Status of Kaon Beam Delivery

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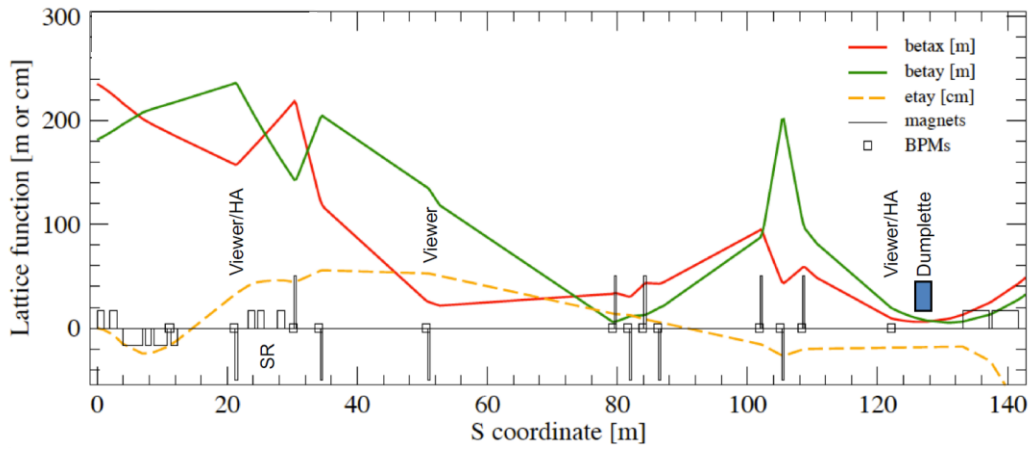
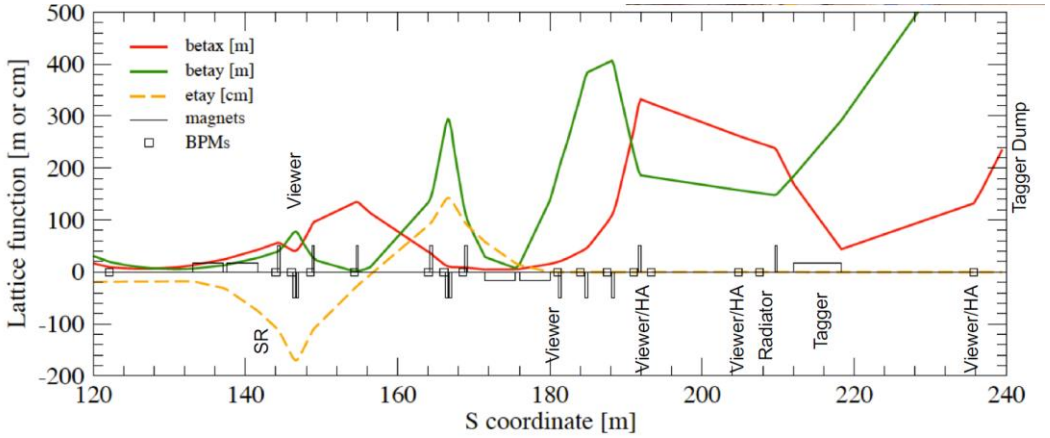
Hall D Beam Line





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.

https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-154003/18-022.pdf

Timing of the beam bunches

Current (μA)	Repetition Rate (MHz)	Harmonic of 499 MHz	Bunch Charge (pC)	Equivalent 499 MHz Current (μA)
2.5	15.59	32nd	0.16	80
2.5	7.80	64th	0.32	160
5.0	15.59	32nd	0.32	160
5.0	7.80	64th	0.64	320

- The current KLF request 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
  - Requires 1-2yr lead time to design and build the system

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 grad 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 grad student to help with the final focusing optics
- Look at a possibility of larger aperture 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?