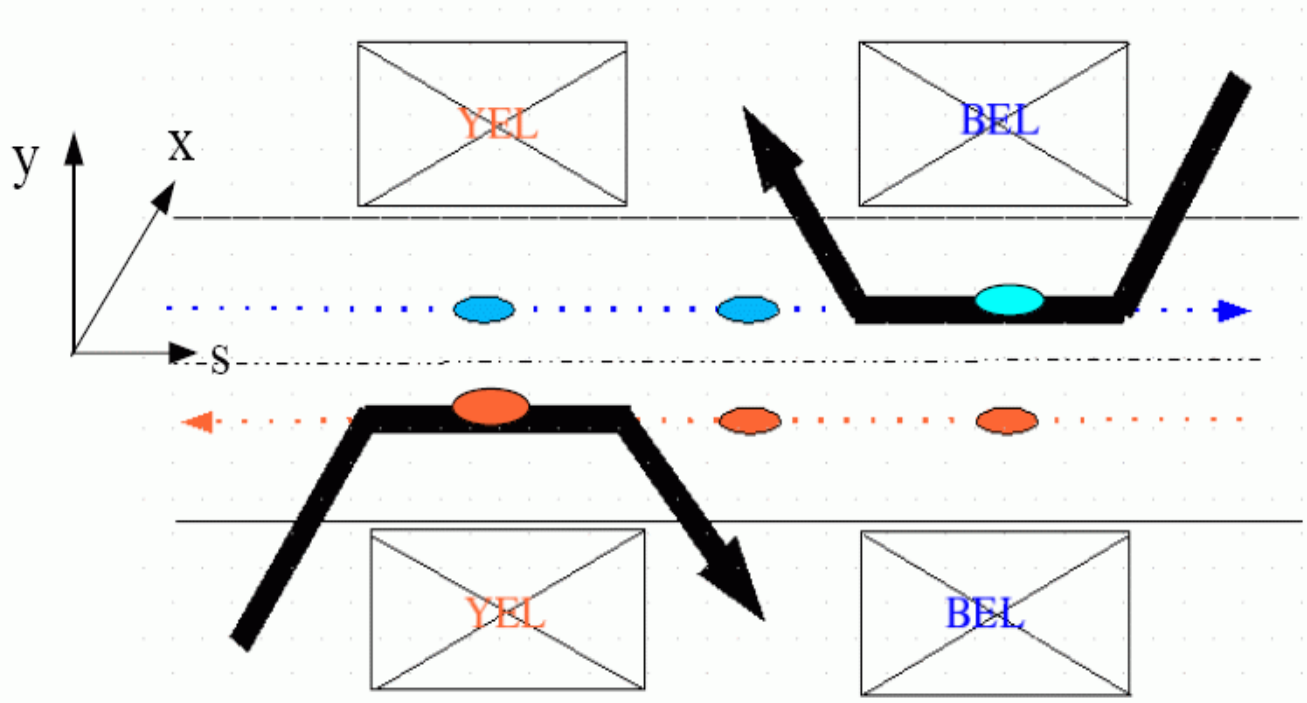
Status of RHIC head-on beam-beam compensation with e-lenses

Y. Luo for the team

1. The idea:



Proton beams are vertically separated around 5~10 mm.
Electron beams are dumped on the IP10 side.

2. Current studies:

Parameters and Layout	W. Fischer and Y. Luo
Single particle stability	Y. Luo and N. Abreu
Multi-particle tracking	Y. Luo and G. Robert-Demolaize
Effects of noises and errors	N. Abreu and G. Robert-Demolaize
Design of RHIC e-lens system	EBIS experts led by A. Pikin

Other important issues

action diffusion->emittance predication	N. Abreu
phase advances between IPs	C. Montag and Y. Luo
LifeTrac for e-lens	J. Beebe-Wang

3. Where we are:

- Ready to close single particle stability study for nominal cases
- Multi-particle tracking gives beam decay and emittance growth
- Action diffusion is being used to predicate emittance growth rate
- LifeTrac is being debugging for e-lens simulation
- Electron gun, collector designs are done and being further modified

- **To be activated**

  effect of noises and errors

  phase advances between Ips

  3-D modeling of magnetic structure, e-beam steering system

- **Current highlight**

  emittance growth predication from direct tracking (Yun, Joanne)

  and analytical calculation (Natalia)

4. What physics results we have:

- Head-on beam-beam is very efficient to reduce the p-p beam-beam generated tune shift and tune spread; Frequency map analysis, Lyapunov exponent, action diffusion all show it heps stabilize particles below 3\sigmas while destabilize particles beyond 4\sigmas. Dynamic aperture reduction with compensation is seen in 10^6 turn tracking.

- Multi-particle tracking up to 10^7 turns shows that half head-on beam-beam compensation gives comparable beam decay as that without compensation; full beam-beam compensation gives several times larger beam decay, especially for WP (28.685, 29.695).

- Emittance predications from numerical trackings and analytical predications are not conclusive yet. It looks like with head-on beam-beam compensation, emittance growth gets smaller compared to that without compensation.

5. What to do next

- **Secure emittance predication**
- **Compare results from different codes or different approaches**
- **Check effect of phase advances between IPs**
- **Effects of noises and errors**
- **Finalize the design of e-lens system**

Time line:

By May 2008, review preliminary study results
By July 2008, give final study report