GBL & Millepede in basf2

❑ Millepede II

- Implementation of the Millepede algorithm (V. Blobel, C. Kleinwort)
  https://www.wiki.terascale.de/index.php/Millepede_II
- Linear least squares fit for *very* large number of parameters
- Key assumption: 2 kinds of fit parameters
  - ***Global*** (= appearing in many measurements) = alignment parameters
  - ***Local*** (single track) parameters (only affect small subset of measurements) … not computed
- Reduces the problem to dimension equal to number of alignment parameters … then inversion/diagonalization… of much smaller matrix
- Solution in one step, no approximation (iterations for non-linearity and outliers)
- Hierarchy constraints added via Lagrange multipliers

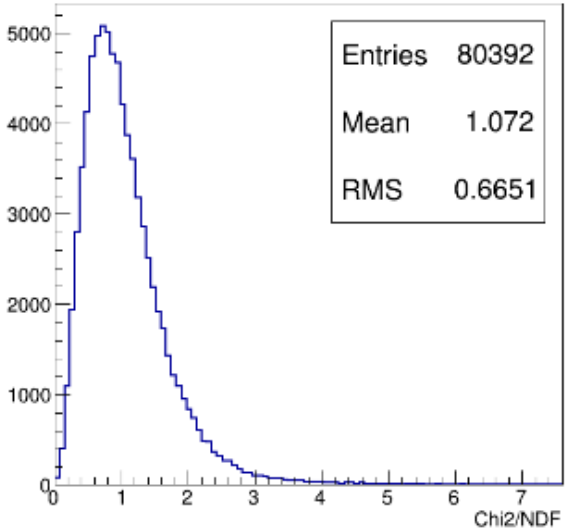
- Used in H1, CMS (see recent paper http://arxiv.org/abs/1403.2286) …

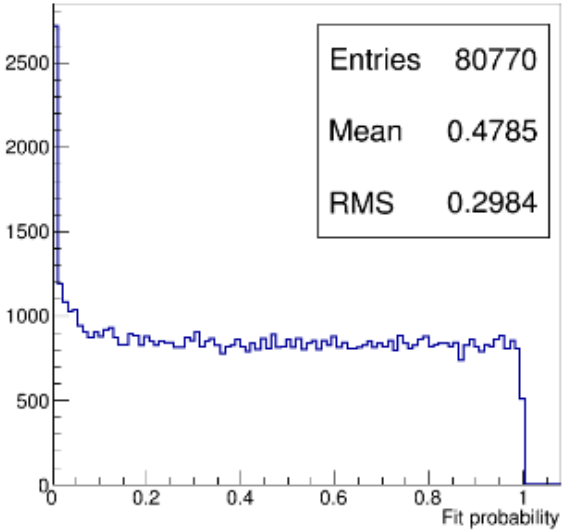
- ❑ Track model / fast refit with proper description of multiple scattering
  - Adds multiple scattering effects to initial trajectory as additional fit parameters
- ❑ Implemented in C++/Python/Fortran (C. Kleinwort)
- ❑ *https://www.wiki.terascale.de/index.php/GeneralBrokenLines*
- ❑ Special structure of normal equations → *„faster“* than Kalman but equivalent
- ❑ Direct output to Millepede (provides $\frac{\partial f_{ij}}{\partial q_l}$ and $\frac{1}{\sigma_{ij}^2}$)

- ❑ Why to use GBL for fitting instead of Kalman filter? Because of alignment.
  - ❑ Standard Kalman filter does not calculate full covariance matrix along track
  - ❑ GBL can output trajectory for Millepde alignment by single command
  - ❑ GBL faster
  - ❑ Both GBL and Millepede maintained from DESY, compatibility and support granted
  - ❑ Also CMS does use GBL now in Millepede alignment

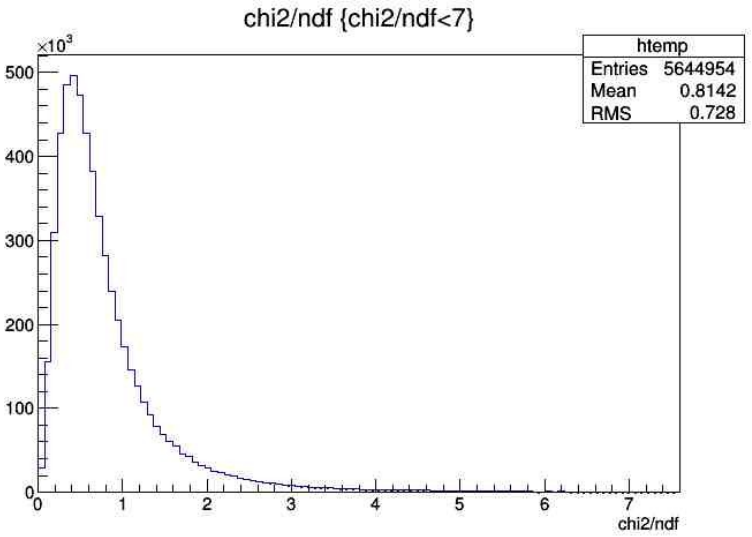
TrueHits vs. Clusters – error estimation

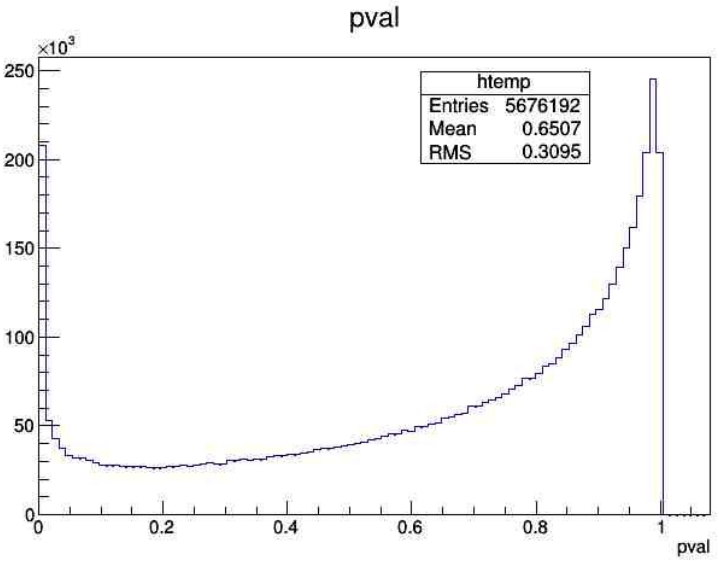
- Track fit with TrueHits in VXD only



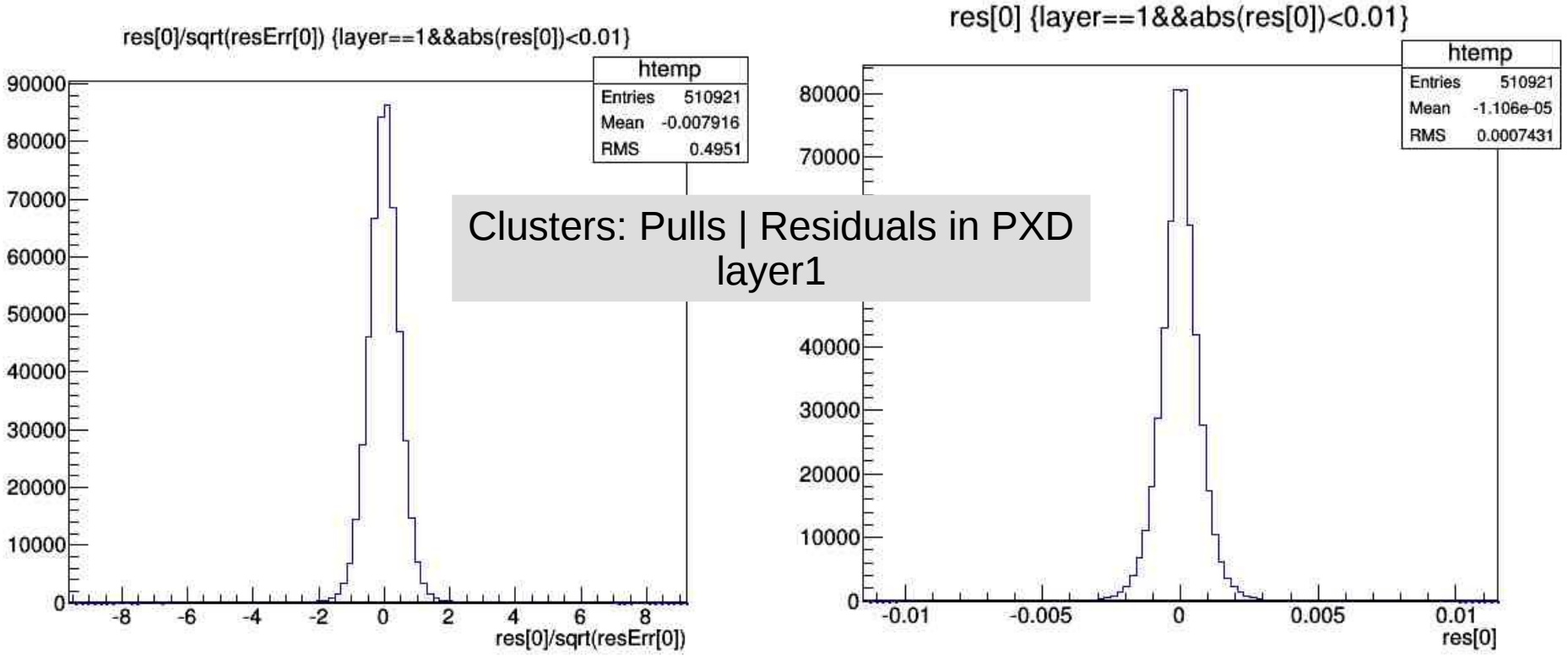


Clusters:





- Working on validation plots
  - P-values, chi/ndf
  - Residuals/pulls at (which?) layers



Issues

- Alignment with cosmics does not work
  - Used to be working...
  - Some NaNs are propagated to Millepede
  - Still investigating
  - Full alignment without cosmics is not good

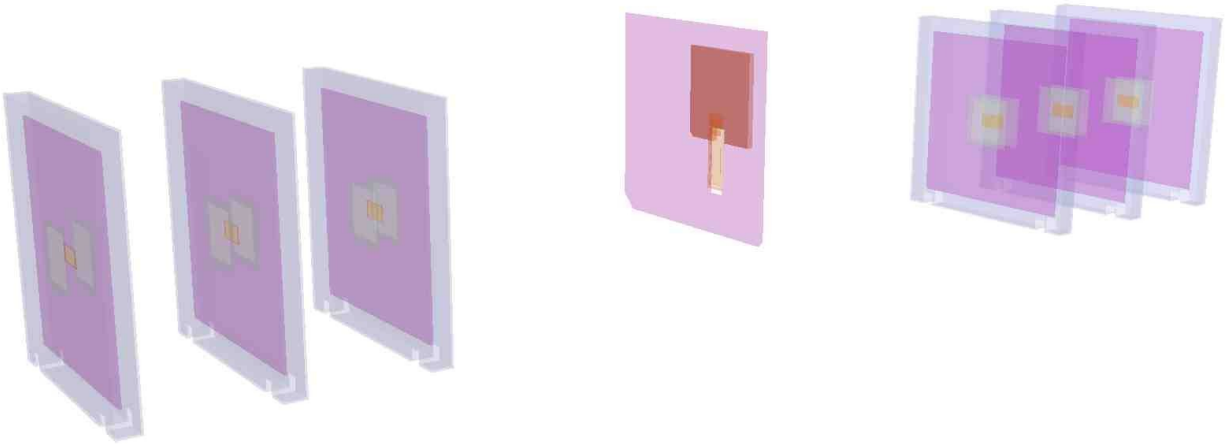
Millepde result on non-misaligned
Geometry with 390k muons with B=1.5T

84801	0.0000	-1.0000		
84802	0.0000	-1.0000		
84803	0.0000	-1.0000		
84804	0.0000	-1.0000		
84805	0.0000	-1.0000		
84806	0.0000	-1.0000		
85121	0.26838E-02	0.0000	0.26838E-02	0.17331E-03
85122	0.18682E-02	0.0000	0.18682E-02	0.18191E-03
85123	0.38845E-02	0.0000	0.38845E-02	0.26507E-03
85124	0.10199E-02	0.0000	0.10199E-02	0.68733E-04
85125	0.44337E-02	0.0000	0.44337E-02	0.14374E-03
85126	-0.92811E-03	0.0000	-0.92811E-03	0.65286E-04
87361	0.86568E-03	0.0000	0.86568E-03	0.74031E-04
87362	0.35573E-02	0.0000	0.35573E-02	0.27421E-03
87363	0.73116E-02	0.0000	0.73116E-02	0.18030E-03
87364	0.96598E-03	0.0000	0.96598E-03	0.65102E-04
87365	0.80569E-02	0.0000	0.80569E-02	0.20692E-03
87366	0.33109E-03	0.0000	0.33109E-03	0.43240E-04

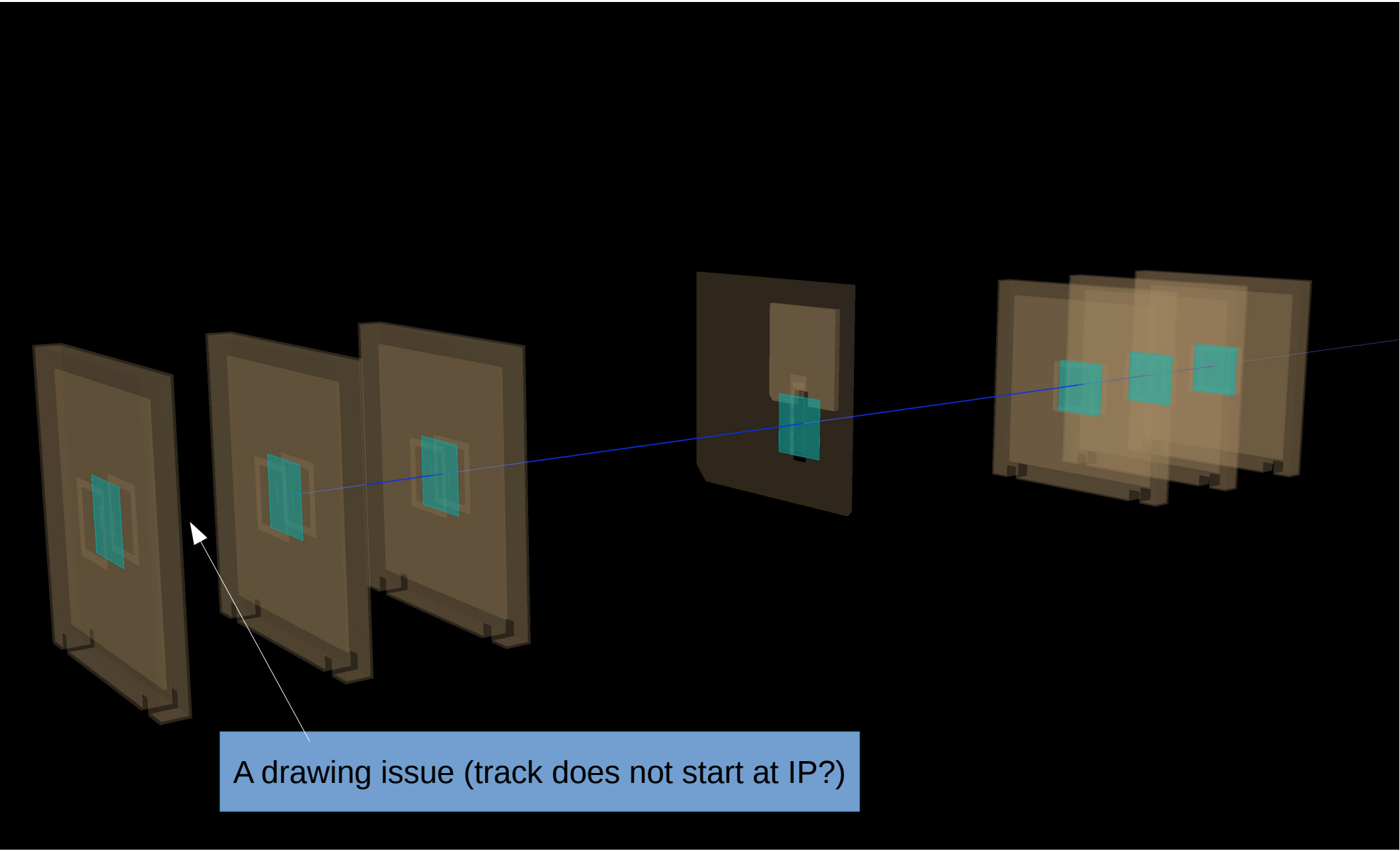
- I have some problems running validation web interface localy (does not load images). Old one works

CERN beam test November 2014

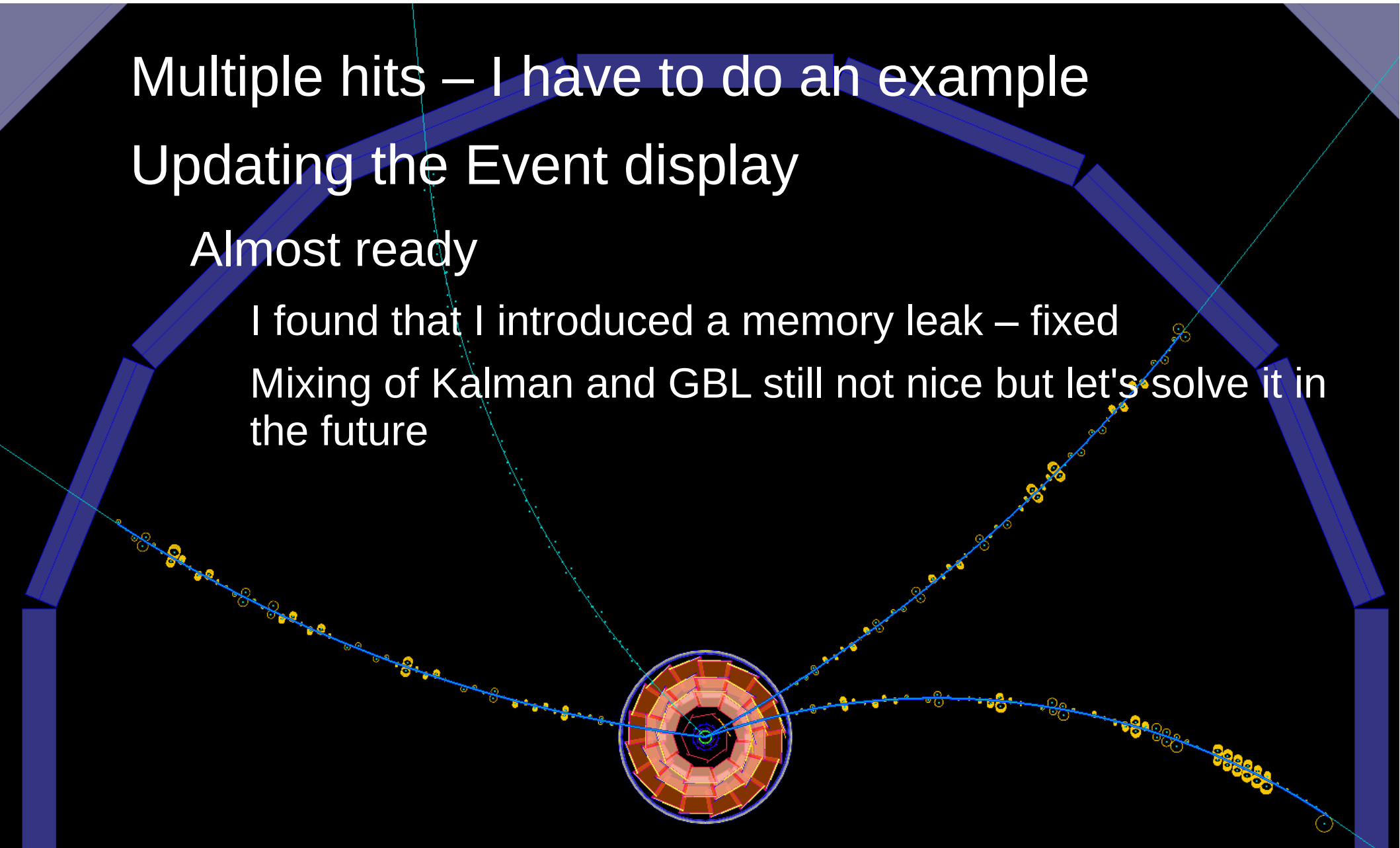
- Basf2 was first to see correlations and tracks
- Took less than 2 days to prepare geometry, processing script and test it on a completely different setup from DESY



First CERN track



Still working on...



- Multiple hits – I have to do an example
- Updating the Event display
  - Almost ready
    - I found that I introduced a memory leak – fixed
    - Mixing of Kalman and GBL still not nice but let's solve it in the future