Status of Kaon Beam Delivery

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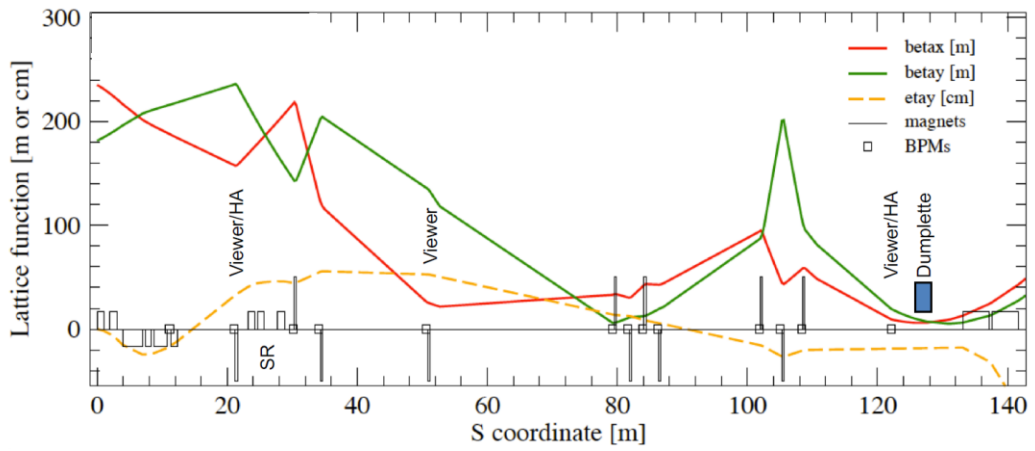
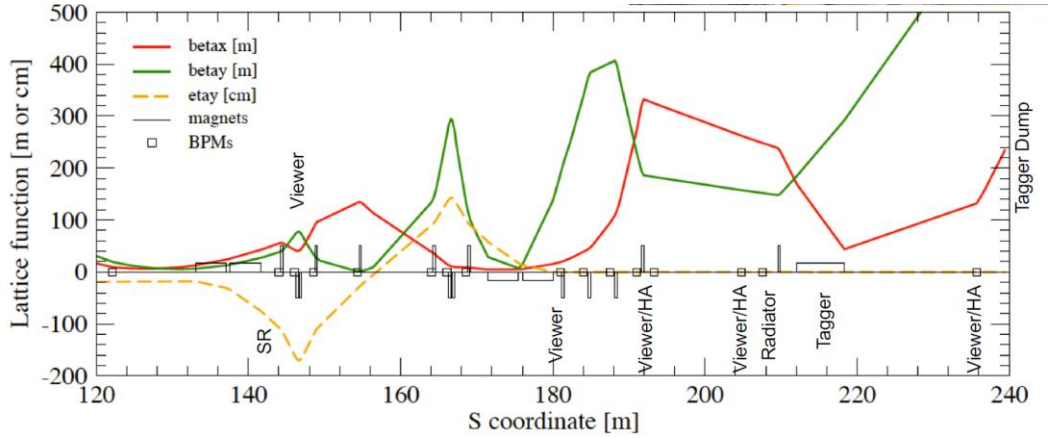
Contents

- Brief look at the current beam delivery and the baseline parameters
- Issues with potential changes to the bunch timing
- Issues with the final focusing system
- Current/Future work
- Accelerator questions for you

Hall D Beam Line





Hall D

Beam Property	Nominal Value/Range	Temporal Stability over 8 hours
Spot size at target♦ (rms) [μm]	Horizontal < 1000 Vertical < 500	Horizontal ~ 100 Vertical ~ 100
Angular divergence at target [μrad]	< 15	< 1
Current [nAmp]	1 - 2000#	10%
Charge per bunch [fCoul]	4×10^{-3} - 8	10%
Bunch repetition rate [MHz]	249.5*	NA
Beam position	± 1 mm	< 40 μm (with 5C11B lock)
Energy spread♠ (rms)	2×10^{-3} - 3×10^{-3}	~ 10% of nominal (linac crested)
Beam direction	± 30 μrad	< 2 μrad (active collimator lock)
Energy range [GeV]	8.8 - 12.1	NA
Energy accuracy♥ (rms)	3×10^{-3}	stable
Background beam halo	< 0.1%	stable
Beam availability (including RF trips)	60%	stable

'<' – 'not to exceed'

♦ Based on emittance measurement at 5C00 logged since late 2015. Straightforward tuning provides geometric emittances of: $\varepsilon_x \sim 7\times10^{-9}$ m-rad, $\varepsilon_y \sim 5\times10^{-9}$ m-rad.

Consistent with 900 kW beam power and limits on Faraday cup and beam stopper.

* Other frequencies, such as 499 MHz are also available.

♠ These are ideal numbers, no RF phase errors, just synchrotron radiation. This assumes phasing software running in background to minimize effects of RF curvature

♥ Set by errors in dipole field measurements only.

Timing of the beam bunches

- The current baseline has a bunch spacing of 64ns
- To increase resolution we have been asked to look at 128ns spacing
  - Laser and gun modifications
    - For lower repetition rates the signal has to pick particular laser pulses to send to the cathode
    - This can lead to a bunch periodically being put into the wrong bucket, so there might be larger gaps from time to time. Is this acceptable?
  - Beam dynamics in injector
    - Simply increasing the bunch charge won't work, though it is not outside of the operations range of CEBAF
    - The dynamics need to be reoptimized

Final Focusing

- The requested beam parameters at the CPS are a spot size of 1-2cm horizontally, and 5mm vertically, and projected to have a minimum at the Be target 67m downstream
  - Horizontal β function is close to the GlueX value, vertical is somewhat small
  - Getting the proper convergence requires a large beamsize in the triplets
    - This beamsize is tight in the existing magnets, there are options for new ones

Further Work

- Looking at bringing in a student to help with GPT simulations of injector dynamics.
- A new amplifier and some laser table work is needed for the pulse formation
- Will be bringing in another student to help with the final focusing optics
- Look at a possibility of larger magnets to go into the final focusing section

Questions for You

- How important is the beamsize at the CPS (what are the tolerances)?
- How important is the longer time in between bunches
  - Are occasional out of phase bunches acceptable?
- What beam quality is acceptable at the CPS?
- Any other issues/constraints I should be aware of?