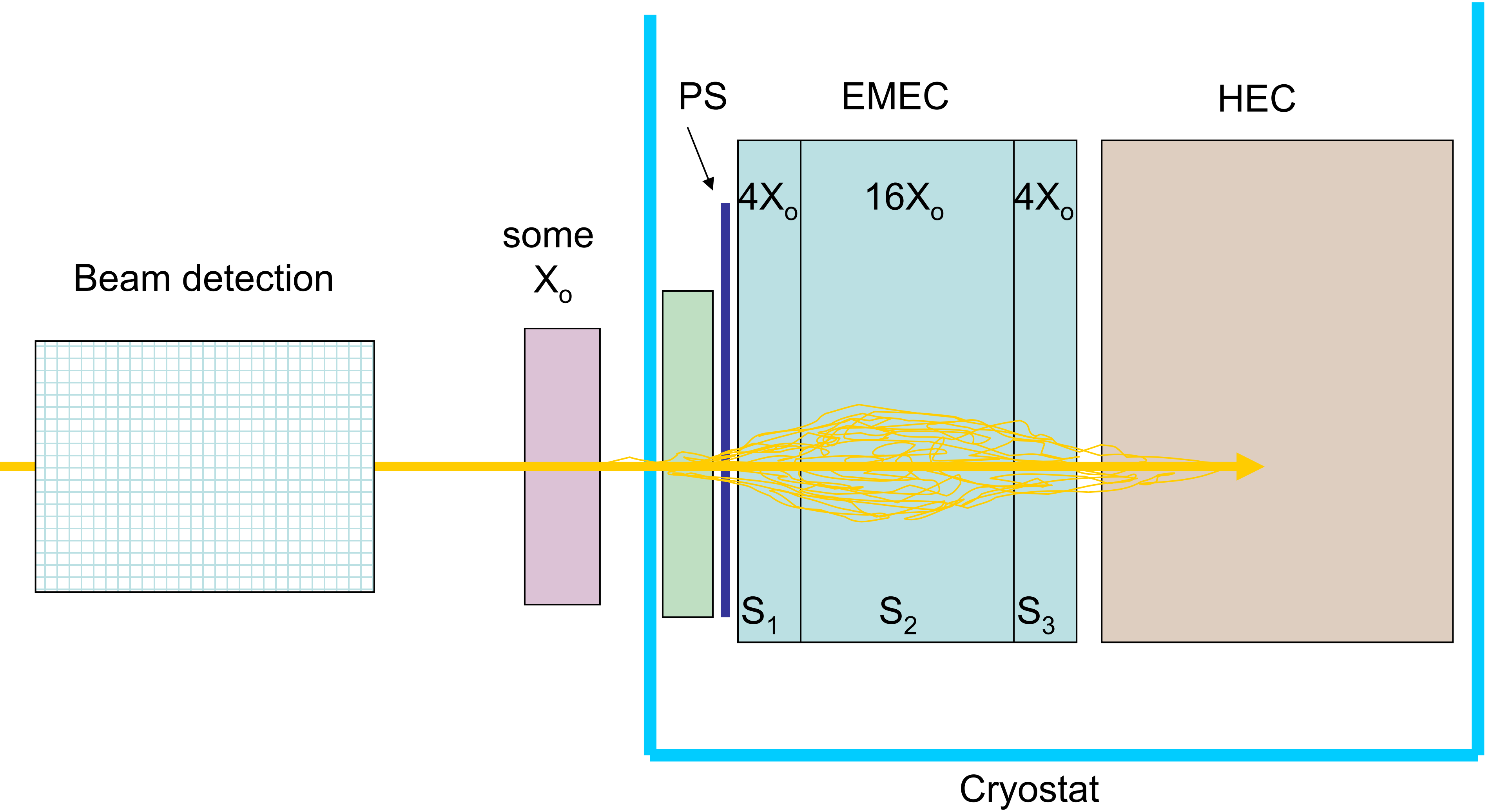
Testbeam (*very* schematically)



Electromagnetic logitidinal shower development

Depth (in X_o)at which the shower has the maximum number of particles:

(e.g.: http://rkb.home.cern.ch/rkb/PH14pp/node58.html)

$t_{max} \approx \ln (E / \varepsilon) - c$ (with: $\varepsilon \cong 550$ MeV/Z $c \cong 1$ for electrons ($Z_{Pb} = 82$))

Shower depth for 95% lognitudinal containment:

$T_{95}[X_o] \approx t_{max} + 0.08 \cdot Z + 9.6$

Parametrization for average differential longitudinal energy deposit:

$DE = k \cdot t^{(a-1)} \cdot e^{-bt} \cdot dt$ (with: $k = E\, b^a / \Gamma(a)$)

Integrate this up to some depth t' :

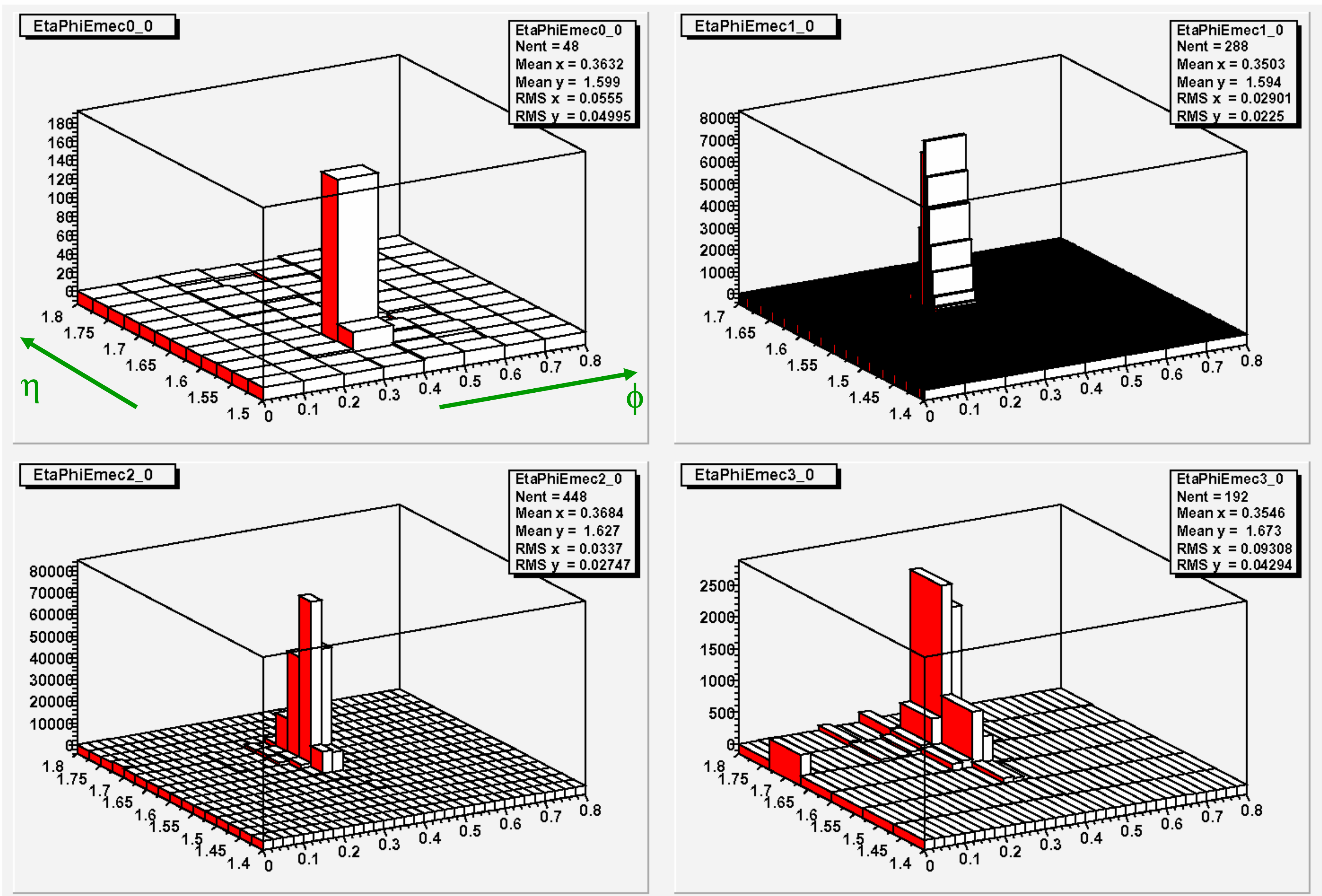
$$E_{t'} = E \int_0^{\tau'} \frac{\tau^{a-1} e^{-\tau}}{\Gamma(a)} d\tau = E \cdot GAMDIS(\tau' , a) \quad \text{(with: } \tau = bt \text{)}$$

CERN Library function

Differentiate DE and set to zero (for shower maximum):

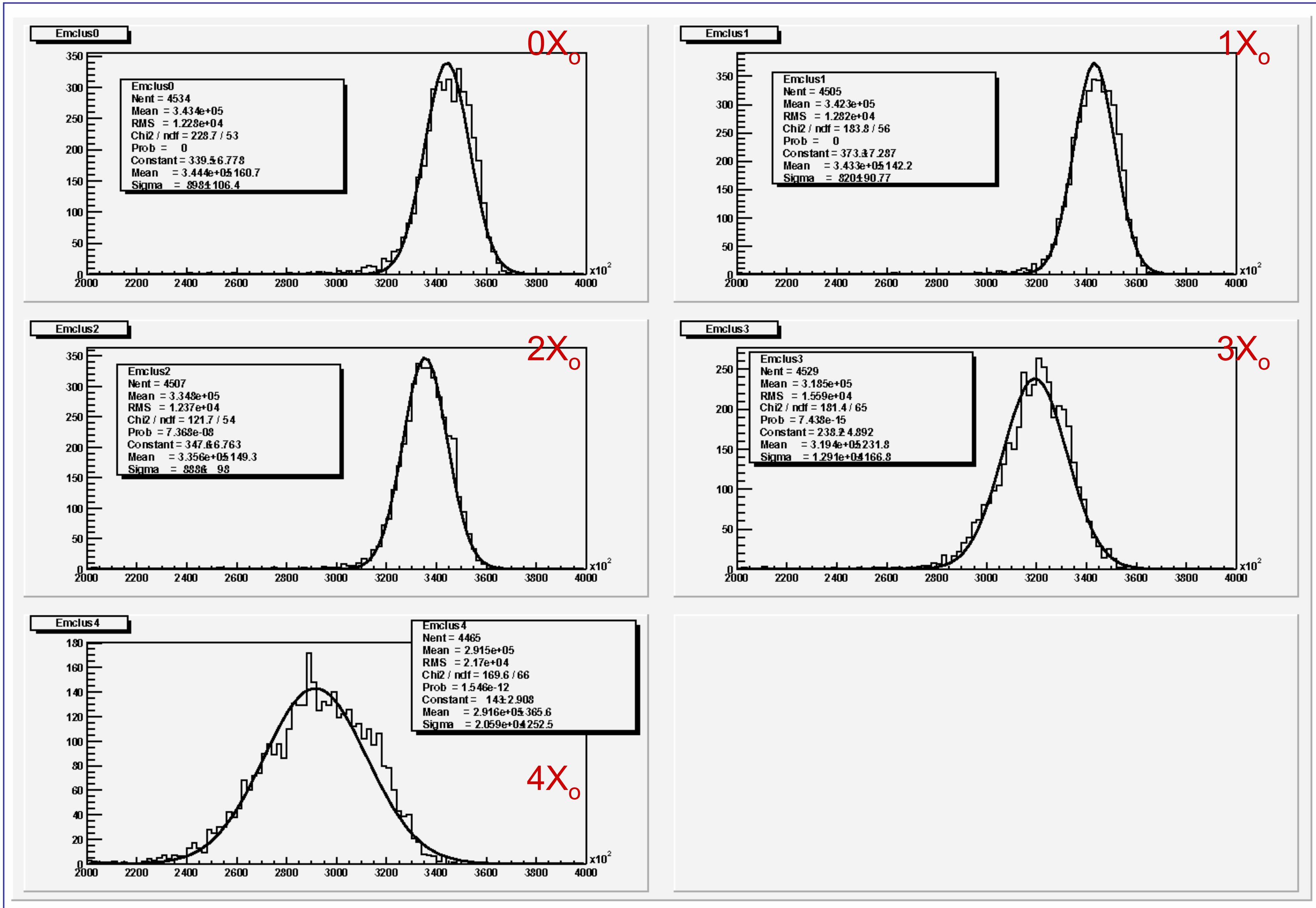
$\Rightarrow t_{max} = (a-1) / b$

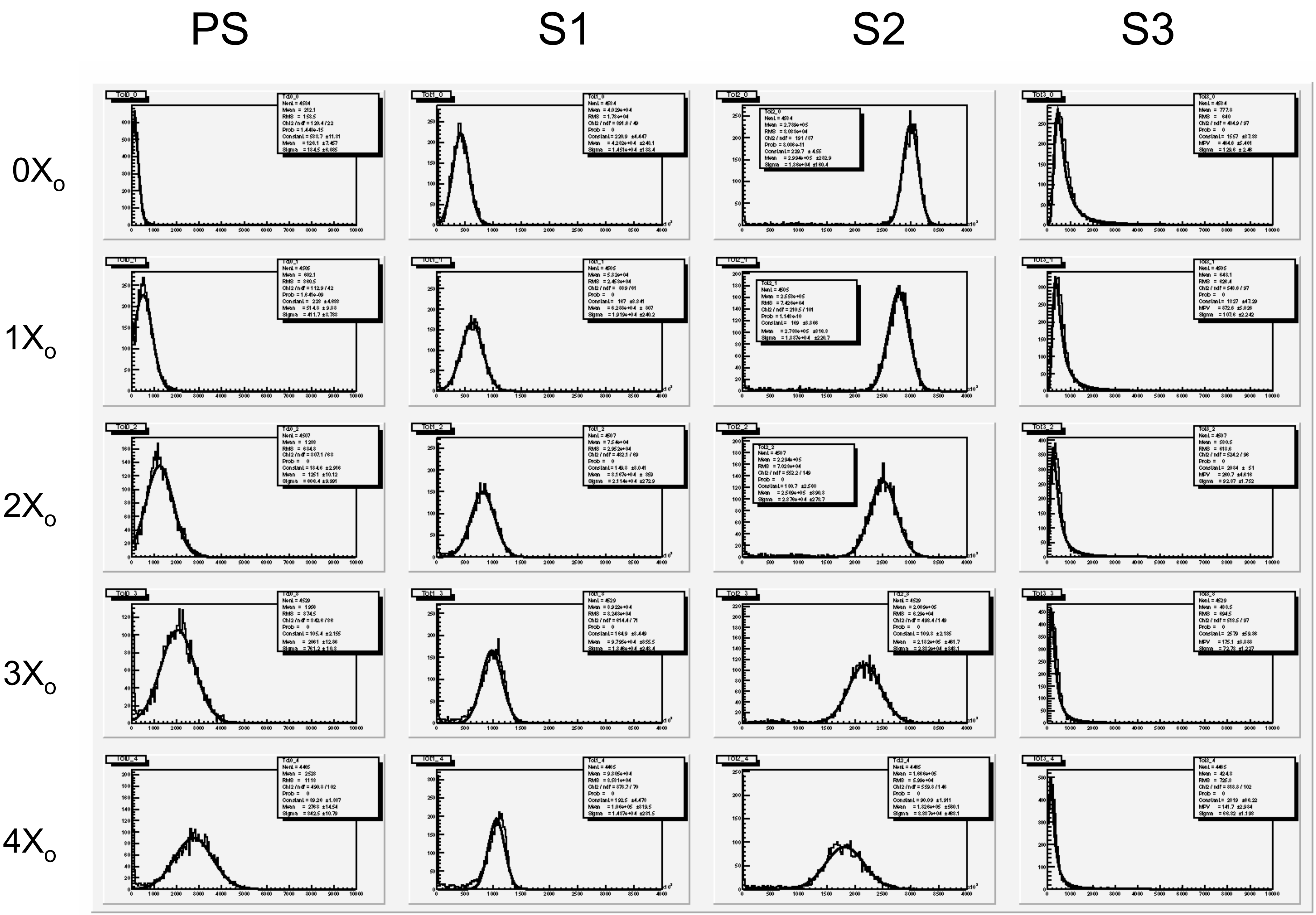
148 GeV e



EtaPhiEmec0_0
EtaPhiEmec0_0
Nent = 48
Mean x = 0.3632
Mean y = 1.599
RMS x = 0.0555
RMS y = 0.04995
η
ϕ
EtaPhiEmec1_0
EtaPhiEmec1_0
Nent = 288
Mean x = 0.3503
Mean y = 1.594
RMS x = 0.02901
RMS y = 0.0225
EtaPhiEmec2_0
EtaPhiEmec2_0
Nent = 448
Mean x = 0.3684
Mean y = 1.627
RMS x = 0.0337
RMS y = 0.02747
EtaPhiEmec3_0
EtaPhiEmec3_0
Nent = 192
Mean x = 0.3546
Mean y = 1.673
RMS x = 0.09308
RMS y = 0.04294

ΣE (S1 + S2 + S3) [nA]


Emclus0
0Xo
Emclus0
Nent = 4534
Mean = 3.434e+05
RMS = 1.228e+04
Chi2 / ndf = 228.7 / 53
Prob = 0
Constant = 339.5 ± 6.778
Mean = 3.444e+05 ± 160.7
Sigma = 8984 ± 106.4
Emclus1
1Xo
Emclus1
Nent = 4505
Mean = 3.423e+05
RMS = 1.282e+04
Chi2 / ndf = 183.8 / 56
Prob = 0
Constant = 373.3 ± 7.287
Mean = 3.433e+05 ± 142.2
Sigma = 8204 ± 90.77
Emclus2
2Xo
Emclus2
Nent = 4507
Mean = 3.348e+05
RMS = 1.237e+04
Chi2 / ndf = 121.7 / 54
Prob = 7.368e-08
Constant = 347.6 ± 6.763
Mean = 3.356e+05 ± 149.3
Sigma = 8886 ± 98
Emclus3
3Xo
Emclus3
Nent = 4529
Mean = 3.185e+05
RMS = 1.559e+04
Chi2 / ndf = 181.4 / 65
Prob = 7.438e-15
Constant = 238.2 ± 4.892
Mean = 3.194e+05 ± 231.8
Sigma = 1.291e+04 ± 166.8
Emclus4
4Xo
Emclus4
Nent = 4465
Mean = 2.915e+05
RMS = 2.17e+04
Chi2 / ndf = 169.6 / 66
Prob = 1.546e-12
Constant = 143 ± 2.908
Mean = 2.916e+05 ± 365.6
Sigma = 2.059e+04 ± 252.5
x10²
2000 2200 2400 2600 2800 3000 3200 3400 3600 3800 4000


PS
S1
S2
S3
$0X_o$
$1X_o$
$2X_o$
$3X_o$
$4X_o$

Take from EMEC paper: $E[GeV] = E[nA] \cdot 0.417 \cdot 10^{-3}$

Use:

$$E_{t'} = E \int_0^{\tau'} \frac{\tau^{a-1} e^{-\tau}}{\Gamma(a)} d\tau = E \cdot GAMDIS(\tau', a) \qquad \text{(with: } \tau = bt \text{)}$$

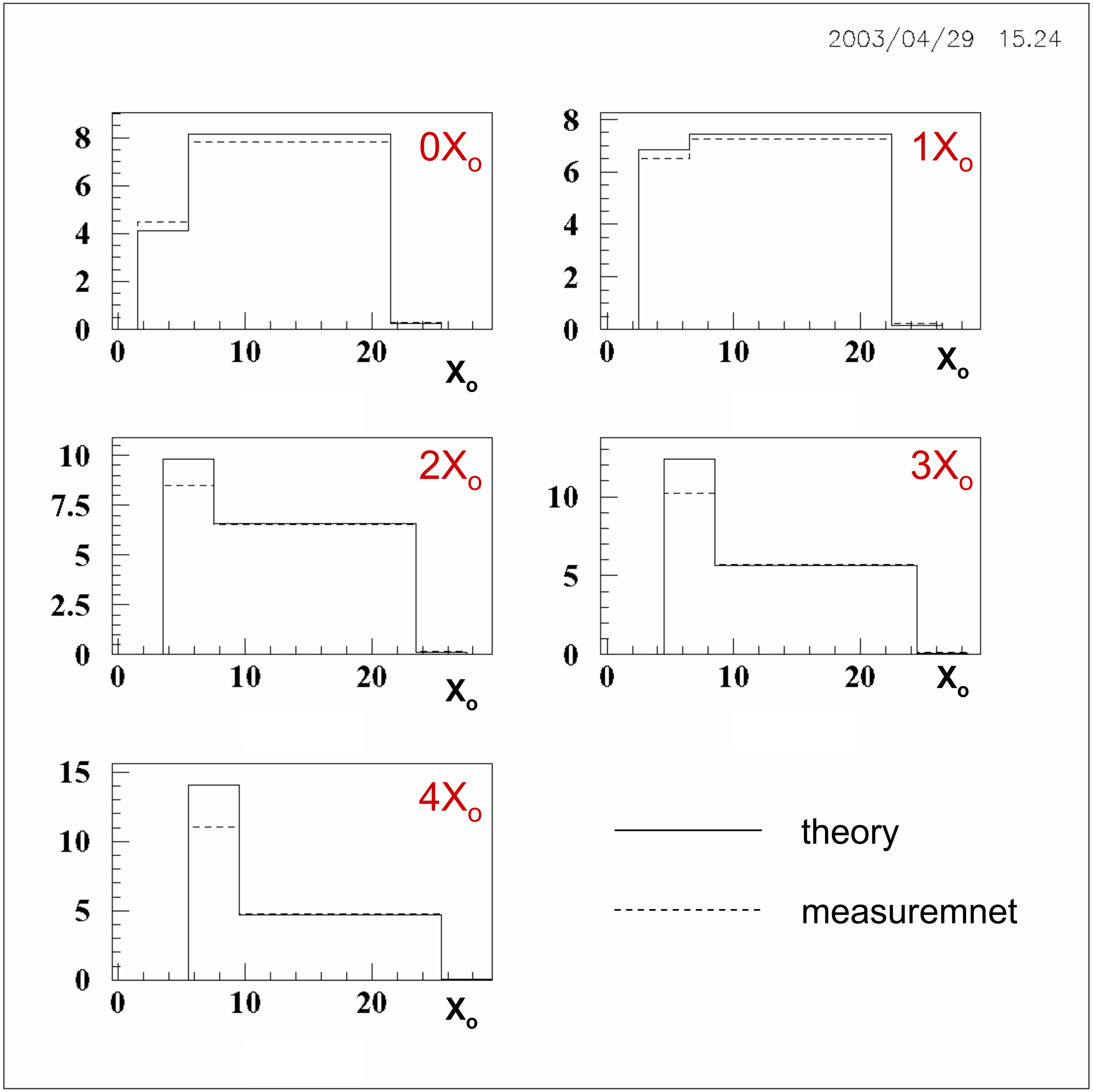
And fit for a,b and the amount of "junk" in front .

For the fit, calculate the energy deposit in each Xo interval (plus some assumed "junk" in front of everything) and then sum up the energy over $4X_o$, $16\ X_o$, $4X_o$ for the 3 depth segments of the EMEC. Compare those segments to the measurements and minimize the χ^2 (assuming the errors are the σ's of the Cluster-energy distributions).

With that, get for 148 GeV electrons:

$a = 6.78$ $b=0.64$ $t_{max} = 9.03$ $\chi^2 = 7.88$ (dof=11) junk = $2.02\ X_o$

(results to be taken with a huge grain of salt….)


2003/04/29 15.24
0X₀
1X₀
2X₀
3X₀
4X₀
X₀
theory
measuremnet

Old MPI note with about half of the number of beam counters gives:

Cryostat window:	0.32 X_o
Air and beam detectors:	0.24 X_o
LAr and excluder:	0.44 X_o

⇒Guess for our beam test:

Cryostat window:	0.32 X_o
Air and beam detectors:	0.48 X_o
LAr and excluder:	0.5 X_o
PS :	0.65 X_o
	1.95 X_o

Next on the list:

Other energies
Better definition of “clusters”
Hadron showers
Radial shower development

⋮