Energy flow comparison between 20 mrad and 2 mrad crossings

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Introduction

- 20 mrad and 2 mrad crossing schemes are being developed.
- New ILC beam parameters have been released.
- Compare two crossing schemes in terms of the detector background.
- Identify potential problems and feedback to the design.

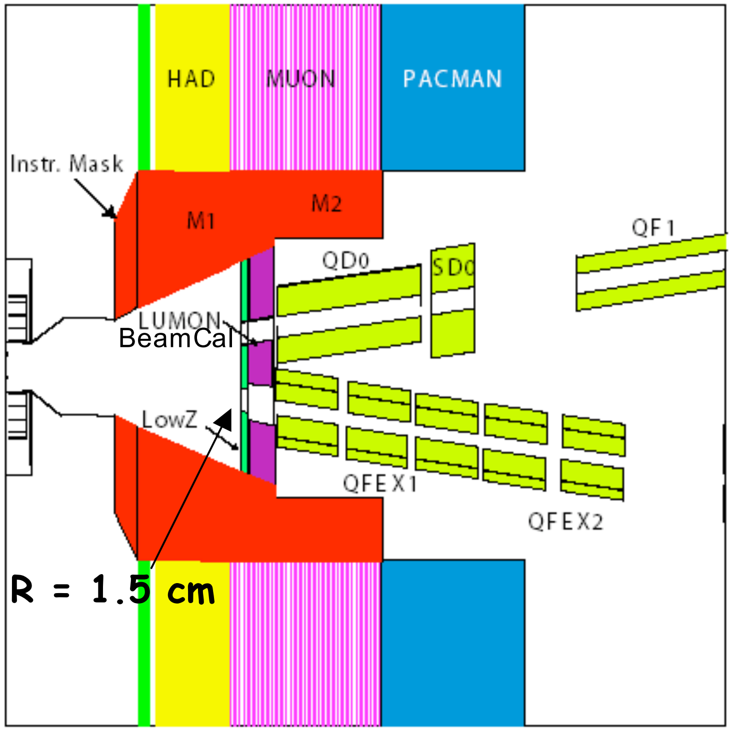
Background sources

- Disrupted primary beam
- Beamstrahlung photons
- Radiative Bhabhas
  - 320 K / BX
  - <E> = 196 GeV
- Beam-beam pairs
  - 76 K / BX
  - <E> = 2.5 GeV
- Synchrotron radiations

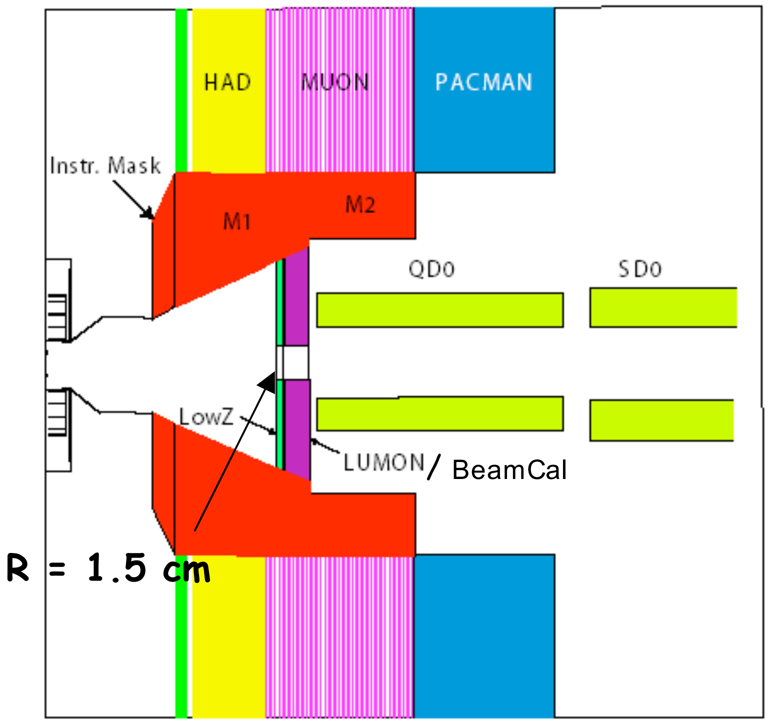
Beam parameters: ILC 500 GeV Nominal

Two Crossing Angle Schemes with SiD Detector

20 mrad

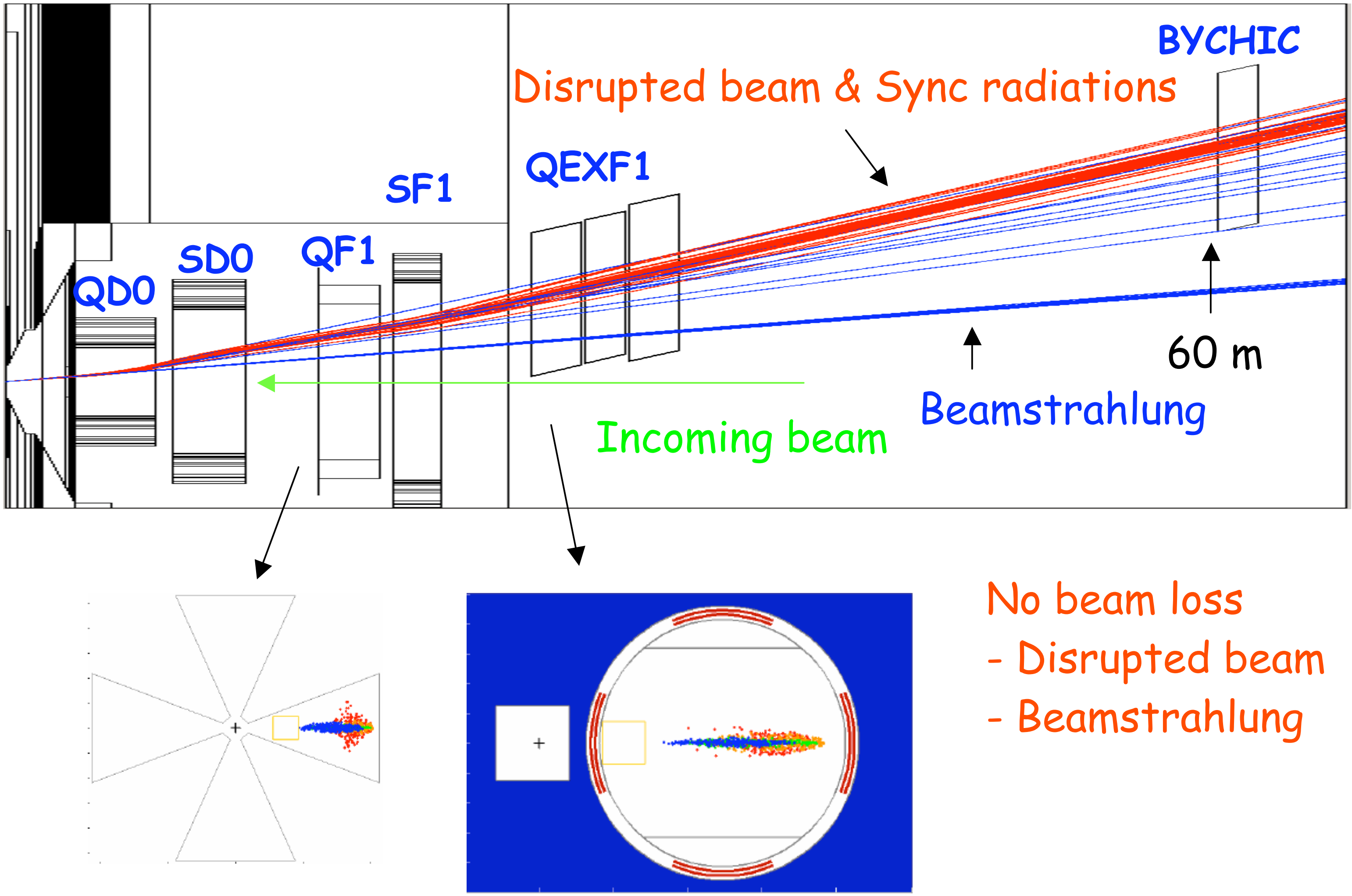


2 mrad



Interaction simulation and particle tracking in Geant 3

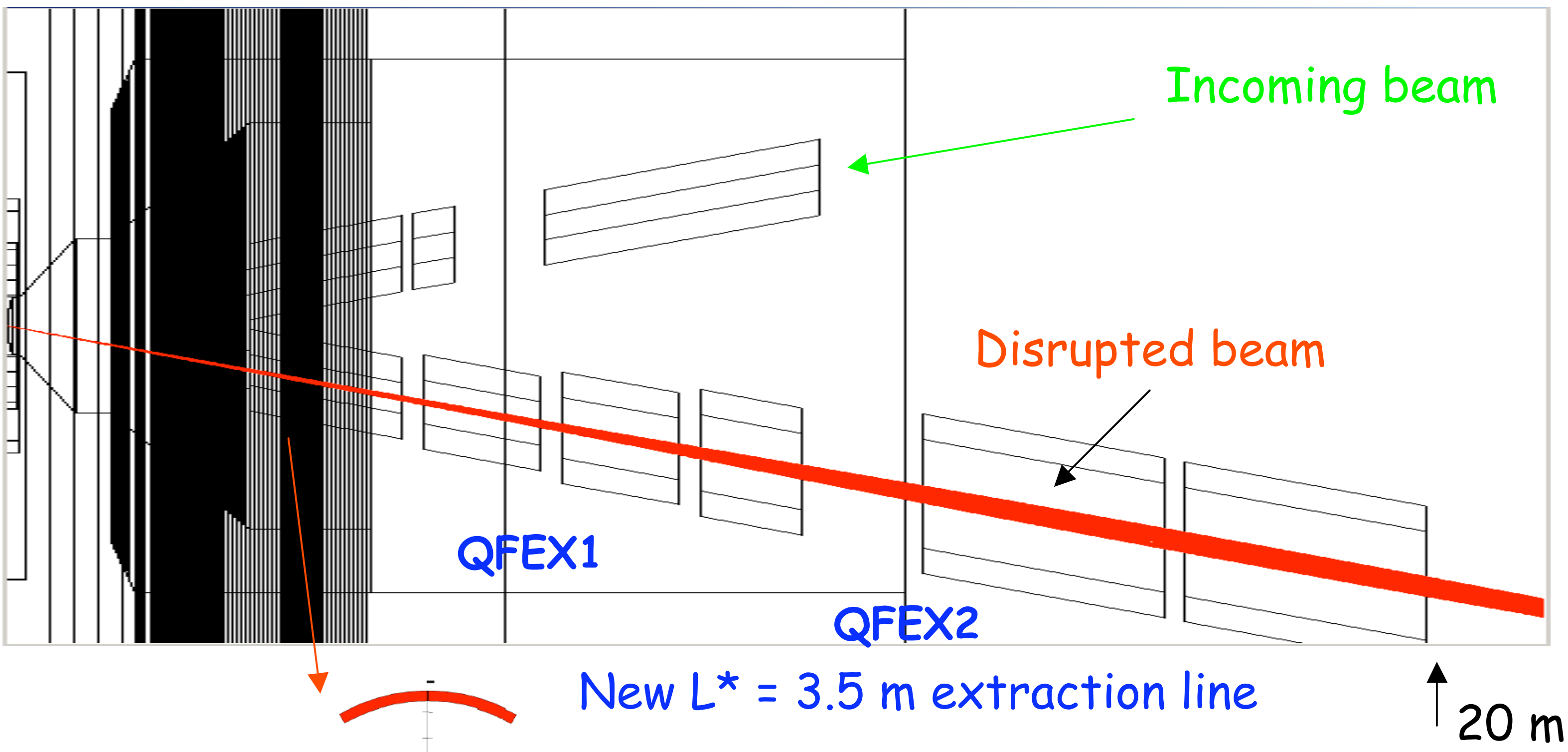
2 mrad extraction

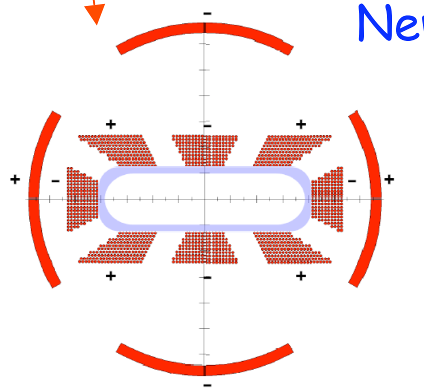


No beam loss

- Disrupted beam
- Beamstrahlung

20 mrad extraction

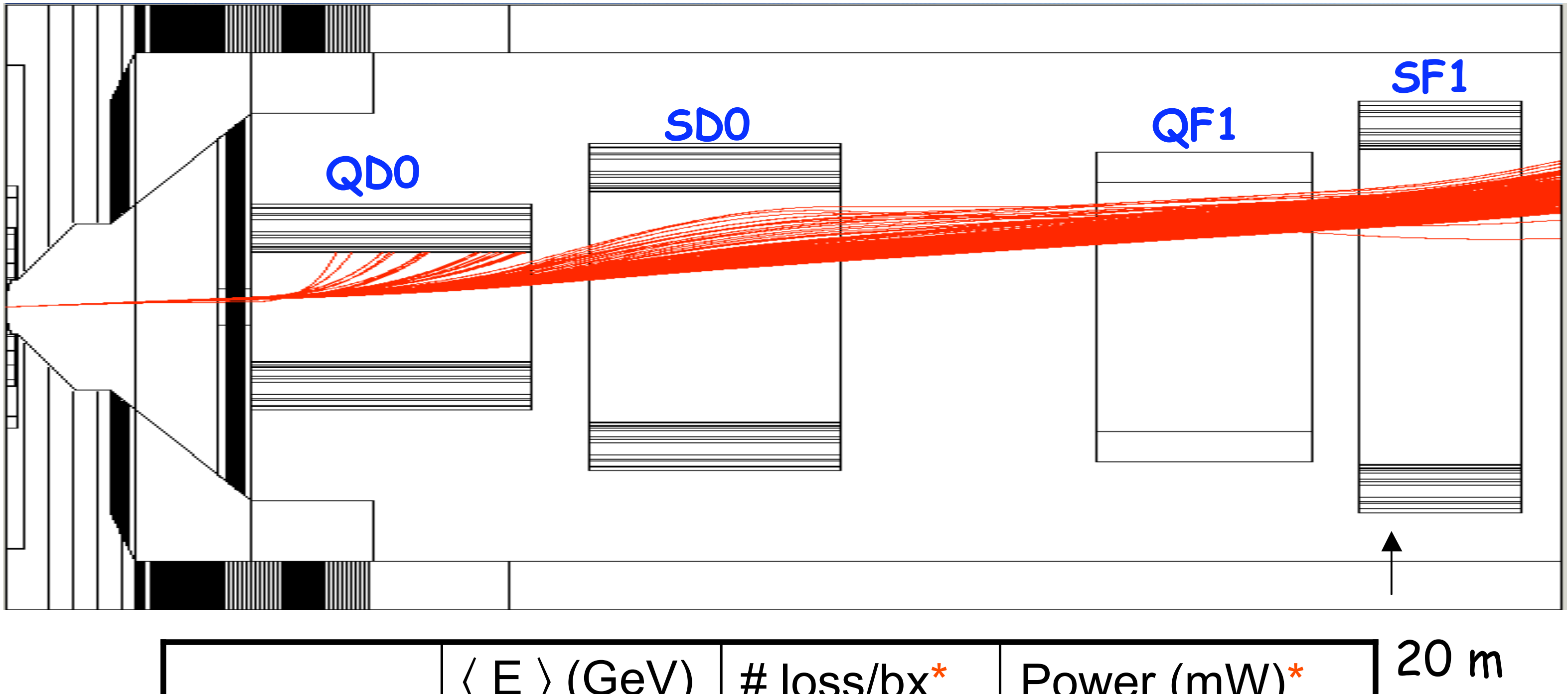




Multi-field Quad
Parker

No beam loss
- Disrupted beam
- Beamstrahlung

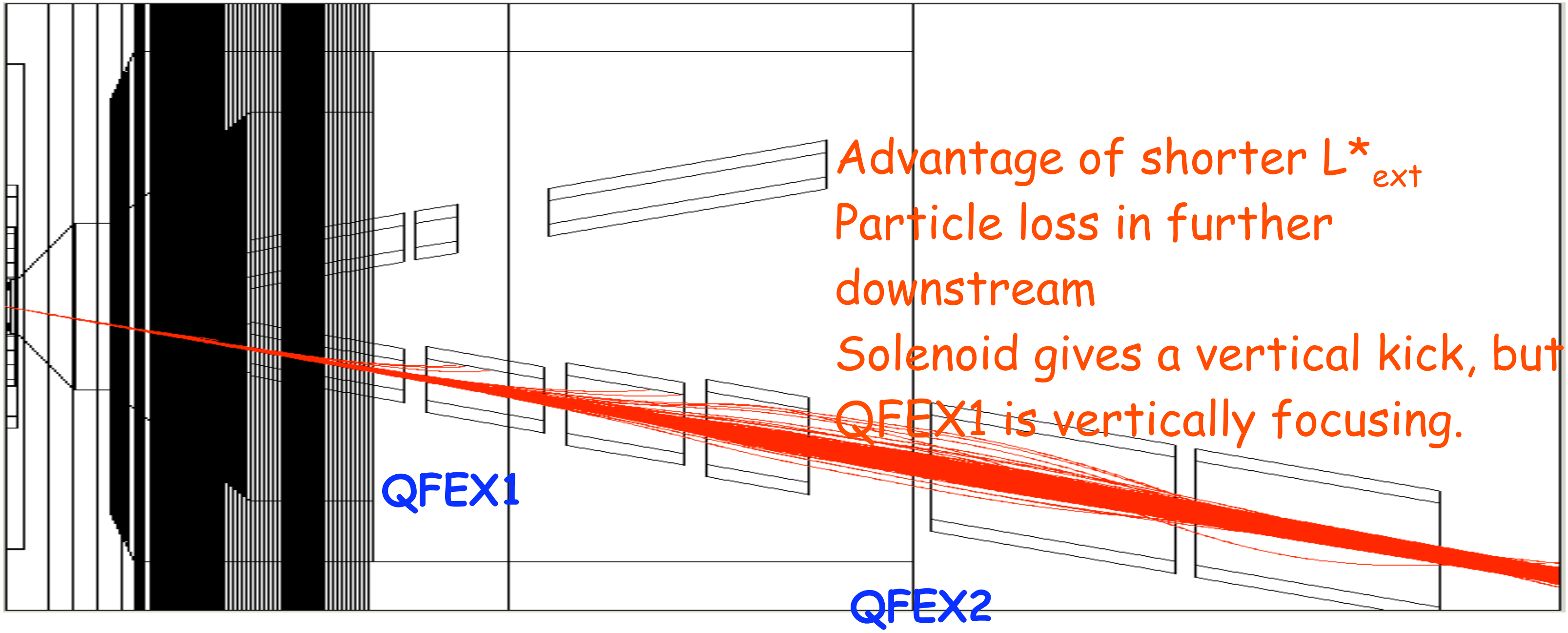
Radiative Bhabhas in 2 mrad



	⟨ E ⟩ (GeV)	# loss/bx*	Power (mW)*
QD0	30	8500	580
SD0	60	340	45
QF1	58	58	8

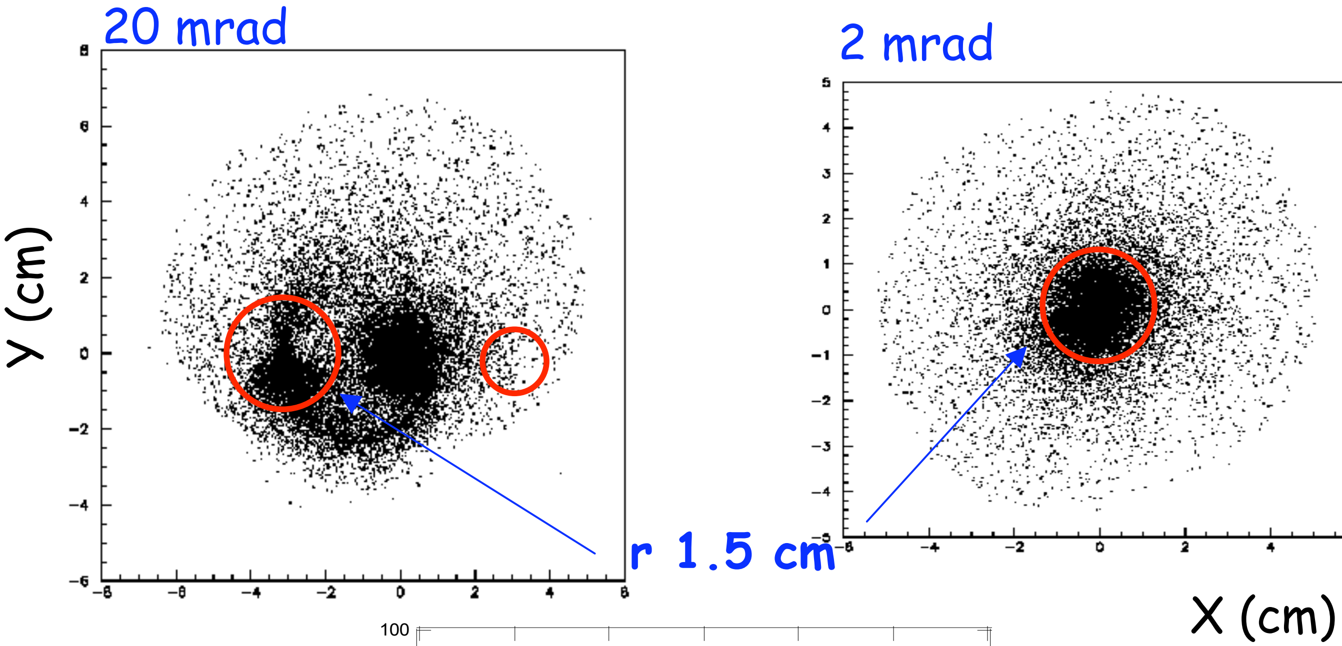
* One side

Radiative Bhabhas in 20 mrad

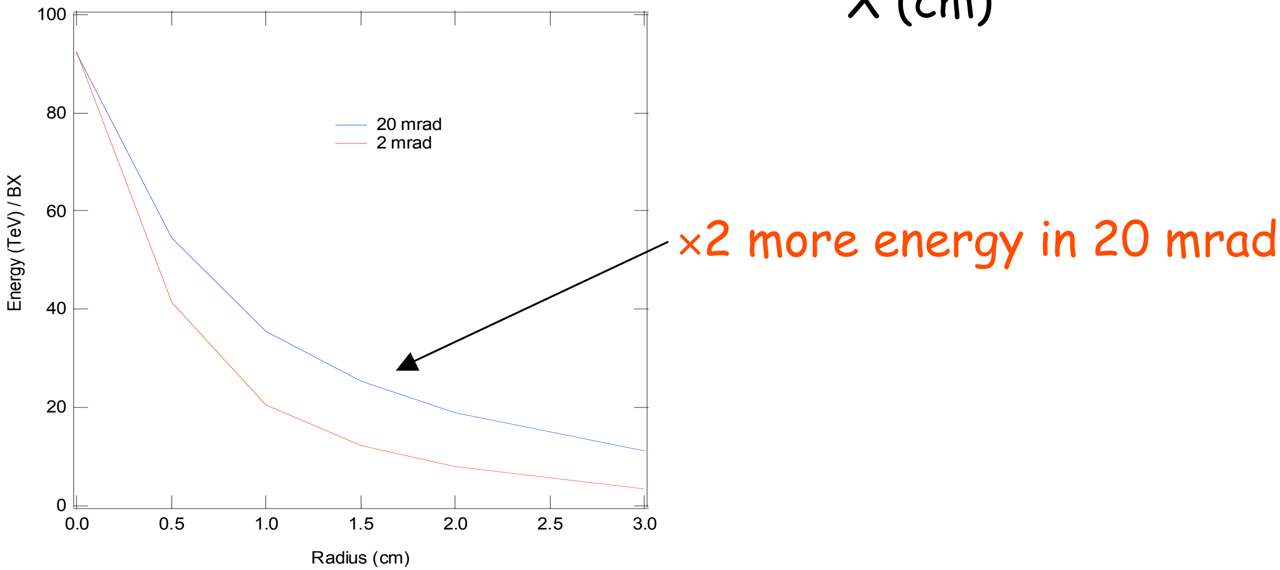


	⟨ E ⟩ (GeV)	# loss/bx	Power (mW)
BeamCal	5	1380	16
QFEX1	13	1040	31
QFEX2	31	4270	300

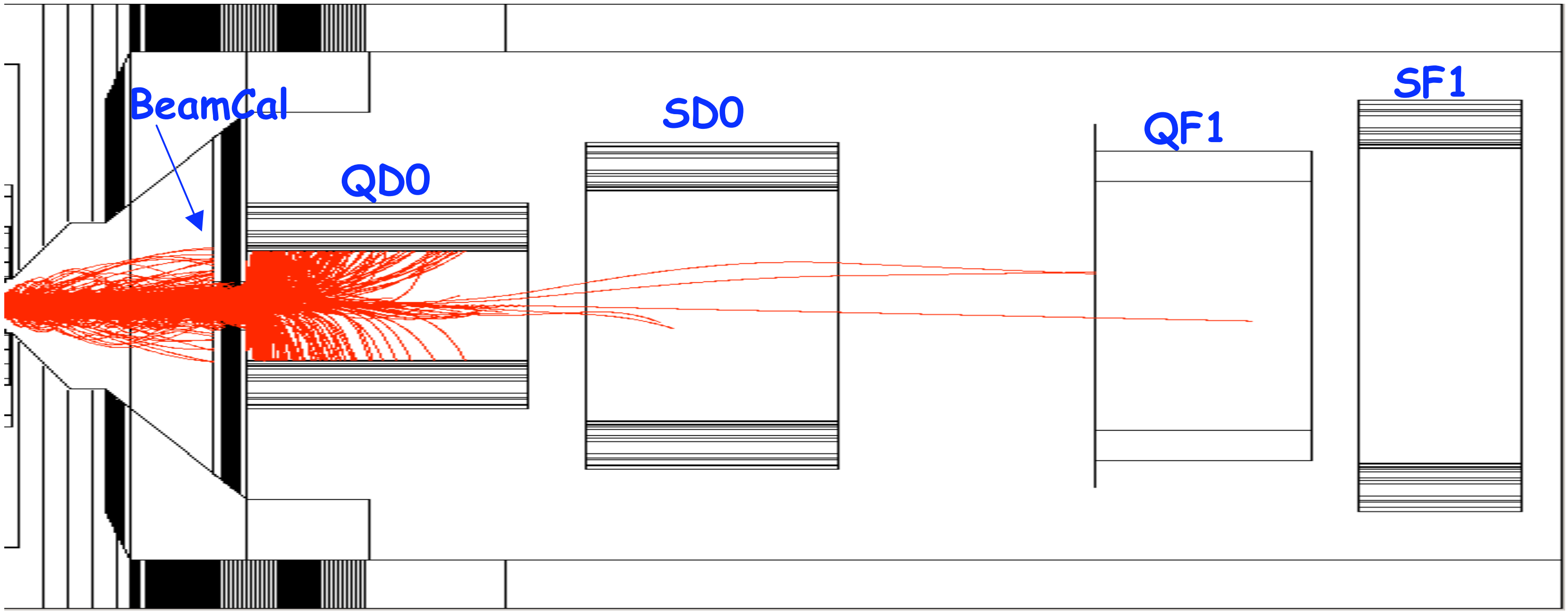
Pairs at Z = 315 cm



Pair energy
in BeamCal

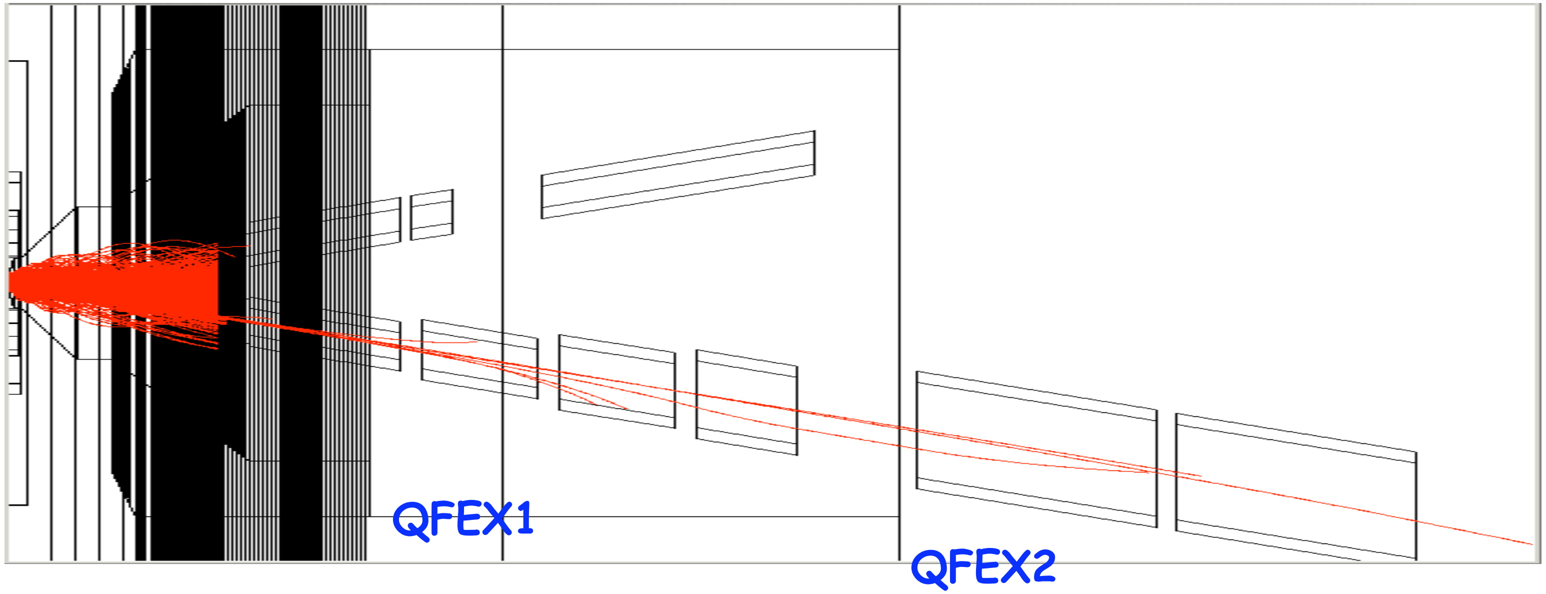


Pairs in 2 mrad



	⟨ E ⟩ (GeV)	# loss/bx	Power (mW)
BeamCal	2.0	6000	27
QD0	2.3	28400	146
SD0	25	230	13
QF1	48	140	15

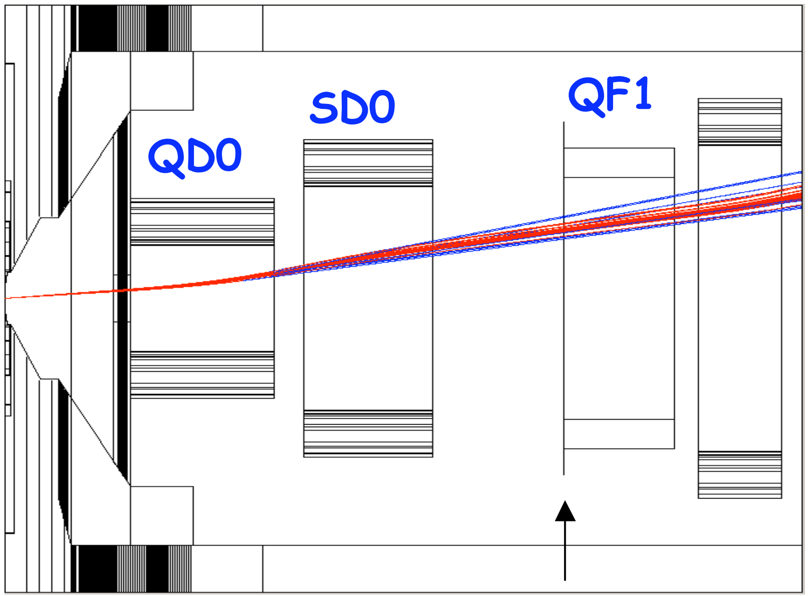
Pairs in 20 mrad



	⟨ E ⟩ (GeV)	# loss/bx	Power (mW)
BeamCal	0.8	32000	58
QFEX1	9	3200	61
QFEX2	31	390	27

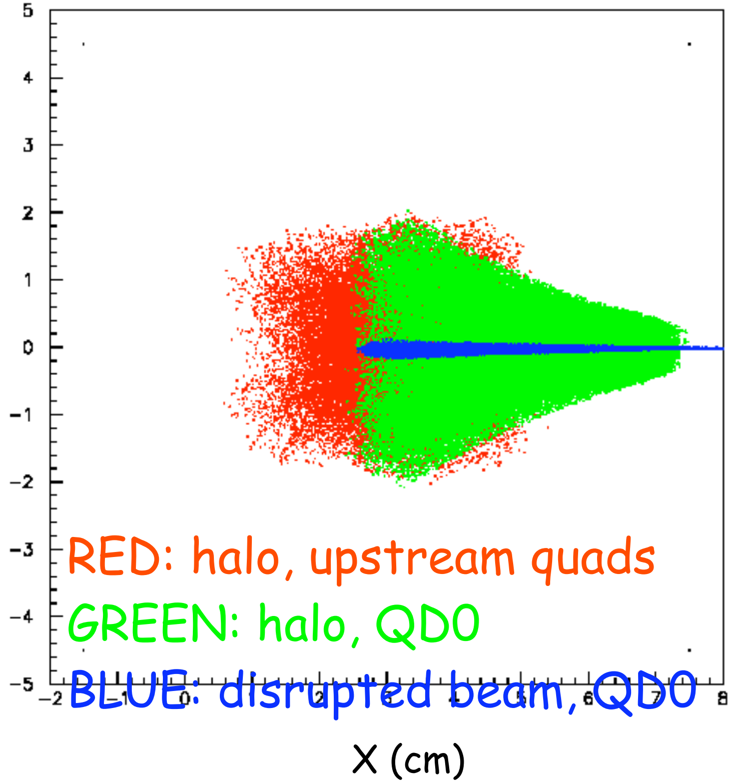
Synchrotron radiation from beam halo in 2 mrad

Disrupted beam with sync photons

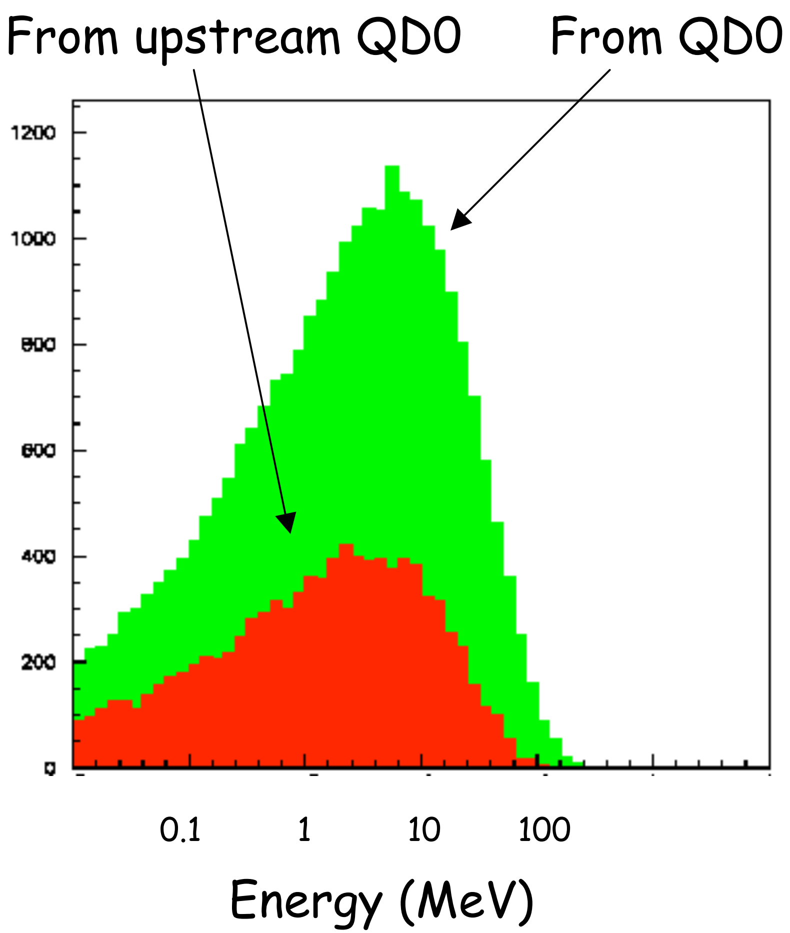


15.6 m

Sync radiations hit the face of QF1



Sync radiations in 2mrad crossing



- No sync radiations from beam core or disrupted beam would hit QF1.
- Sync radiations from beam halo hit QF1.

	QD0	upstream QD0
<E> (MeV)	10.	5.7
# N/e-	23	9.
Hit rate (%)	1.8	9.6
Power (kW)	0.18*f_{halo}	0.21*f_{halo}

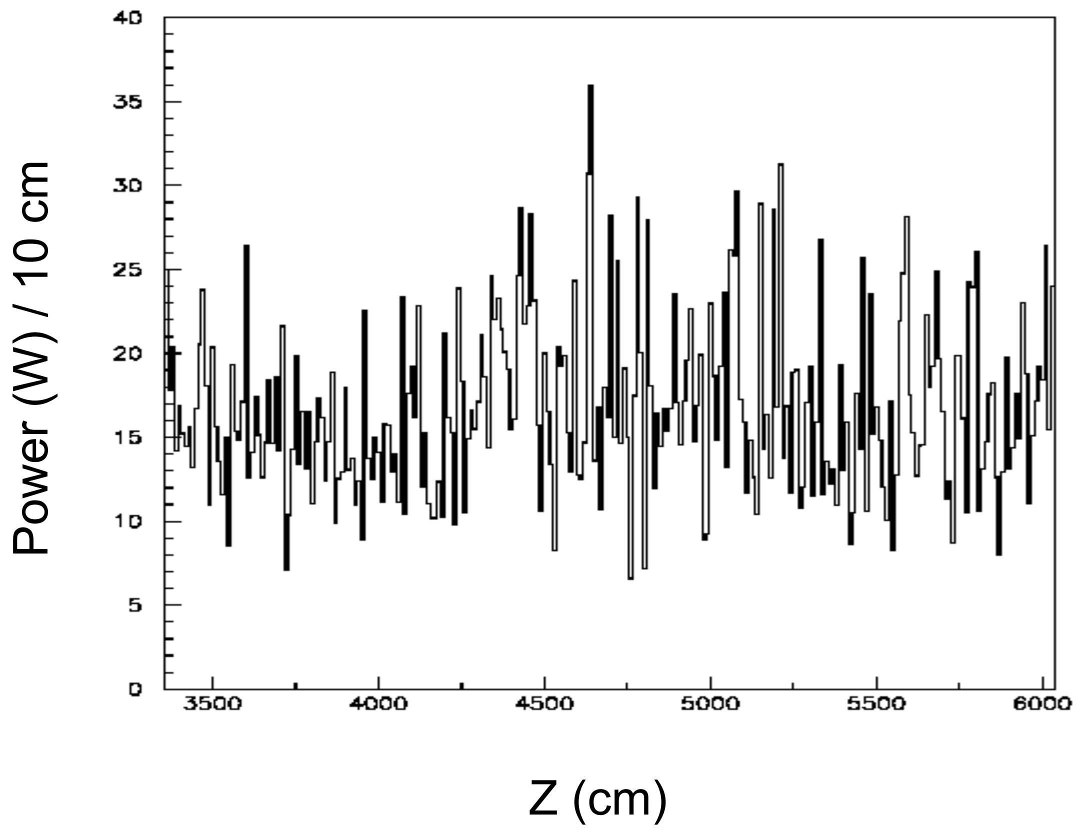
  – Photon backscattering from Z = 16 m to IP is negligible $< 10^{-7}$

f_{halo}: halo fraction

Synchrotron radiation from Z=33 to 60 m

Total power = 5 kW

Power density = ~15 W/cm^2



Photon absorber and beampipe need to be properly designed, but these photons do not contribute to detector background.

Conclusions

- Energy flow seems acceptable for both crossing angle schemes.
- Disrupted beam and beamstrahlung photons can be extracted cleanly.
- QD0 in 2 mrad has energy deposition from radiative Bhabhas and pairs.
  - Need more detailed energy deposition study for SC quad.
- BeamCal has $\times 2$ more pair energy in 20 mrad than in 2 mrad.
- Shorter L* has an advantage in capturing low energy radiative Bhabhas and transporting them away from IR.
- Synchrotron radiations can be serious for 2 mrad, but they don't appear to contribute to the detector background