More about
IP Beam sizes...
Lattice Functions & Beam Emittances

- IP
  - (Aug-07):
    - $\beta_y, H \approx 10.8$ mm, $\beta_y, L = 10.9$ mm,
    - $\beta_x, H = 35$ cm, $\beta_x, L = 23$ cm
  - Aug-06
    - HER: $\beta^* x \approx 74$ cm, $\beta^* y \approx 11$ mm
    - LER: $\beta^* x \approx 21$ cm, $\beta^* y \approx 10$ mm

- **Beam emittances:**
  - MIA
    - HER $\epsilon_y = 0.3$ nmr, $\epsilon_x = 60$ nmr
    - LER $\epsilon_y = 0.8$ nmr, $\epsilon_x = 40$ nmr
**X Beam sizes**

- HER emittance and HER $\beta_x^*$ are larger than LER's (usually) => HER size > LER size
  - MIA emittances:
    - HER $\sigma_x$: 145 $\mu$m, LER $\sigma_x$: 96 $\mu$m (at low beam current)
    - Add dynamic $\beta_x$: $\beta_x^*$ down, $\varepsilon_x$ up. Net effect is $\sigma_x$ down.
  - "Scenario 2": HER $\sigma_x$: 205 $\mu$m (@low current).
    - At high current (1910 on 2600 mA):
      \[ \sigma_{x,\text{HER}}: 147 \mu m, \sigma_{x,\text{LER}}: 71 \mu m, \sigma_{x,\text{lum}} = 64 \mu m \]
      \[ \varepsilon_{x,\text{HER}}: 221 \text{ nmr}, \varepsilon_{x,\text{LER}}: 49 \text{ nmr} \]
      - linear dynamic $\beta$ only!
  - The $x$ size mismatch was as large or larger in Aug-06!

\[ \sigma_{x,L} = \frac{\sigma_{x,+} \sigma_{x,-}}{\sqrt{\sigma_{x,+}^2 + \sigma_{x,-}^2}} \]
**Dyn. β Formulae**

- **Dynamic β:**
  \[ \beta = \beta_0 \frac{\sin \mu_0}{\sin(\mu_0 + \delta \mu)} \]

- **Dynamic ε:**
  \[ \varepsilon = \varepsilon_0 \frac{1 + 2\pi \xi_0 \cot \mu_0}{\sqrt{1 + 4\pi \xi_0 \cot \mu_0 - 4\pi^2 \xi_0^2}} \]

Hirata & Ruggiero,

CERN
**Y beam sizes**

- MIA-derived models usually give HER ≤ LER \( y \) emittance.
- SLM and SXM data tend to be inconsistent with observed luminosity behaviour and the MIA-model prediction of emittance.
  - Finite resolution (pedestal, add in quadrature)
    - most likely present in HER Interferometer
  - Calibration (scale factor) (should not be!)
  - Local coupling (rotation of beam planes)
  - We can try to compare \( 1/\Sigma_y \) to \( L_{\text{spec}} \) & make them agree…
The trend in $L_{sp}$ is now reflected in the trend of $1/\Sigma_y$!
Y Beam sizes adjusted, @ Monitor

Scale LER SXM by 0.4
(LER Y change too large for $L_{sp}$ change)

Subtract 0.17 mm resolution from HER SLM
(HER size change too small for $L_{sp}$ change)
• With these “adjustments”, we get
  – HER: $\varepsilon_y \approx 1.6 \ldots 1.9$ nmr, LER: $\varepsilon_y = 0.8 \rightarrow 1.5$ nmr
• @ IP:
  – HER: $\sigma_y \approx 4.1 \ldots 4.6$ $\mu$m, LER: $\sigma_y \approx 3 \rightarrow 4$ $\mu$m
  – … somewhat small compared to $\Sigma_y$ scans.
Raw SXM Data for Expt.