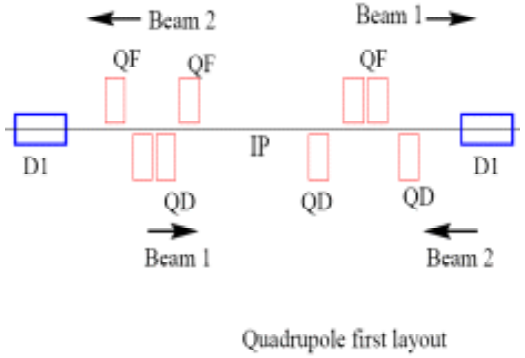
Summary of IR Upgrade Status & Beam-Beam

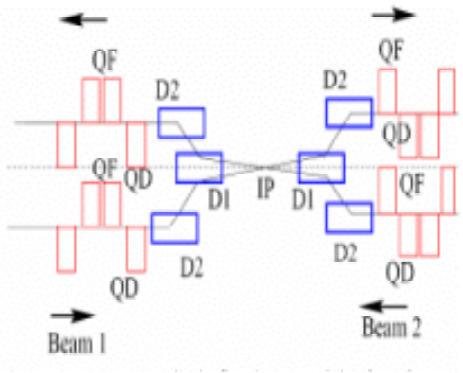
(LARP Collaboration Meeting, April, 2006)

John A. Johnstone

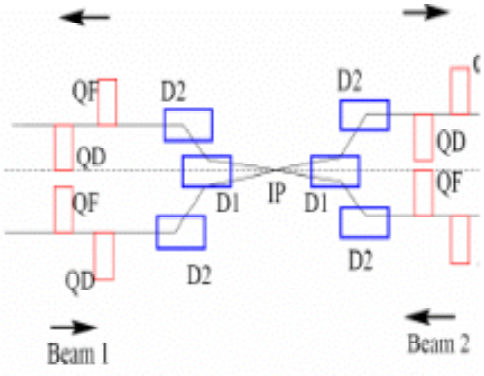
- 3 basic configurations are under consideration:



Triplet quads first



Dipoles first & triplets



Diples first & doublets

- It had been proposed that IR designs should be evaluated based on the criteria:

  (i) Luminosity reach;

  (ii) R&D time for critical hardware, and;

  (iii) Operational time required to implement an upgrade scheme into routine operations.

- A repository of the various layouts is maintained for study at CERN containing lattice files, plots of apertures, and optics functions. The goal being to deliver a baseline upgrade scenario by the end of 2006.

- The general concensus at the LARP meeting seemed to be that the rating criteria are too simplistic. "Luminosity Reach", in particular, is an ill-defined concept, and the interplay of many complex parameters must be evaluated, e.g:

  magnet fields & apertures
  energy deposition
  beam-beam interactions
  susceptibility to random noise - ground motion, power supply ripple, etc.
  closest approach of magnets to the IP (L*)
  …….

Sampling of IR Issues Discussed:

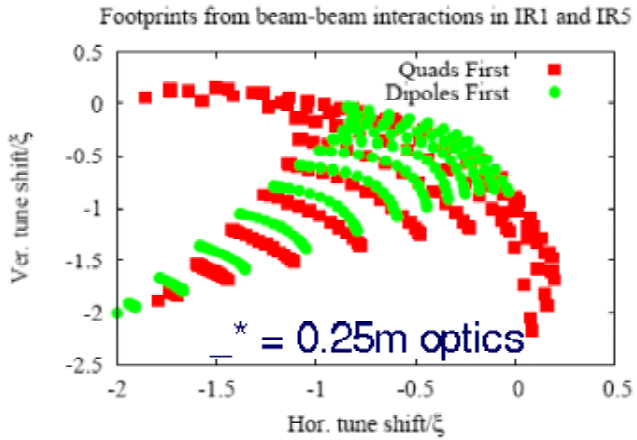
- All 3 schemes require quad apertures >100 mm, which implies Nb_3Sn technology.

- Quadrupoles first:

  Advantages are the minimum operational times required to implement successfully, and the greatest luminosity benefits acheived by reducing L*.

- Dipoles first & triplet optics:

  Major motivation is the smaller number of long-range beam-beam interactions (~12 per IR, compared to ~30 with quads first).

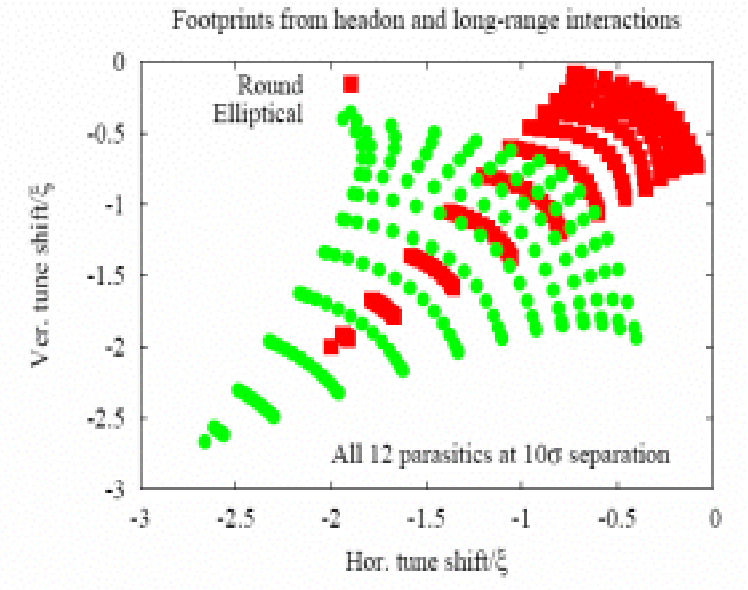


- Do the 'wings' have an adverse impact? Needs to be studied with simulations.
- If wire compensation is shown to be effective this may not be a concern.

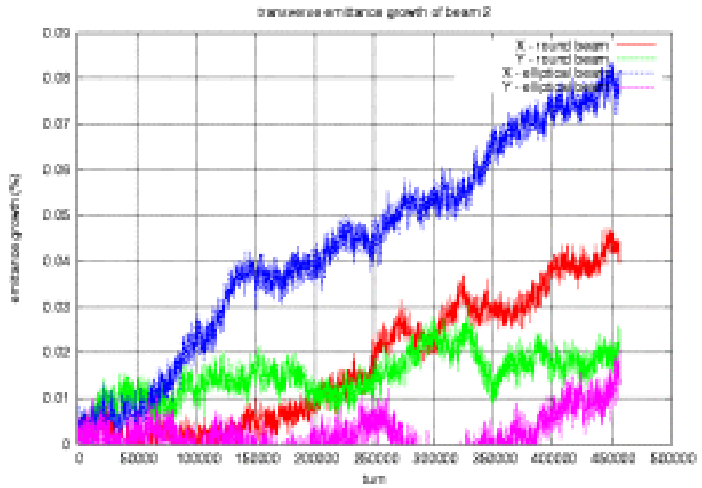
- Dipoles first & doublet optics:

  Doublets produce elliptical beams at the IP, giving a luminosity increase >30% for equivalent β^* to round beams & same β_{max} (reduced crossing angle in plane of larger β^*).

  Beam-beam behavior is different from round beams:



Elliptical beam have a larger footprint

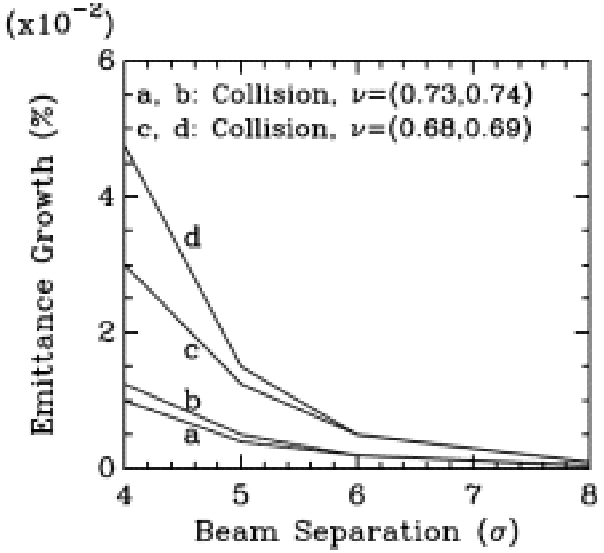


Emittance growth from head-on collisions is larger for elliptical beams (J. Qiang)

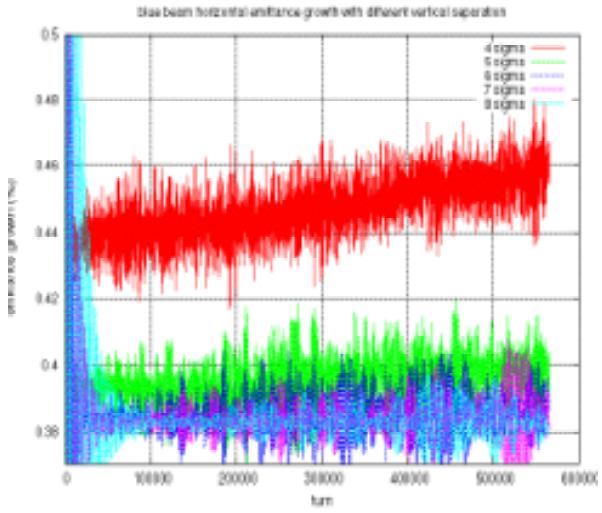
- Doublet optics need more analysis before becoming a truly viable candidate.

RHIC Beam-Beam Experiments & Simulations:

- Beam-beam experiments are intended to quantitatively answer whether a single parasitic causes beam losses that need to be compensated, leading to test of wire compensation in 2007.
- Wire compensator has been designed.
- Simulations are being performed at FNAL, SLAC, LBL, and U. Kansas to improve codes & predict RHIC observations and effects of wire compensation.



Emittance growth with beam separation & working point (U. Kansas)



Emittance growth with vertical separation - cliff at ~5σ (LBL)

Summary of IR Summary

- IR optics layouts have been proposed, with a lattice repository at CERN. The goal is to rate IR designs with an eye to defining a baseline scenario by the end of 2006(!).
- Beam-beam simulations will be helpful in deciding between IR configurations.
- Beam-beam experiments have been started at RHIC & initial beam-beam simulations results have been reported by several groups.
- Both wire compensators will be installed in RHIC during the 2006 shutdown, and first tests with beams are scheduled for 2007.

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