# the non-destructive vertical Halo-monitor on the ESRF electron beam

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- the "Halo", what are we talking about ?
- the technique & components used
- how to detect the weak Halo and to block against the strong central beam-core
- adjusting & testing & verifications
- results obtained







there are still (many) electrons .....

# this <u>vertical beam Halo</u> in our 6GeV light source

- what is the Halo? Electron density, at <u>"large" distance</u> from the central core
- what creates it ? <u>Scattering</u> between :
  - the electrons themselves (Touschek)
  - electrons & residual gas particles

how does its vary with different beam conditions ?

- stronger beam density -> stronger Halo

is it a problem ? - yes, for small-gap In-Vacuum undulators

the non-destructive vertical beam Halo monitor

## technique & components :

- -1- using <u>X-rays</u> from a <u>dipole</u> (Source)
- -2- on a free beamport inside an un-used Front-End
- -3- with an vertically adjustable <u>X-ray Absorber</u> to shadow the intense beam-core
- -4- an Aluminium window (to let the X-rays from UHV to air)

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 -5- and a <u>sensitive Detector</u> further down-stream to image the X-rays with scintillator, optics, camera

Goal : the <u>permanent</u> monitoring (at 1Hz) of the Halo intensity, in a region of 1 – 3mm away from the beam-core, and with a <u>calibrated</u> value of this intensity









- 1) X-rays have a none-zero divergence
- 2) the **central beam-core** has 10<sup>6</sup> more intensity then the Halo level



1) X-rays have a none-zero divergence

2) the **central beam-core** has 10<sup>6</sup> more intensity then the Halo level

so we need to block all X-rays from core, upto E-9 level  $\rightarrow$  200urad

side-view not to scale







### answer : scrape off that electron beam Halo !





the Halo is effectively being scraped-off !







vertical position +100um









divergence for 40KeV , B=0.57T, Window 6mm Alu





beam-current= 0.018 mA



#### 2 pm vert. emittance



#### 10 pm vert. emittance





6mA single bunch only, 4 pm vert. emit.



only 6mA beam current (Single-Bunch) Tungsten 1mm removed 600ms, 13dB = maximum sensitivity settings of the detector

and Halo signal still very clear !





## BLDs : installed & commissioned in 2019 by Laura ! nowadays maintained & surveyed by Elena !





normalized BeamLosses (sum all 128 BLDs) and Halo level

#### 1cm Lead shielding Box



the detector, well-protected, works very reliably

# HZB Helmholtz Zentrum Berlin Halo lujah

# thank you for your attention !



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