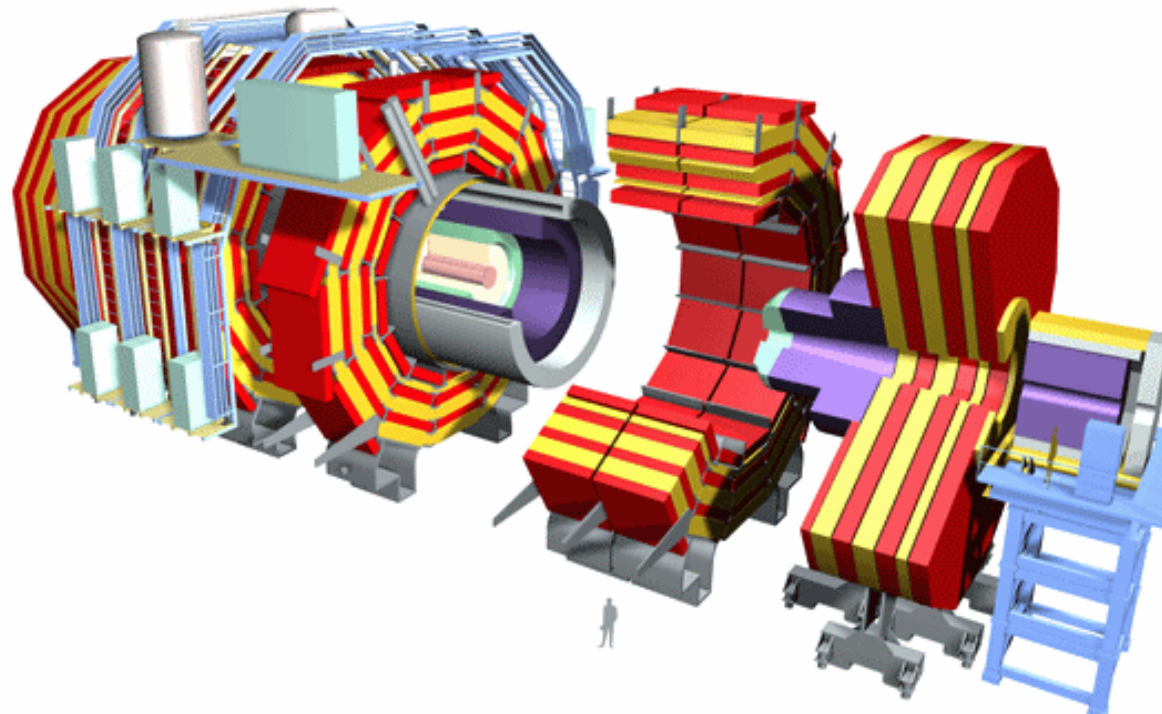




# Compact Muon Solenoid



## **Encontro da Colaboração Portuguesa em CMS**

**Nuno Almeida IST/LIP/CERN**



## **Simulação ECAL**

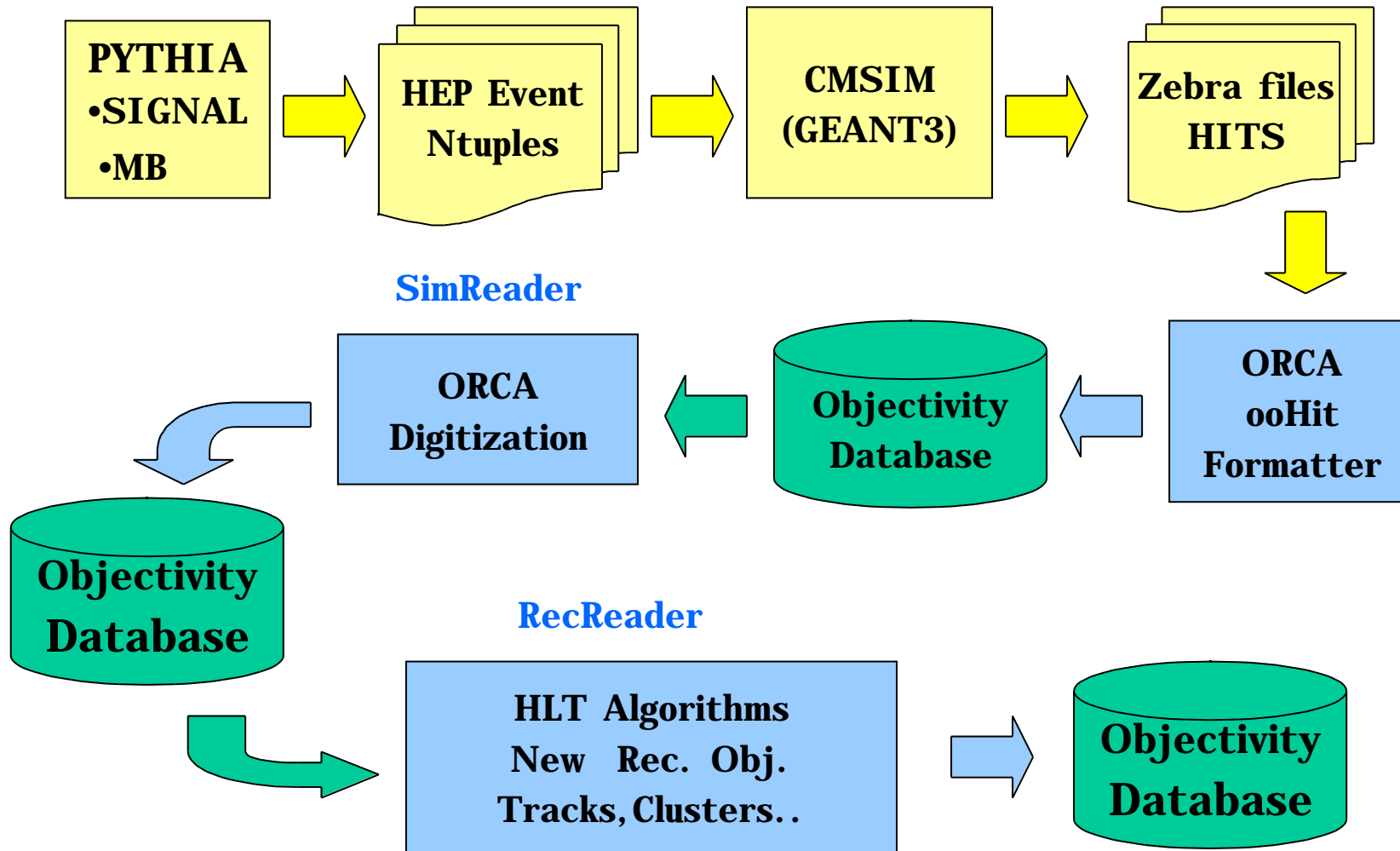
- Processo da Simulação no ORCA4
- Digitização
- Formatação / Geração do Evento Simulado

## **Selective Readout**

- Consequências a Nível da Física
- Perspectivas Futuras



# Simulação no ORCA4



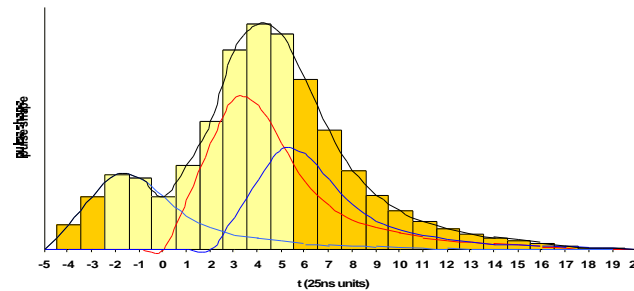
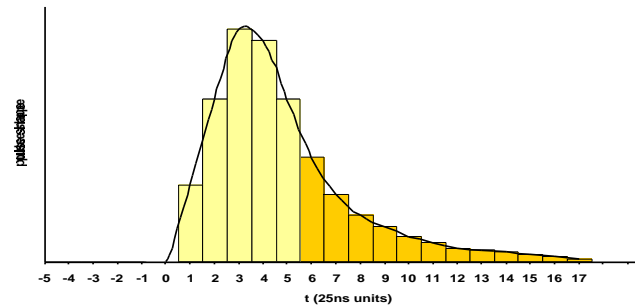


# Digitização



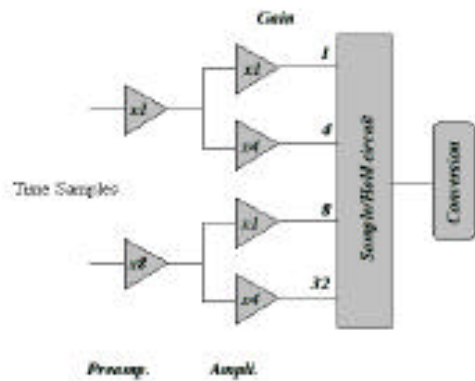
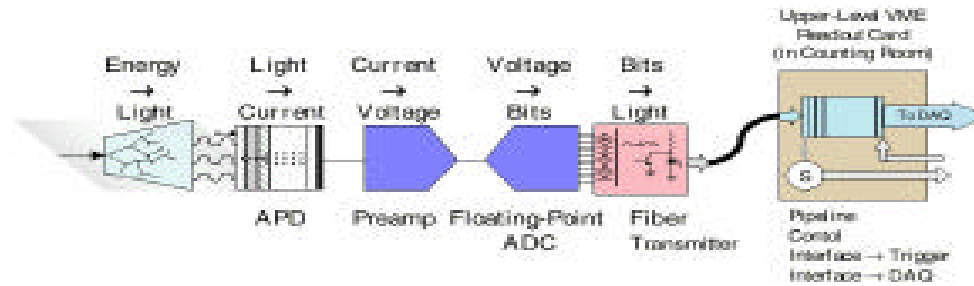
•

$$f(t_n) = A_0 (x_f + c_2 x_f^2 + c_3 x_f^3) \exp(-x_f + d_2 x_f^2 + d_3 x_f^3) \quad \text{onde} \quad x_f = \frac{t_n - t_0}{\tau} \quad \text{e} \quad t_n = n(25ns)$$





# Crystal / TPG Data Words



## TPG :

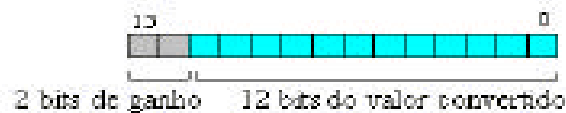
•  $E_t = \sum(E_{ti} \text{ de } 5 \text{ strips em eta})$  aplicando-se o L1Filter a cada uma dessas strips

L1filter : energy filter + peak finder

• Fine Grain Veto Bit :

Bit que caracteriza a dispersão lateral dos showers e.m.

Crystal Data Word



TPG Data Word

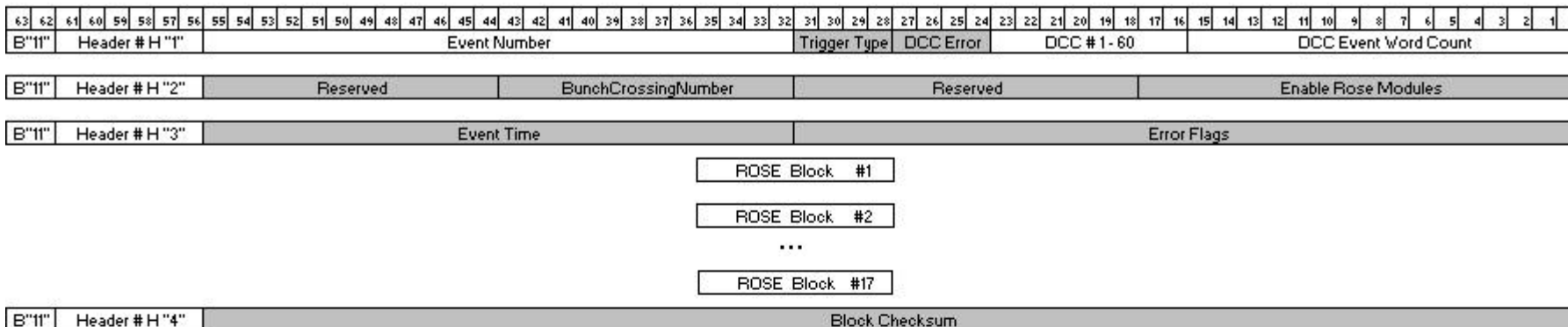




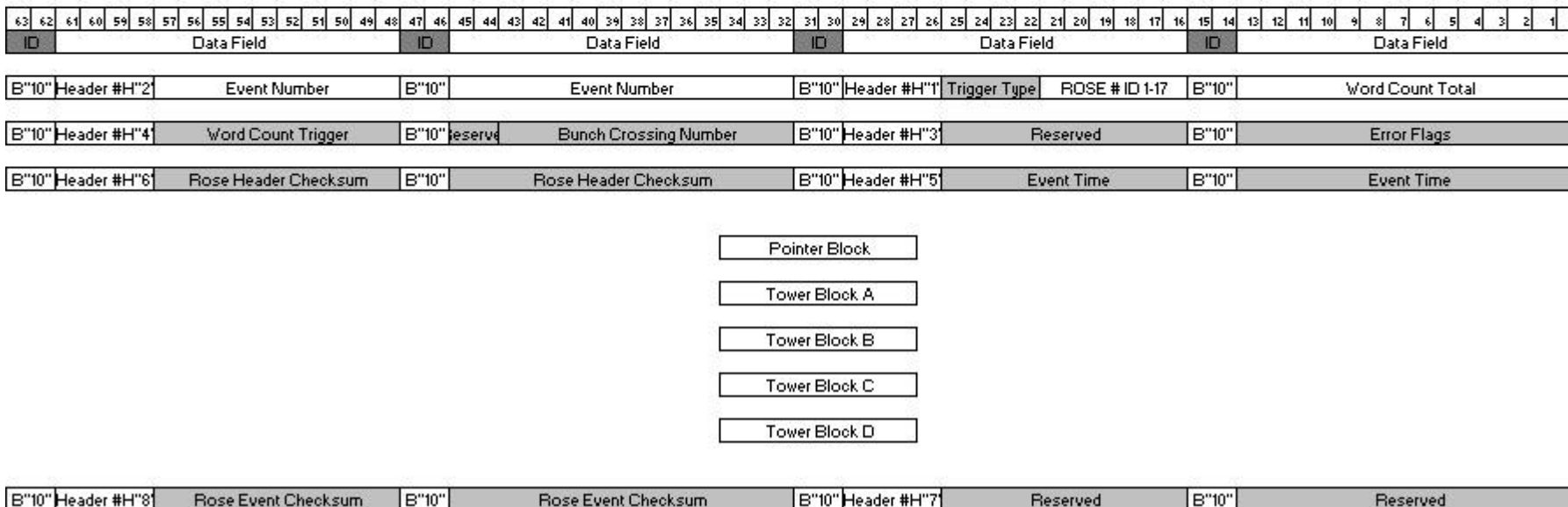
# ECAL Data Format



## DCC Block



## Rose Block





# ECAL Data Format



## Pointer Block

63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
ID	Data Field																ID	Data Field																ID	Data Field																ID	Data Field															
B"01"	Reserved																B"01"	Reserved																B"01"	Reserved																B"01"	Block Word Count = 3															
B"01"	Towed D Pointer																B"01"	Towed C Pointer																B"01"	Towed B Pointer																B"01"	Towed A Pointer															
B"01"	Pointer Block Check Sum																B"01"	Pointer Block Check Sum																B"01"	Reserved																B"01"	Reserved															

## Tower Block

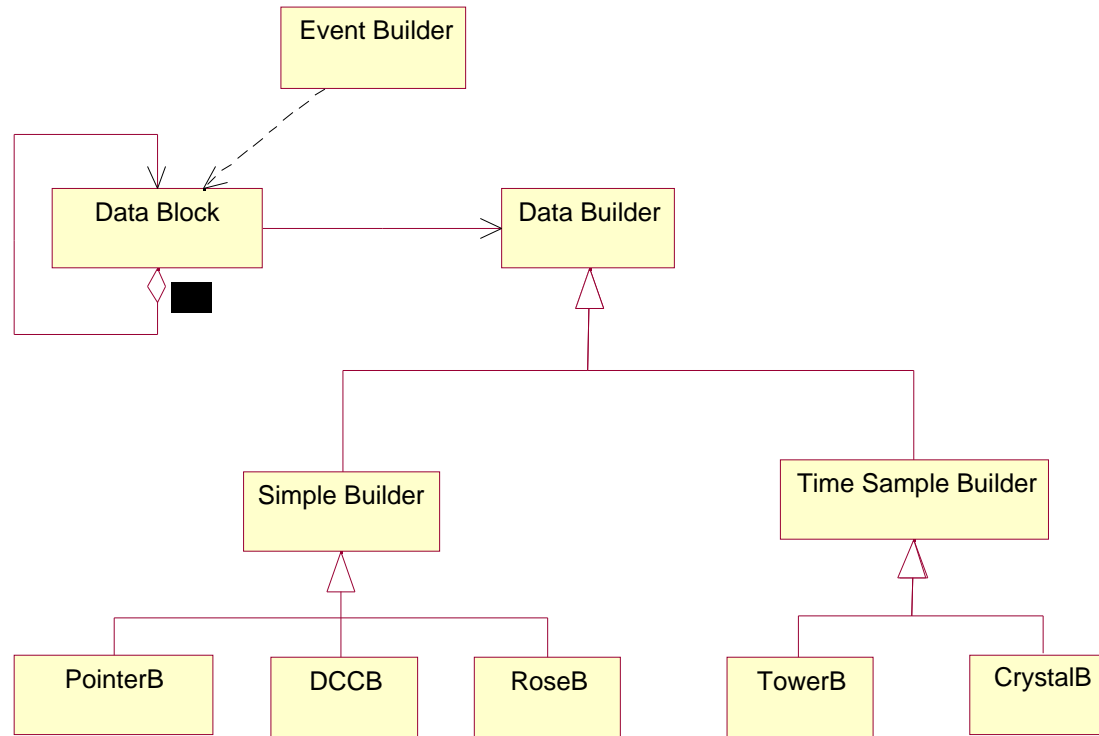
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0							
ID	Data Field																ID	Data Field																ID	Data Field																ID	Data Field																		
B"00"	Reserved																Coarse G.W.cnt	B"00"	TPG Data Word #1																B"00"	Begin Fine Grain																# Time Samples	B"00"	Tower ID																Fine Grain Block Word Count
B"00"	TPG Data Word #5																B"00"	TPG Data Word #4																B"00"	TPG Data Word #3																B"00"	TPG Data Word #2																		
B"00"	TPG Data Word #n																B"00"	TPG Data Word #n-1																B"00"	TPG Data Word #n-2																B"00"	TPG Data Word #n-3																		
n Crystal Blocks																																																																						
B"00"	Tower Block Check Sum																B"00"	Tower Block Check Sum																B"00"	End Fine Grain																# Time Samples	B"00"	Tower ID																Fine Grain Block Word Count	

## Crystal Block

63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0						
ID	Data Field																ID	Data Field																ID	Data Field																ID	Data Field																	
B"00"	Crystal Data Word #2																B"00"	Crystal Data Word #1																B"00"	Reserved																# Time Samples	B"00"	Crystal ID																Cr. Blok Word Count
B"00"	Crystal Data Word #6																B"00"	Crystal Data Word #5																B"00"	Crystal Data Word #4																B"00"	Crystal Data Word #3																	
B"00"	Crystal Data Word #n																B"00"	Crystal Data Word #n-1																B"00"	Crystal Data Word #n-2																B"00"	Crystal Data Word #n-3																	



# Geração do Ficheiro de Eventos







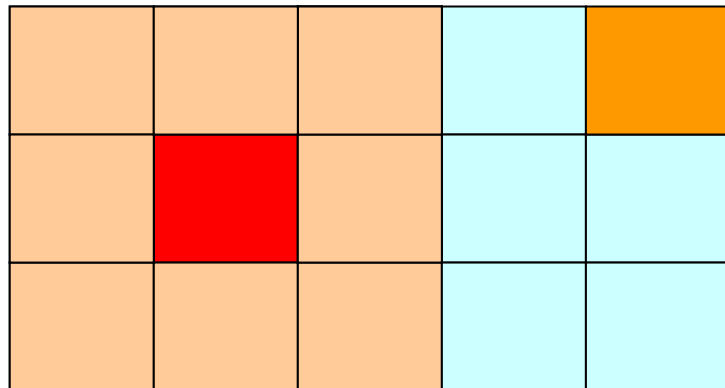
# Selective Readout



## • Supressão de zeros

Apenas são considerados cristais de energia superior a  $2\sigma \sim 60\text{MeV}$

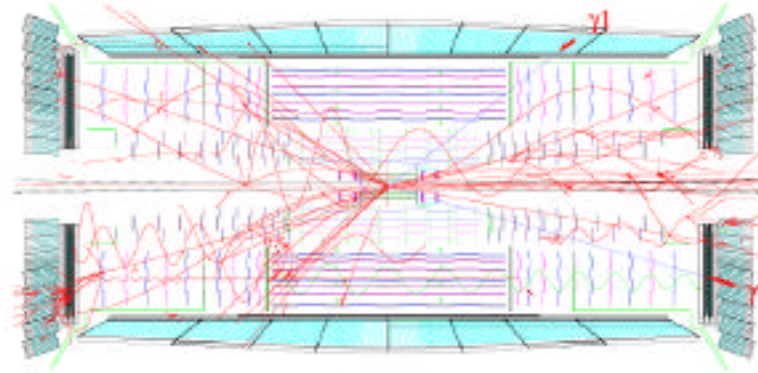
## • Tower Selective Readout



**CENTER**  $\Rightarrow Et > HTR$   
**SINGLE**  $\Rightarrow HTR > Et > LTR$   
**NEIGHBOUR**  $\Rightarrow Et < LTR$   
**NOTREAD**  $\Rightarrow Et < LTR$   
and not neighbour....



Higgs →



**Higgs ->γγ (M= 110 GeV)**

**•ORCA :**

**PU:AverageEvents = 17.3**

**EcalIslandClustering**

**TSR Marker : HTR = 2.5 GeV LTR = 1.0 GeV**

**•Análise (limitada pela ausência de tracker):**

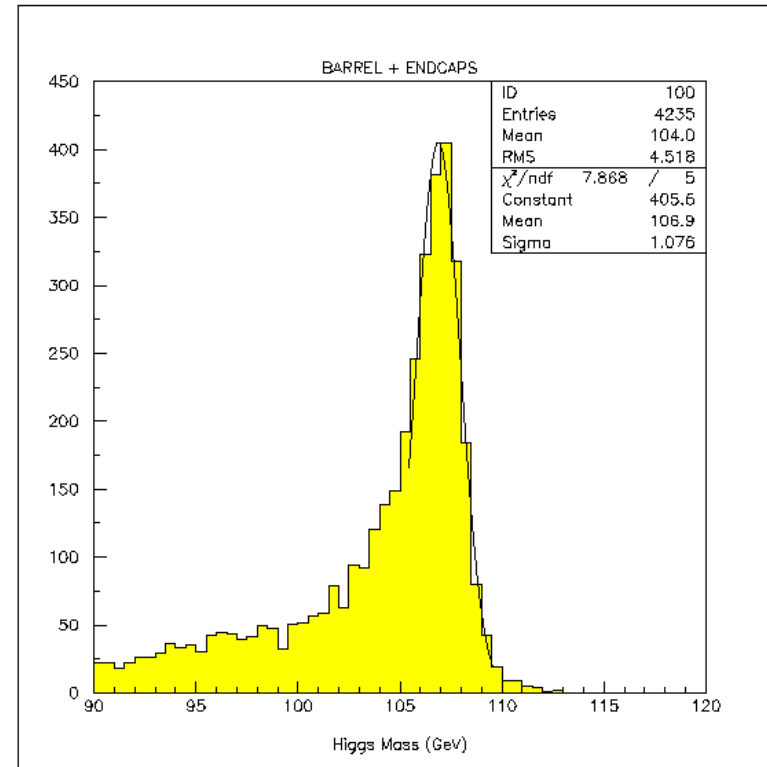
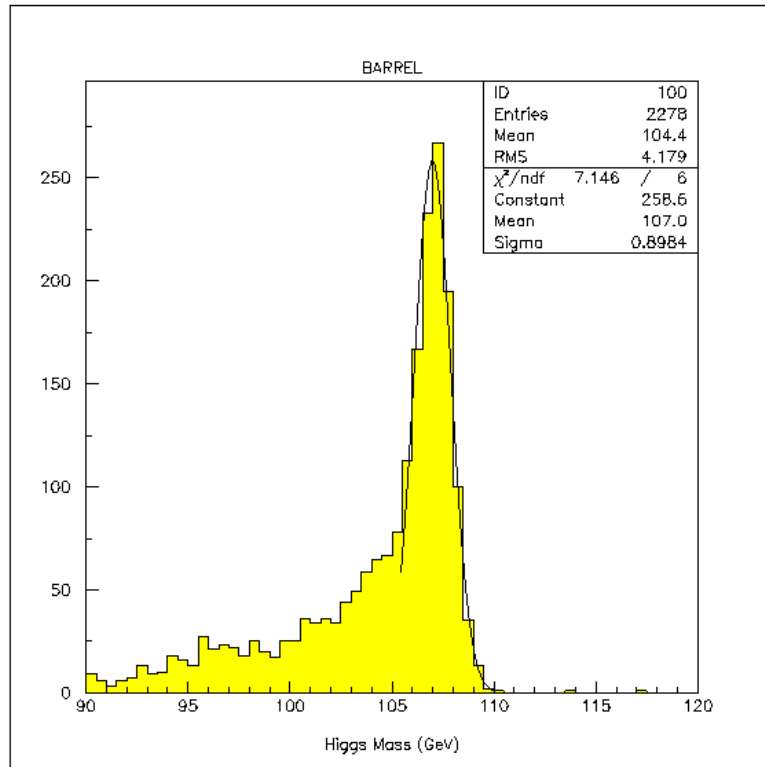
**Et > 10. GeV**

**|eta| < 2.5**

**No caso de haver mais que um Higgs reconstruído exige-se que  $M \in [100,120 ]$  GeV**

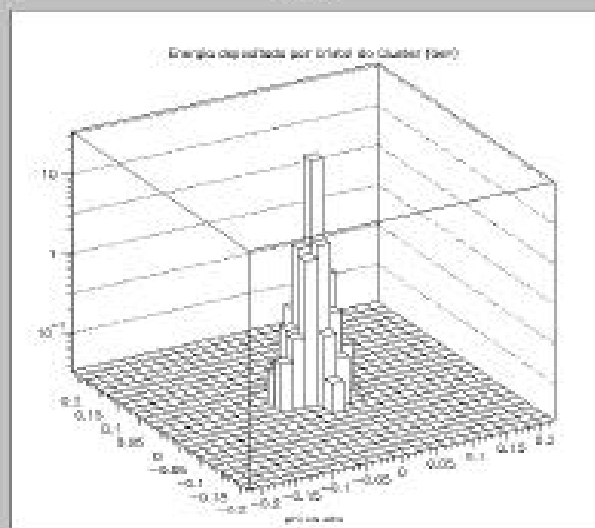
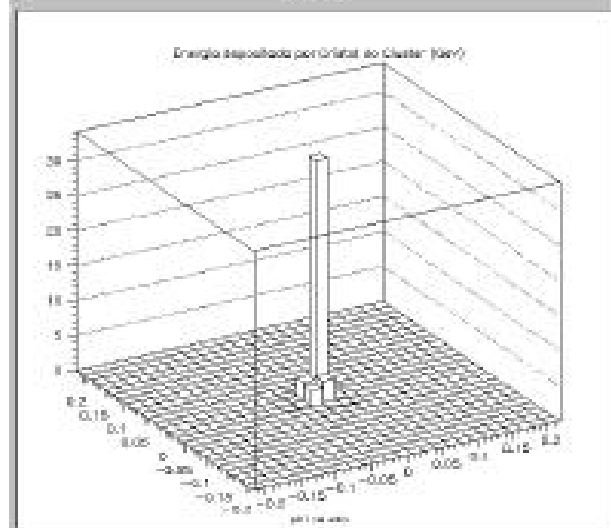
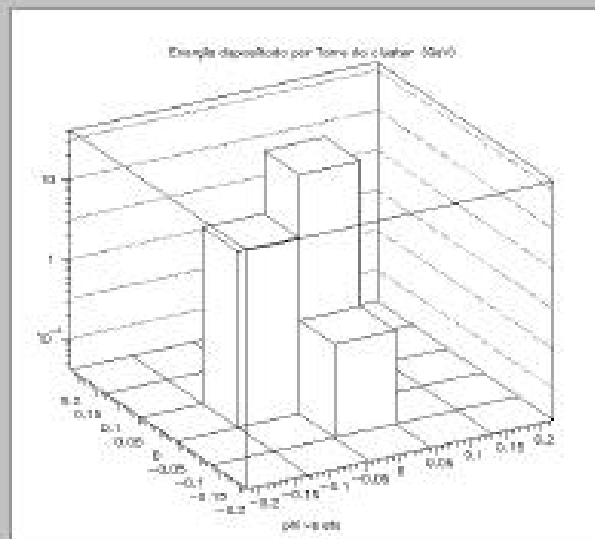
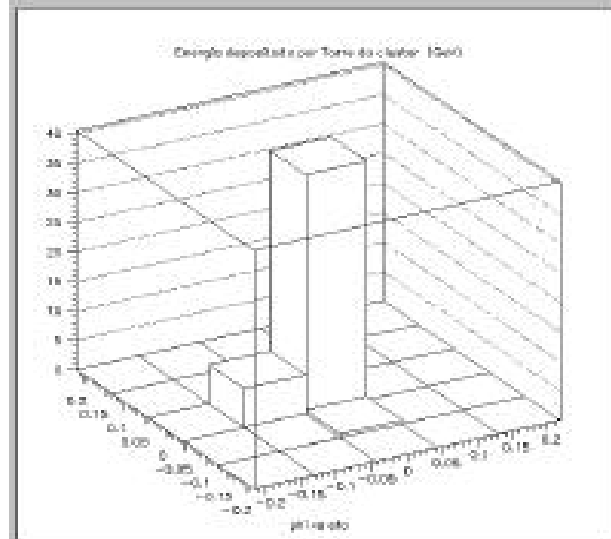


# Higgs →





# Higgs →



Ex. de um  
cluster  
reconstruído  
no barrel

---

30 RecHits

4 Torres :

2 Center

1 Single

1 Neighbour

---

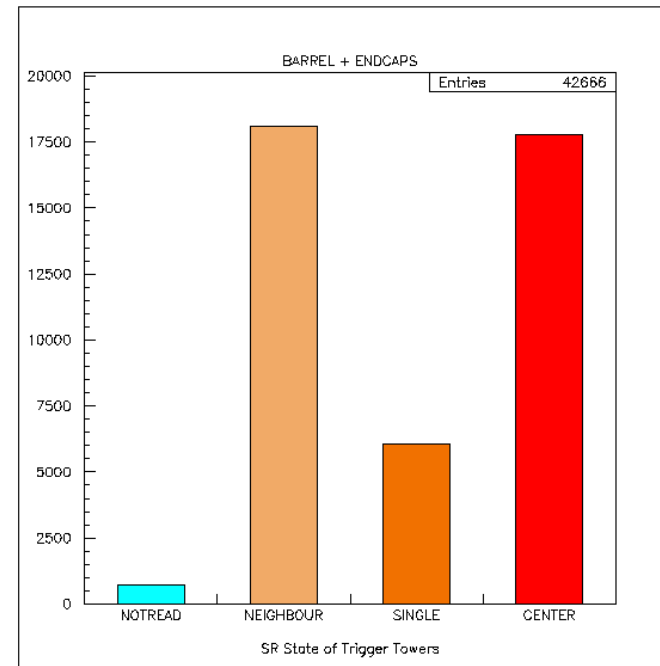
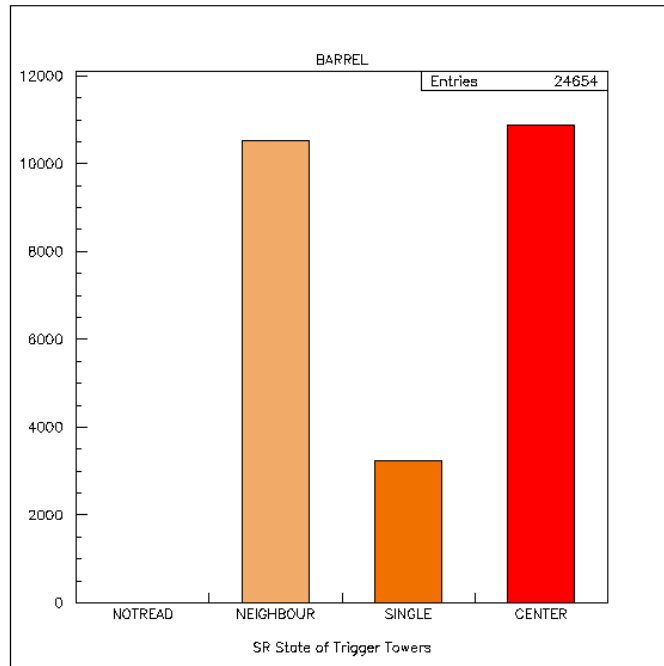
$E_t = 47.98 \text{ GeV}$

$\Phi = 0.1772$

$\text{Eta} = 1.2048$



# Higgs →



## Há torres de estado NOTREAD no Endcap !

- Maior probabilidade de conversão de fótons para as EndCaps e do par  $e^+ e^-$  ser englobado num único cluster
- Menor dimensão das torre nas EndCaps



## Geração do Ficheiro de Eventos :

- Fazer o update para o ORCA4

## Tower Selective Readout :

- Inclusão do Tracker na análise
- Possibilidade de desenvolvimento dos algoritmos associativos entre tracks e clusters
- Optimização do TSR para as EndCaps
- Estudo do efeito do TSR nos outros canais de decaimento do Higgs