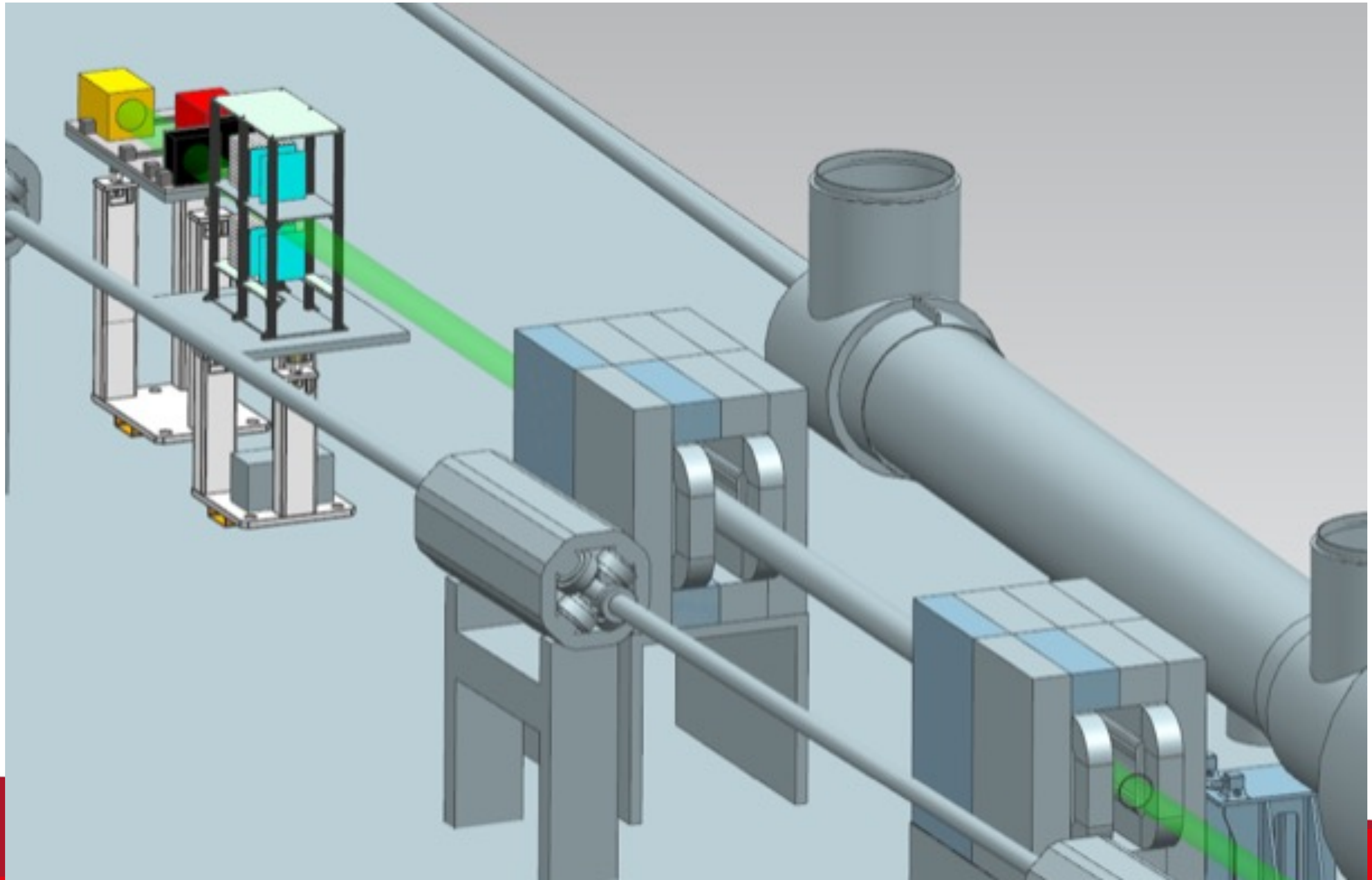
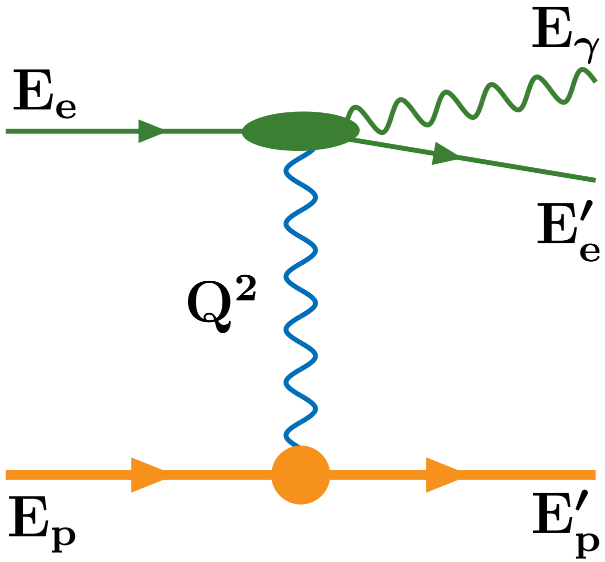
Direct Photon Calorimeters: **calibrations tools & radiation hardness**

Krzysztof PIOTRZKOWSKI



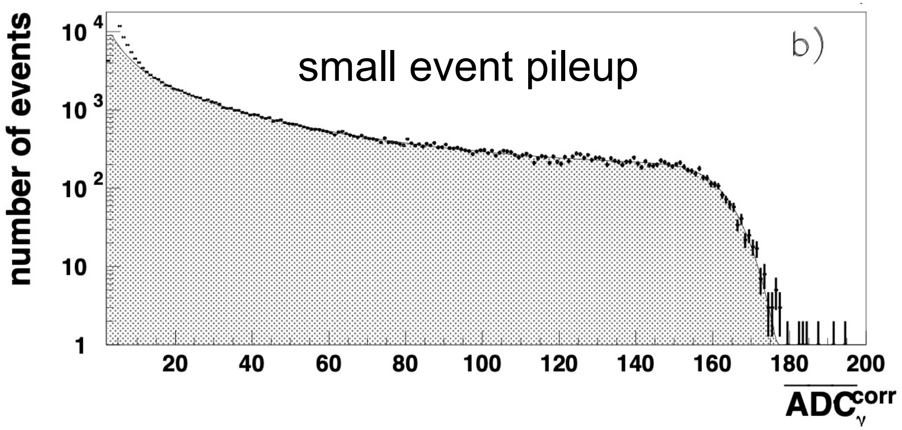


Working conditions

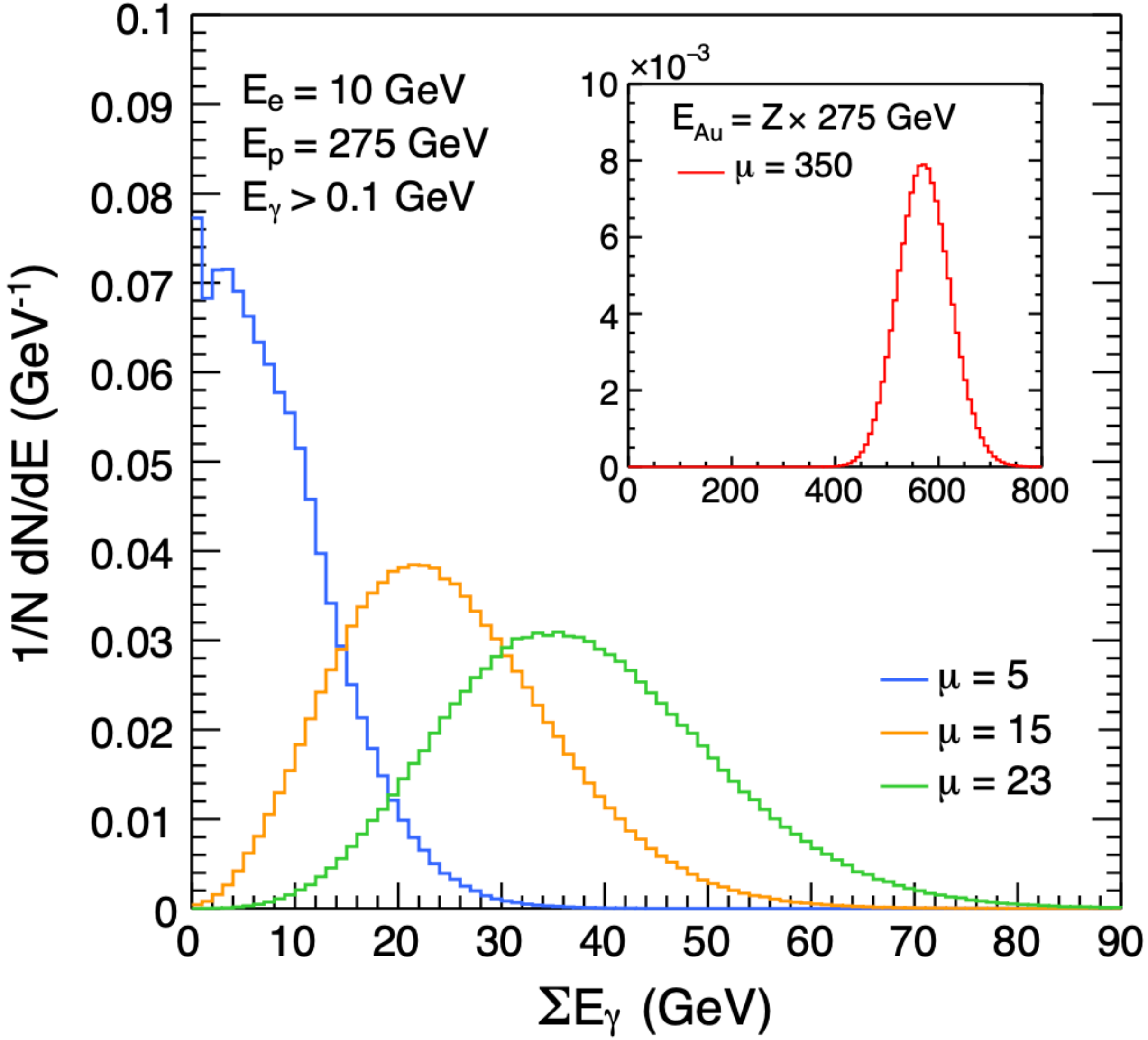
Two major challenges must be coped with:

1. **Huge and unavoidable irradiation** of active material (Sci/Q) due to bremsstrahlung itself,

at EIC every 10 ns ⇒

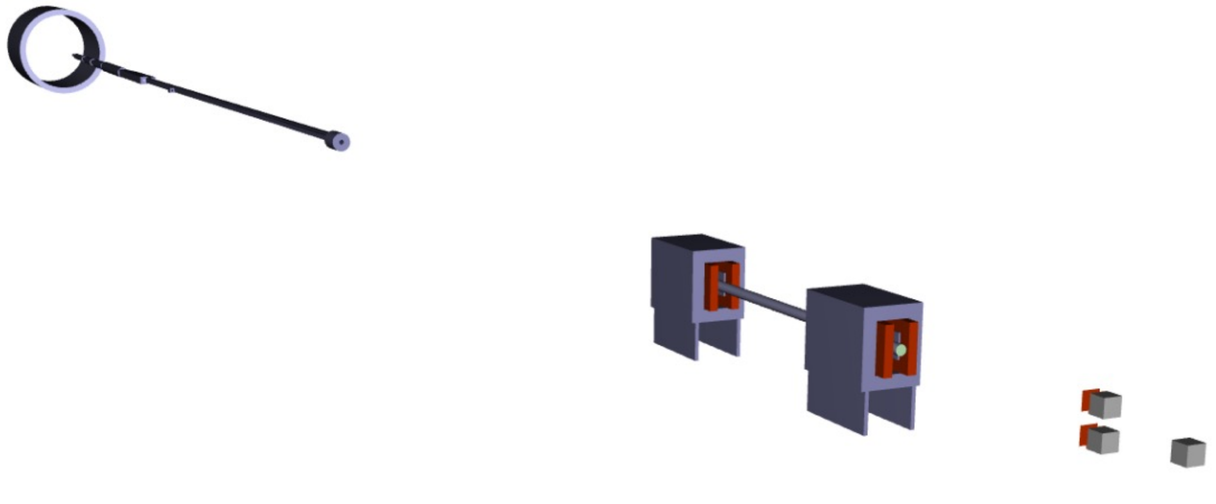


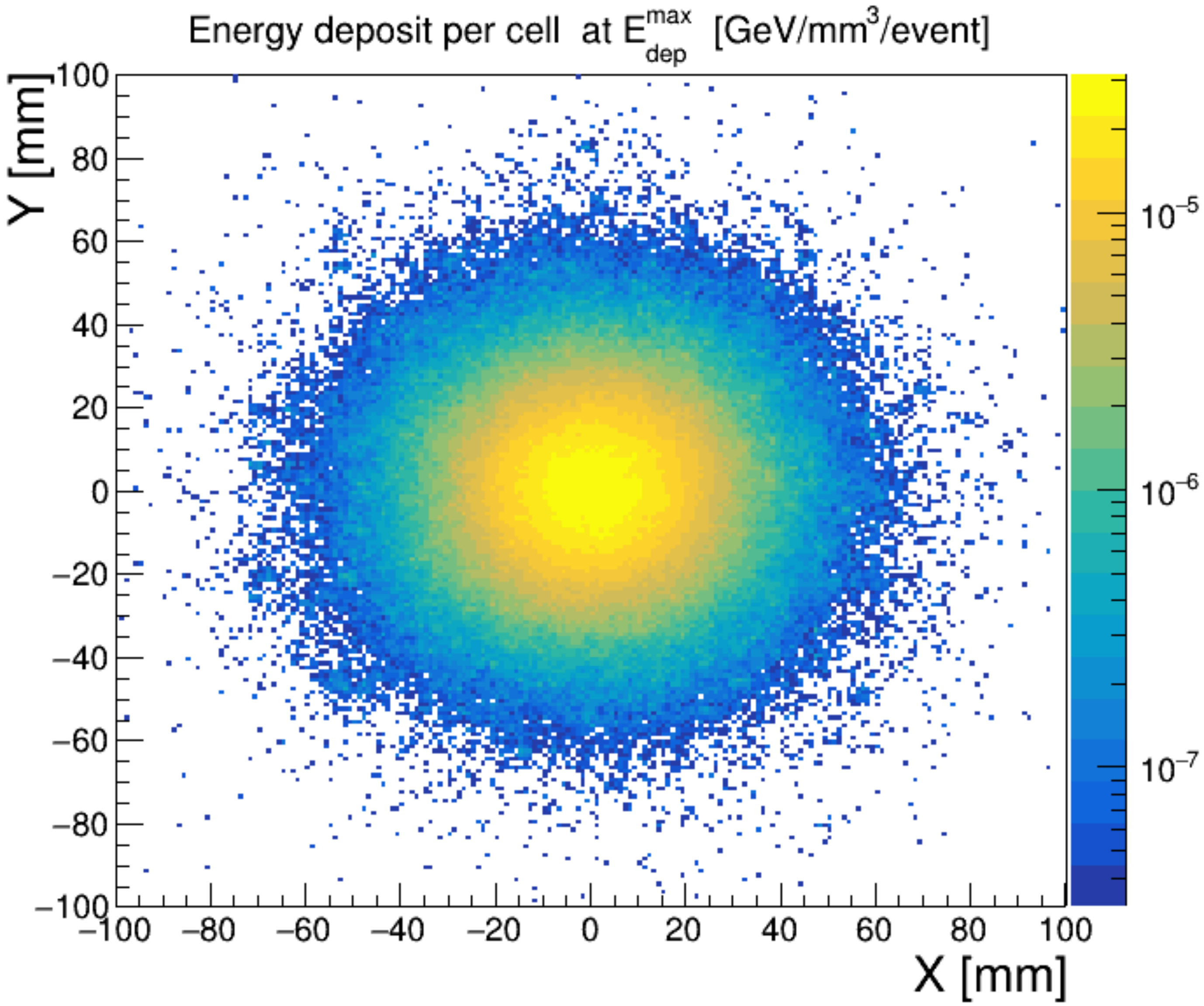
HERA I – measured bremsstrahlung spectrum – *Acta Phys. Polon. B* **32** (2001)



2. Huge and unavoidable flux of (direct) **synchrotron radiation**

Simulations of direct photon calorimeter irradiations

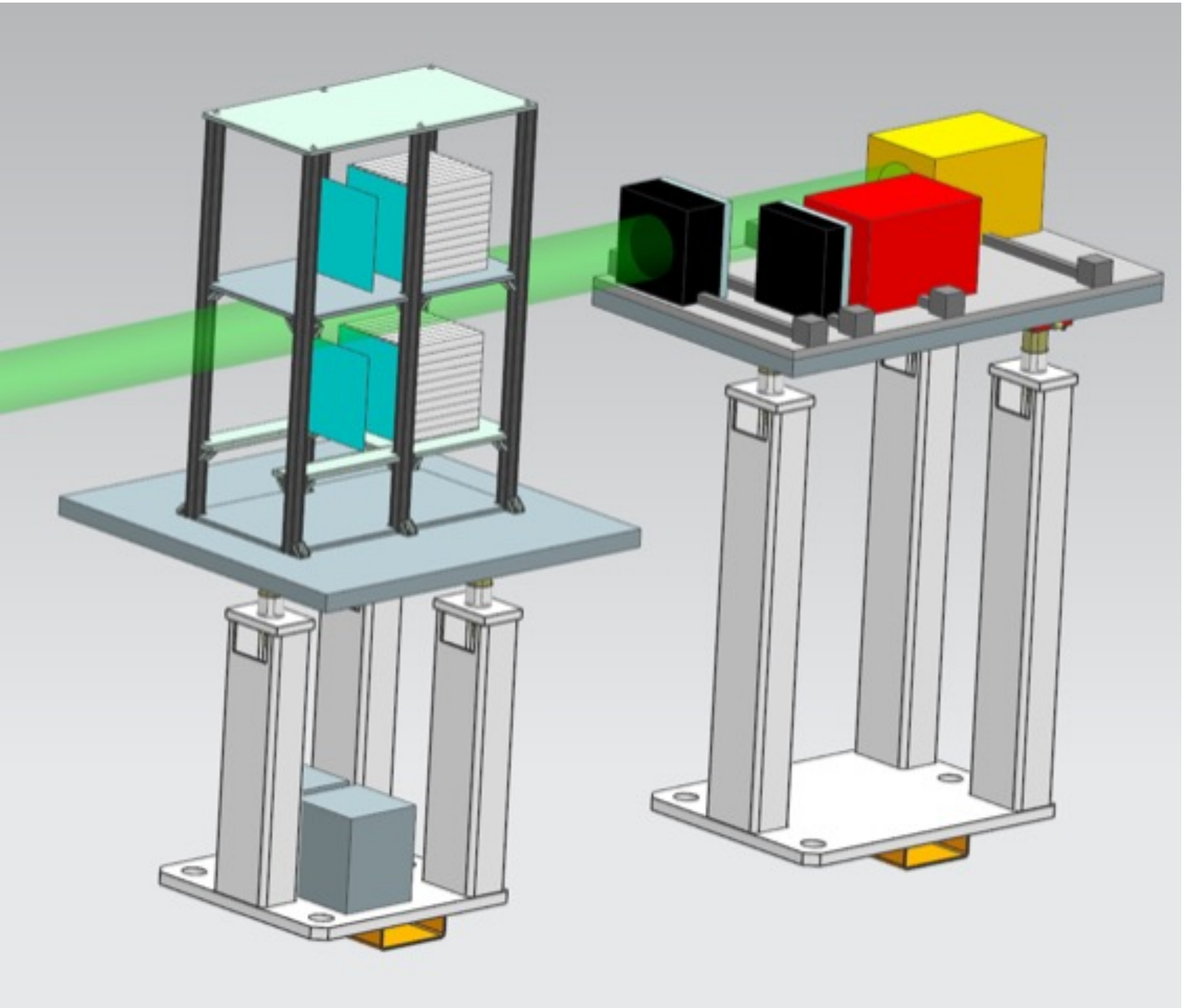




G4 simulations predict maximal irradiation density of about **2 MeV/g** per photon ⇒ maximal annual (local) dose, assuming 100 fb^{-1}, of about **7 MGy**!

- Only quartz fibers can be used then
- Irradiation levels can be partially mitigated by changing calorimeter position from time to time ⇒ at 10 fb^{-1} one can use SciFi as dose < 0.1 MGy

SR shielding



1. No extra SR attenuation needed at 5 GeV

2. Only 5 cm graphite block (< 0.3 X_0) is needed to stop all SR at 10 GeV

3. 35 cm graphite (< 2 X_0) is needed to stop SR at 18 GeV – it is good news as such filter was used for direct photons at HERA I, when 1% luminosity precision was achieved

Data-driven calibrations

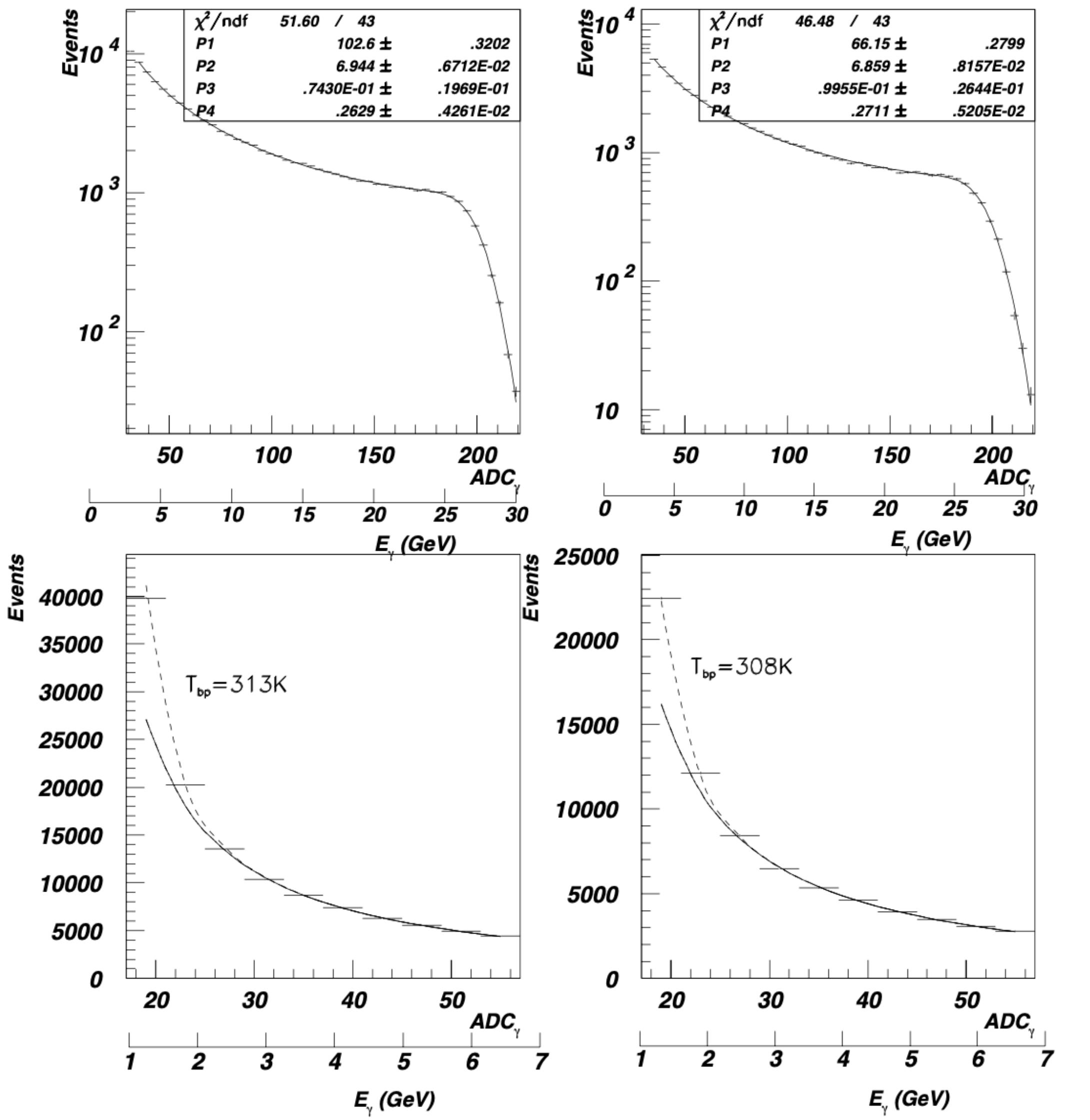


Figure 3: Two spectra of eN bremsstrahlung measured in the luminosity monitor using the electron pilot bunches. The histograms represent the data and the curves are results of fitting the function F (from Eq.1) for $E_\gamma > 3.5$ GeV; in the lower plots the low energy parts of the spectra are shown with extrapolations of the curves obtained from the fits - the excess of events with $2 > E_\gamma > 1$ GeV is well described by adding a contribution from Compton scattering of the blackbody photons off the beam electrons (dashed curves, T_{bp} is the beam-pipe temperature).

Working conditions for direct photon calorimeters are extremely harsh whereas luminosity measurement with direct photons heavily rely on precise measurements photon energy…

⇒ we will profit from ”infinite” event statistics to **continuously** make **high precision data-driven calorimeter re-calibrations**, not only to control bunch-to-bunch energy scales, but also to monitor energy resolution and non-linearities

⇐ example of high statistics fits @ HERA

LED pulsers

We will have also channel-to-channel calibration monitoring systems:

1. **Fast LED pulsers** will produce ~1 ns light pulses distributed via quartz fibers to every channel – fibers glued to light guides

2. **All** 100 (+ 28 for SR monitors) will be continuously flashed – at couple of empty bunch crossings

3. **All LED calibration data will be streamed out** along with data from all other bunch crossings