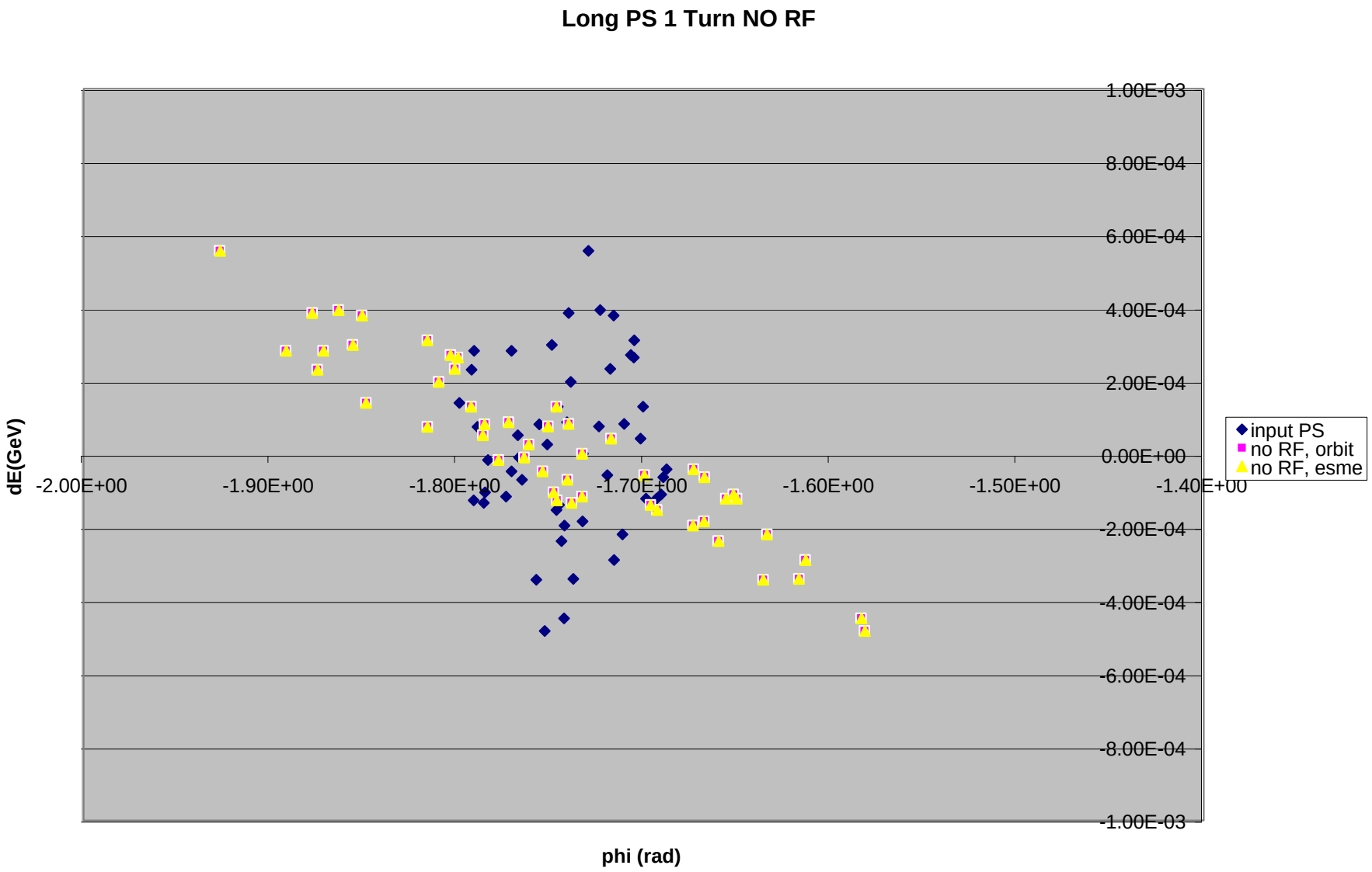
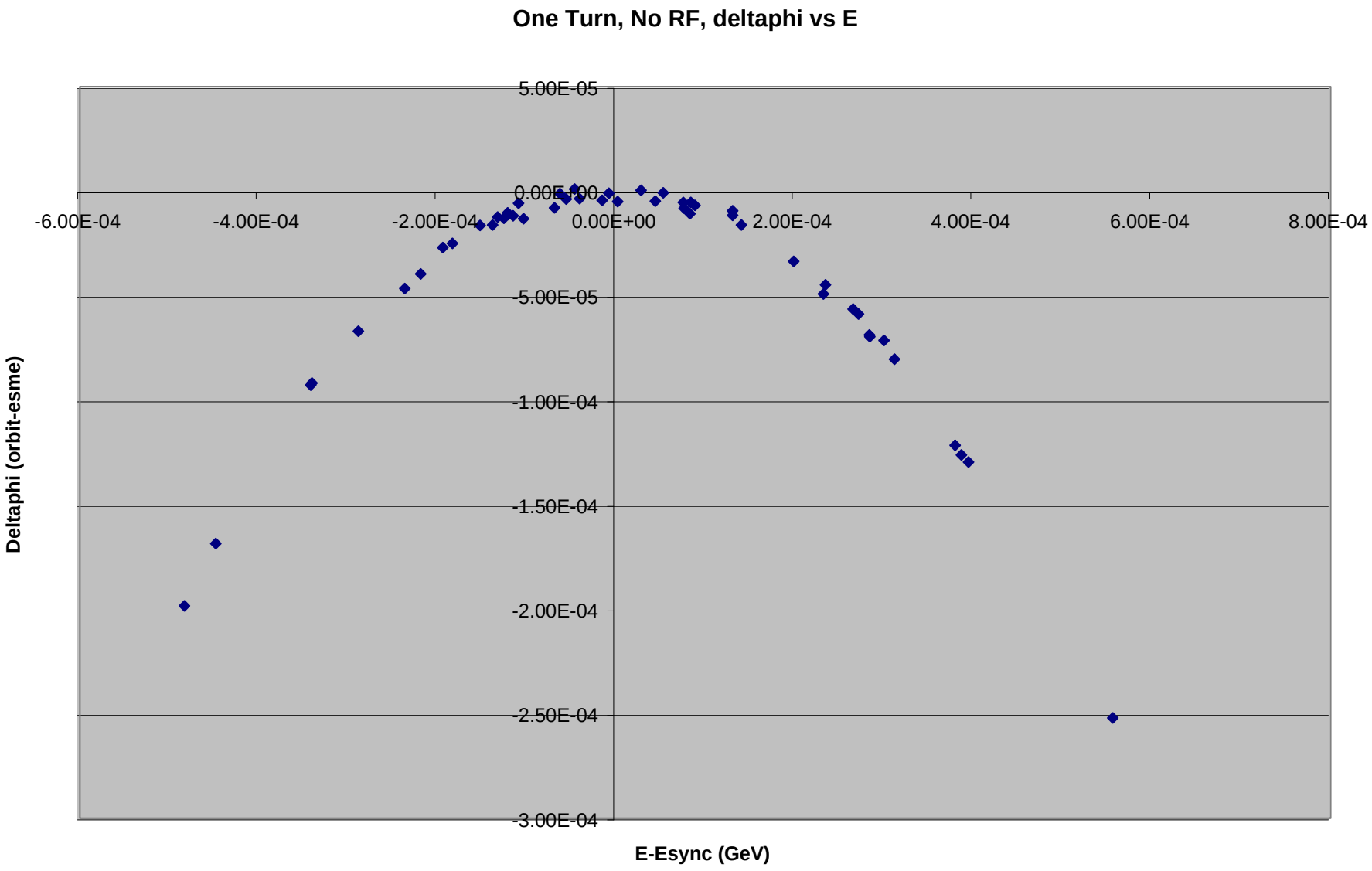

Long PS 1 Turn NO RF
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
-2.00E-04
-4.00E-04
-6.00E-04
-8.00E-04
-1.00E-03
-2.00E+00
-1.90E+00
-1.80E+00
-1.70E+00
-1.60E+00
-1.50E+00
-1.40E+00
dE(GeV)
phi (rad)
input PS
no RF, orbit
no RF, esme


One Turn, No RF, deltaphi vs E
5.00E-05
0.00E+00
-5.00E-05
-1.00E-04
-1.50E-04
-2.00E-04
-2.50E-04
-3.00E-04
-6.00E-04
-4.00E-04
-2.00E-04
0.00E+00
2.00E-04
4.00E-04
6.00E-04
8.00E-04
Deltaphi (orbit-esme)
E-Esync (GeV)

P. Lucas 2/19/04

Differences Orbit-Esme

① Need $\frac{\delta P}{P}$

Orbit $\frac{\delta P_j}{P_s} \approx \frac{1}{\beta_s^2}\frac{\delta E_j}{E_s}$ Esme $\frac{\delta P_j}{P_s} = \frac{P_j - P_s}{P_s}$

For #1, $= .0004582503$, $= .0004583757$

② Need $\frac{\delta R}{R} = \alpha_0 \frac{\delta P}{P} + \underbrace{\alpha_1\left(\frac{\delta P}{P}\right)^2 + \alpha_2\left(\frac{\delta P}{P}\right)^3 + \alpha_3\left(\frac{\delta P}{P}\right)^4}_{\text{Not in orbit}}$

$\alpha_0 = \frac{1}{\gamma_T^2}$

α_1 FNAL Booster $= .0172$

This is not the source of the discrepancy

③ Phase propagation

Orbit: $\phi_{n+1} = \phi_n + 2\pi \cancel{h}\left(\frac{1}{\gamma_T^2} - \frac{1}{\gamma_s^2}\right)\frac{\delta P}{P}$

$h = 1$

Esme: $\phi_{n+1} = \phi_n + 2\pi\left[\left(1 + \frac{\delta P_j}{P}\frac{1}{\gamma_T^2}\right)\frac{\beta_s}{\beta_j} - 1\right]$

$= 1 - \frac{\delta\beta}{\beta_j} \approx 1 - \frac{\delta\beta}{\beta_s}$

$\left[1 - \frac{\delta\beta}{\beta_s} + \frac{1}{\gamma_T^2}\frac{\delta P}{P_s} - \frac{1}{\gamma_T^2}\frac{\delta P}{P_s}\frac{\delta\beta}{\beta_s} - 1\right]$ — 2nd order

$$\approx \left[-\frac{\delta\beta}{\beta_s} + \frac{1}{\gamma_T^2}\frac{\delta p}{p_s} \right]$$

$$\frac{\delta\beta}{\beta_s} \approx \frac{m^2}{p^2 + m^2}\frac{\delta p}{p} = \frac{1}{\gamma_s^2}$$

For particle 1, for the 1st turn increment / ($2\pi * 84$)

Orbit	Esme
$-.00020988$	$-.00020973$