

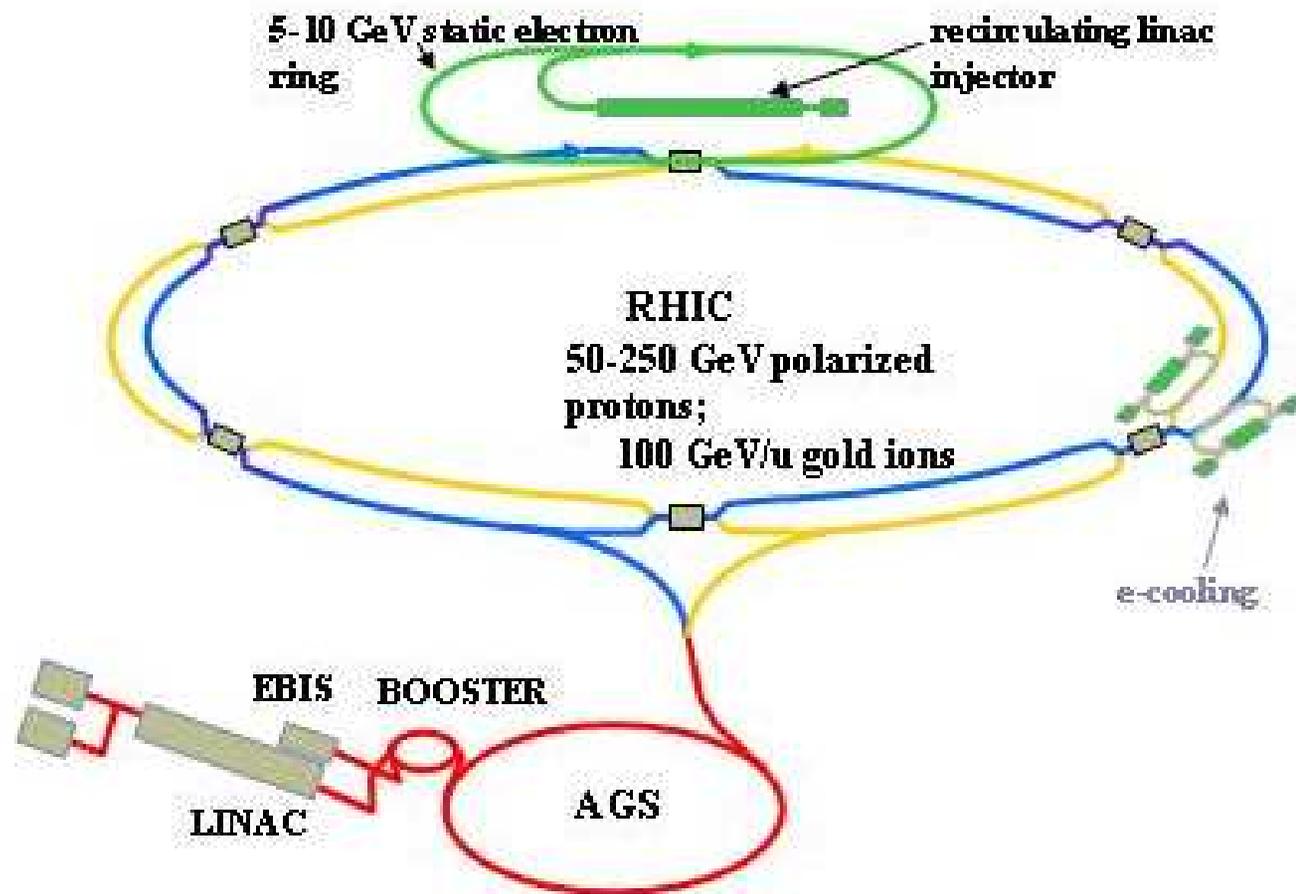
eRHIC Status

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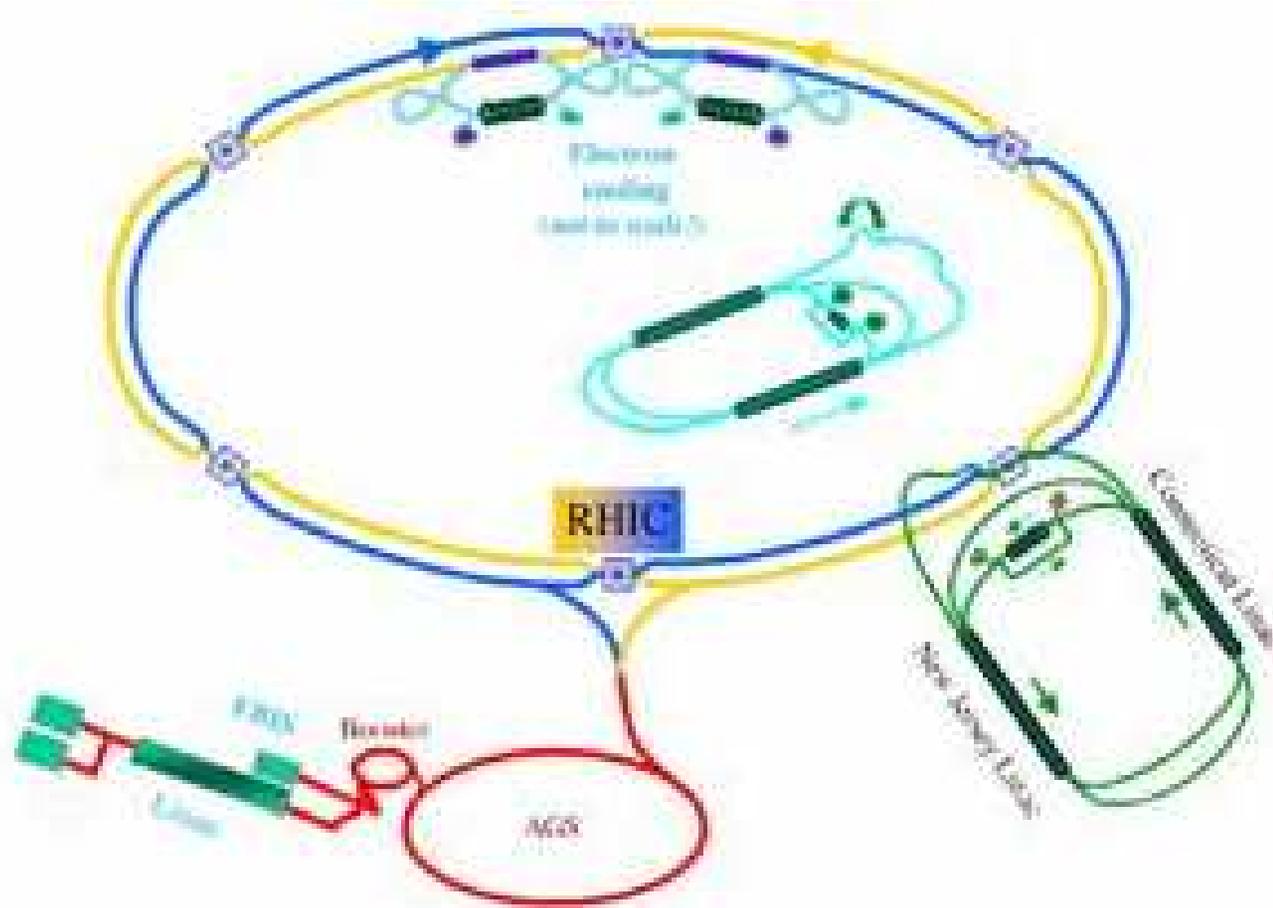
Scope of this talk

- eRHIC overview, parameters and status
- Beam experiments and development related to eRHIC

Ring-ring design option



Linac-ring design option



Ring-ring parameters

	High energy setup	
	\vec{p}	\vec{e}
Circumference [m]	3834	1278
Energy [GeV]	250	10
Bunch intensity [10^{11}]	1	1
Number of bunches	360	120
emittance (x/y) [nm]	9.5/9.5	53/9.5
β^* (x/y) [m]	1.08/0.27	0.19/0.27
beam-beam parameter (x/y)	0.0065/0.00325	0.029/0.08
Luminosity [$10^{32} \text{ cm}^{-2} \text{ sec}^{-1}$]	4.4, no cooling required	

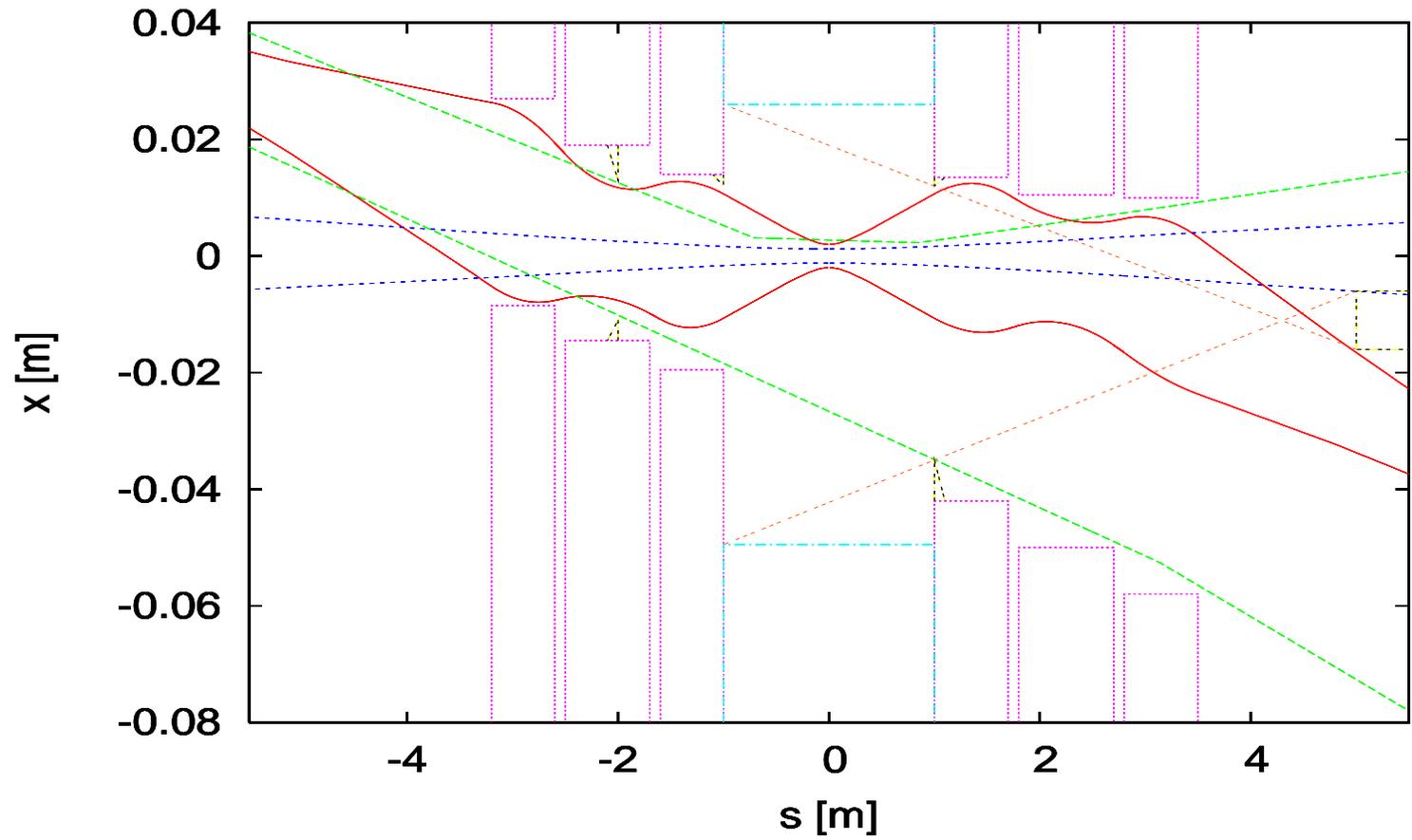
Cooling required for electron-ion operation

Linac-ring parameters

	High energy setup	
	\vec{p}	\vec{e}
Circumference [m]	3834	
Energy [GeV]	250	10
Bunch intensity [10^{11}]	1-2	1
Number of bunches	360	
emittance (x/y) [nm]	9.5/9.5	2.5/2.5
β^* (x/y) [m]	0.27/0.27	0.99/0.99
beam-beam parameter (x/y)	0.0065/0.0065	
Luminosity [$10^{32} \text{ cm}^{-2} \text{ sec}^{-1}$]	10-20, no cooling required	

Cooling required for electron-ion operation

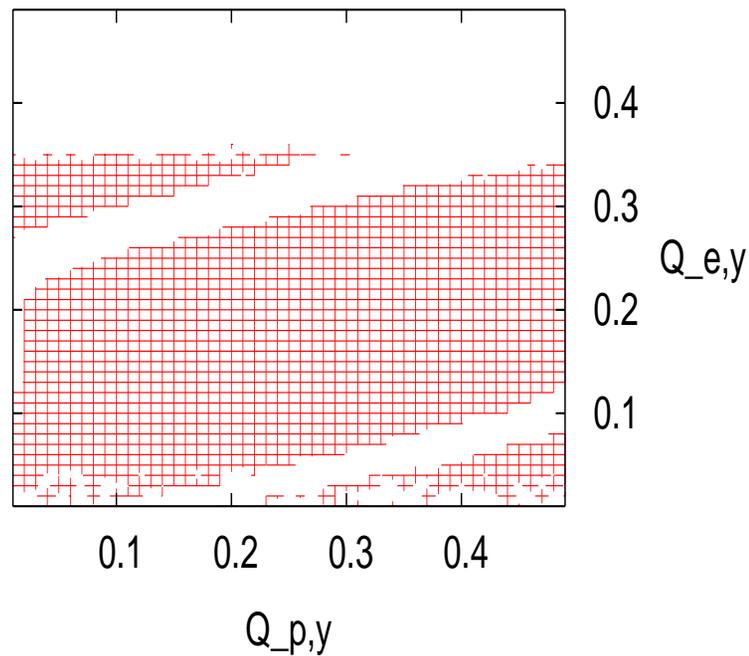
Ring-ring interaction region



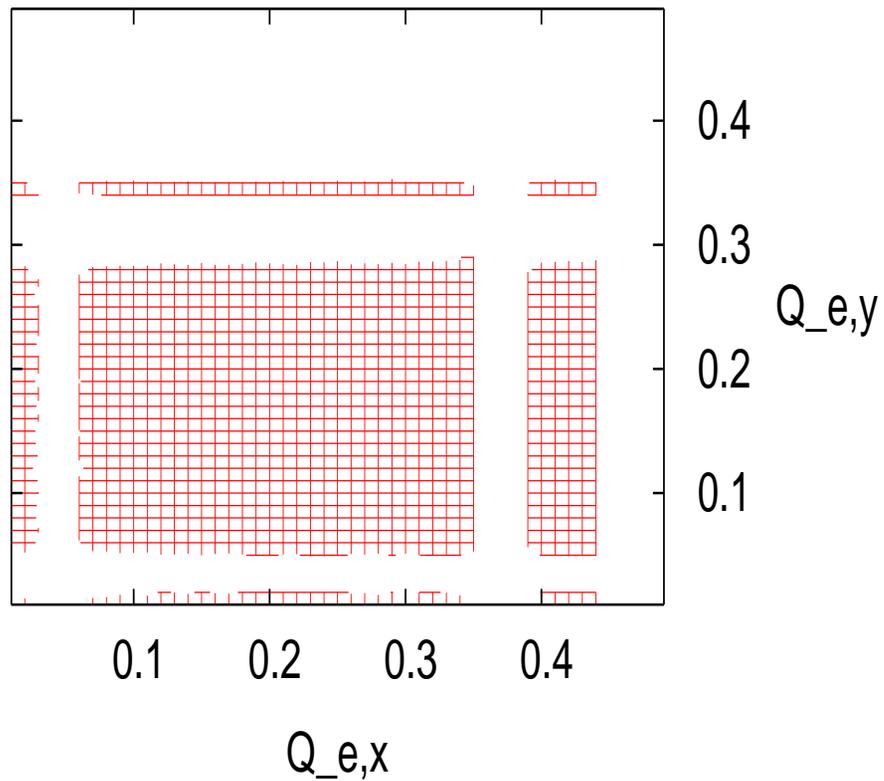
Unequal circumferences

Tunes of both rings have to be chosen properly to avoid barycenter motion of beams

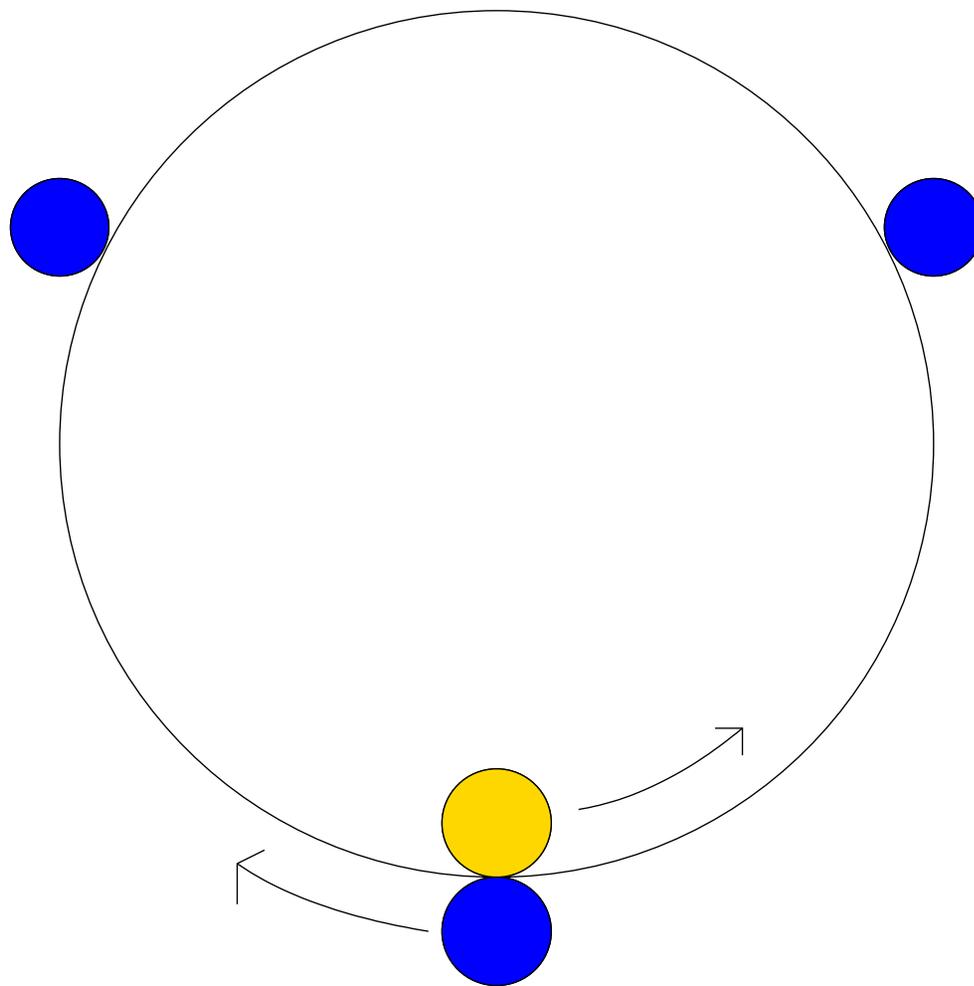
Stable tune regions (checkered) in the vertical plane, $\xi = 0.08$:



Stable electron tune regions (checkered), for nominal proton tunes $Q_x = .21$, $Q_y = .23$ and $\xi_x = 0.029$, $\xi_y = 0.08$:



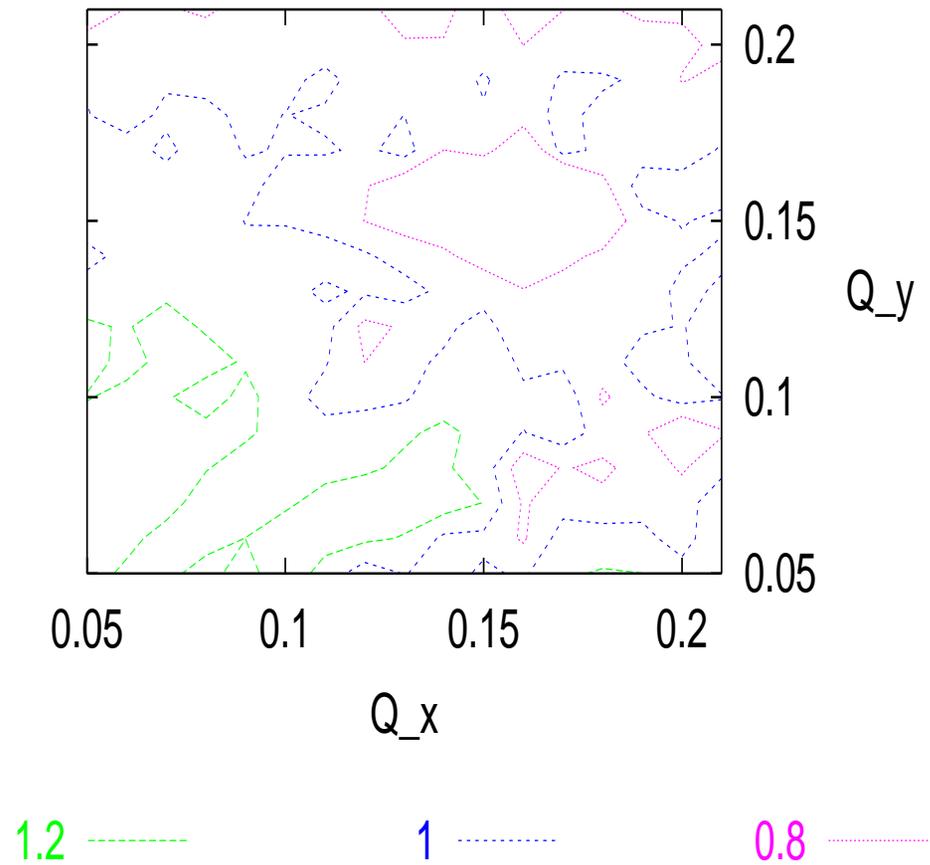
This effect can in principle be studied at RHIC:



Ion bunch intensity

- eRHIC design bunch intensities already routinely achieved for both protons and gold beams
- Limitations due to beam-beam tune shift
 1. between two ion beams in parallel mode
 2. on electron beam in both dedicated and parallel operations mode (ring-ring only)
- Other limits due to cryogenic load, e-cloud and single bunch instabilities

Luminosity contours vs. electron working point, in units of the design luminosity



Electron bunch intensity

- Limitation due to beam-beam tune shift on ion beam
 - Beam-beam tune shift for Cu-Cu at maximum intensity will be very close to eRHIC design parameter
- Total intensity limited by synchrotron radiation heat load (10kW/m)

Number of RHIC bunches

- Need large number of bunches to get $\approx 10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$ e-p luminosity
- Vacuum pressure rise, electron cloud
Remedies: NEG pipes, baking, solenoids
- Instabilities
- Cryogenic heat load
- Parasitic collisions in existing IPs
- Requires new, very fast injection kickers

Conclusion

- Cu-Cu beam-beam tune shift parameter will be very close to eRHIC design value
- Ongoing studies and efforts to explore and improve electron cloud and pressure rise issues
- Effect of unequal circumferences can be studied at RHIC, if necessary
- Polarization development
- Proton acceleration to 250 GeV