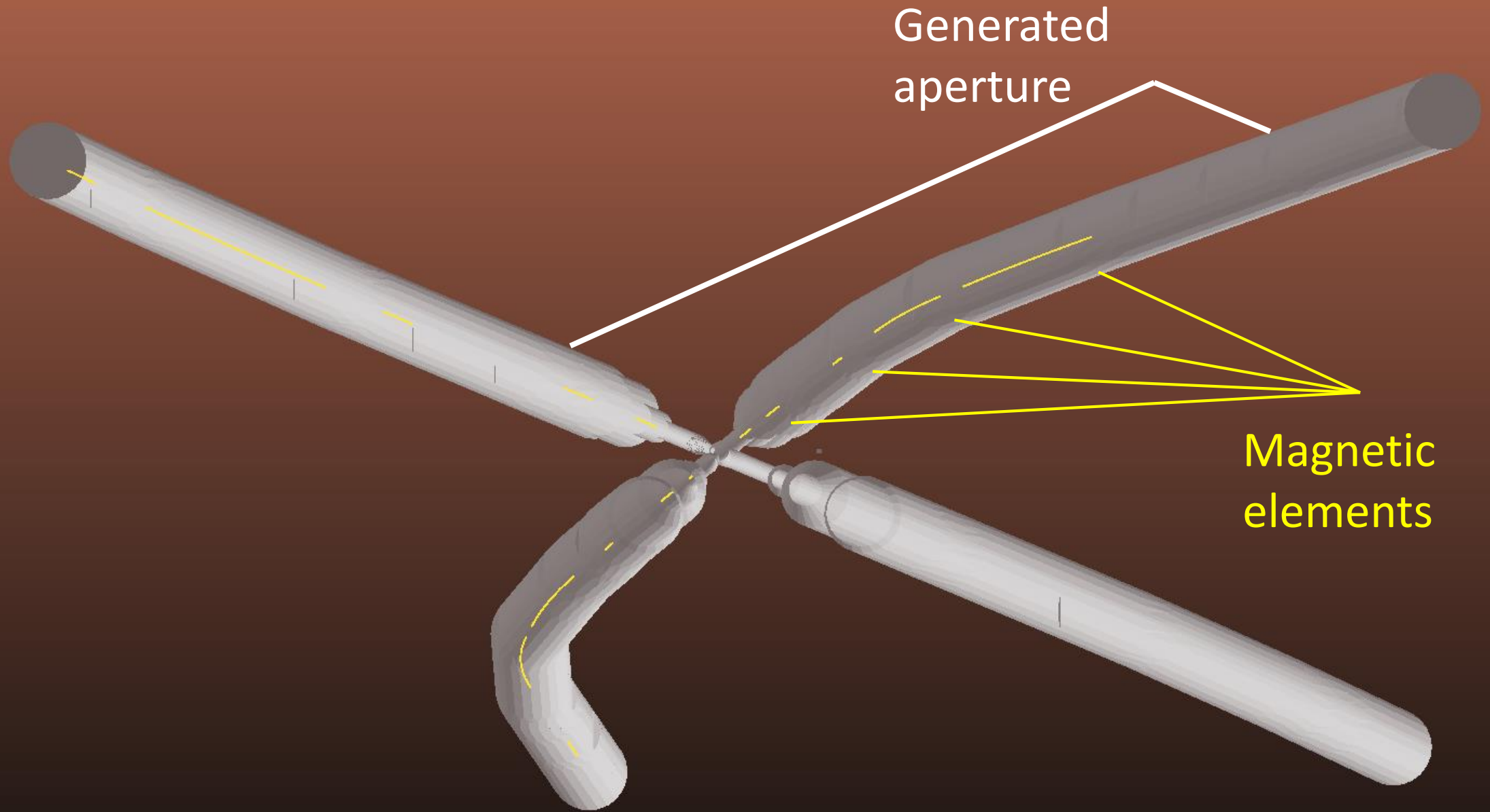
Photon Emin (eV) 
 Photon eMax (eV) 
 End row:

Output dir:  
 file number prefix
  s position suffix

bxy filename:

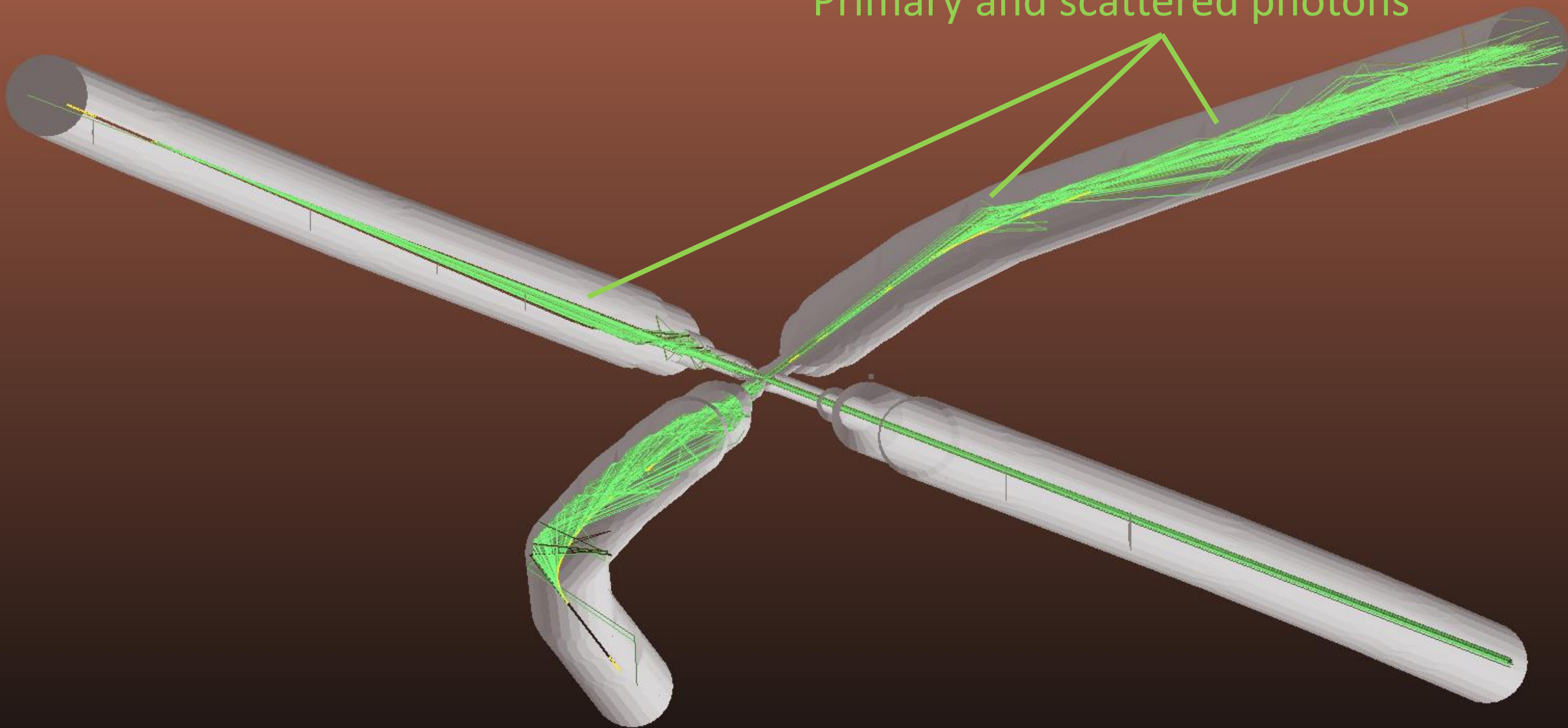
geom. filename:  
 Circle sides: 
 curve step every  radians

- Tool reads element and aperture list
- Calculates X,Y,Z positions
- Generates input files for Synrad
- Generates polygonised vacuum chambers





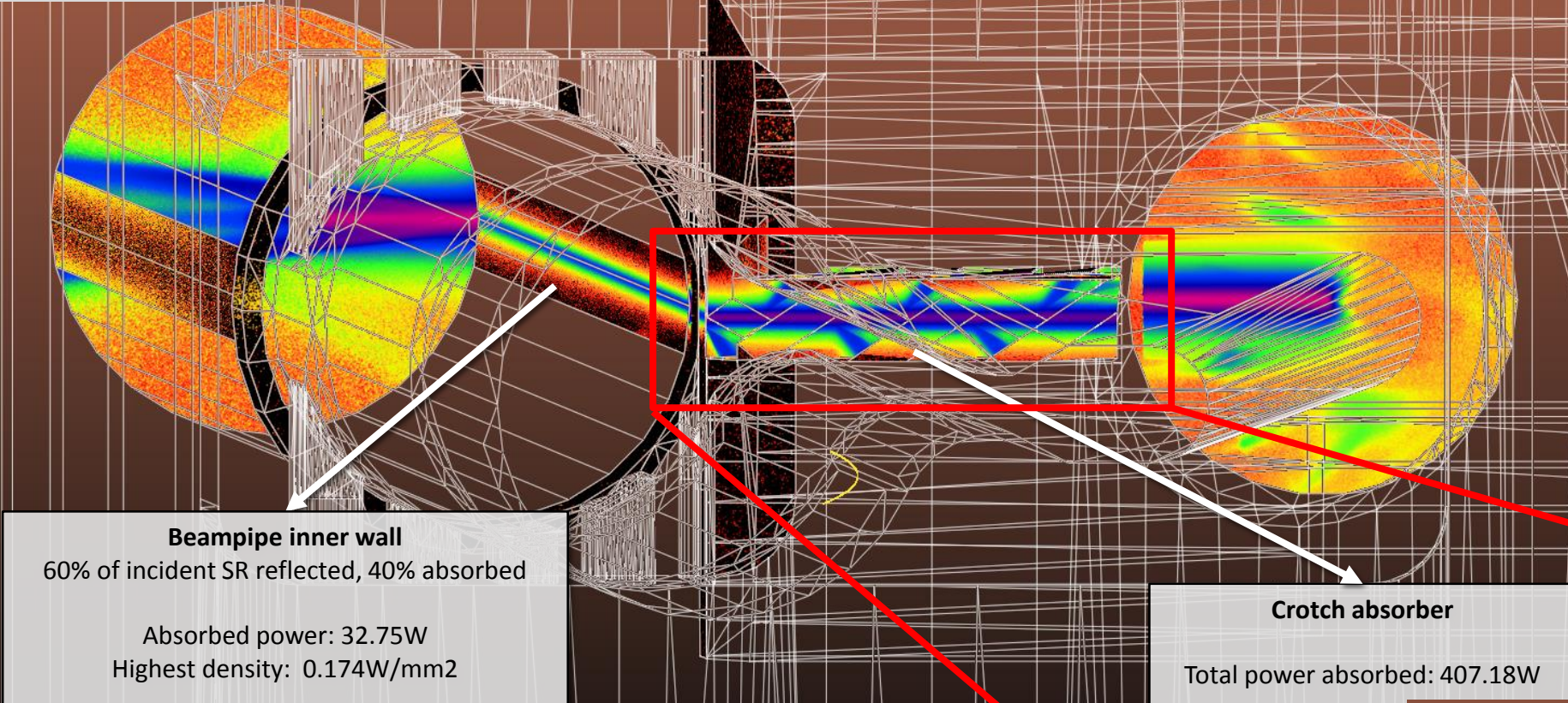
## Primary and scattered photons





Front view (from bending magnet)

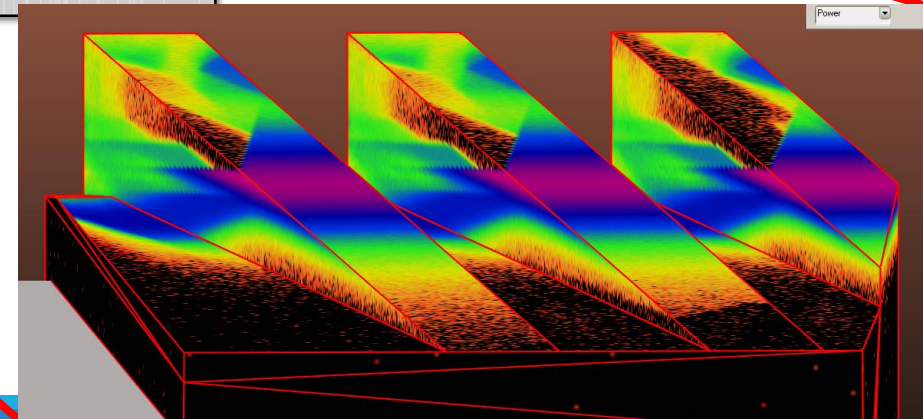
Power density [W/cm2]



**Beampipe inner wall**  
 60% of incident SR reflected, 40% absorbed  
 Absorbed power: 32.75W  
 Highest density: 0.174W/mm2

**Crotch absorber**  
 Total power absorbed: 407.18W

# Flux visualized at absorption locations



# Feasibility for the Demonstrator

- SR mask has to be on the copper liner
- Total liner length is 500mm
- Inner diameter  $\varnothing 80\text{mm}$
  
- Stopper on the liner
- Or in the gasket

