CORE Tracking Update

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I. INTRODUCTION

The final (December 2021) CORE tracker design is illustrated in Fig. 1. The tracker includes is a $\sim$ 30G-pixel MAPS array, consisting of three thin, curved vertex layers, three outer barrel layers, and six disk layers in both the forward (ion) and backward (electron) directions. In December, Ernst Sichtermann produced a new study of the resolution performance of the tracker. In this note I compare these latest results with the parameterized performance included in the DELPHES simulations for the CORE proposal. The new results will be used in the response to the questions from the Detector Advisory Committee (DAC) and the Detector Proposal Advisory Panel (DPAP). The momentum resolution shows minor

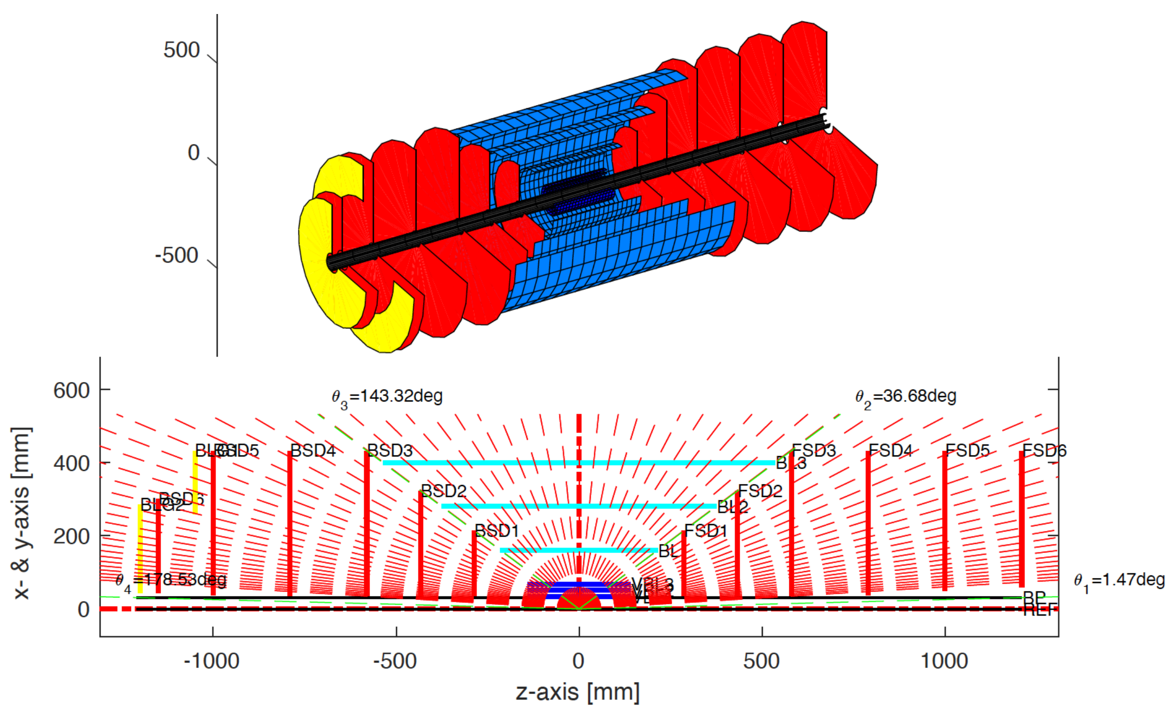

FIG. 1. CORE Monolithic Active Pixel Array (MAPS) tracker.

changes. The vertex resolution shows significant improvement, presumably a consequence of adding a third vertex layer.

II. COMPARISON OF NEW TRACKER STUDY WITH PREVIOUS DELPHES IMPLEMENTATION

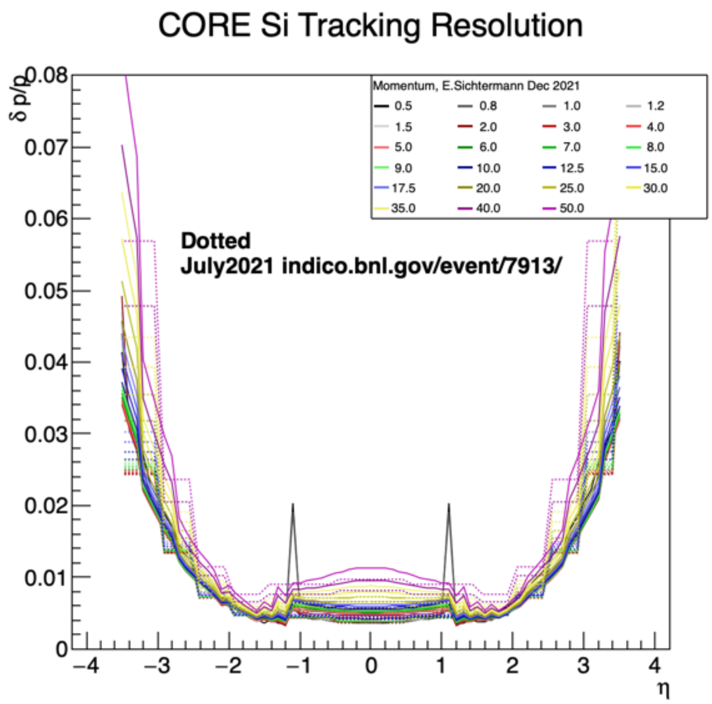

FIG. 2. CORE MAPS tracking resolution. Solid lines are the results from the final design at 23 values of momentum, as indicated, and 71 equal steps in η from -3.5 to 3.5. Dashed lines are the previous DELPHES implementation.

The CORE DELPHES tracking resolution was implemented by by Joseph Grassi, based on the July 2021 report of Reyner-Cruz Torres. The CORE-MAPS dp/p resolution as a function of $\eta = -\ln(\tan(\theta/2))$ is illustrated in Fig. 2. The previous DELPHES implementation is of the form

$$\frac{dp(\xi, p)}{p} = \sqrt{[A(i)]^2 p^2 + [B(i)]^2} \qquad \text{for } \xi \in \text{ bin } i. \tag{1}$$

The new results (solid lines) are more detailed in their momentum-dependence, and show a spike at $\eta = \pm 1.1$ at low momentum, presumably due to a support frame, and/or a transition from vertex layers to disk layers.

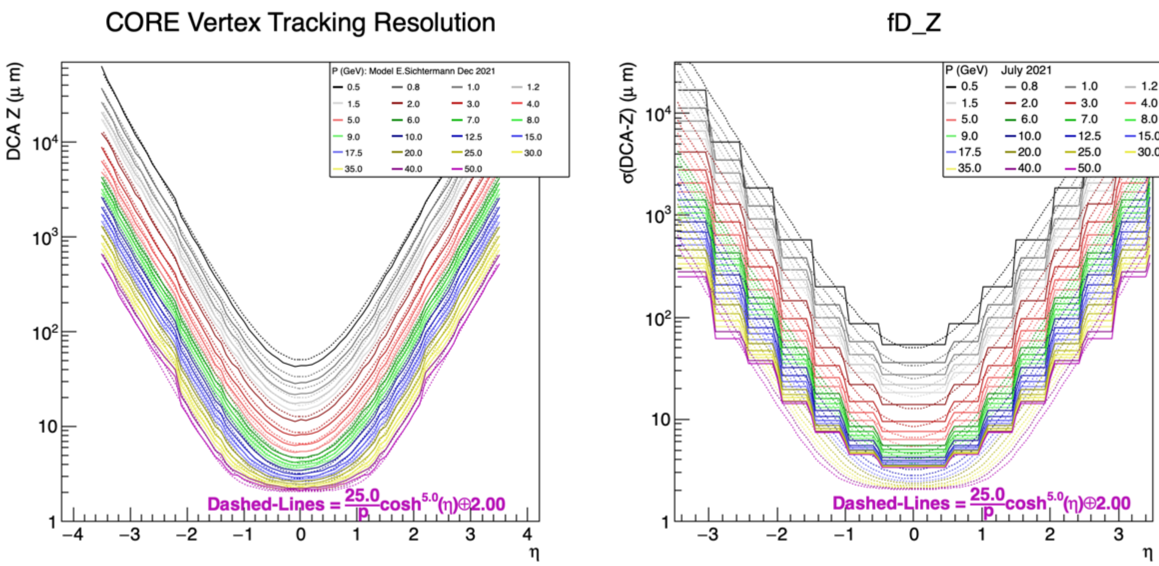

FIG. 3. Left: Updated CORE vertex resolution (solid lines). The dashed lines are a global fit. Right: Comparison of the global fit (dashed) to the previous implementation in DELPHES (solid). Note that the vertex resolution is significantly improved for $|eta| < 2$.

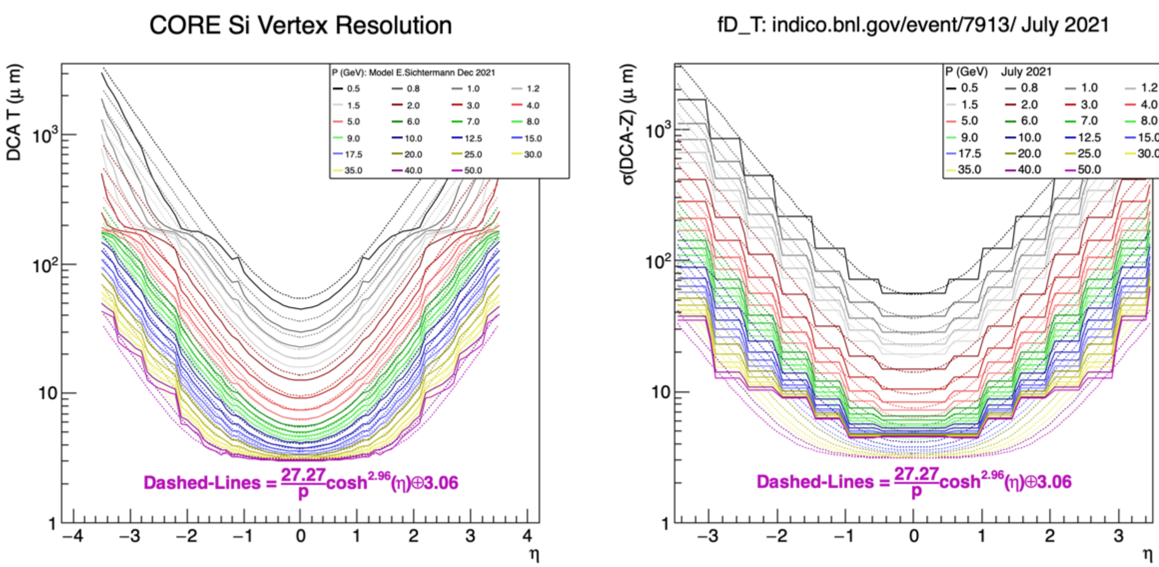

FIG. 4. Left: Updated CORE transverse vertex resolution (solid lines). There is structure at $|\eta| \sim 2$, but otherwise the distributions are moderately well described by the global fit (dashed lines). Right: Comparison of the global fit with the previous DELPHES implementation.

The CORE vertex resolution in z is illustrated in Fig. 3. The resolution is well described by a simple global fit. The vertex resolution in the transverse coordinate, also often labeled $r\phi$ is illustrated in Fig. 4. The new results are moderately well described by a global fit.

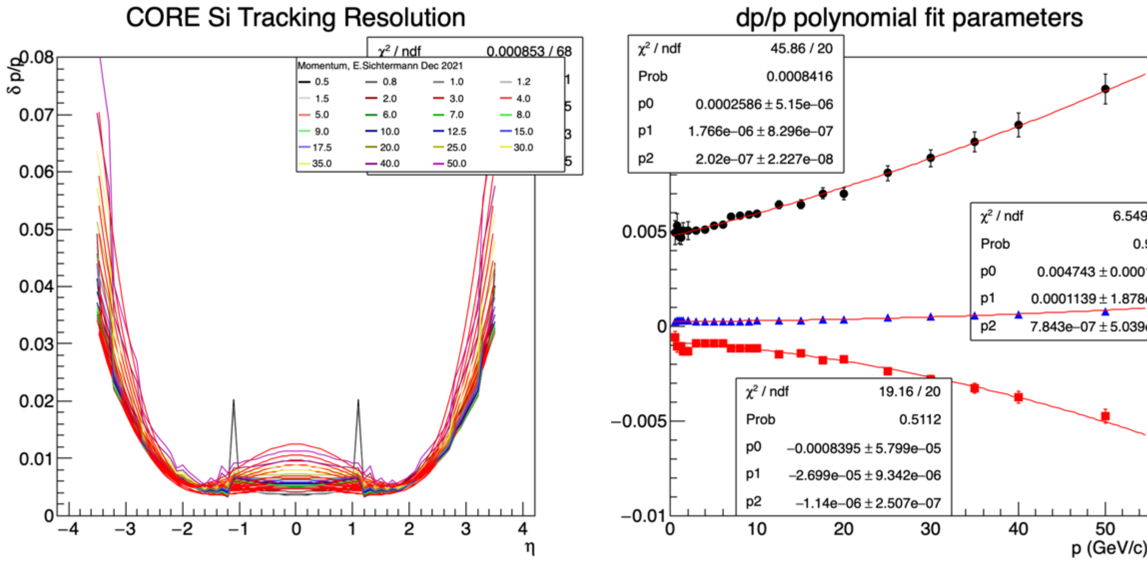

FIG. 5. Updated $\delta(p)/p$, with local fits. Left: Quadratic fits in η^2 for each momentum value (not color coded). Right: Black dots are constant terms $a_0(i)$; Red squares are quadratic terms $a_2(i)$; Blue triangles are quartic terms $a_4(i)$.

The $\sigma(p)/p$ results are shown again in Fig. 5, with local fits of the form:

$$\frac{\sigma_p(\eta, p_i)}{p_i} = a_0(i) + a_2(i)\eta^2 + a_4(i)\eta^4 \tag{2}$$

III. NEW DELPHES PARAMETERIZATIONS

The 2-D parameterization of the momentum resolution is

$$\begin{aligned} \frac{\sigma_p(\eta, p)}{p} &= 0.0047 + 1.14 \cdot 10^{-4} p + 7.84 \cdot 10^{-7} p^2 \\ &- \eta^2 \left[8.4 \cdot 10^{-4} + 2.7 \cdot 10^{-5} p + 1.14 \cdot 10^{-7} p^2\right] \\ &+ \eta^4 \left[2.59 \cdot 10^{-4} + 1.77 \cdot 10^{-6} p + 2.02 \cdot 10^{-7} p^2\right] \end{aligned} \tag{3}$$

This global parameterization is illustrated in Fig. 6

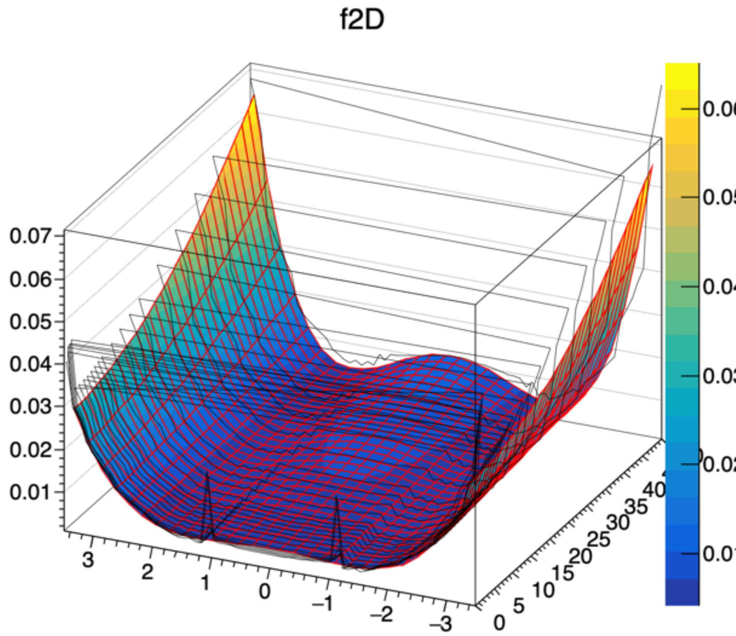

FIG. 6. 2D plot of dp/p and global parameterization.