



Wedge Absorber

Craig Brown

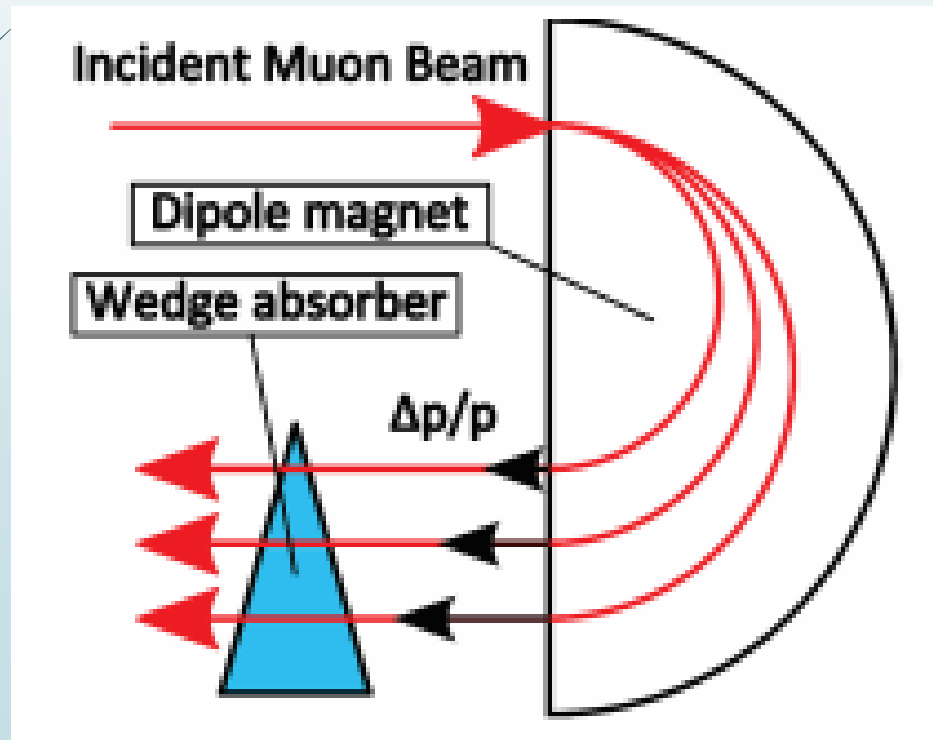
Brunel University

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Aims

- Demonstrate Emittance Exchange in the Wedge using MICE data
- Number of techniques: KDE, KNN, Voronoi Tessellations, etc.
- Today, will briefly look at KDE from Tanaz



Kernel Density Estimation (KDE)

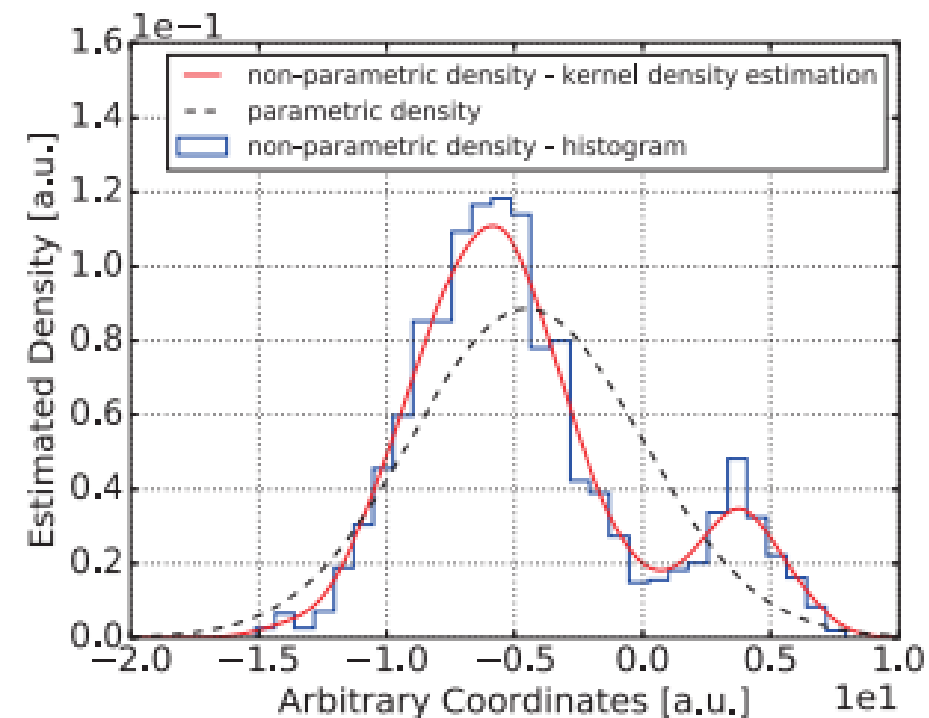
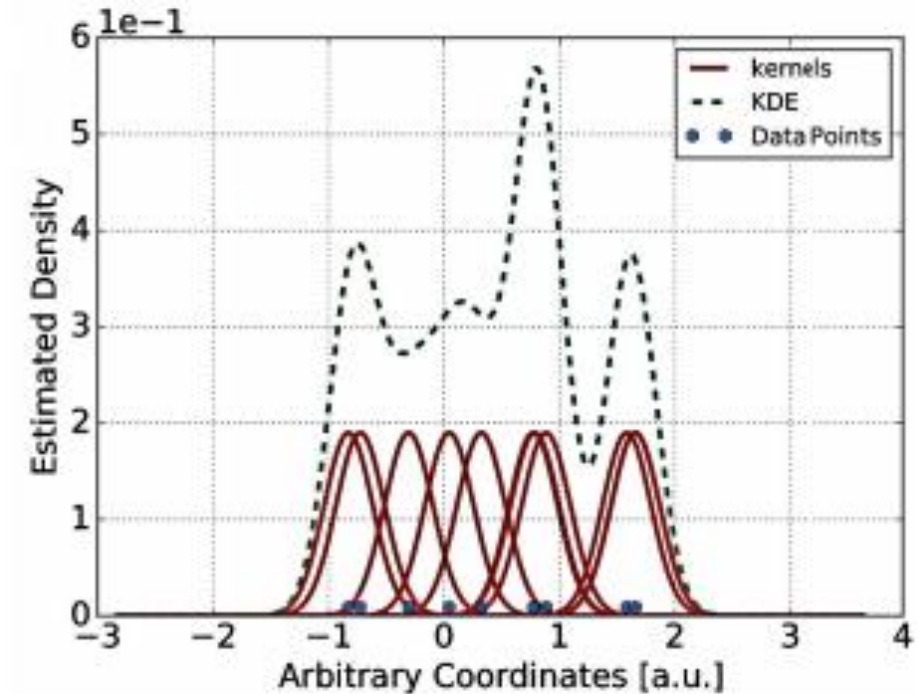
Tanaz – IPAC 2018

- Calculate the kernel, a multivariate Gaussian for each data point
- Sum all the kernels to get the KDE

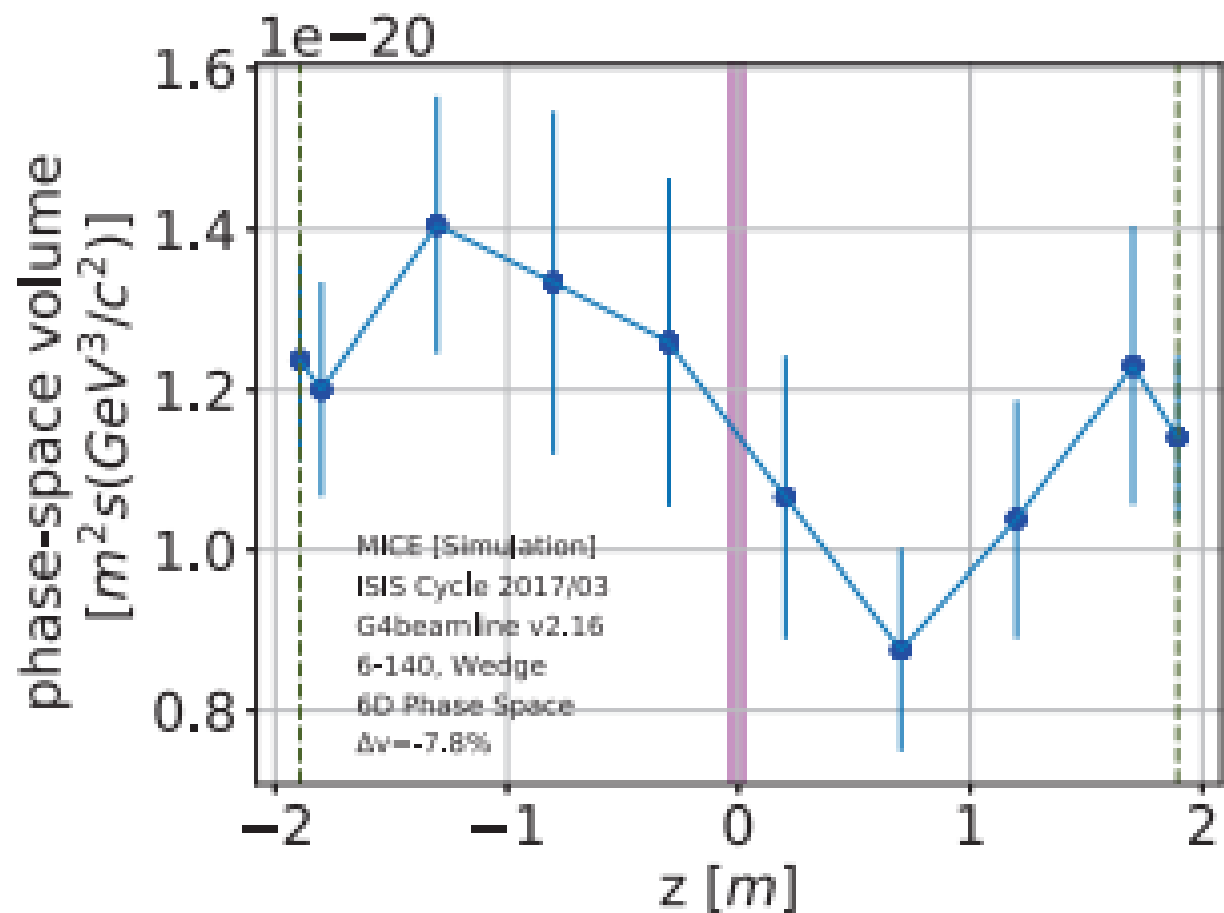
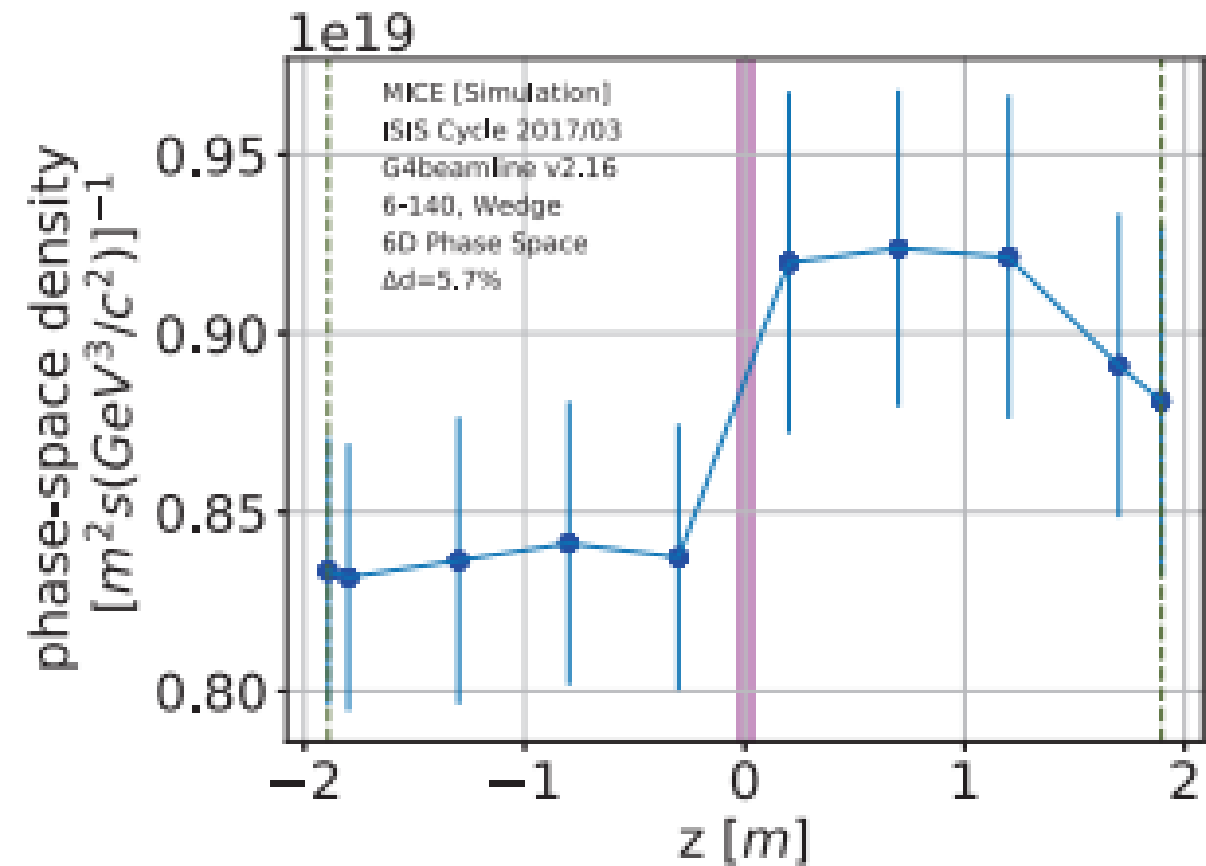
$$\hat{f}(\vec{x}) = \frac{1}{nh^d \sqrt{2\pi}} \sum_{i=1}^n k\left(\frac{-|\vec{x} - \vec{X}_i|^2}{2h^2}\right)$$

- Bottom left: Comparison between KDE, Histogram and a parametric approach

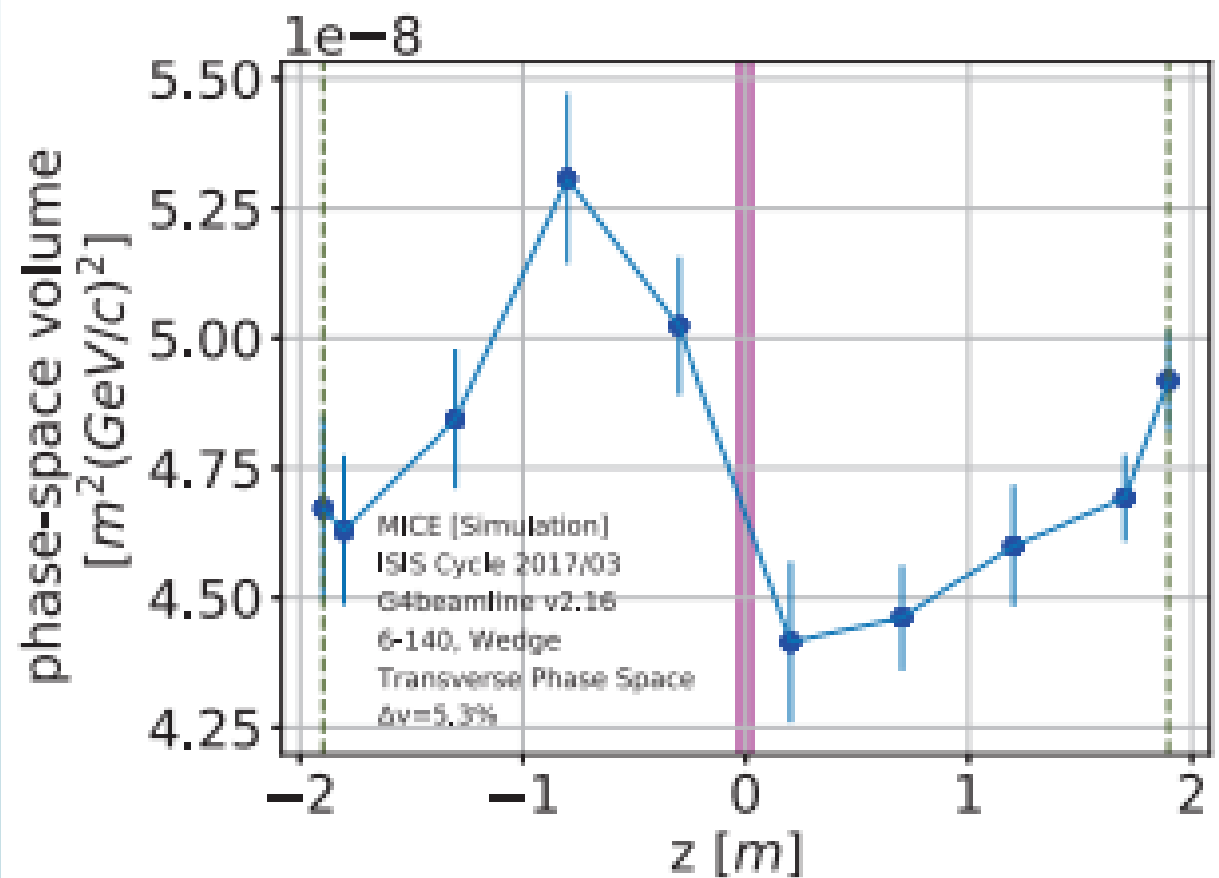
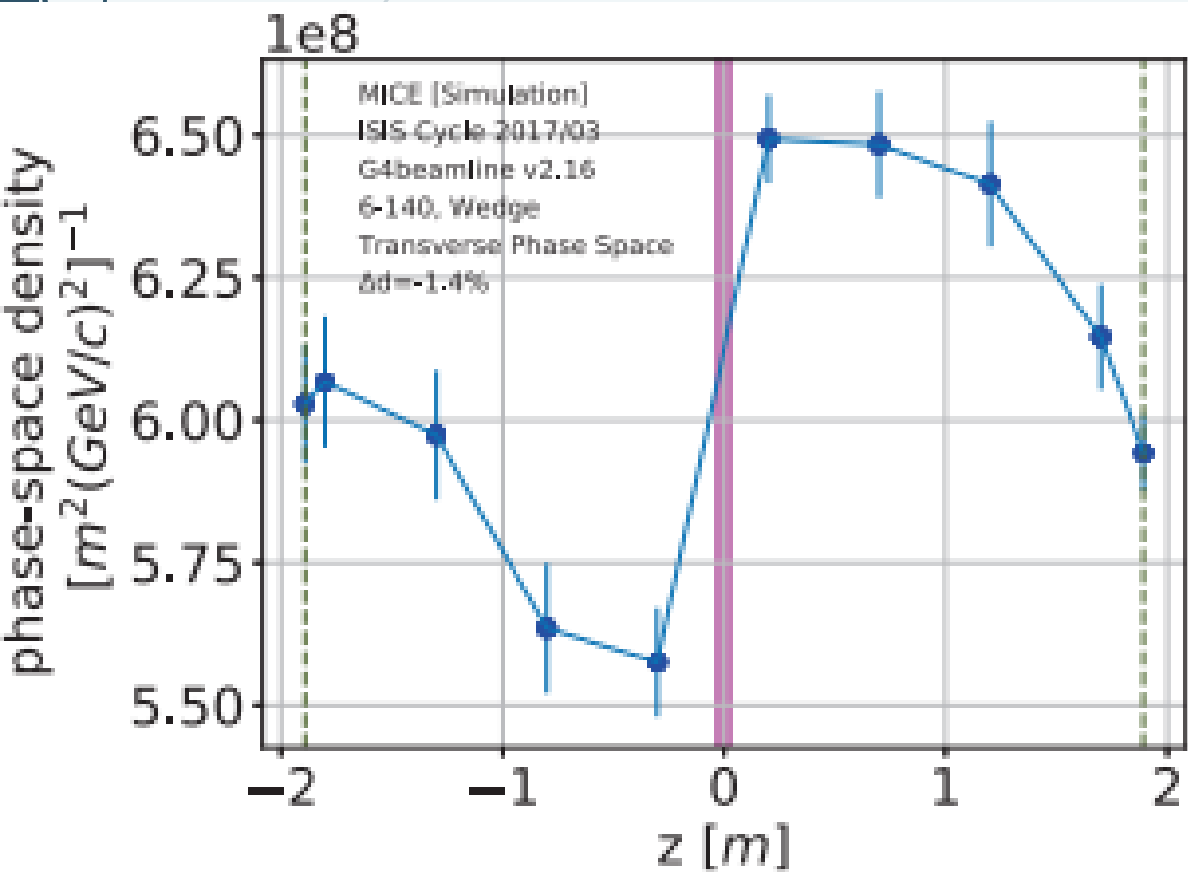
Parametric methods make an assumption of the underlying distribution



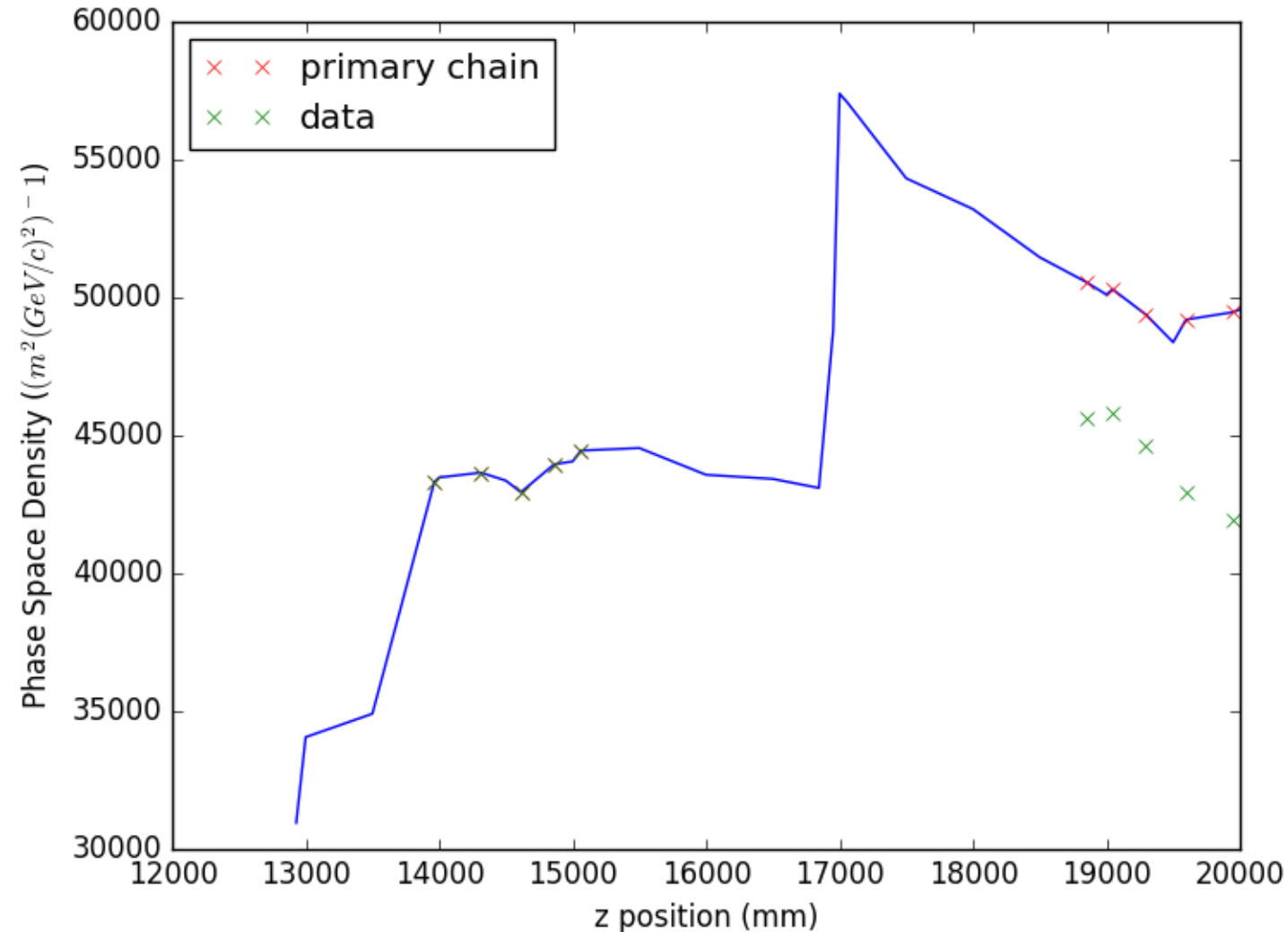
Tanaz's 6-140 6D results – IPAC2018



Tanaz's 6-140 transverse 4D results – IPAC2018



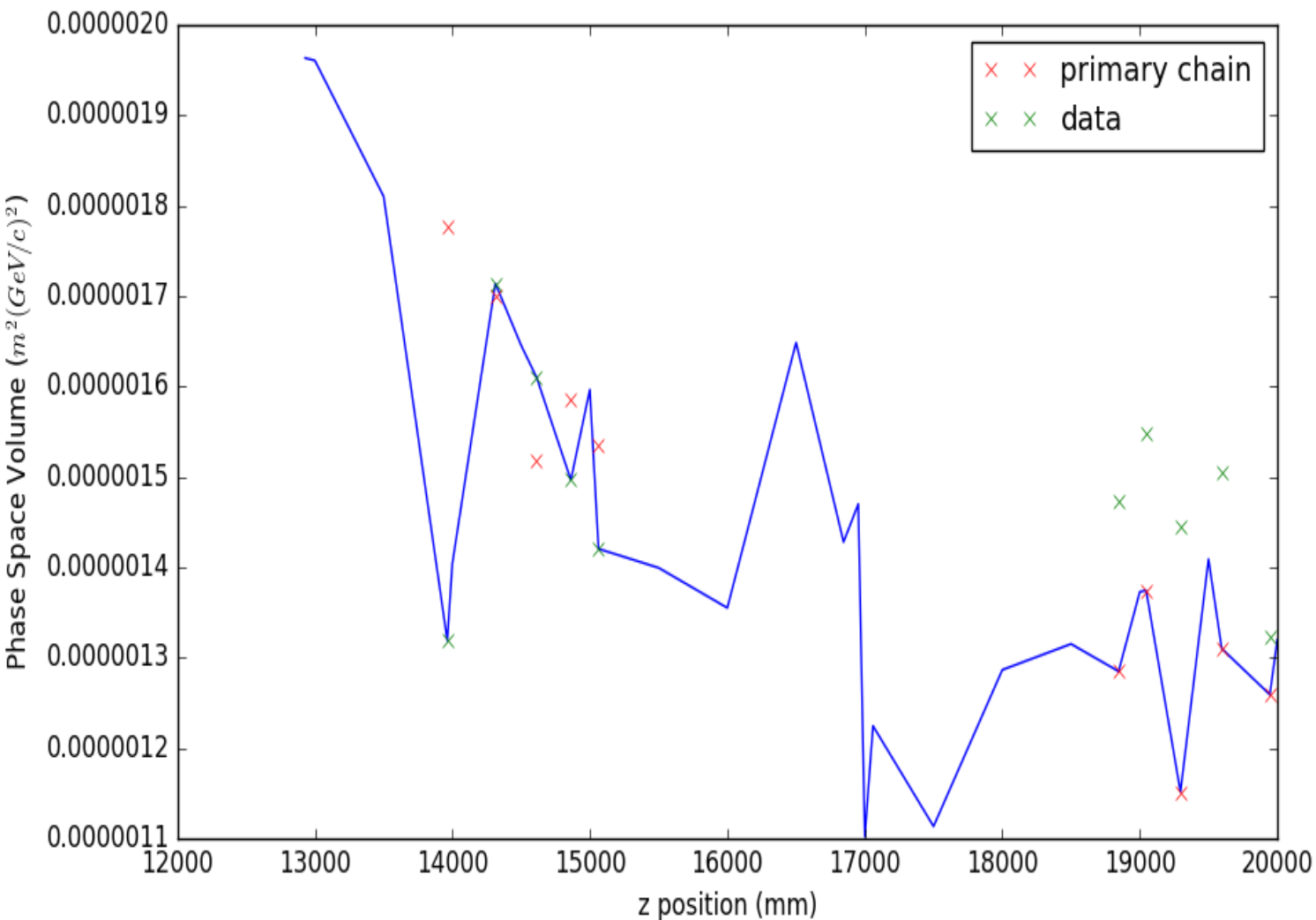
Try to recreate Tanaz's results



Problems

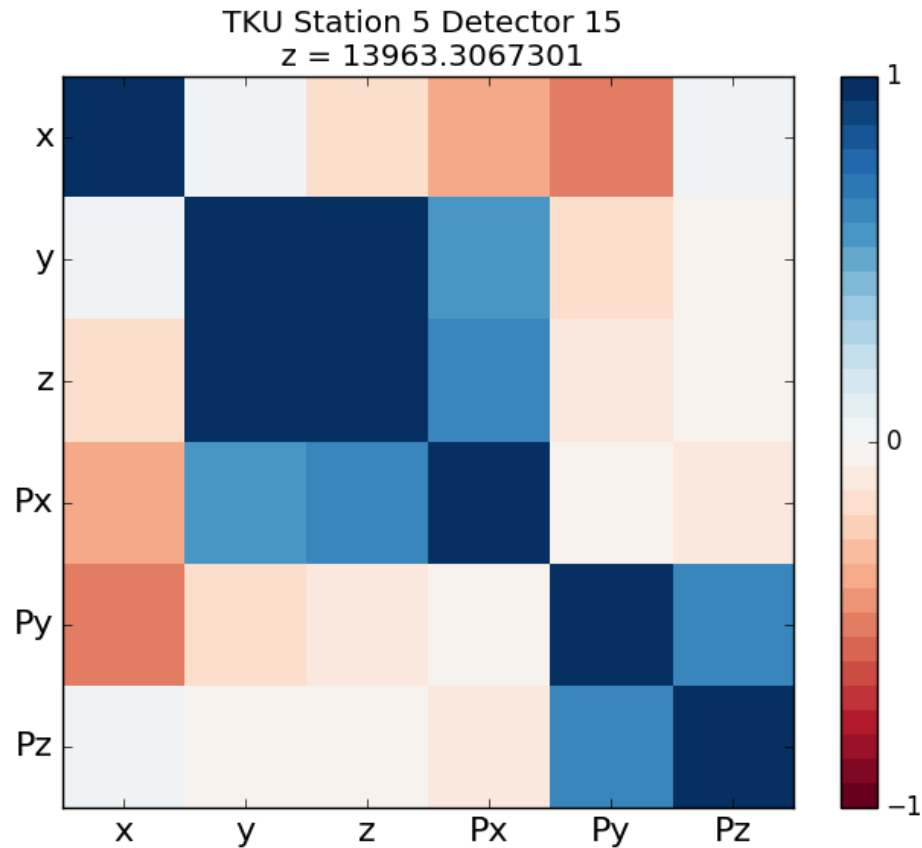
- Only started looking at Tanaz's work, so I have likely made some mistakes
- Axial look-up, cylinder not very Wedge shaped, primary chain extrapolation doesn't reflect Wedge
- Need to run extrapolation with Wedge geometry
- I am off by a factor of $>10^4$
- No Cuts on data
- Only require a matched upstream track to a downstream track

Try to recreate Tanaz's results



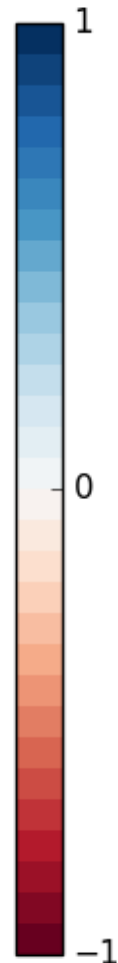
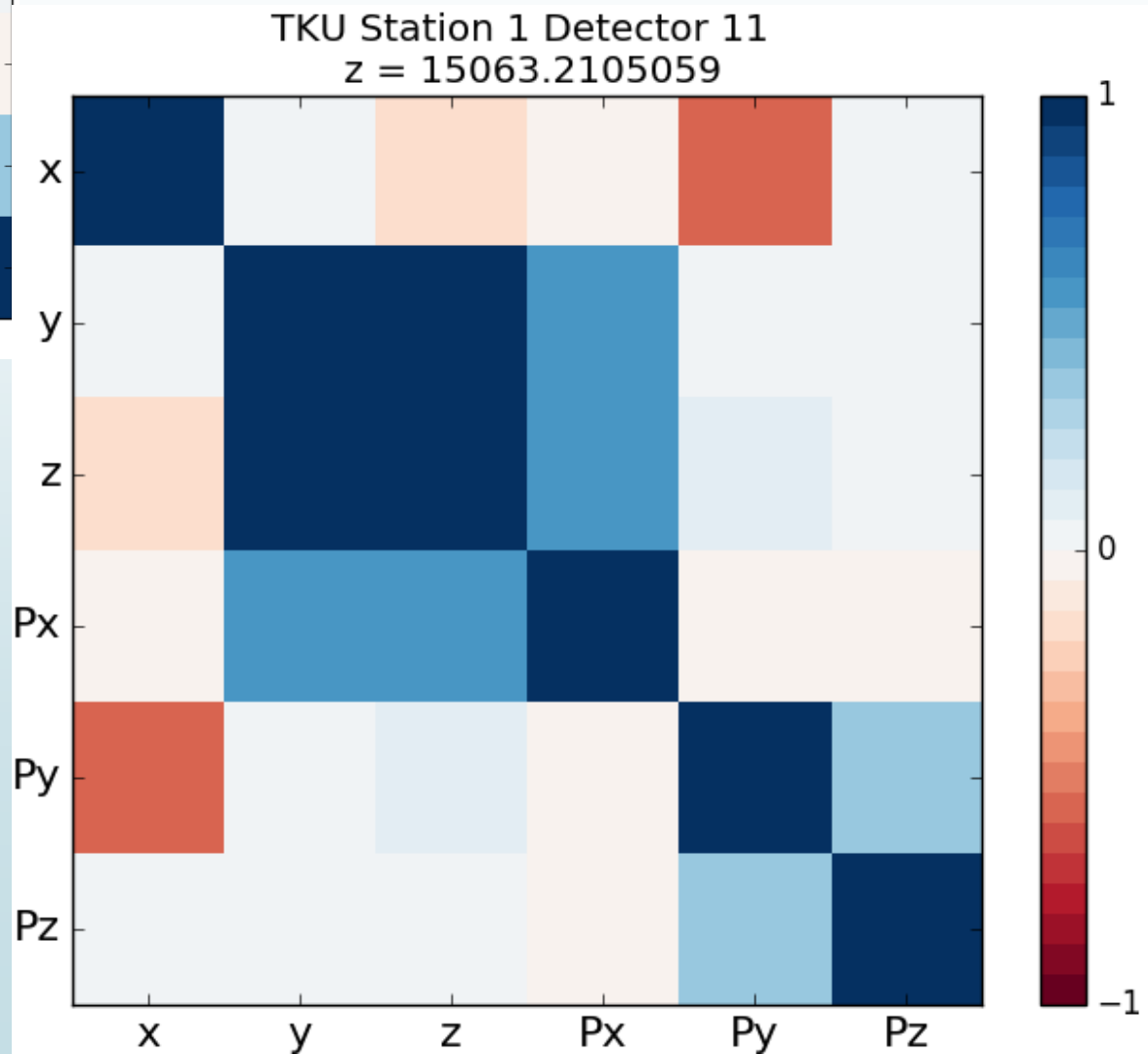
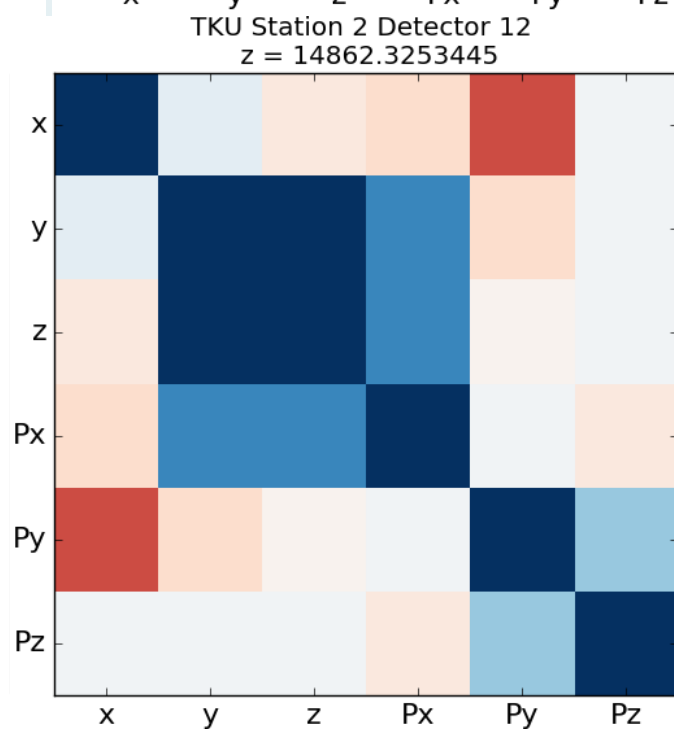
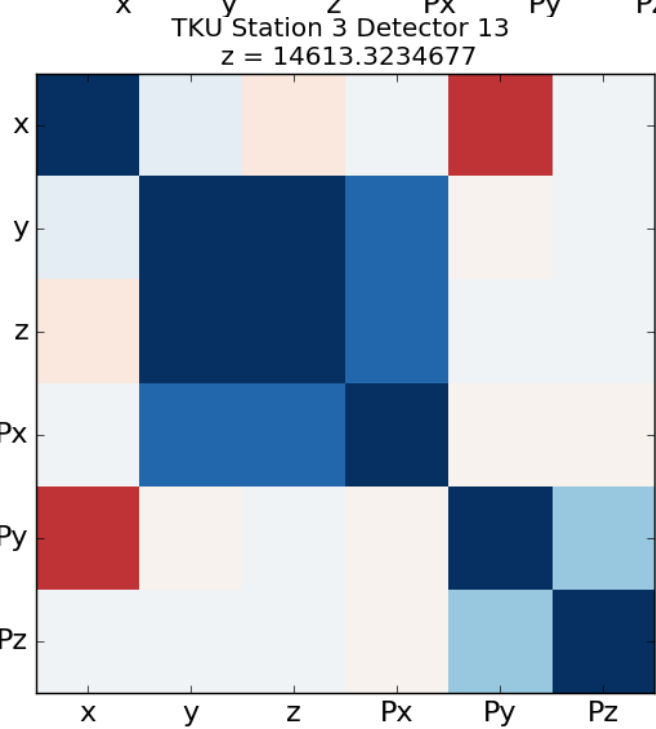
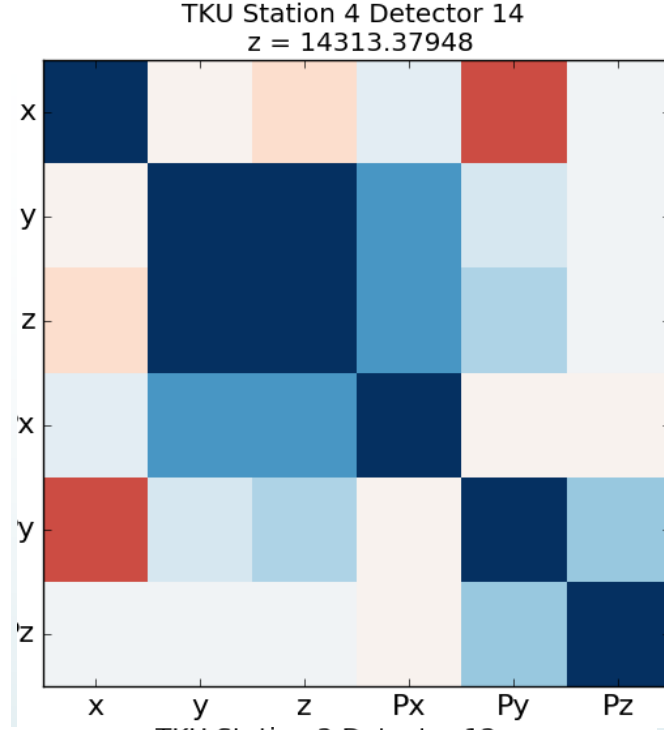
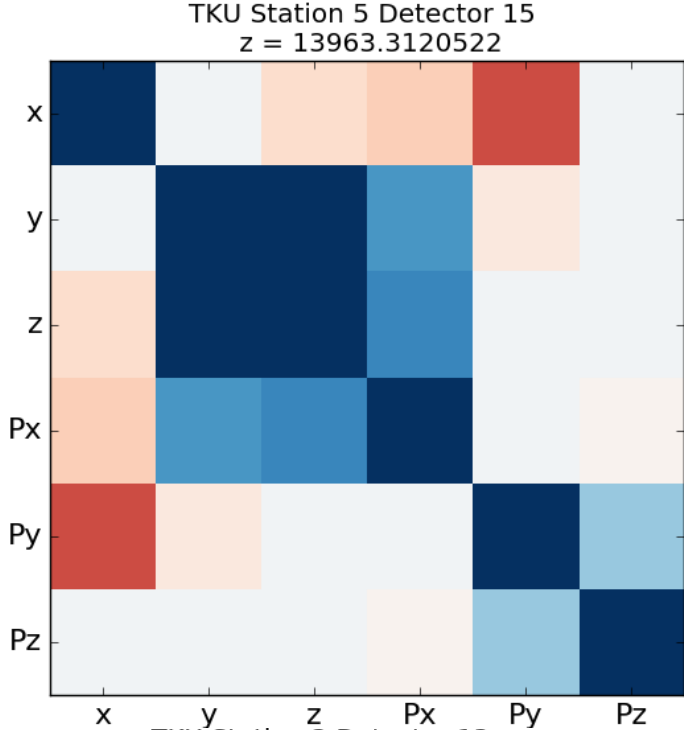
- Have only used 1000 points for Monte Carlo to calculate Phase Space Volume
- Again off by a factor
- Need to talk to Tanaz to fully understand what all parameters in her KDE routine do
- Graph smooths with higher number of points for Monte Carlo

Covariance/Correlation Matrix evolution through the cooling channel



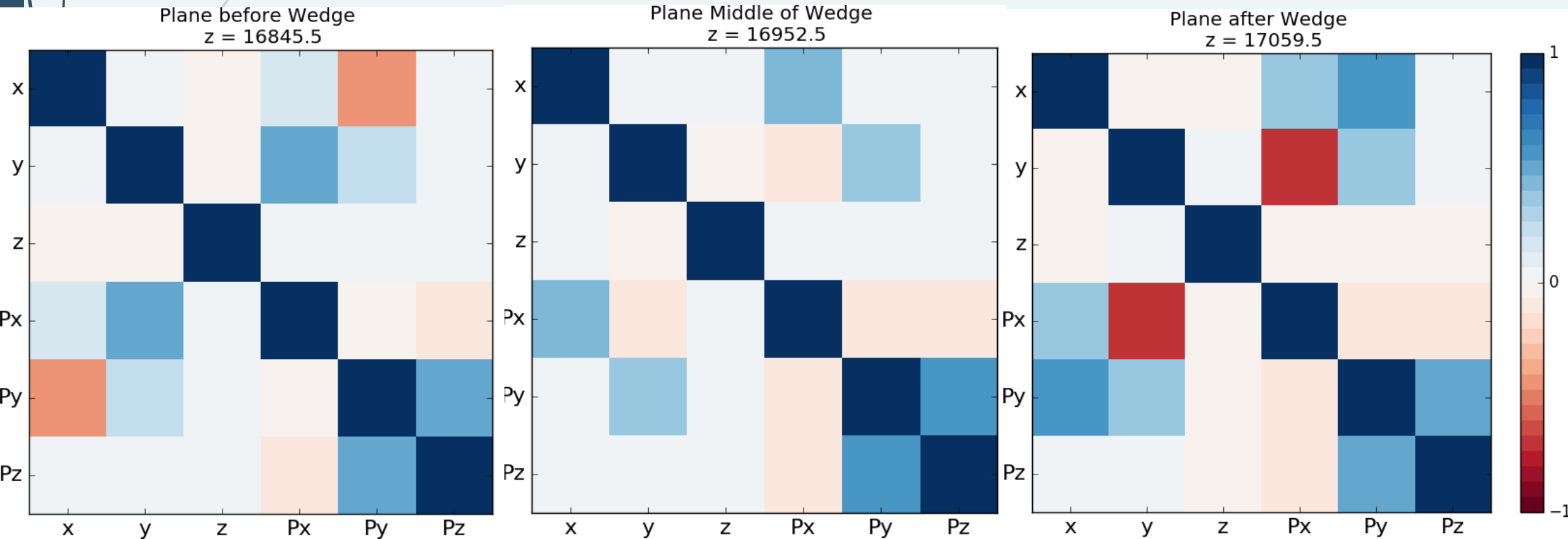
- Covariance matrix used for many applications such as KDE
- Correlation matrix can tell how two quantities (e.g. x and p_x) are related to one another
- Can show evolution of the matrix through Cooling channel
- Aim is to show change in correlation matrix through the Wedge (using virtual planes before, in the middle and after the Wedge).
- Problem again: Axial symmetry, only planes up to the Wedge give any meaning, need to run a full geometry Wedge simulation

Upstream Correlation Matrix Evolution



Correlation matrix through the wedge at virtual planes

- Remember, still have axial look-up geometry!
- Flip mode



Summary

- ▶ Began looking at various techniques to show emittance exchange
- ▶ Tried to recreate Tanaz's plots
- ▶ Looked at Covariance/Correlation matrix evolution

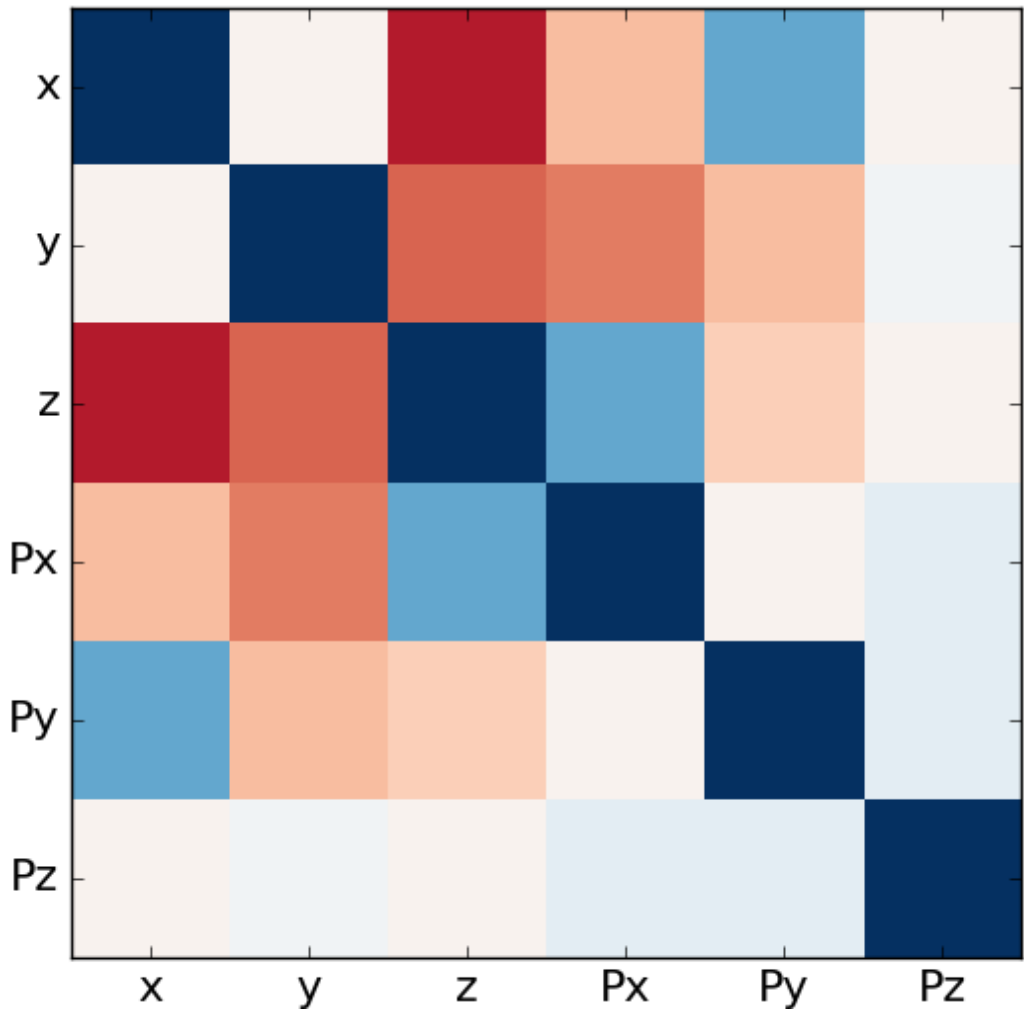
Future:

- ▶ Need to talk to Tanaz/look more closely at what I am doing to recreate her results
- ▶ Run MICE simulation with wedge geometry
- ▶ Look at other techniques – KNN, Voronoi, etc, Benefits/Disadvantages
- ▶ Look at beam reweighting

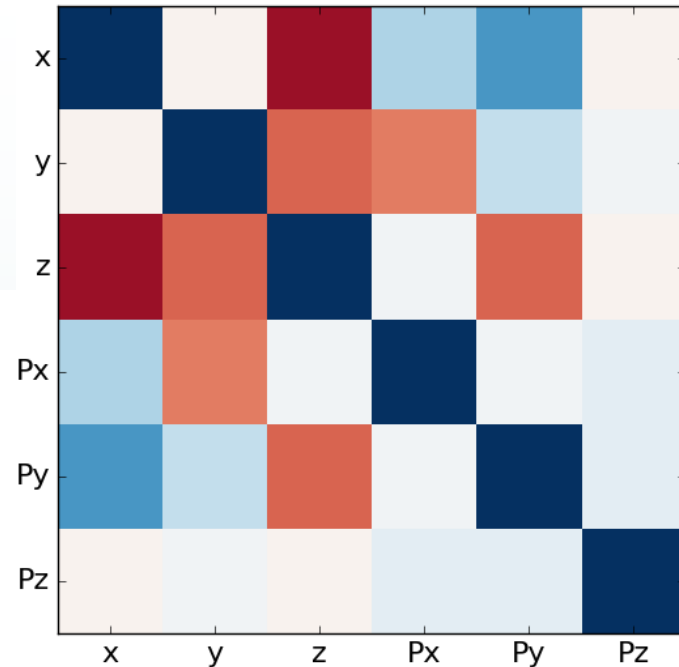
The End

Extra Slide Downstream

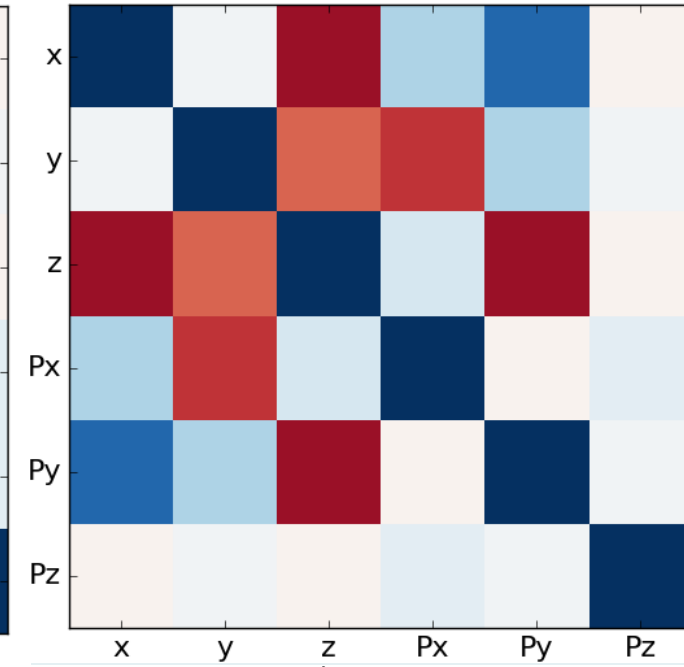
TKD Station 1 Detector 17
 $z = 18846.9839027$



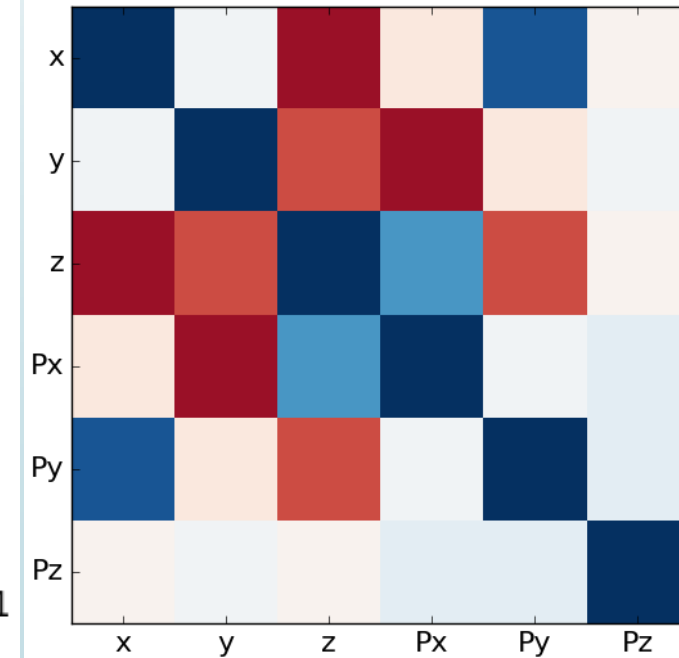
TKD Station 2 Detector 18
 $z = 19046.9518187$



TKD Station 3 Detector 19
 $z = 19296.8115335$



TKD Station 4 Detector 20
 $z = 19596.808092$



TKD Station 5 Detector 21
 $z = 19946.741162$

