An Electron Trigger
Why?
How

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WHY?

- **For Central Au+Au the answer is always YES!**
  In the PHENIX aperture, $\Delta\phi/2\pi = 0.5$, $\Delta\eta = 2 \times 0.35$:
  $$dn^{\rm ch}/dy \simeq 1000 \rightarrow 500\pi^0 \times 0.35 = 175\pi^0 \quad .$$
- **This means** $175 \times 0.012 = 2$ **Dalitz pairs (4 "electrons") per central collision**
- Good news is that the spectrum falls strongly with increasing p_T
- Thus a meaningful trigger must require $p_T \geq$ a threshold, the simplest method being to use an EM calorimeter.
- The EM cal must avoid triggering on every photon. Here Pad3 would help enormously, since if $E_{cal} > E_{minI}$ there are "no" charged hadrons, only photons (somebody please do better, see PN194).
- **HOW—Connect electrons identified in RICH with calorimeter clusters.**

1 Trajectories in polar coordinates

The equations of a trajectory in a uniform magnetic field in polar coordinates for a particle emitted from the origin are:

$$\sin\alpha = \frac{R}{2\rho} \tag{1}$$

$$\sin(\phi - \phi_0) = \frac{R}{2\rho} = \sin\alpha \tag{2}$$

where:

- ϕ is the azimuthal coordinate of the trajectory measured at radius R
- ϕ_0 is the azimuth of the trajectory at the origin (azimuthal angle of emission)
- α is the local tangent angle of the trajectory relative to the radial direction;
- $\lambda = \phi + \alpha$ is the local tangent of the trajectory in space;
- ρ is the bending radius.

The radius in meters of a particle with transverse momentum p_T (in GeV/c) in a uniform magnetic field B (in Tesla) is

$$\rho = \frac{3.336 p_T}{B} \quad . \tag{3}$$

1.1 Field-free region—RICH to EMCal connection

Consider a radius R in a field free region which is outside a radius $R_{\check{c}}$ at which (it is assumed) the magnetic field goes to zero. In a field free region, the trajectory vector $\lambda = \lambda_{\check{c}}$ does not change. However the local tangent angle α to the radius changes because the azimuthal coordinate ϕ of the trajectory changes:

$$\sin\alpha = \frac{R_{\check{c}}}{R}\sin\alpha_{\check{c}} \tag{4}$$

$$\phi + \alpha = \lambda = \lambda_{\check{c}} \tag{5}$$

$$\phi = \lambda_{\check{c}} - \alpha = \lambda_{\check{c}} - \sin^{-1}\left(\frac{R_{\check{c}}\sin\alpha_{\check{c}}}{R}\right) \quad . \tag{6}$$

The calorimeter cluster is at some ϕ_γ at the R_γ of the calorimeter. The RICH measures the angle $\lambda_{\check{c}}$ of the trajectory in space which should be **equal** to the ϕ_γ of the calorimeter cluster (Eq. 6), except for a small momentum dependent correction (α_γ) which can be computed (Eq. 4) since the energy of the calorimeter cluster gives p_T (since there is "no bending" in the θ plane). Approximately:

$$\sin\alpha_{\check{c}} \sim \frac{R_{\check{c}}}{2\rho} = \frac{R_{\check{c}}}{2}\frac{B}{3.336 p_T} = \frac{p_T^{\rm cutoff}(R_{\check{c}})}{p_T}$$

$$\lambda_{\check{c}} - \phi_\gamma = \alpha_\gamma \sim \sin^{-1}\left(\frac{R_{\check{c}}^2}{2R_\gamma}\frac{B}{3.336 p_T}\right)$$

MJT Electron Trigger Strategy

- Match $\lambda_{\check{c}}$, $\theta_{\check{c}}$ hits on RICH
- To ϕ_γ, θ_γ hits on Calorimeter
  - within 1 ns of $\beta = 1$
  - charged only
  - (For different slices of E_γ)

- to θ, λ, ϕ tracks in tracker (when available, level X)
- Then match p and E
- Then reject Dalitz (level X+?)
  - Optimum magnetic field setting?
- Also, Select Dalitz!