



Generation of data for GANs – CMS ECAL

THIAGO TOMEI

SPRACE-UNESP

Data Generation

CMSSW_9_2_0 (2017 release)

Electron gun with:

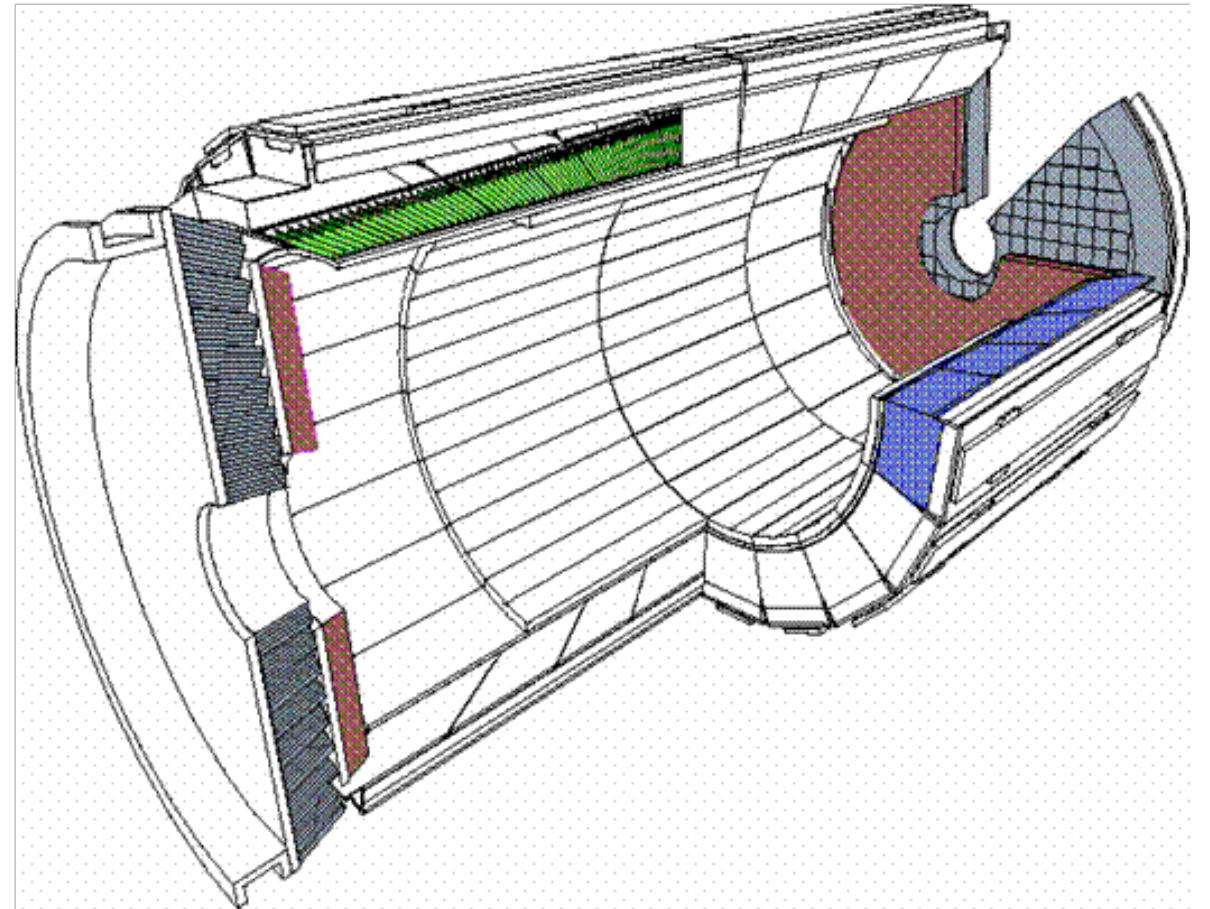
- ❑ Energy in 20—100 GeV
- ❑ (η, ϕ) in $(-1E-11, 1E-11)$ range (EcalBarrel)

Full simulation

- ❑ GEANT4, version 10.0 patch02
 - En passant: this was the first version that used event-level parallelism (needed for MT CMSSW)

Reminder of the EcalBarrel

- ❑ η/ϕ grid with the ranges
 - IETA: -85 --> +85, with no crystal at IETA=0
 - IPHI: 1 --> 360
 - TOTAL: 61200 crystals



(Sim) Calohits Dump example

[ParticleListDrawer] analysing particle collection genParticles

idx	ID	Name	Stat	Mo1	Mo2	Da1	Da2	nMo	nDa	pt	eta	phi	px	py	pz	m
0	11	e-	1	-1	-1	-1	-1	0	0	89.017	-0.000	0.000	89.017	0.000	-0.000	0.001

Found 490 CaloHits (hitEnergy > 0.3)

Calohit ID 838861323, energy = 1.59949, time = 4.89627, depth = 0, Gtrack = 4, ieta = -1, iphi = 11
Calohit ID 838861323, energy = 1.18513, time = 4.82876, depth = 0, Gtrack = 20, ieta = -1, iphi = 11
Calohit ID 838861322, energy = 1.04111, time = 5.3573, depth = 0, Gtrack = 21, ieta = -1, iphi = 10
Calohit ID 838861323, energy = 29.659, time = 4.92216, depth = 0, Gtrack = 21, ieta = -1, iphi = 11
Calohit ID 838861323, energy = 26.9305, time = 5.0053, depth = 0, Gtrack = 21, ieta = -1, iphi = 11
Calohit ID 838861324, energy = 1.35424, time = 4.94778, depth = 0, Gtrack = 21, ieta = -1, iphi = 12
Calohit ID 838861324, energy = 7.31911, time = 5.06141, depth = 0, Gtrack = 21, ieta = -1, iphi = 12
Calohit ID 838861325, energy = 0.545047, time = 5.1847, depth = 0, Gtrack = 21, ieta = -1, iphi = 13
Calohit ID 838861834, energy = 0.310606, time = 5.29379, depth = 0, Gtrack = 21, ieta = -2, iphi = 10
Calohit ID 838861835, energy = 0.691366, time = 5.15271, depth = 0, Gtrack = 21, ieta = -2, iphi = 11
Calohit ID 838861836, energy = 0.594102, time = 5.1377, depth = 0, Gtrack = 21, ieta = -2, iphi = 12
Calohit ID 838926857, energy = 0.570987, time = 5.24825, depth = 0, Gtrack = 21, ieta = 1, iphi = 9
Calohit ID 838926858, energy = 2.17152, time = 5.56262, depth = 0, Gtrack = 21, ieta = 1, iphi = 10
Calohit ID 838926859, energy = 0.453819, time = 4.99368, depth = 0, Gtrack = 21, ieta = 1, iphi = 11
Calohit ID 838926859, energy = 3.52052, time = 5.11757, depth = 0, Gtrack = 21, ieta = 1, iphi = 11
Calohit ID 838926860, energy = 1.4998, time = 5.06787, depth = 0, Gtrack = 21, ieta = 1, iphi = 12
Calohit ID 838926861, energy = 0.398331, time = 5.33493, depth = 0, Gtrack = 21, ieta = 1, iphi = 13

avg ieta = -0.80
avg iphi = 11.1

Data Generation (1)

Ecal doesn't have quite that much granularity for electrons!

- ▣ See the “basic cluster” on the side

On the other hand, electrons radiate and leave extended energy footprints in phi direction.

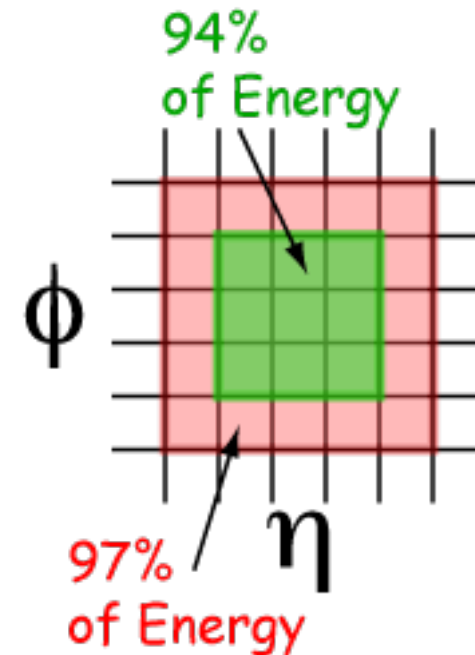
- ▣ Basic clusters → Superclusters, all the joys of Egamma reco.

Most of the hits are low energy, see next slide.

- ▣ But some times electron radiate HARD

I don't think it is worth it trying to come with a very sophisticated algorithm to find out where the electrons are.

- ▣ Just take the full phi ring and a 5-width strip around the eta region: $360 \times 5 = 1800$ crystals.



Data Generation (2)

5 seconds / event

- Mostly empty events, no PU

560 CaloHits/event

Energy distribution:

- Average: 0.1 GeV (!)
- Std. dev: 1.3 GeV

