

Beam Optics Evolution in the Cooling Channel

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April 12, 2018



- Aim to evaluate the current understanding of the beam optics in the cooling channel
- Compared the beam optics (4D transverse emittance, beta function, alpha function) calculated from data and MC



- Analysis H57a, Run 10448
- 2017-02-7 setting
- Flip mode, 3T in SSU (M1, M2 on), 2T in SSD (M1 off, **M2 on**)
- LiH Empty (None)
- 140 MeV/c, nominal emittance 3 mm, $\beta_{\perp} = 500$ mm



- Reconstruct beam optics in the trackers from real data, applying the following cuts:
 - TKU $\text{Chi}^2/\text{ndf} < 4$
 - TOF01 consistent with muon peak : 29 - 31 ns
 - TKU: $135 \text{ MeV}/c < \text{total momentum} < 145 \text{ MeV}/c$
 - Transmission cut: analyse only events with 1 track in each tracker
- For all particles that survive the first three cuts above, extract their information at the first scifi plane in station 5 of TKU → feed it into the MC simulation
- Calculate beam optics of the MC simulated beam at a series of virtual planes along the cooling channel, between both stations 5 of TKU and TKD

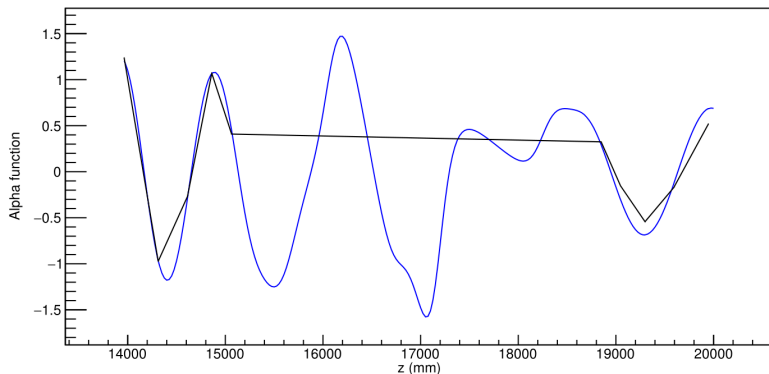


Results

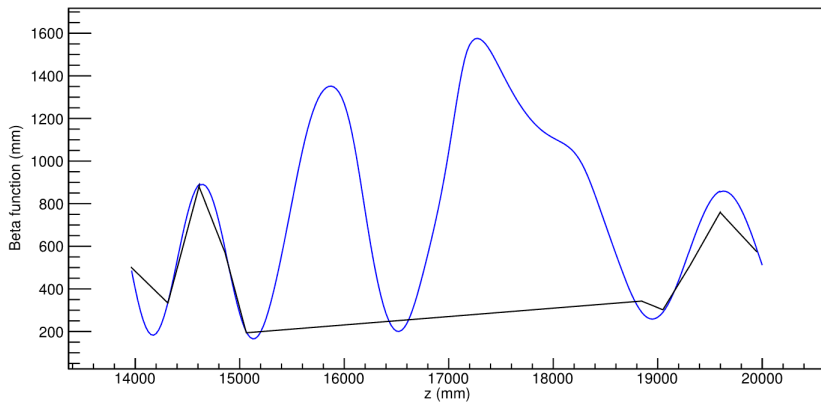


Alpha function

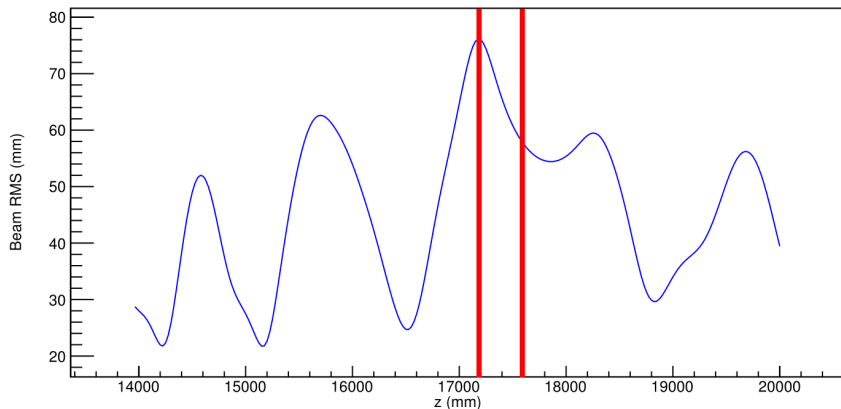
- In the following comparisons, only events with 1 track in each trackers are analysed, both in data and MC



Beta function



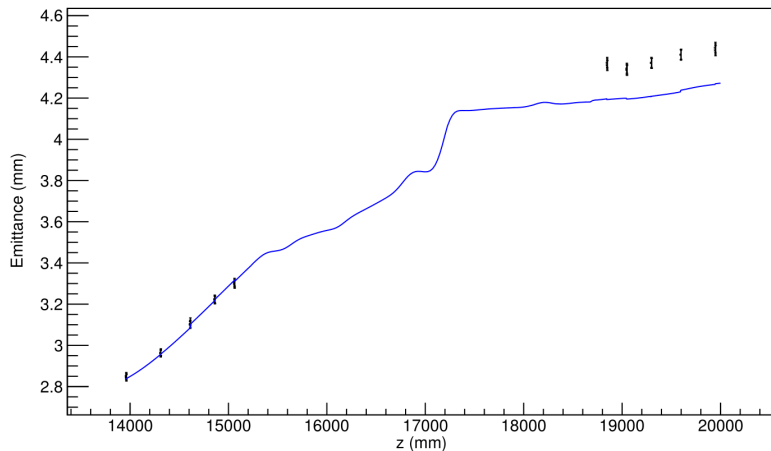
Beam RMS



- red lines indicate downstream flange of AFC (160 mm) and entrance in SSD (180 mm)

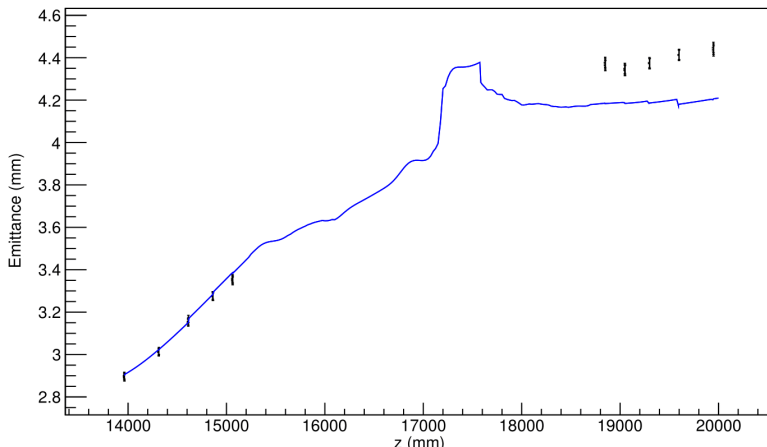


Emittance (a)

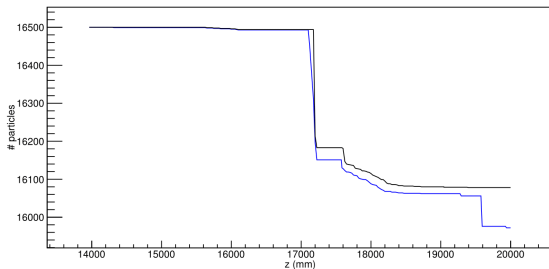


Emittance (b)

- No transmission cut applied on data, MC
- Aperture cuts applied at TKU, TKD (150 mm), AFC (160mm), SSD (180 mm) on MC



Number of particles



- MC, no transmission cut applied
- No cuts (black) vs aperture/radius cuts in TKU, TKD, AFC, and SSD (blue)
- As previously signaled, beam scraps apertures at AFC and SSD entrance



- Good agreement in SSU, discrepancies in SSD need further investigation
- SSD beam optics include particles that are deflected off the apertures, while in MC simulation such events get discarded → do not contribute towards the optics calculation
- Next steps
 - Include cuts plots
 - Apply a radius/diffuser cut on the real data to select only particles that have tracks confined within a certain radius are included in analysis
 - Momentum bins
- In future work will aim to gain a better understanding of both linear and non-linear optics in the cooling channel and ultimately provide an emittance evolution toy model



Thank you!

