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Beamstrahlung monitoring of the Beam-beam effects

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LCWS Paris April 2004

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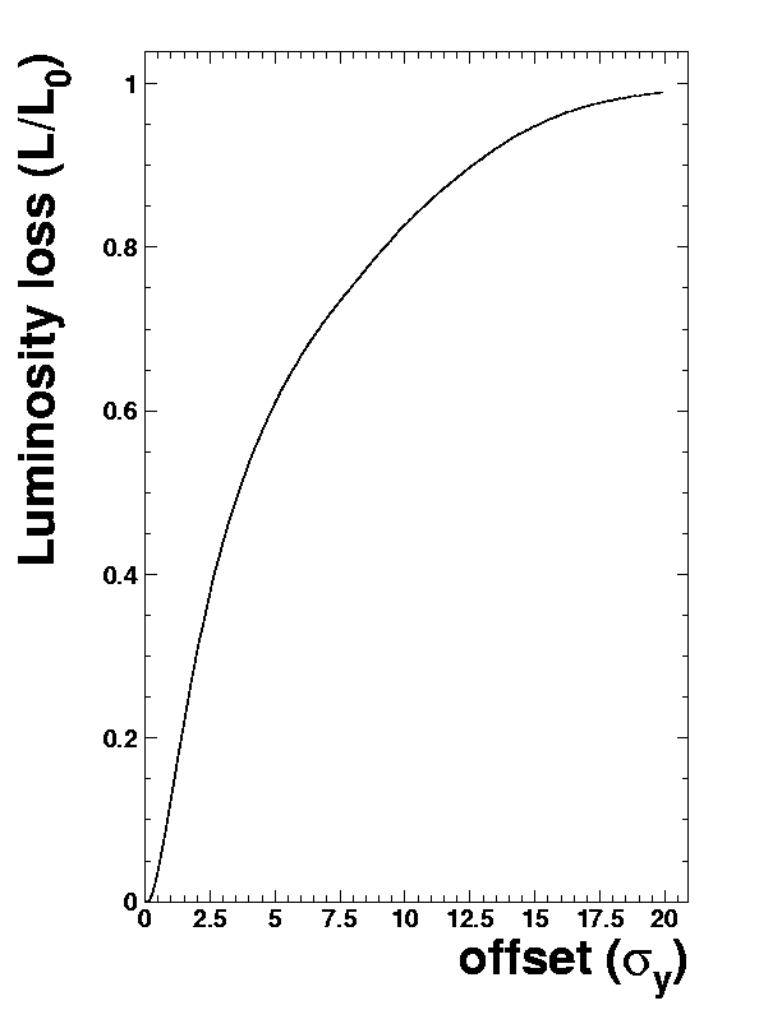
Beam misalignment



- Fast ground motion will lead to beam misalignment and thus to luminosity loss.
- Fast feedback system (see FEATHER/FONT talk in the Accelerator session) will correct most of the displacement.
- Need an independent monitor of beam misalignemnt

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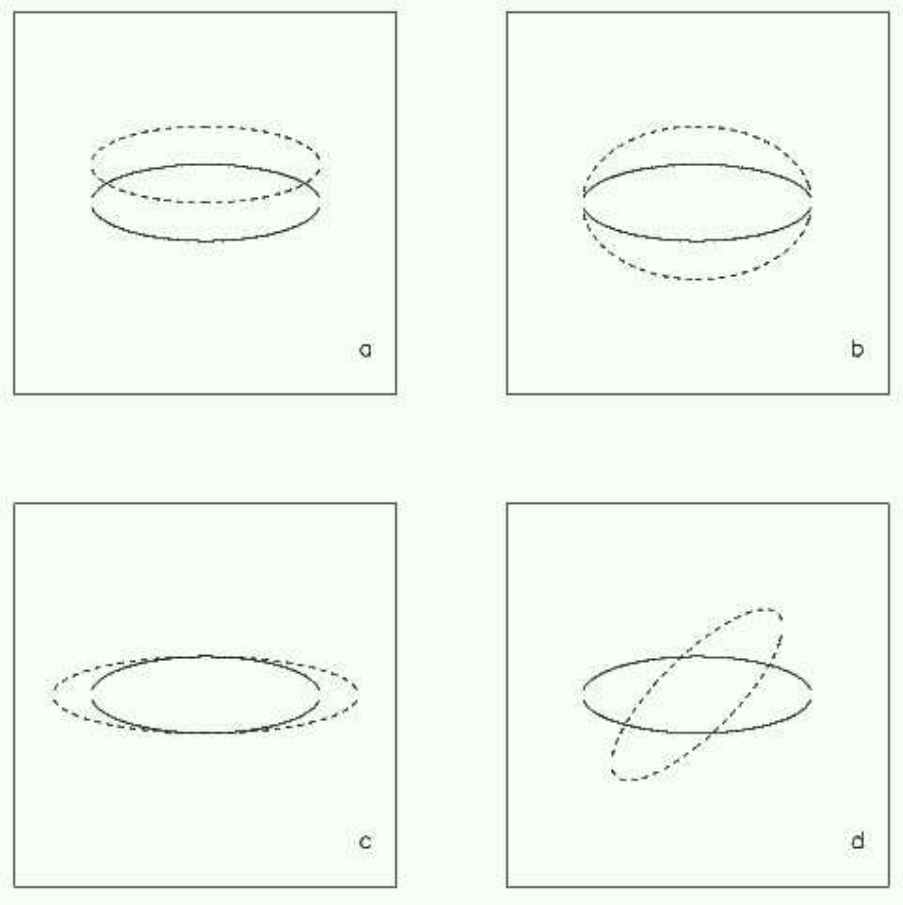
Beam mismatches



- Beam mismatches at the IP will generate beamstrahlung
- The beamstrahlung pattern contains information on the mismatch at the IP.

Contributed by G.Bonvicini

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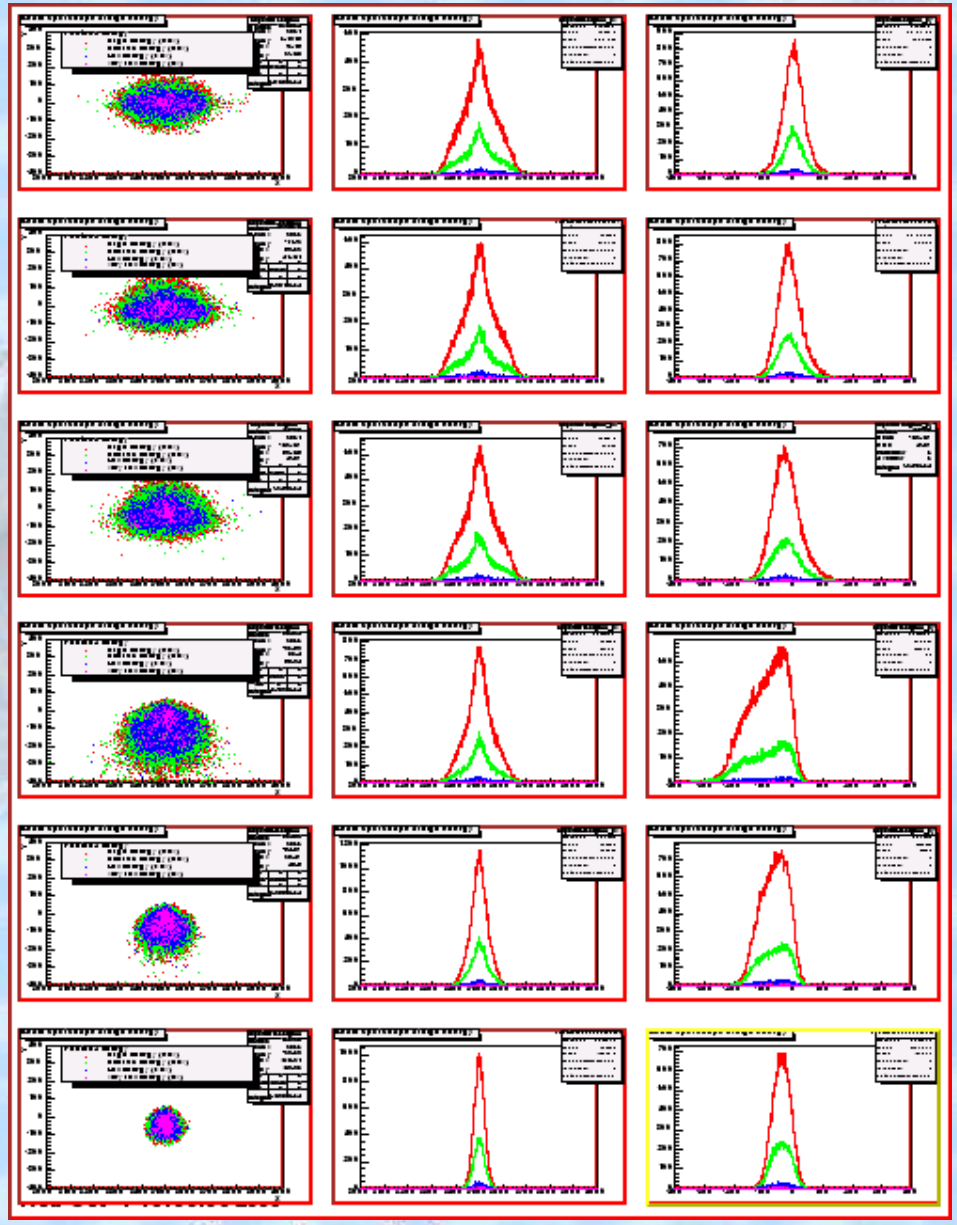
Beamstrahlung pattern

Beamstrahlung pattern varies according to the vertical offset between the 2 beams.

Plots: vertical offset of 0, 0.5, 1, 10, 40 and 100 beam size.



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Coherent Beamstrahlung yield vs beam offset

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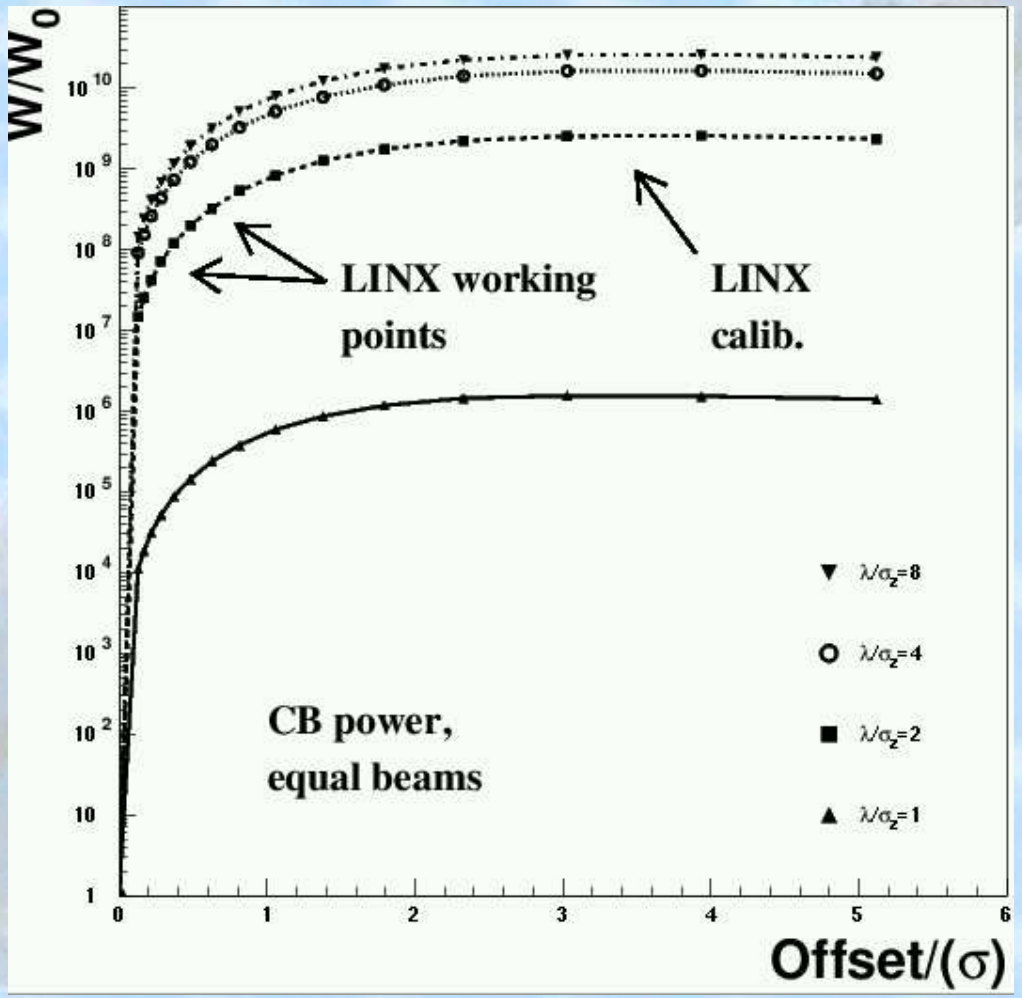

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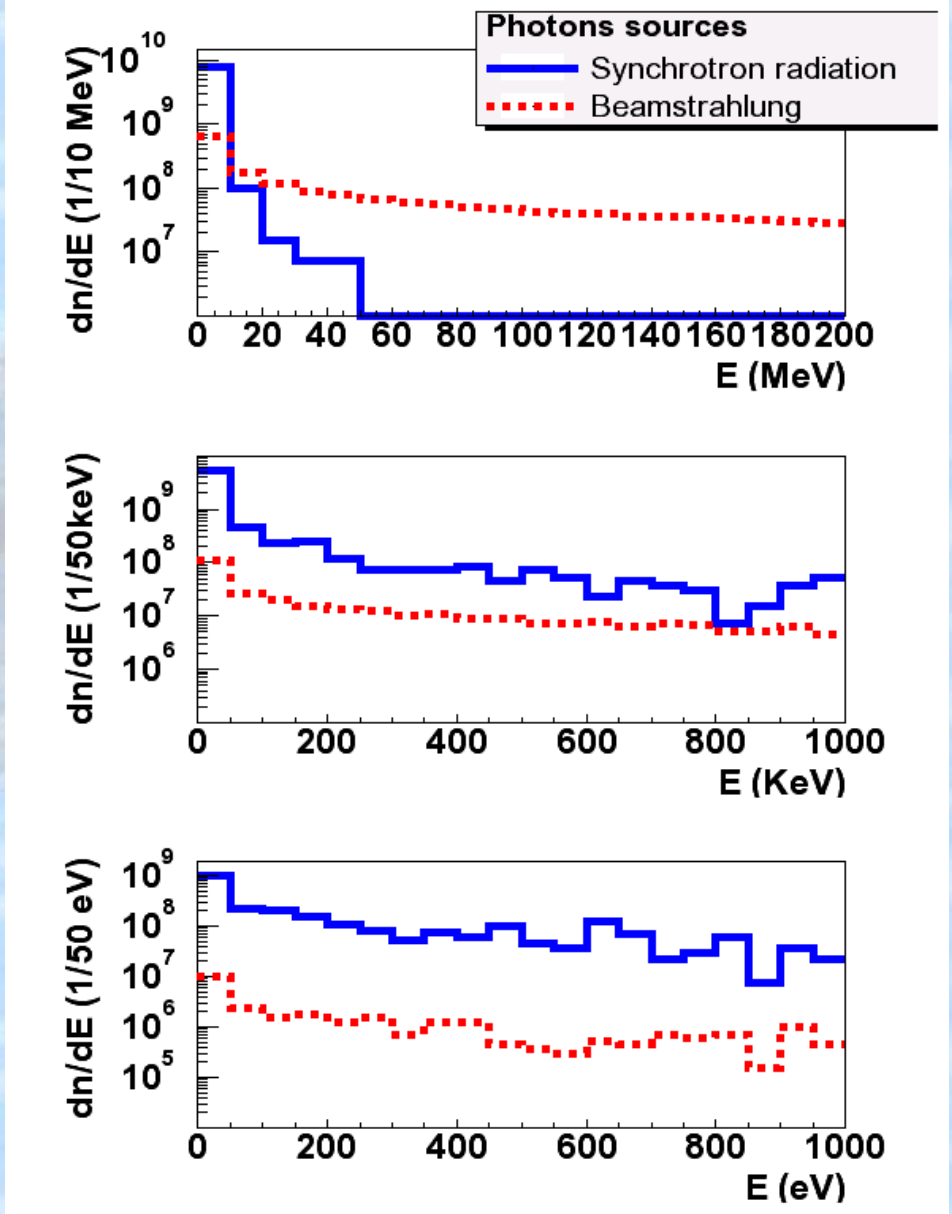
Beamstrahlung vs synchrotron radiation

Beamstrahlung is more intense than the synchrotron radiation at very high energy.
In the optical range, it is ~2 orders of mag. lower.



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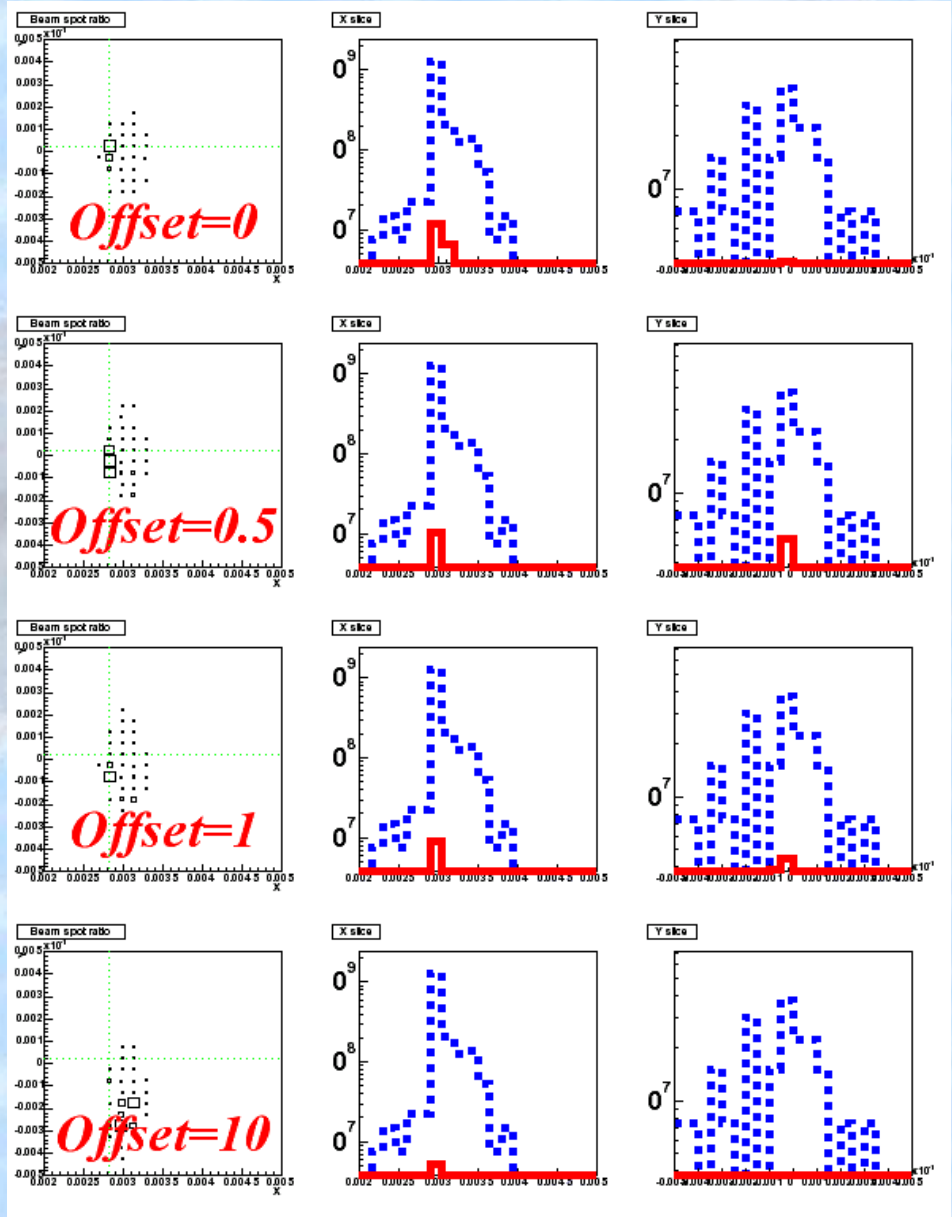
Beam pattern evolution

The pattern evolves as a function of the beam offset.

Plot evolution of the pattern from 0 to 100 sigma offset.



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Observation of the beamstrahlung pattern (1)

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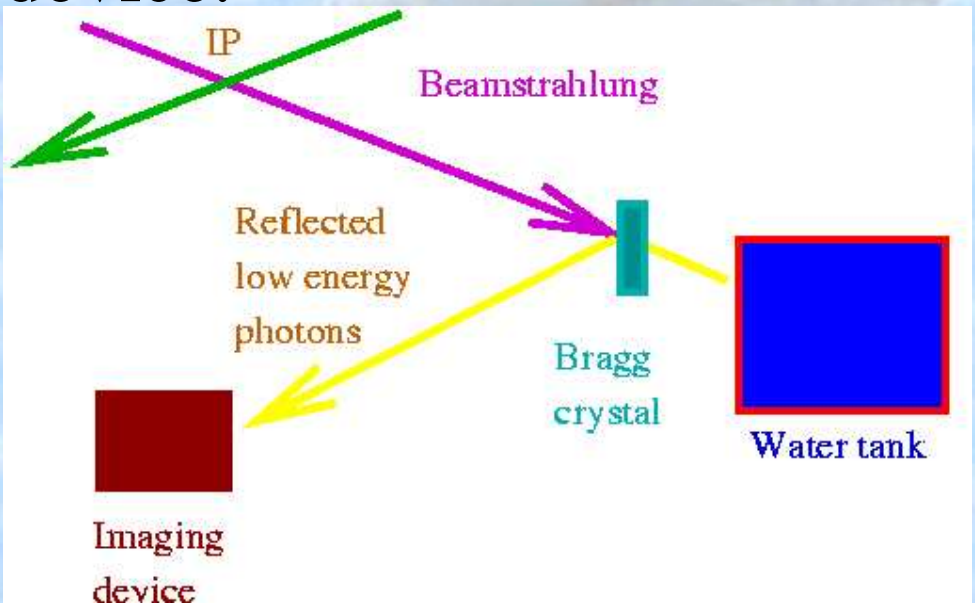
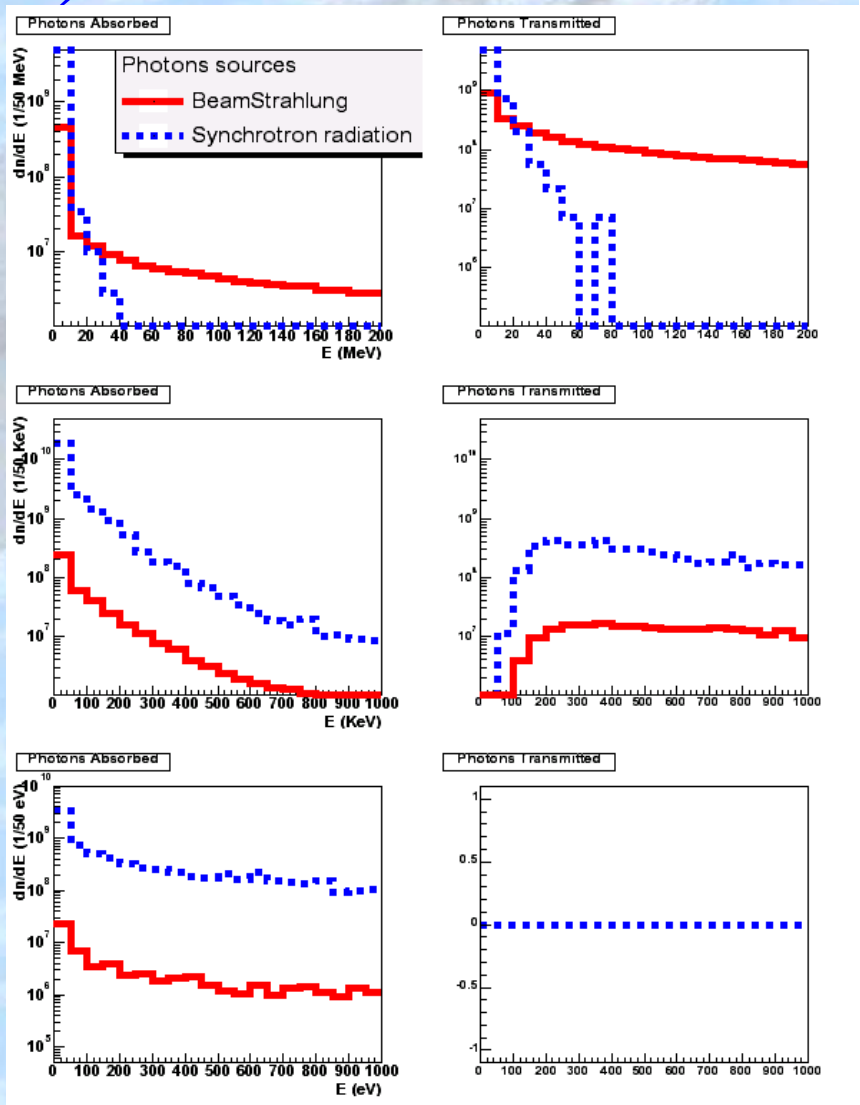
A thin Bragg crystal placed in the photon flux would diffract at a known angle photons of selected (low) energy. They could then be measured with a conventional fast imaging device.





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Observation of the beamstrahlung pattern (2)

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- Beamstrahlung pulse is shorter than SR
  = > A streak camera would distinguish the two component.
- SR is strongly (90%) polarized radially, thus the extraction of only the tangential component would retain mostly the beamstrahlung.
- SR and beamstrahlung have different source (Final magnet and IP respectively), an elliptical grating used as a mirror would thus separate the two.

Contributed by G.Bonvicini

Observation of the beamstrahlung pattern (3)

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Other solutions to measure the high energy component of the spectrum (pure Beamstrahlung):

- Conventional wire scanner

(but needs a measurement over many trains)

- Thin metallic plate to produce e+ e- pairs +analysing magnet
- An electron wire (similar to current laser wire)

Low energy electrons would be scattered by the high energy photons.

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Observation of the beamstrahlung pattern at CESR

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A beamstrahlung monitor has been installed at CESR

Data taken show low backgrounds and reliable pointing capabilities.

Full system should be installed soon and signal should be observed this year.

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Outlook

Beamstrahlung carries important informations about the beam-beam offset and beam length

Solutions to monitor the Beamstrahlung at the LC are under study at different places.

Beamstrahlung will provide useful information about the beams at the IP and for beam diagnostics.

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