Survey of the Pixel detector of the Heavy Flavor Tracker

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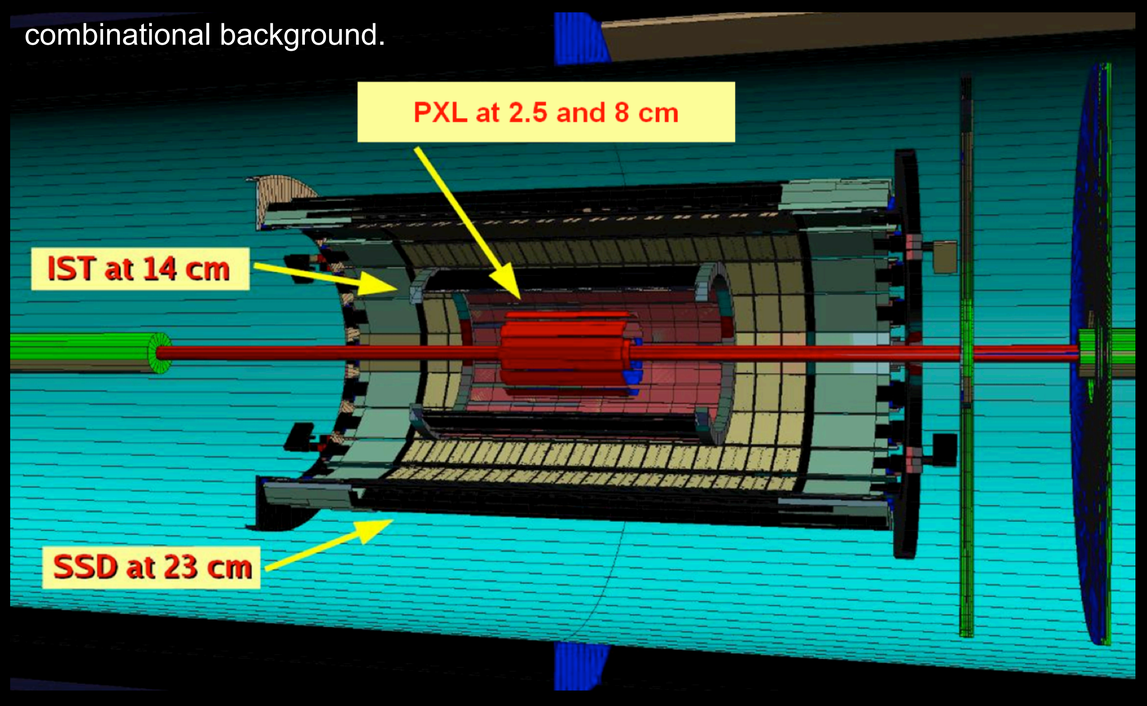
HFT and the Pixel (PXL) detector

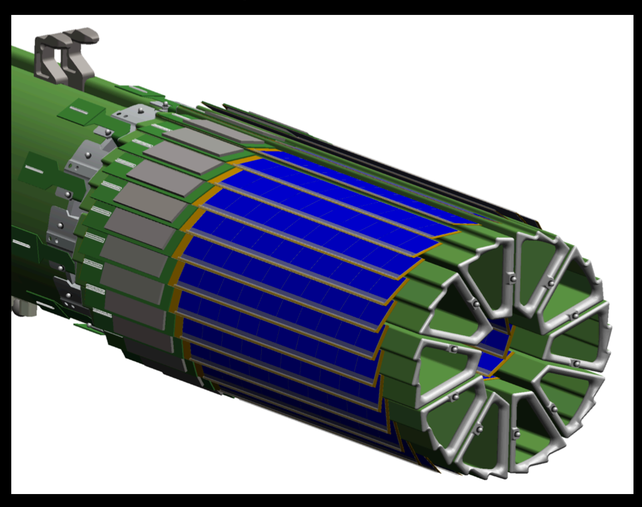
Heavy flavor particles are considered to be good probes for the Quark Gluon Plasma produced in relativistic heavy ion collisions. However, their low production yield and short decay length (for example, D^0 $c\tau$ ~ 120 μm) make them difficult to study in heavy ion collisions with massive production of light flavor particles.

The Heavy Flavor Tracker (HFT) shown below is a silicon detector, which can measure position of charged tracks very precisely, enabling distinguishing of decay vertices of heavy flavor particles from primary vertices and significantly reducing combinational background.



The Pixel detector (PXL) below is the innermost and most precise detector in HFT.

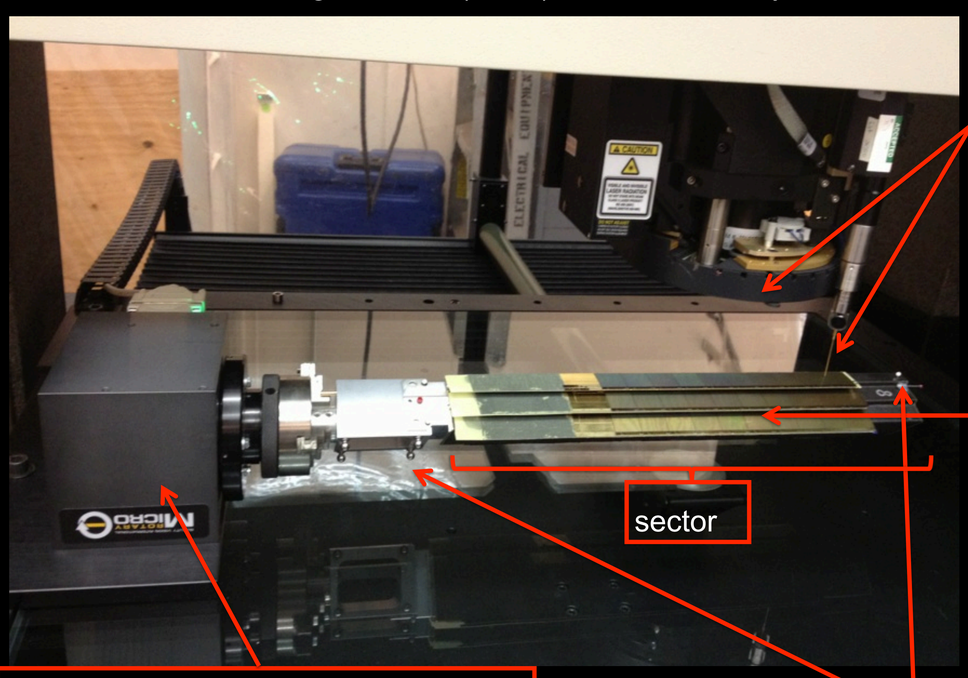
- ~ 436 M 20 × 20 μm pixels
- 400 silicon chips
- 2 layers
- 10 sectors, 40 ladders
- resolution ~ 10 μm

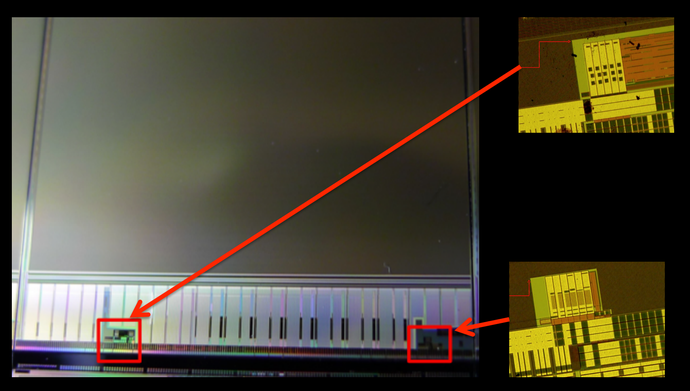


In order to fully use the potential of such precision to reconstruct heavy flavor particles, a survey is conducted to precisely measure any deviation for each pixel of the detector from their designed position.

Survey Set-up

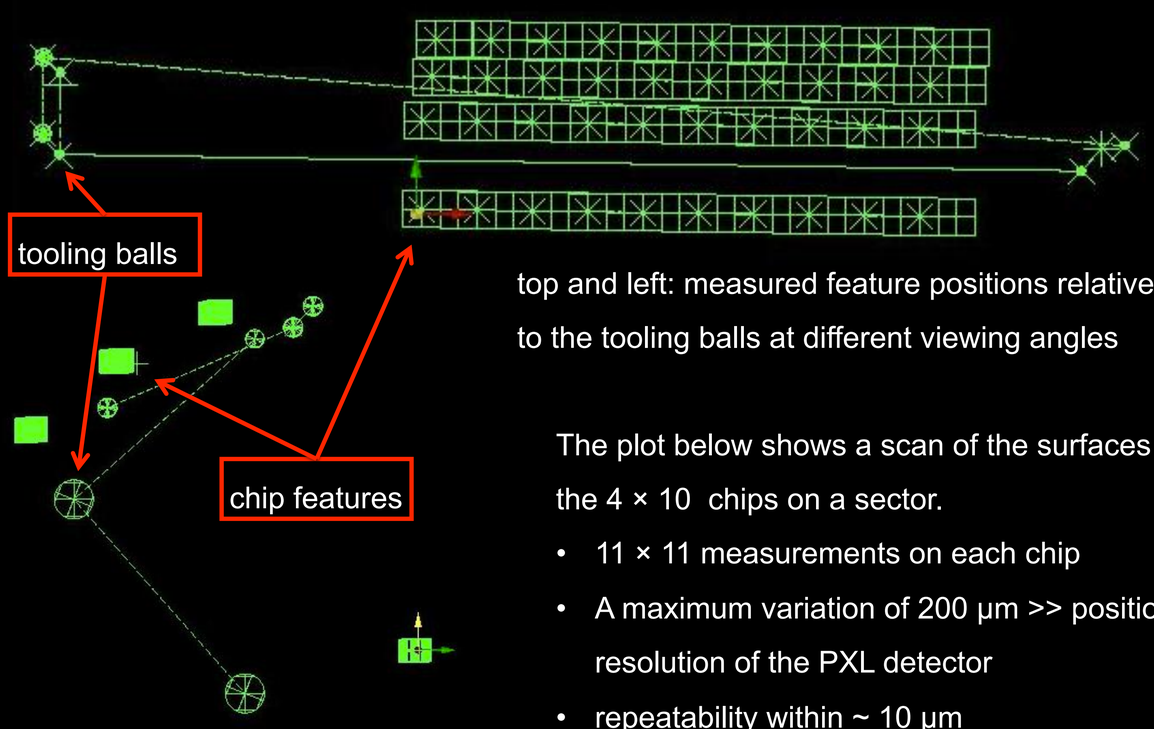
A Coordinate Measuring Machine (CMM) is used to survey a sector of the PXL detector.





2 features on the silicon chips are used to define the chip local coordinate system.

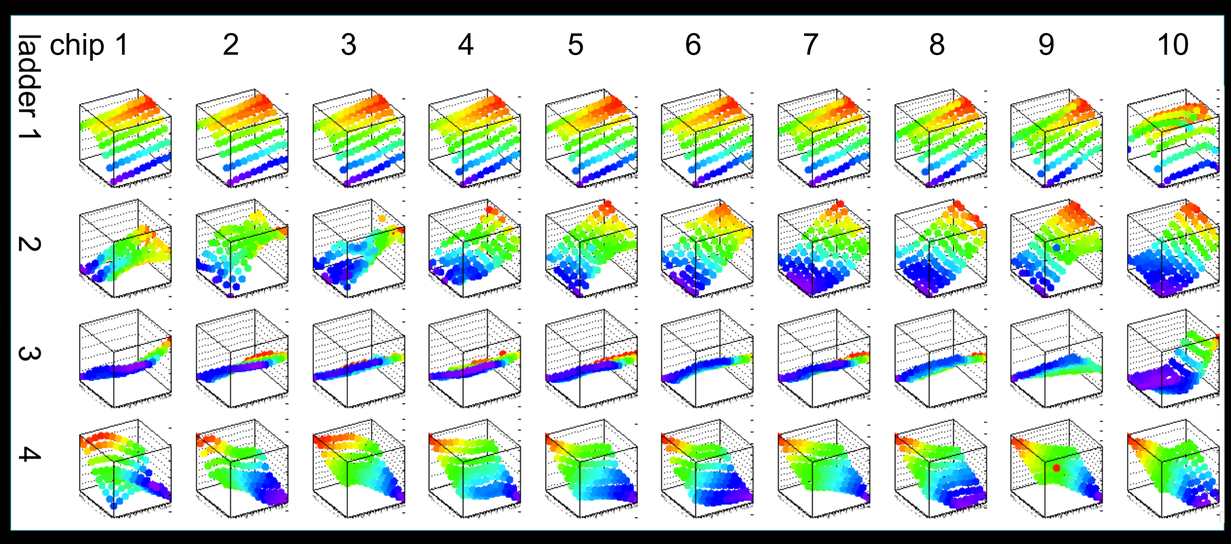
Results

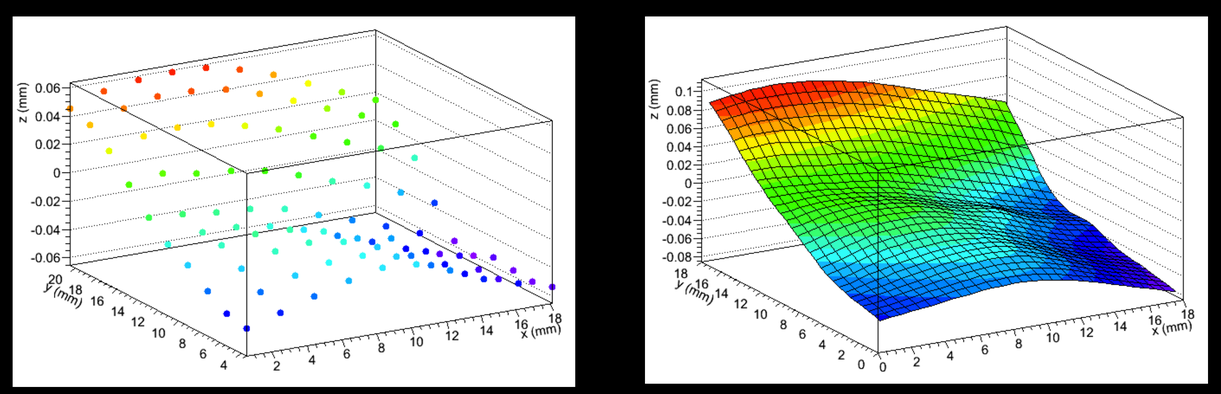


top and left: measured feature positions relative to the tooling balls at different viewing angles

The plot below shows a scan of the surfaces of the 4 × 10 chips on a sector.

- 11 × 11 measurements on each chip
- A maximum variation of 200 μm >> position resolution of the PXL detector
- repeatability within ~ 10 μm





One chip alone in the PXL detector has ~ 1 M pixels. Thus it is almost impossible and unnecessary to measure the deformation at each pixel. A Thin Plate Spline method is applied to fit the 11 × 11 measurements (left) and fill up the whole surface profile (right).

Summary and Plan

A survey is conducted to measure the chip surface profiles and relative positions of features of the PXL detector in HFT. A maximum variation of 200 μm is observed with a repeatability within 10 μm, satisfying the specifications required by the project. With the survey results we will be able to apply alignment corrections for data taken by the PXL detector in the future, and make full use of its position resolution.

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