RF & Stochastic Cooling for pA

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Thanks to Mike Brennan, Steve Tepikian and Wolfram Fischer

Outline

- Frequency considerations
- RF configurations
- Ion stochastic cooling
- Technical considerations

Frequency considerations

Differing revolution frequencies results in modulating the beam-beam force.

This greatly reduces the allowed bunch intensity.

The revolution frequencies of both beams therefore, need to be the same.

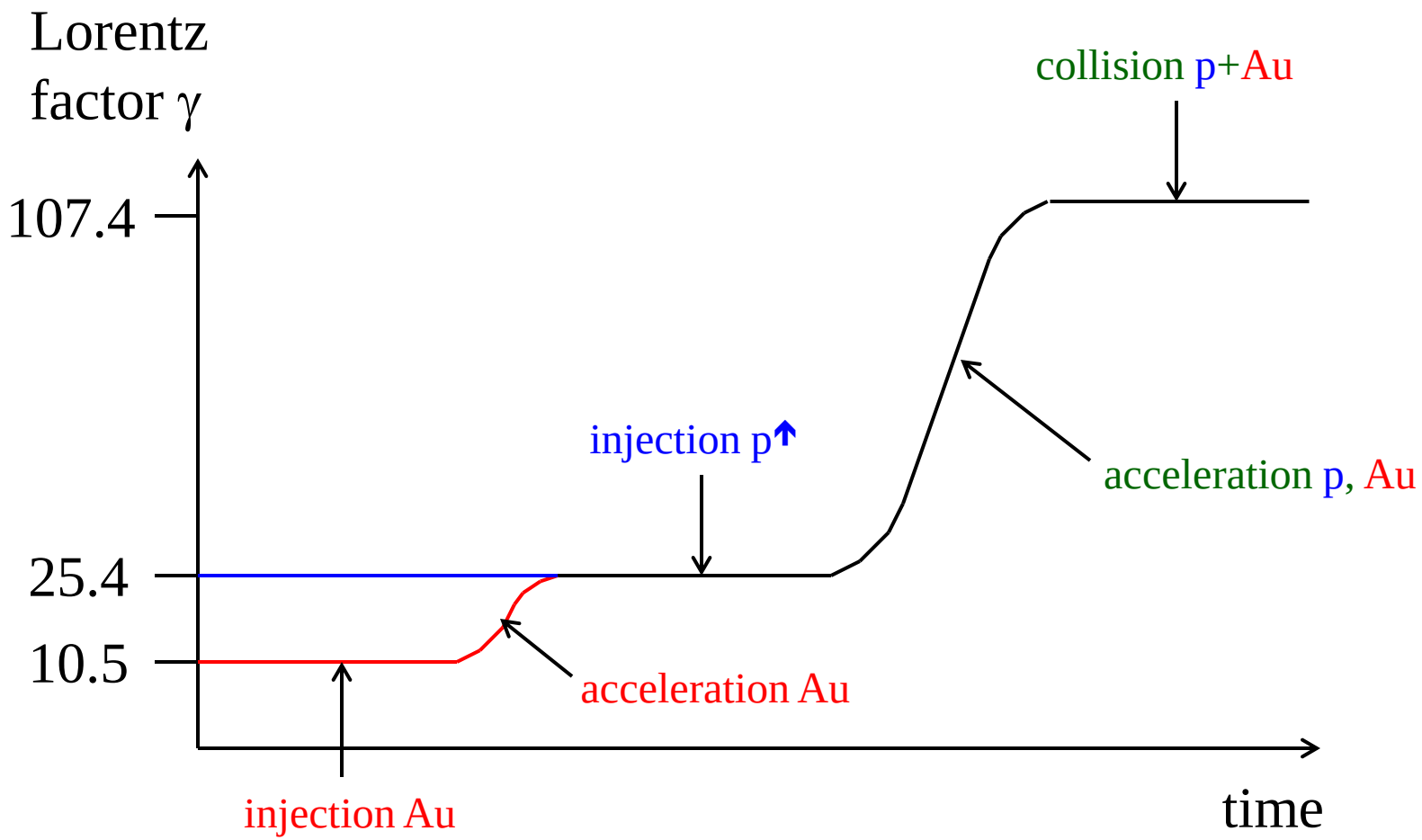
The circumference for p will be 2 cm more than for Au, yielding $\delta\gamma / \gamma \leq 5\times10^{-3}$, ignorable for this discussion.

Typically, Z/A ≤ ½ for ions so their maximum value of γ in AGS is about 10. For protons we typically go to γ=25.4.

The electron cloud problems in RHIC occur when the bunch is short, so protons going though transition would be bad.

Therefore, we will inject the ions at γ ≈ 10, accelerate to γ=25.4 and then inject protons.

p+Au injection and acceleration



RF configurations

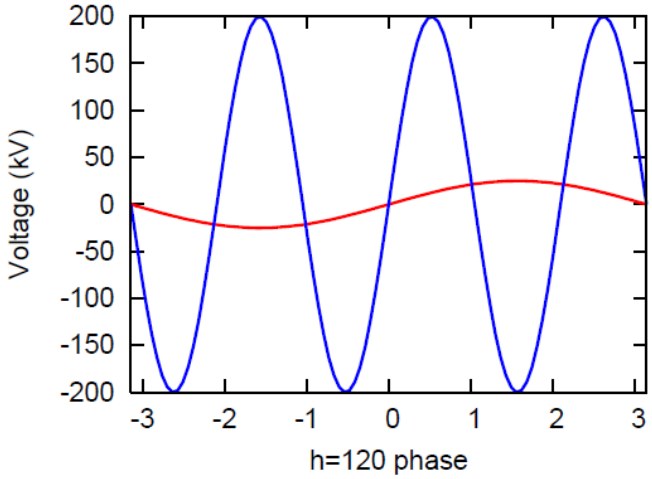
As of now only the 9.4 MHz (h=120) cavity is shared by both rings. Its voltage is limited to 25 kV.

For heavy ions the 28 MHz system (h=360) is the prime mover.

Typically, V=200 kV for 28 MHz.

We can run the 9.4 MHz on the ramp without bothering the ions.

During proton rebucketing the 9.4 MHz is not varied so this will not bother the ions.



Ions use no shared cavities at all.

Therefore, the RF parameters for protons and ions will be the same as they are when we run a single species.

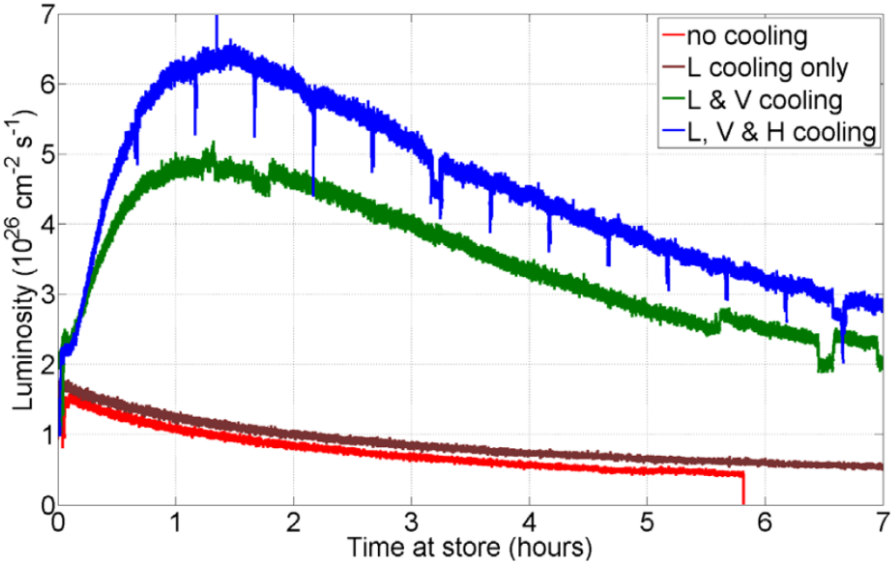
Ion stochastic cooling

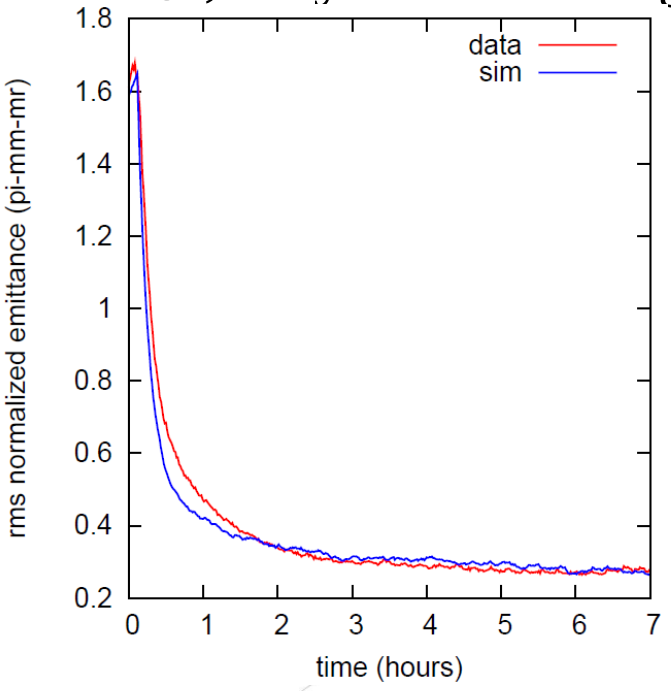
Ion RF and lattice parameters are the same as during single species running.

Stochastic cooling systems for the two rings are independent.

So, stochastic cooling will be identical to that for single species running.

Other considerations, like beam-beam $\propto 1/\varepsilon$, may limit cooling.





Technical Considerations

When injecting protons we will need to make sure the ion beam does not see or induce time dependent beam-beam.

Best solution would be to run the protons at fixed frequency and allow for small (10 degree?) phase modulation in the ion ring to damp any longitudinal oscillations.

Probably, we can turn off beam control in the ion ring and run at fixed frequency, like during store. KISS principle suggests this should be the first step.

The proton injection porch will vary from cycle to cycle, so the length of the γ=25.4 porch for ions will vary.

Snap-back might be an issue (JMB).

Gold IBS could be significant during proton injection (WF).