# Fast Luminosity Feedback

Super-B

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# Problem



- Beam size at IP is very small
  - About 10 um (x), 0.04 um (y), 200 um (z for crab waist)
- Beams will move
  - Slow (mechanical)
    - Ground motion
    - Diurnal temperature variation
  - Fast
    - Power supply noise at 50, 150, 300, 600 Hz

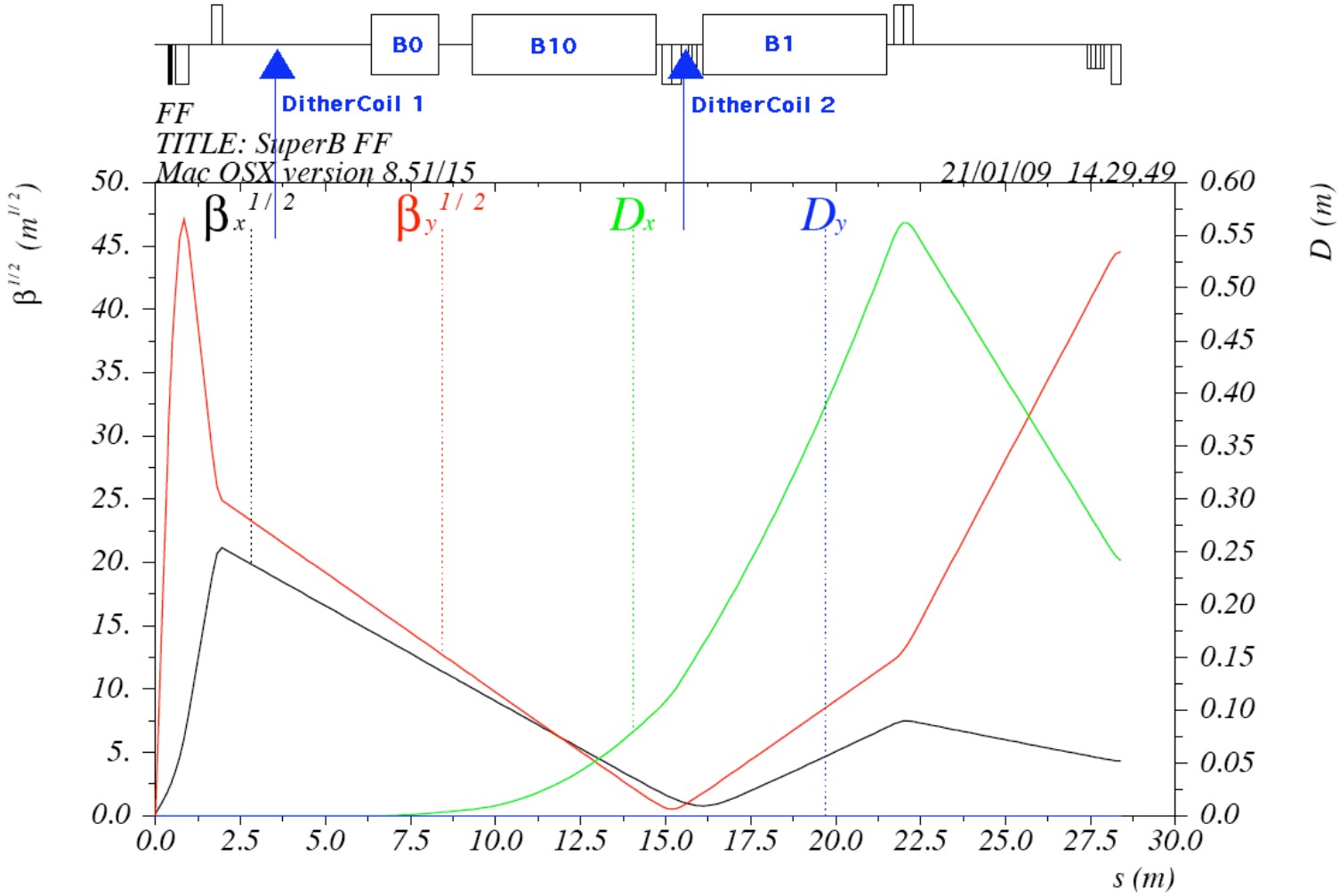
# Dither Coils

SuperB

- Dither LER at IP in x, y, y'
  - Nominally a few % modulation of lumi
- Frequency: 1-3 kHz
  - Above power supply freqs
  - Below synchrotron and betatron freqs
- 4 coil sets needed (each set has an x and y coil)
  - One near IP on each side
    - Want large $\sqrt{\beta}\sin\psi$
    - About 3.5 m from IP: just outside detector solenoid
  - Another further from IP on each side
    - Want large $\sqrt{\beta}\cos\psi$
    - Between QD2 and SDM2, between B10 and B1

# Coil Locations

SuperB




$\delta_E / p_0 c = 0.$

*Table name = TWISS*

# Required Dither Amplitudes

SuperB

| | Preferred Location | Alternate Location |
|---|---|---|
| X (1 um) | (3.5, 3.7) | (-2.3, 10) |
| Y (0.004 um) | (0.18, -0.03) | (0.23, -0.08) |
| Y' (100 urad) | (-1, -30) | (43, -76) |
| Total field (x) | (3.5, 4) | (2.5, 10) |
| Total field (y) | (1, 30) | (43, 76) |

- Table entries are (Coil1, Coil2) excitations in G-cm
  - 4 GeV beam: 13 G-cm gives 1 urad deflection
  - Table assumes 10% shift of beam position--more than enough
- Alternate location puts coil 2 between B0 (soft bend) and B10
- Note high y sensitivity!
  - Even more sensitive at ends of -I insertion (because beta y large)
  - Has implications for QD, QF, S power supplies here
- Expect coupling between x and y; true excitations will be mixed

# Beam Pipe



- Ceramic with ~1-2 um Cu coating
  - Skin Depth ~2 um at 1 GHz
- HOM considerations
  - Want multiple skin depths at ~8 GHz (for ~6 mm bunch)
- Dither frequency considerations
  - 1 um Cu induces ~0.2 degrees phase shift at 1 kHz
- Image current considerations
  - Resistance ~0.1 ohm/m (1 um Cu; 5 cm dia pipe)
  - Dissipates ~0.4 W/m at 2 A beam current

# Coils



- Propose coil similar to CRT deflection coils
  - "Saddle" coils with cos(θ) current distribution, ferrite shield
  - Much more efficient than PEP-II Helmholz coils
- Estimated parameters
  - 10 cm long
  - 1 ohm, 2 mH
  - 200 mA for "nominal" excitation, 2A allowed
  - ~$1k per coil set from commercial vendors

# System Issues



- Luminosity Monitor
  - Statistical noise depends on lumi signal
  - Feedback system must change with lumi; reduced bandwidth at low lumi
- Corrections
  - LF (< ~1 Hz) through normal dipole correctors
  - HF (> ~1 Hz) through dither coil system
    - Can correct at 10-20% of dither freq at high lumi

# References


- A.S. Fisher et al, “Commissioning the Fast Luminosity Dither for PEP-II”, Proceedings of PAC 07, Albequerque, NM, 4165-4167; SLAC-PUB-12608, July 2007.
- S.M. Gierman et al, “New Fast Dither System for PEP-II”, EPAC 2006, Edinburgh, U.K., 3029ff; SLAC-PUB-12679.