E_{EM}: electromagnetic energy in tower

E_{HAD}: hadronic energy in tower

θ_{EM}, η_{EM}: angle between the beamline and the direction given by the line between the vertex and the center of the EM component of the tower. (See figure 21 of CDF note 5293.)

θ_{HAD}, η_{HAD}: Same as above for the hadronic component of the tower.

ϕ_{EM}, ϕ_{HAD}: Phi of the tower measured in the EM and HAD component.

StandardCalculator:

$$E_{EM_T} = E_{EM} \sin\theta_{EM}, \;\; E_{HAD_T} = E_{HAD} \sin\theta_{HAD} \tag{1}$$

$$E_T = E_{EM_T} + E_{HAD_T} \tag{2}$$

If $E_T > E_{T_{threshold}}$, compute the following:

$$\eta = \frac{\eta_{EM} E_{EM_T} + \eta_{HAD} E_{HAD_T}}{E_T} \tag{3}$$

$$\phi = \frac{\phi_{EM} E_{EM_T} + \phi_{HAD} E_{HAD_T}}{E_T} \tag{4}$$

$$p_x = E_{EM} \cos\phi_{EM} \sin\theta_{EM} + E_{HAD} \cos\phi_{HAD} \sin\theta_{HAD} \tag{5}$$

$$p_y = E_{EM} \sin\phi_{EM} \sin\theta_{EM} + E_{HAD} \sin\phi_{HAD} \sin\theta_{HAD} \tag{6}$$

$$p_z = E_{EM} \cos\theta_{EM} + E_{HAD} \cos\theta_{HAD} \tag{7}$$

FourVectorCalculator:

$$p_x = E_{EM} \sin\theta_{EM} \cos\phi_{EM} + E_{HAD} \sin\theta_{HAD} \cos\phi_{HAD} \tag{8}$$

$$p_y = E_{EM} \sin\theta_{EM} \sin\phi_{EM} + E_{HAD} \sin\theta_{HAD} \sin\phi_{HAD} \tag{9}$$

$$p_T = \sqrt{(p_x)^2 + (p_y)^2} \tag{10}$$

If $p_T > E_{T_{threshold}}$, compute the following:

$$p_z = E_{EM} \cos\theta_{EM} + E_{HAD} \cos\theta_{HAD} \tag{11}$$

$$E = E_{EM} + E_{HAD} \tag{12}$$

$$\mathbf{p} = (p_x, p_y, p_z, E) \tag{13}$$

$$\eta = \frac{1}{2} \ln \frac{p + p_z}{p - p_z} \tag{14}$$

$$\phi = \tan^{-1} \frac{p_y}{p_x} \tag{15}$$