Energy resolution – Sampling term

- We consider a sampling calorimeter using Lead as absorber and Plastic Scintillator as active material, with the following properties:
  - 5 mm thick lead plates
  - 3 mm thick scintillator tiles
  - A resolution of 16% / √E (sampling term)
- Compute the sampling fraction of this calorimeter
- What is the sampling fraction that would be required to get a sampling term of 13% / √E ?
- Consequently, what is the lead plate thickness that would be required, if we use the same scintillator thickness as before (3mm)?

material	Z	A	ρ	dE/dx	λ_0	X_0	R_M	ϵ
			[g/cm^3]	[MeV/cm]	[cm]	[cm]	[cm]	[MeV]
Al	13	27.0	2.70	4.37	37.2	8.9	4.68	39.3
Liq. Ar	18	40.0	1.40	2.11	80.9	14.0		29.8
Fe	26	55.9	7.87	11.6	17.1	1.76	1.77	20.5
Cu	29	63.5	8.96	12.9	14.8	1.43	1.60	18.7
W	74	183.9	19.3	22.6	10.3	0.35	0.92	7.9
Pb	82	207.2	11.35	12.8	18.5	0.56	1.60	7.2
U	92	238.0	18.95	20.7	12.0	0.32	1.00	6.6
NaI			3.67	4.84	41.3	2.59		12.4
Plastic scintillator			1.032	2.03	68.5	42.9		87.1

Energy resolution – Comparison of two EM calorimeters

- We are comparing the resolutions of the ATLAS and CMS EM calorimeters, as measured in test beams:

CMS

$$\frac{\sigma(E)}{E} = \frac{0.03}{\sqrt{E(\mathrm{GeV})}} \oplus \frac{0.3}{E(\mathrm{GeV})} \oplus 0.005$$

ATLAS

$$\frac{\sigma(E)}{E} = \frac{0.1}{\sqrt{E(\mathrm{GeV})}} \oplus \frac{0.3}{E(\mathrm{GeV})} \oplus 0.007$$

- Fill the following table for both calorimeters. And comment these numbers.

	10 GeV	1 TeV
Stochastic [%]		
Noise [%]		
Constant [%]		
$\sigma(E)$ / E [%]		