

Detector interface

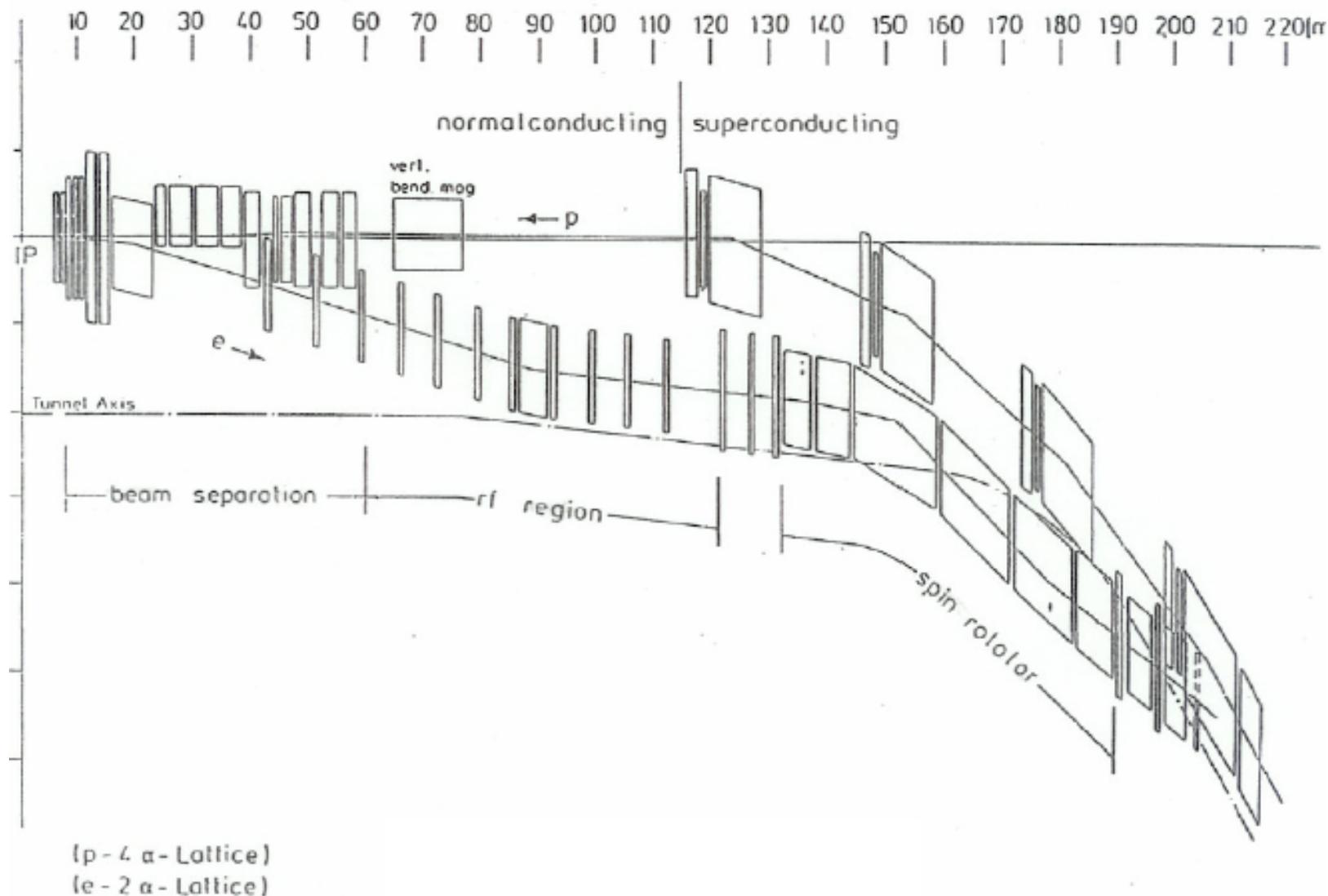
■ Topics for detector interface:

- Location and dimension of beam pipe
- Location and dimension of synchrotron radiation absorbers
- Location and dimension of machine elements (quadrupole magnets, vacuum pumps, ...) in detector volumes
- For rear direction (e-direction): location of luminosity monitors (Bremsstrahlung-photon and low-angle electron-tagger)
- For forward direction (p/A-direction): location of hadr. final state taggers (p/n tagger)
- Central magnet
- Installation procedures of inner detector elements in connection with
- Moveable detectors at one IR

■ Input needed:

- Machine parameters at IR
- Beam envelopes in IR region
- Synchrotron radiation fan (Basis to decide on beam pipe dimension, absorber location, ...)
- Layout of machine elements beyond actual main detector volume (Crucial for rear and forward tagger design)

Detector interface



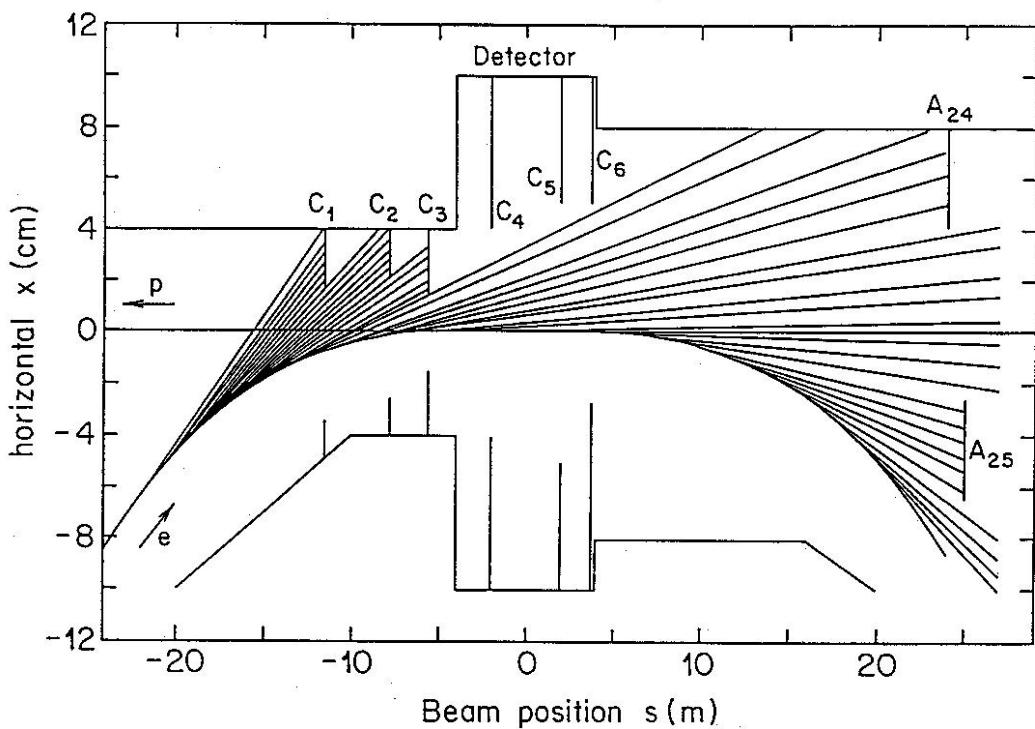
HERA ep collider detectors - ZEUS

■ Background (Synchrotron radiation: HERA I)

- Total power 6 kW (original design 18.6 kW at 35 GeV)
- Critical energy 34 keV (original design 70 keV at 35 GeV)

$$P[W] = 14I[A] \frac{\Delta\phi[mrad]}{\rho[m]} (E_e[GeV])^4$$

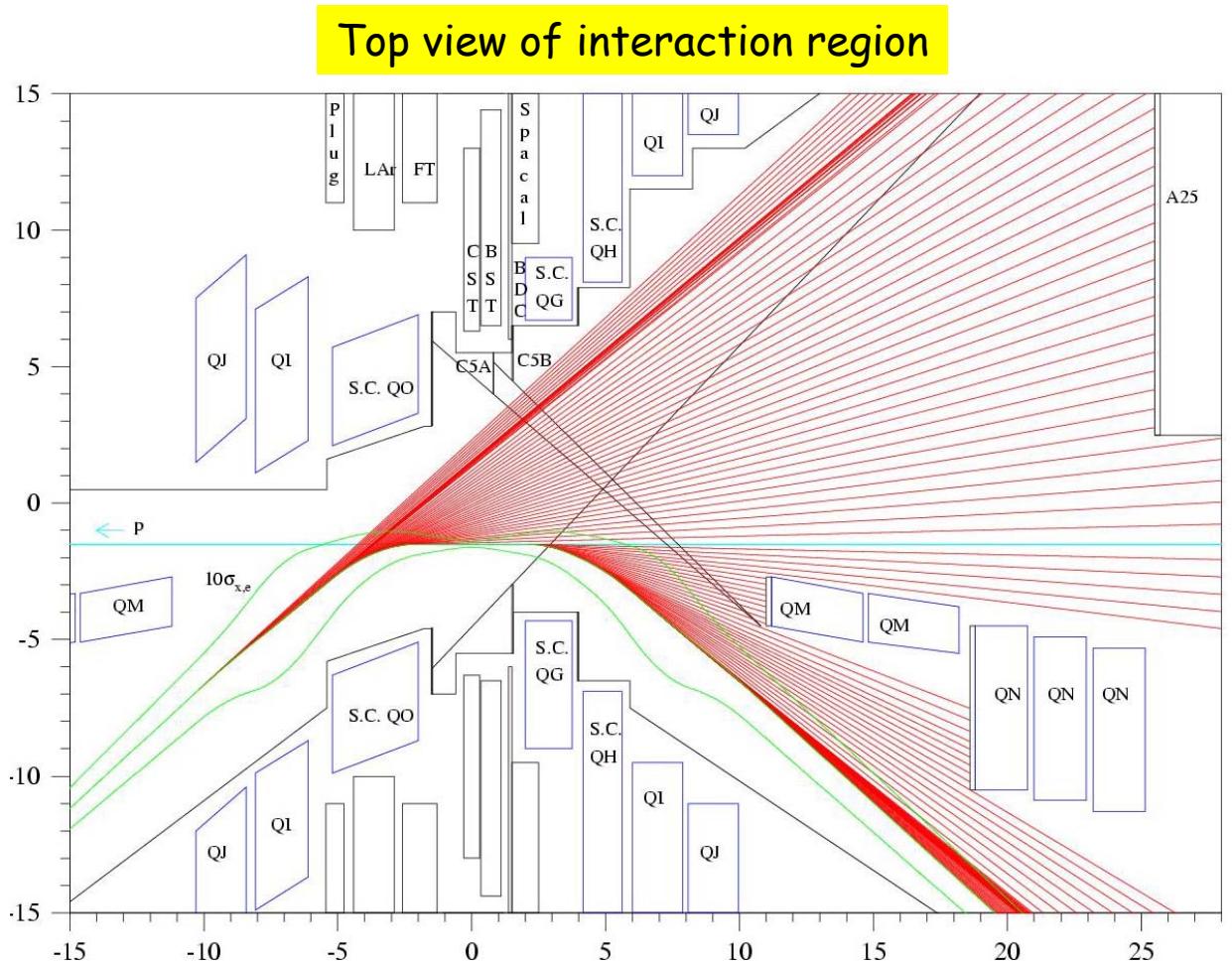
- Detector shielded by 3 movable upstream collimators.
- Two fixed collimators near IP against back-scattering.
- Background conditions very low.



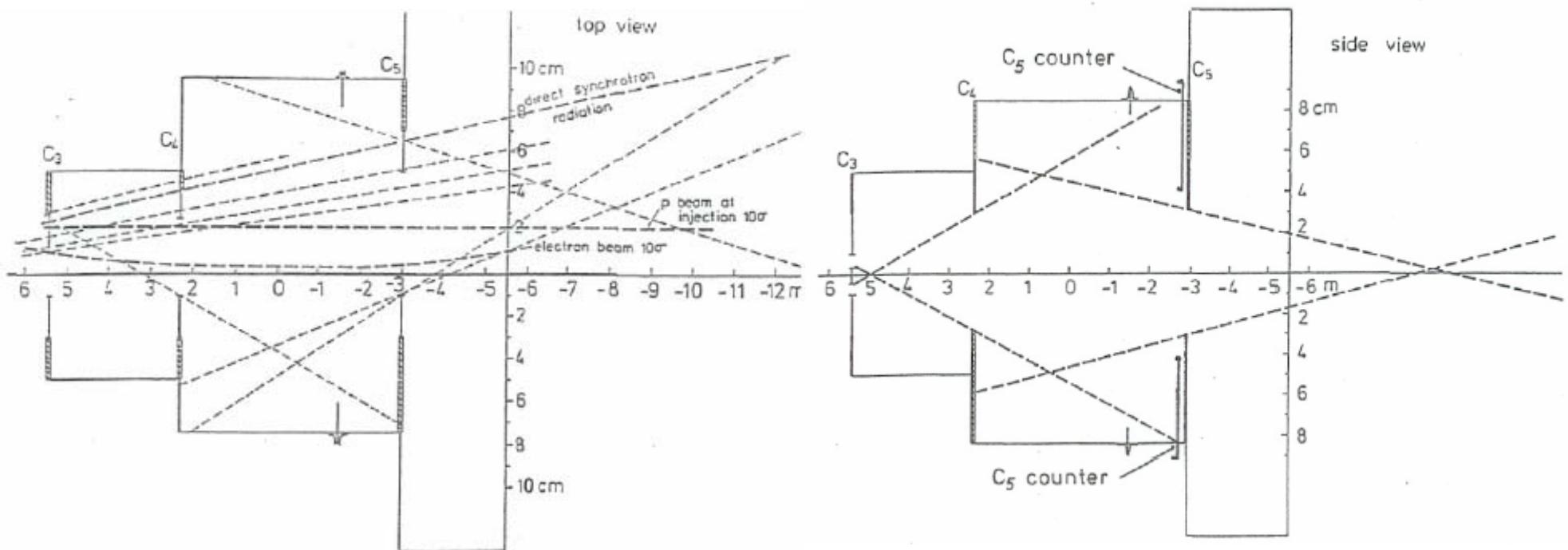
HERA ep collider detectors - ZEUS

■ Background (Synchrotron radiation: HERA II)

- Total power 18kW (26kW at 30GeV)
- Critical energy up to 115 keV (150 at 30 GeV)
- "No" upstream collimators
- Radiation fan must pass through IR
- Main background source: back-scattering from absorbers 11 to 27 m right of IP
- Small central beam pipe



Detector interface



HERA ep collider detectors - ZEUS

■ Luminosity (General concept)

- Method: measure rate of bremsstrahlungs process



- Originally, measure coincidence of e' and γ .
- Detectors in HERA tunnel:

$$E_e = E_{e'} + E_\gamma$$

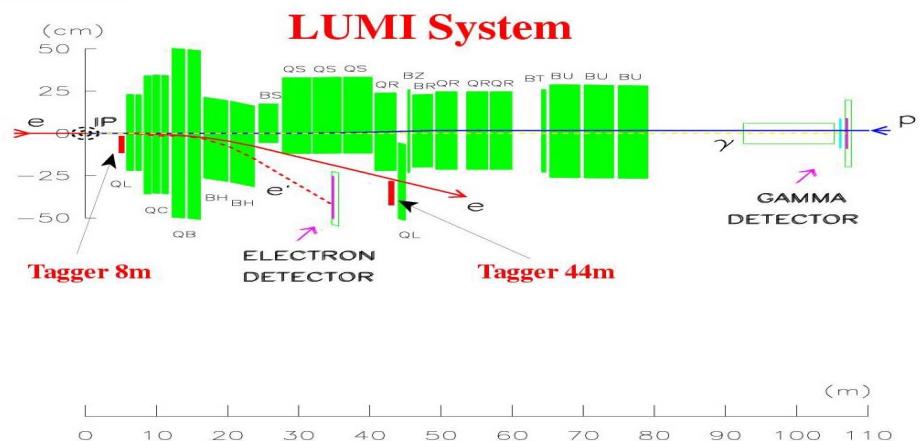
$$L = 1 / \sigma_{BH}^{obs} [R_{tot} - (I_{tot} / I_0) R_0]$$

- Photon detector 107m from IP at 0° (p beam is bent upwards)
- Electron detector 35m from IP (HERA magnets act as spectrometer)

- Rate: 230kHz at $1.5 \cdot 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$

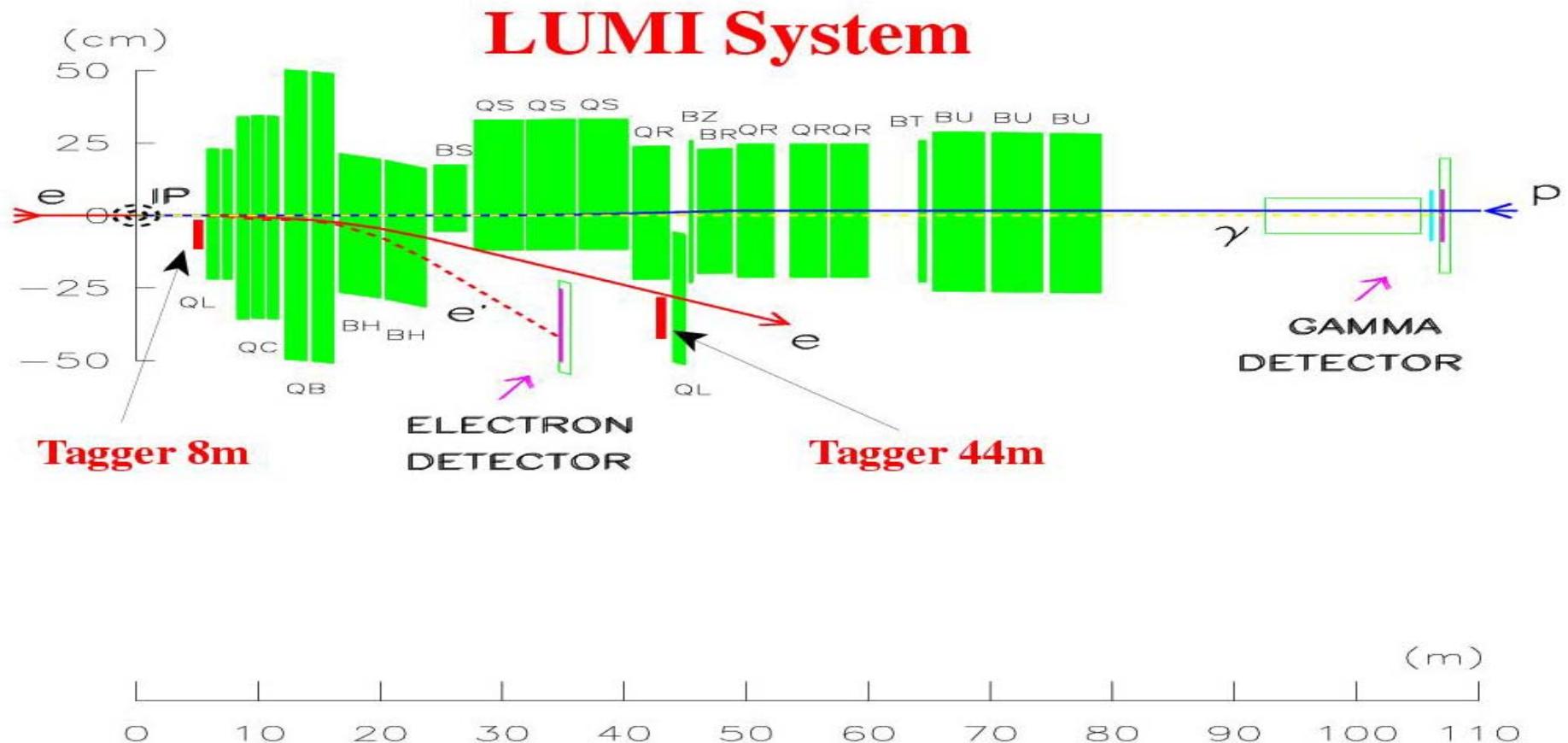
- Bethe-Heitler cross section: $\sigma_{BH}^{obs} = A_\gamma \sigma_{BH}^{corr}$

- Main background: beam gas \Rightarrow subtracted using pilot bunches



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Luminosity (General concept)



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■ Luminosity (Small angle taggers)

- Small electromagnetic calorimeters at different locations in HERA tunnel
- HERA magnets act as spectrometer
- Taggers (HERA I IR)

z-position	acceptance
44 m	21 - 26 GeV
5 m	5 - 19 GeV
8 m	1 - 3 GeV

- Physics
 - Photon-proton total cross section
 - Photoproduction
 - DIS: reject photoproduction backgrd
 - Used for calibration

