2017
ECAL DPG & EGamma POG

30th November 2017

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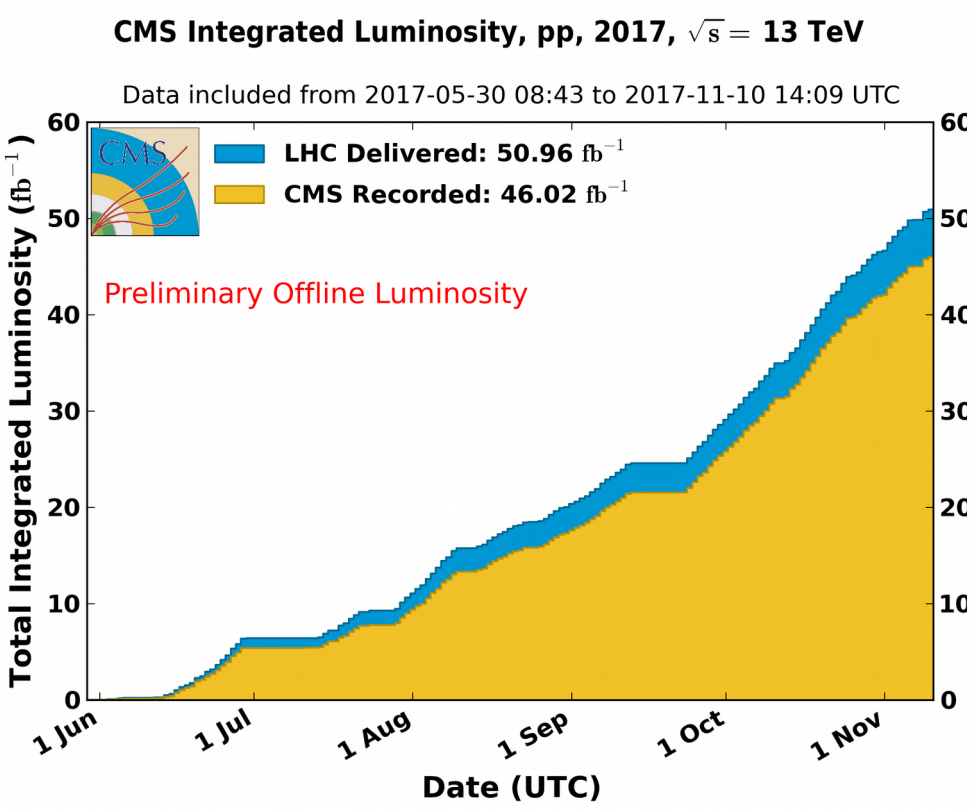
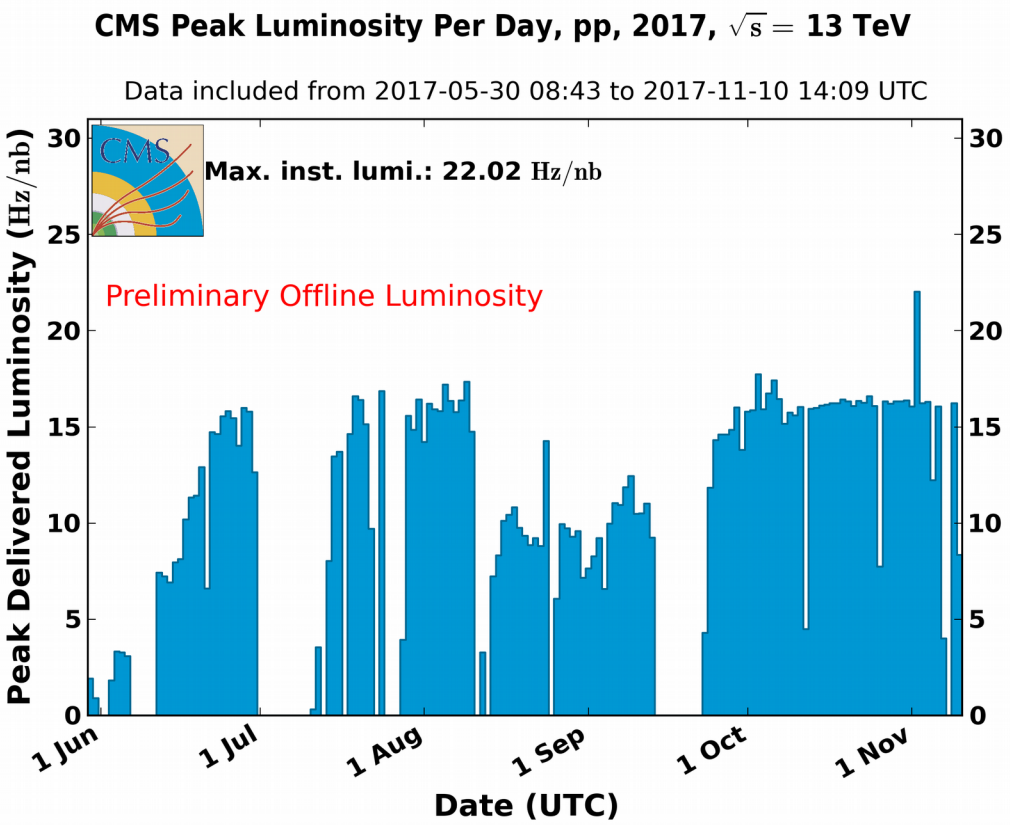
CMS Italia 2017
https://agenda.infn.it/conferenceTimeTable.py?confId=13352

2017

- Un lungo anno, con tanti dati e molte sfide
- Alta **luminosita'** → piu' **dati** per scoprire **nuova fisica** ed eseguire **misure di precisione** :)
- Alta **luminosita'** → **invecchiamento** del rivelatore :(

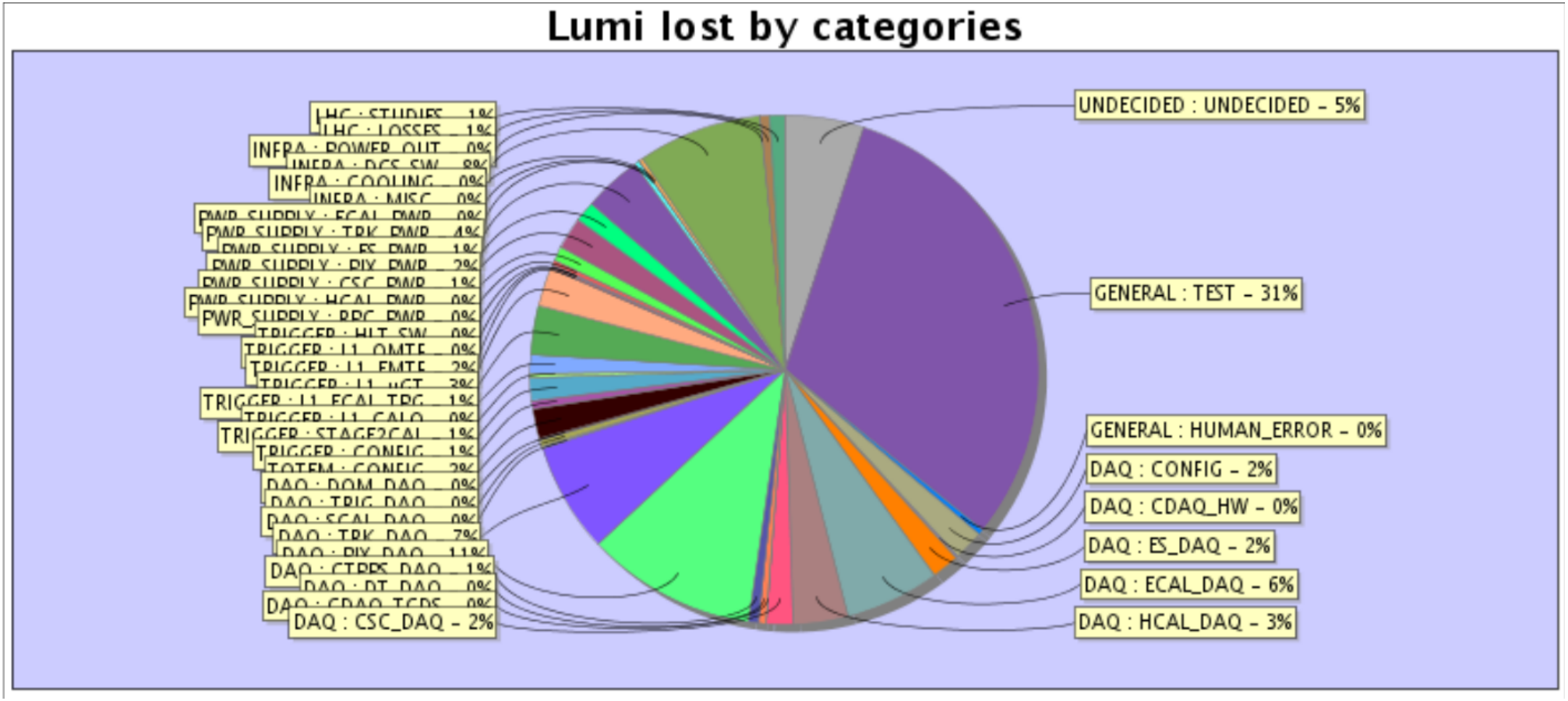




Online @ P5

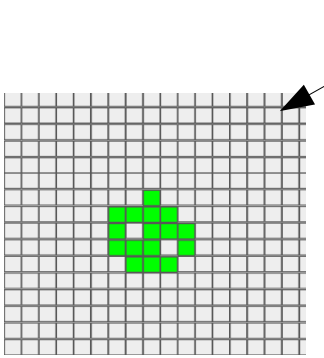
P5 performance

- Ottime performance @ P5
  - Stabilita' data-taking migliorata rispetto al 2016 → riduzione del numero di errori (ES DAQ) che richiedevano uno stop&start in passato → riduzione **Downtime**
  - **Deadtime** sotto controllo → legato alle soglie online

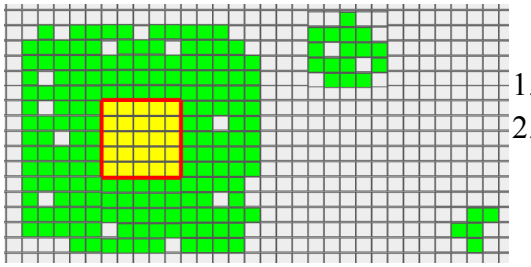


DAQ conditions

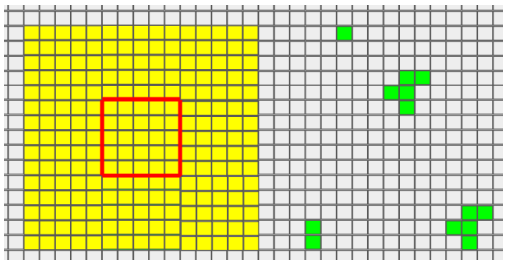
- Adattamento delle soglie online
  - 75k cristalli → non possiamo salvare tutti i cristalli per ogni evento selezionato (Full readout)
    - Limite nell'elettronica (2kB/evt/DCC payload @ 100 kHz di L1 rate)
  - Logica del **Selective Readout** (SR): definizione di zone di interesse
  - **Zero suppression**: salva cristallo se sopra ad una soglia
- Motivi per aumentare le soglie:
  - Pile-up
  - Perdita di trasparenza
  - Aumento del noise



Low Interest - **LI**
E_T < 1.5 GeV @ 2016
E_T < 2.5 GeV @ 2017



Medium Interest - **MI**
1.5 GeV <E_T< 2.5 GeV @ 2016
2.5 GeV <E_T< 4.5 GeV @ 2017



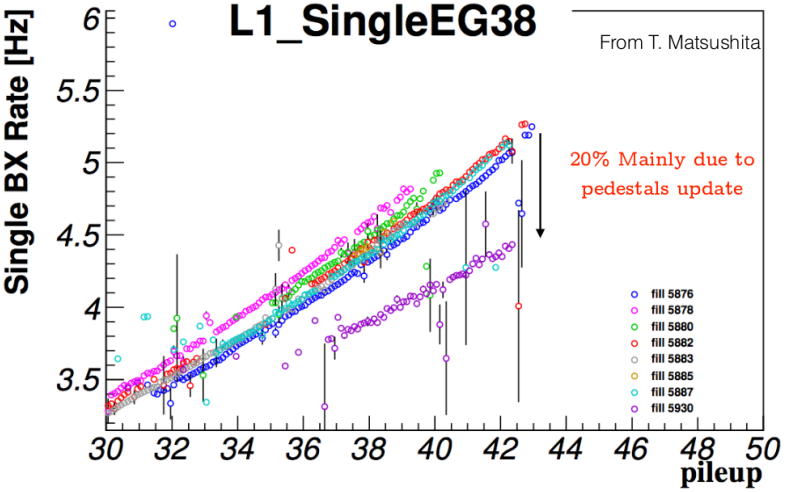
High Interest - **HI**
E_T > 2.5 GeV @ 2016
E_T > 4.5 GeV @ 2017

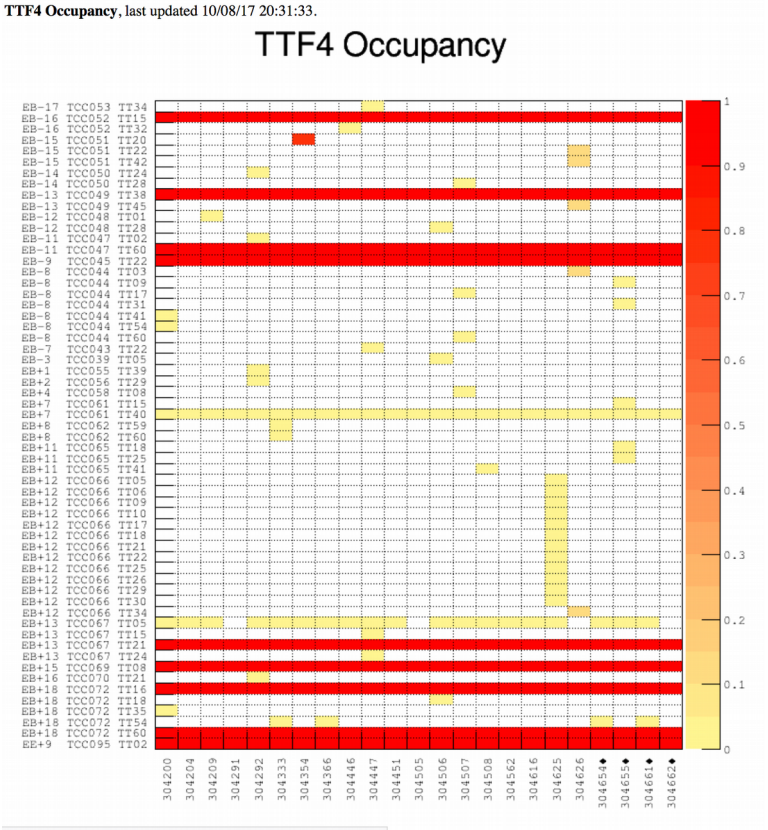
	2016	2017
SR	1.5 GeV / 2.5 GeV	2.5 GeV / 4.5 GeV
ZS	4.5 ADC in EB 6.5 ADC in EE	4.5 ADC in EB 6.5 ADC in EE

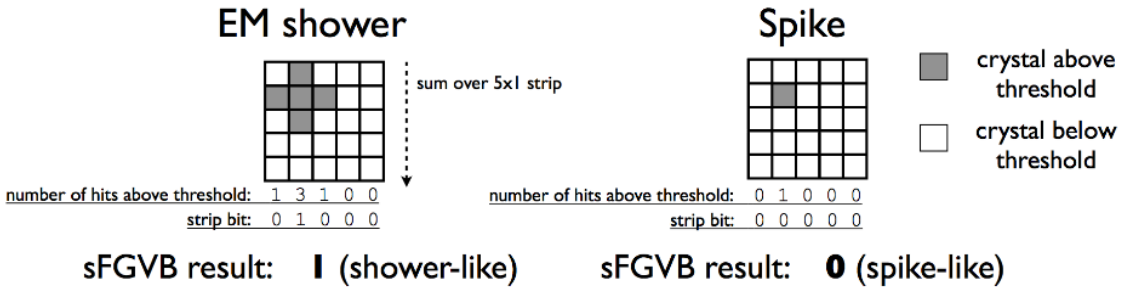
- Effetti su depositi energetici a **bassa energia** (π^0, isolamento, shower shape) e **alta energia** (regression)
- Soglie per 2018 da definire entro fine anno, usate anche per produzione MC

Trigger updates in 2017

- Campagna di **smascheramento** all'inizio del 2017 per controllare le **torri rumorose**
- **Ottimizzazione** delle soglie online vs **spikes**
  - Aggiornamento pedestalli per TP & spike killer algorithm
    - Riduzione ~ **30%** di spikes! → meno spike = piu' L1 trigger per fisica
- **Auto-masking di torri problematiche**: commissioning del Cumulative Overflow Killing Engine (COKE): EB e EE (work in progress)
  - Monitoring delle torri mascherate

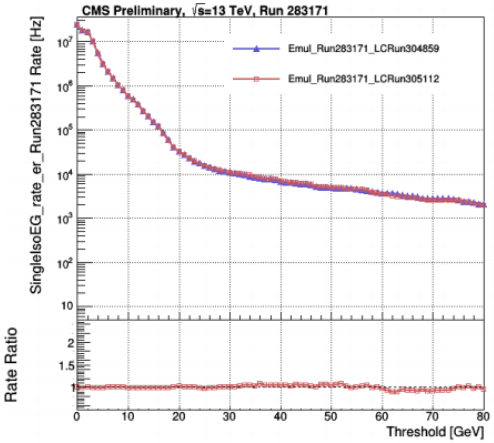




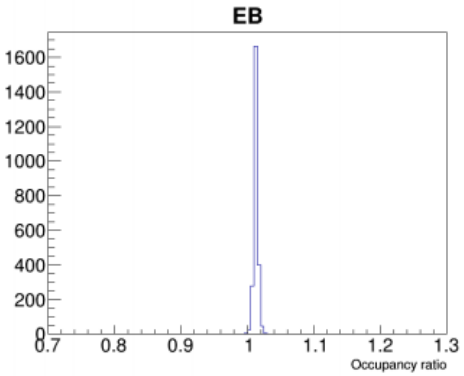


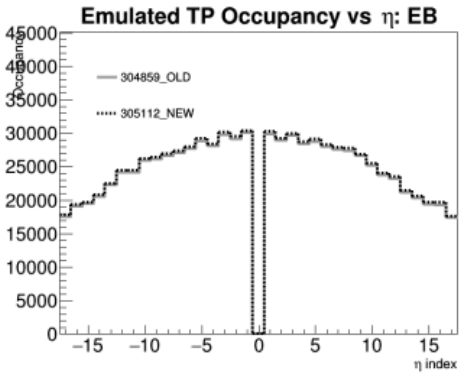
Trigger updates for luminosity

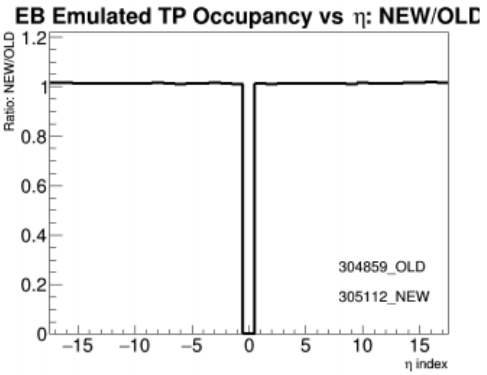
- Aggiornamenti per correzione per la perdita di **trasparenza** a L1 e HLT: **2 volte a settimana**
  - Aggiornamenti piu' frequenti rispetto al 2016 per diminuire le variazioni di rate vs tempo
  - Controllo effetti @ HLT e L1 degli aggiornamenti
  - Work in progress per **automatizzare** nel 2018

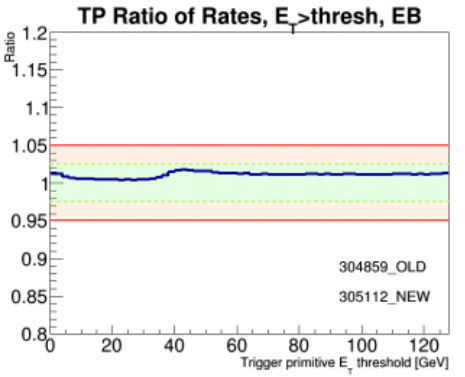


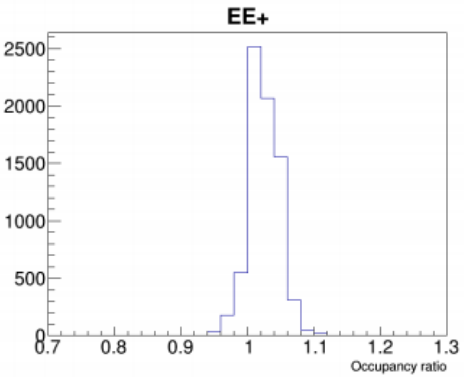
L1_SingleIsoEG_er

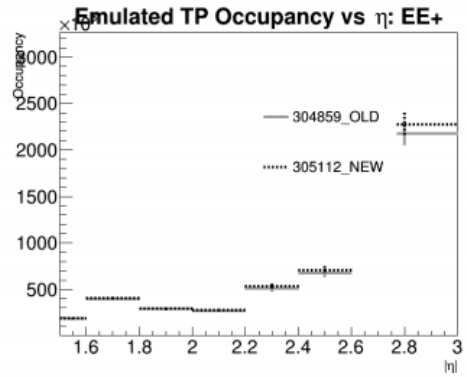


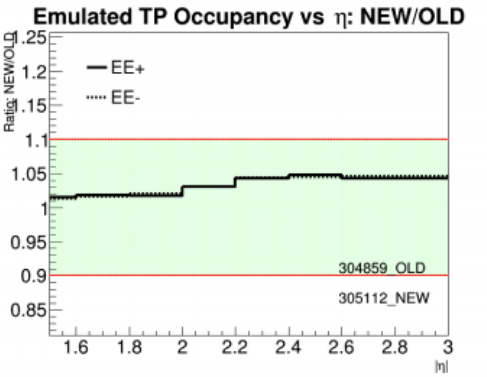


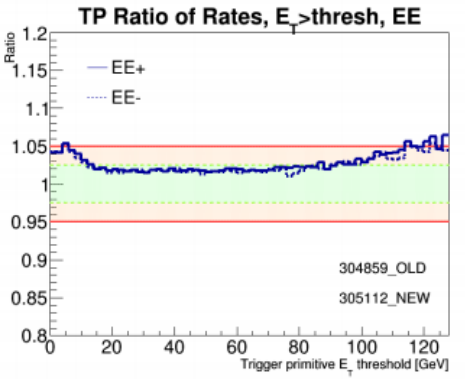




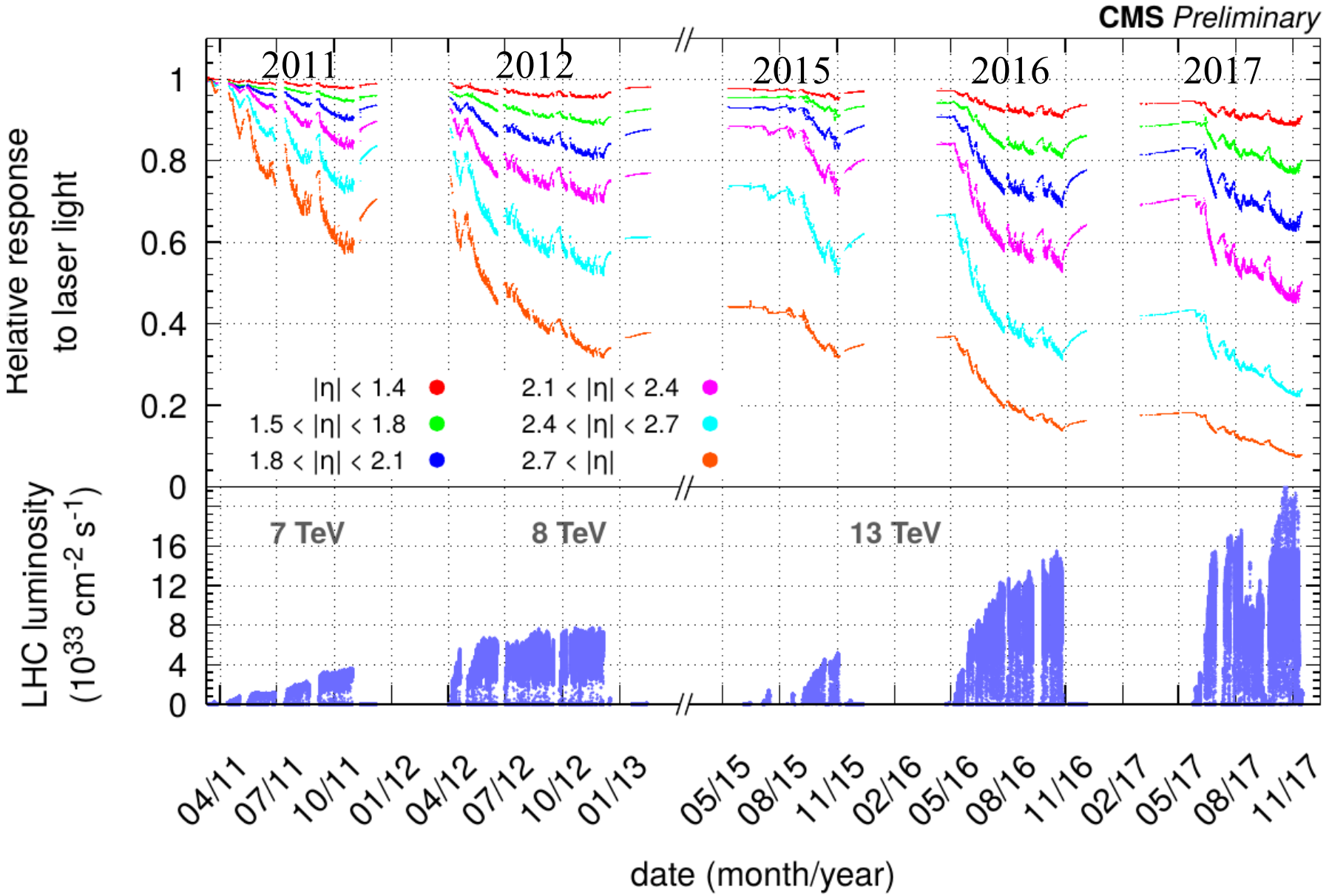




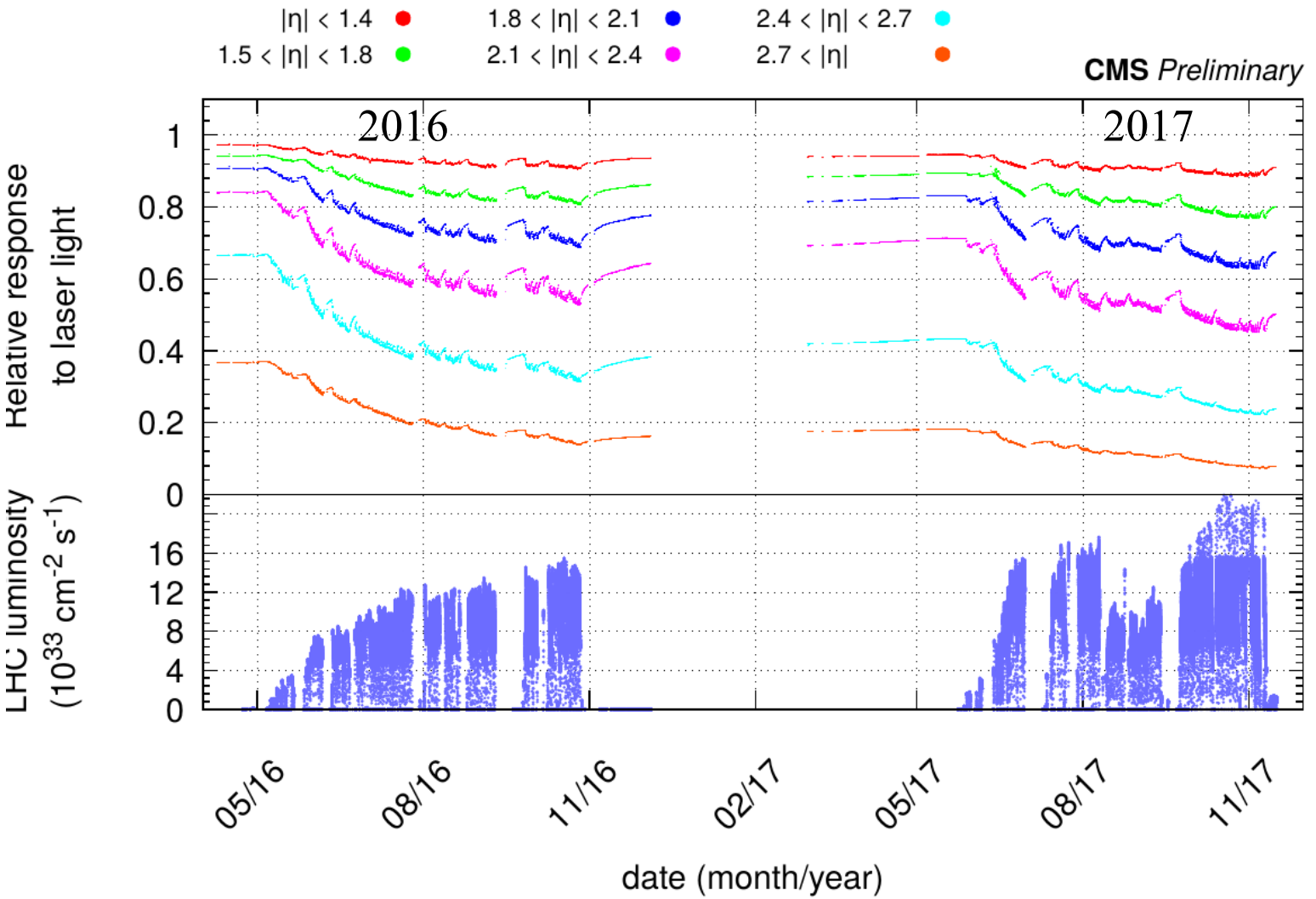




Perdita di trasparenza



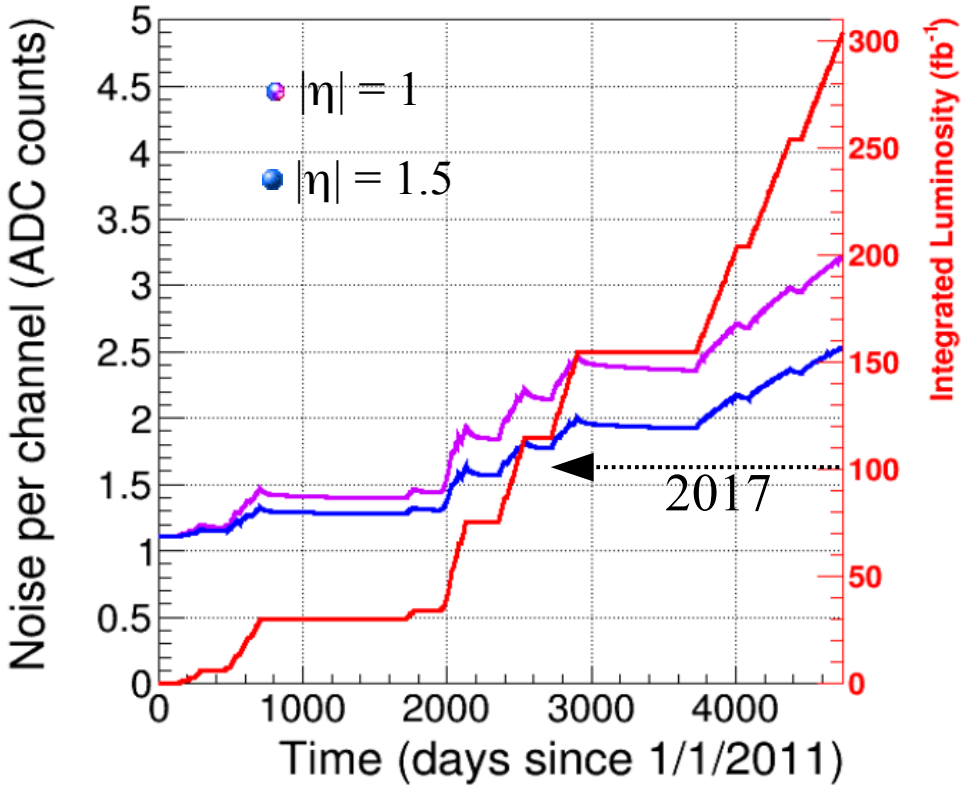
Perdita di trasparenza (zoom)

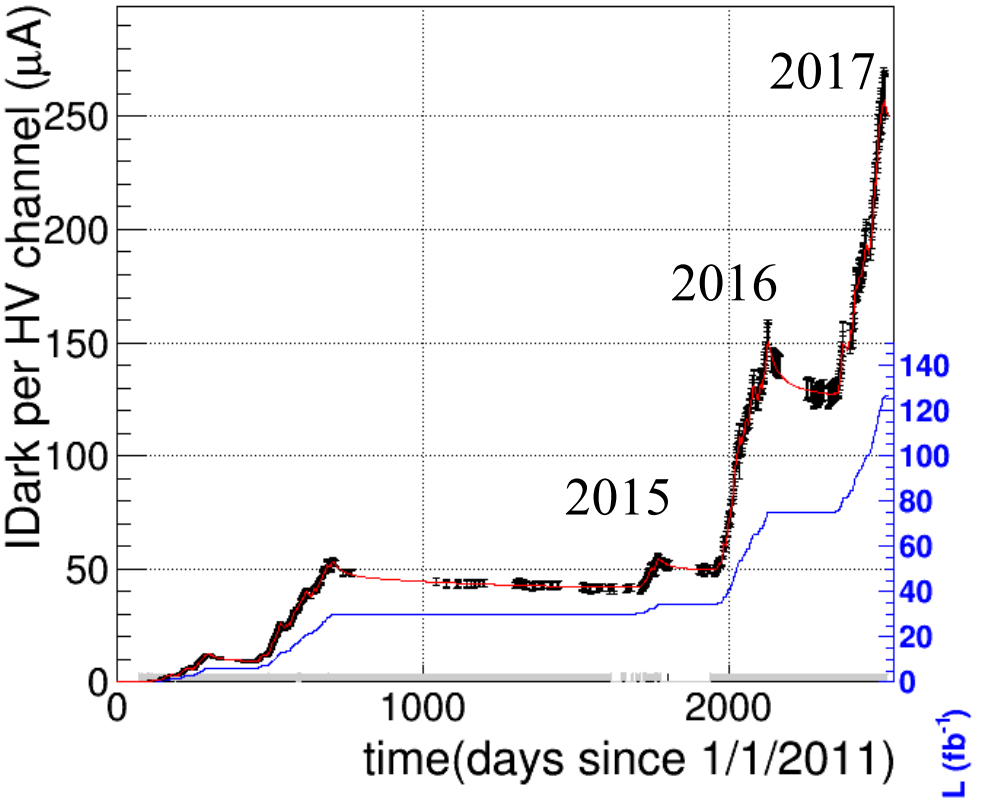


- Effetto **noto** e **sotto controllo** → continuo **monitoraggio** della risposta di ECAL → **prompt** gia' corretta
- Risultato netto: aumento del **rumore equivalente** nelle regioni ad alta perdita di risposta
  - NB: ~ 10% risposta ad alto η (effetti solo sui jet)

Noise

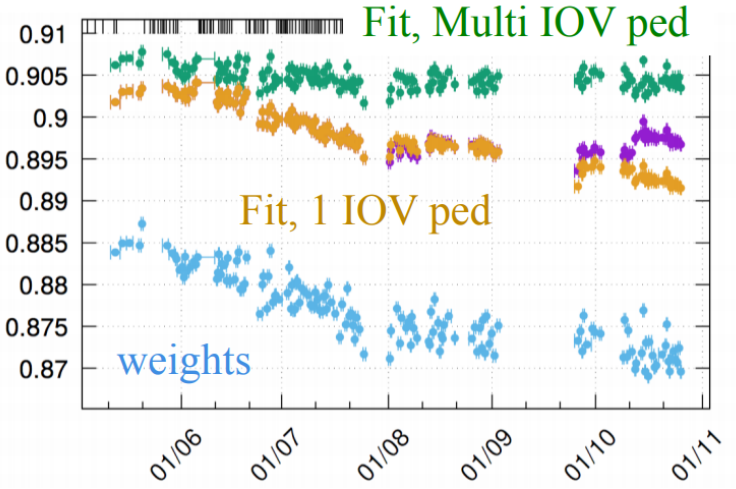
- **Aumento** del **rumore** in **EB** in ADC (1 ADC ~ 40 MeV in EB)
- Rumore in **EE** in ADC (1 ADC ~ 60 MeV in EE) ~ stabile → ma data la perdita di risposta, fino a x10 del **rumore in energia** equivalente
- Prime indicazioni del perche' abbiamo bisogno di ECAL **upgrade**: sia EB che EE



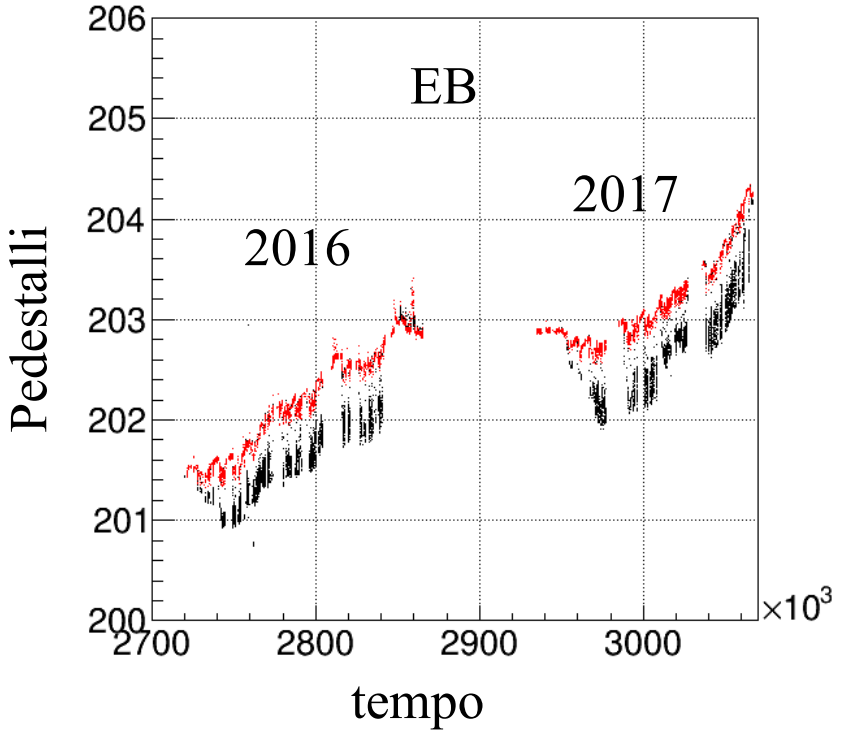


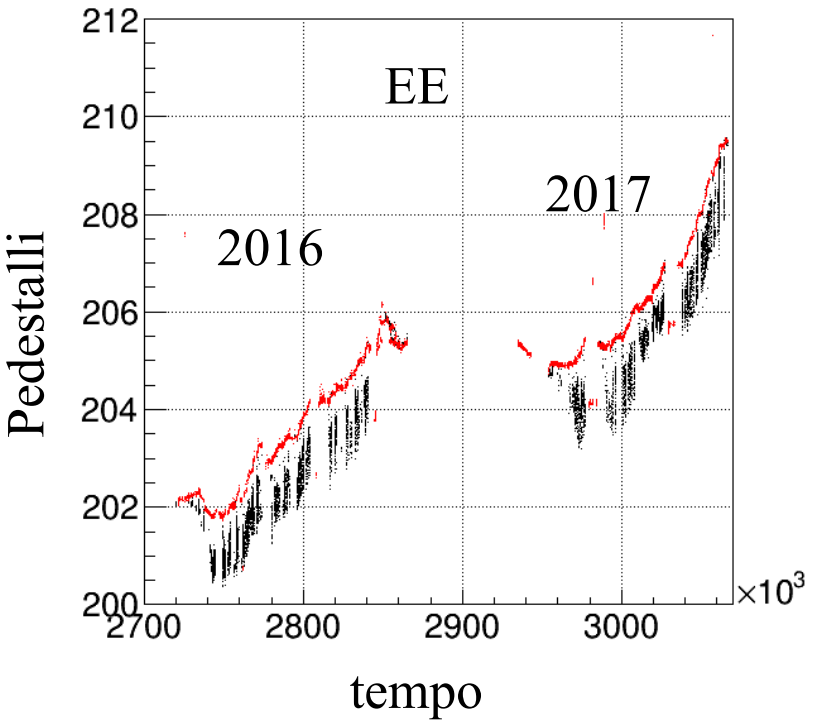
ECAL Stability: pedestalli

- Lezione dal **2016**: **Pedestalli** e **Pulse shape** da aggiornare durante l'anno
  - Stabilita' per scala e per shower shape
- Sviluppo per (durante) il 2017: **Pedestalli** al Prompt Calibration Loop (Ped@PCL)
  - Misura online da **Ottobre** dopo una validazione accurata del nuovo metodo



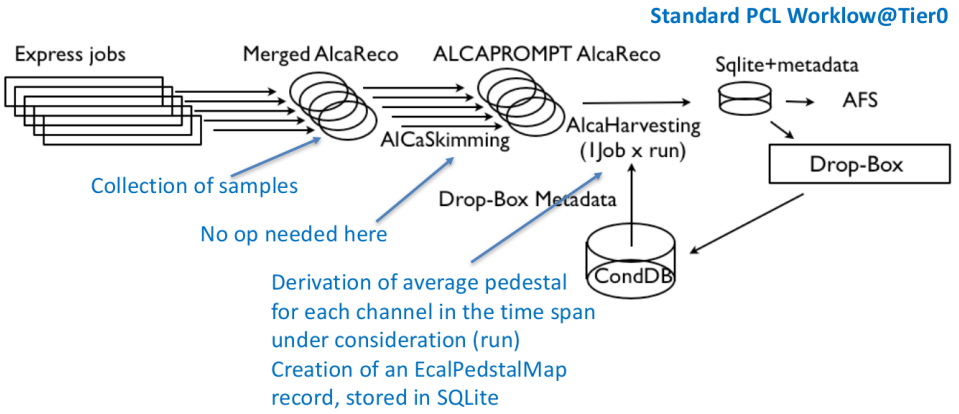
R9

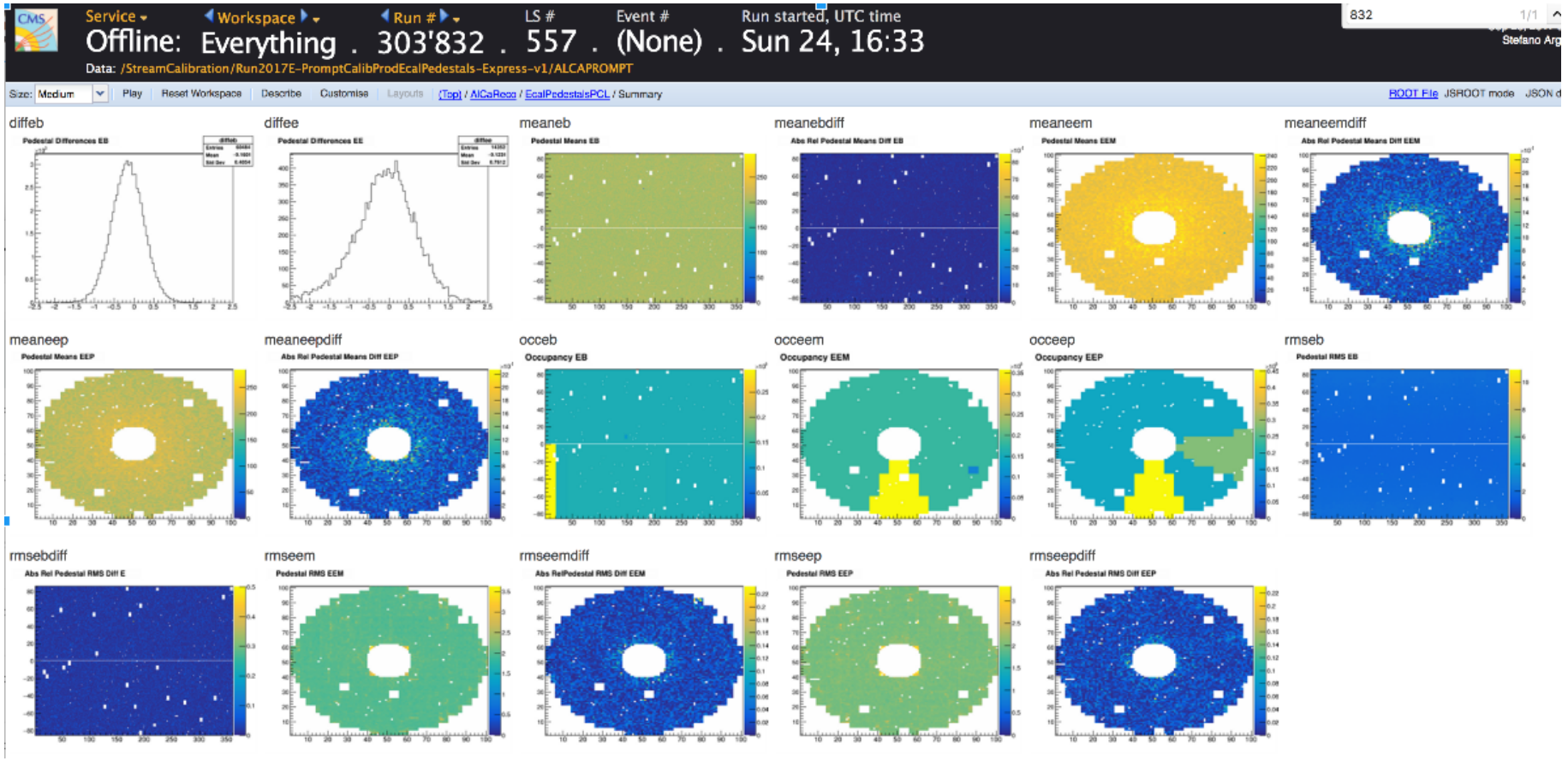




Pedestals @ PCL

- **Pedestalli** al Prompt Calibration Loop (Ped@PCL)
  - Dati della calibration sequence (100 Hz) per misurare i pedestalli
  - Misura @ PCL per la prompt
  - Controllo performance in DQM

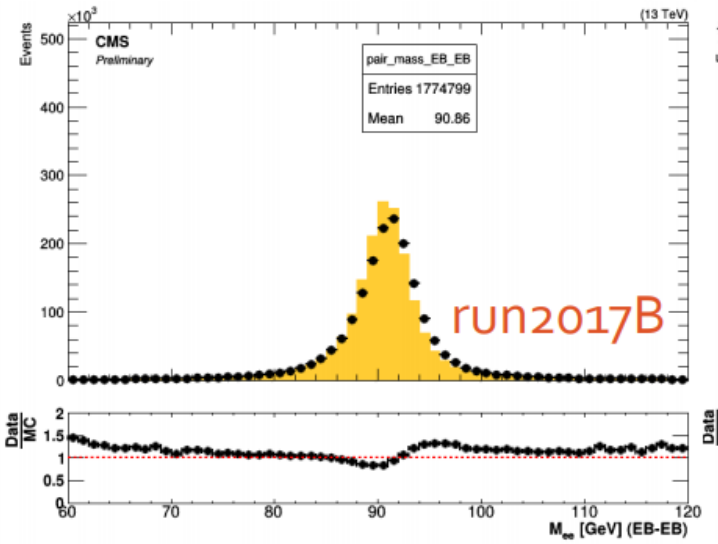


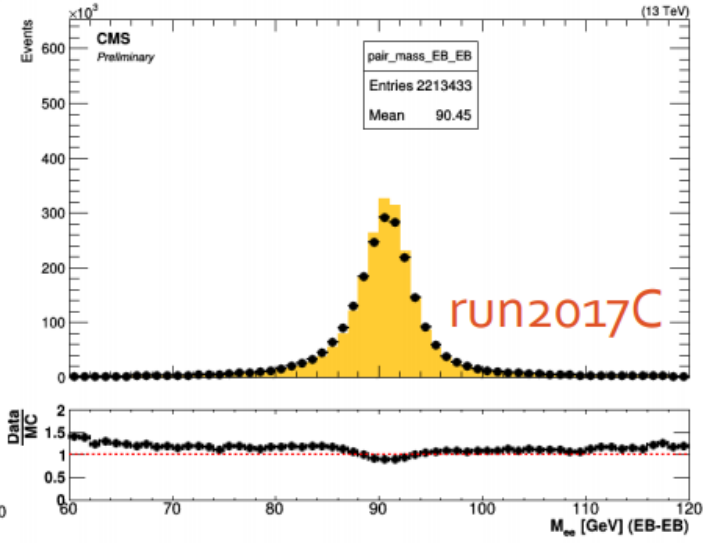


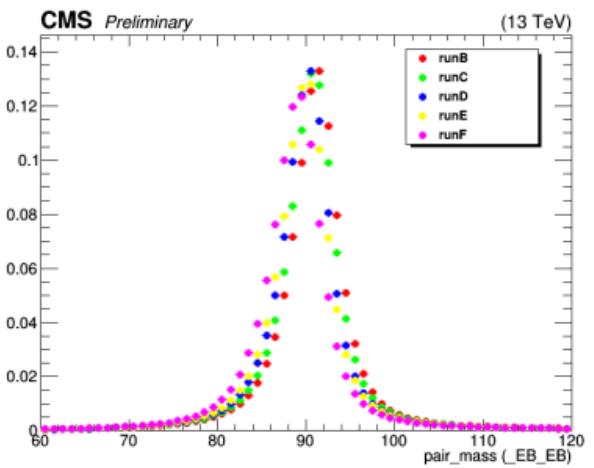
ECAL Stability

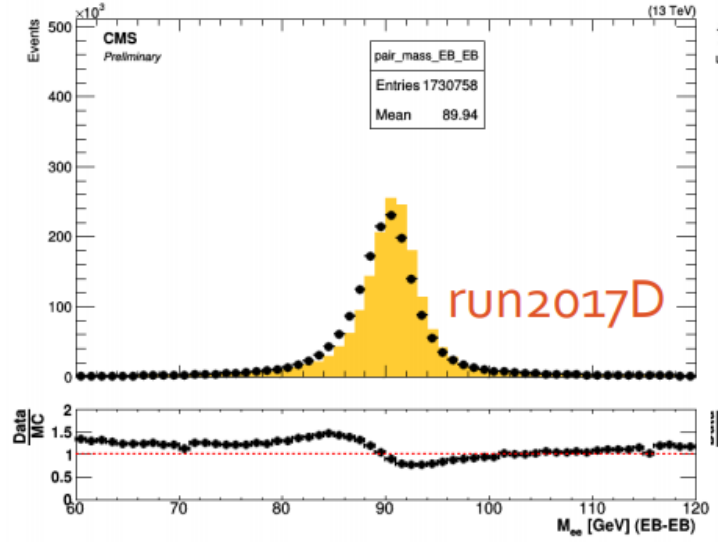
Prompt

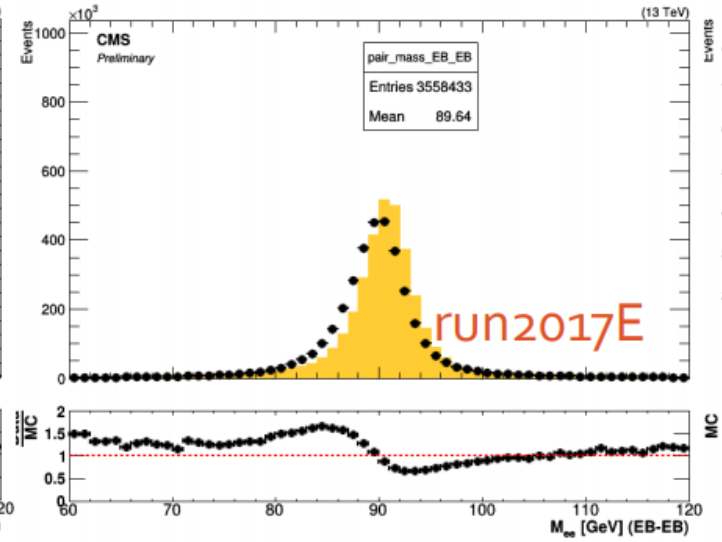
Electron EB + Electron EB

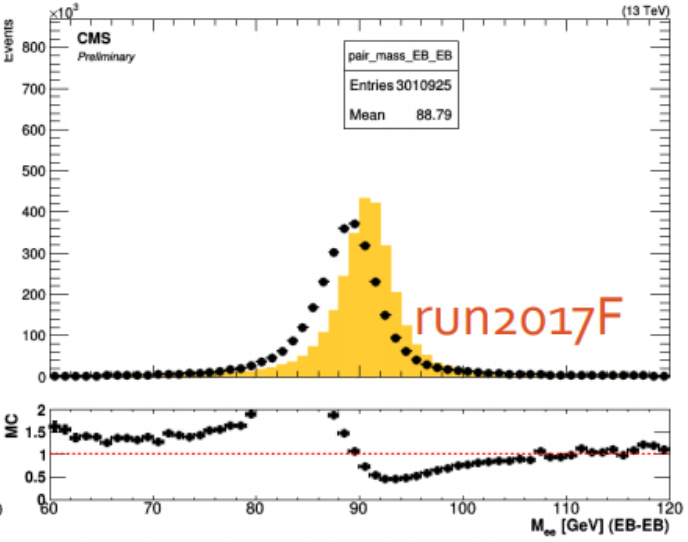






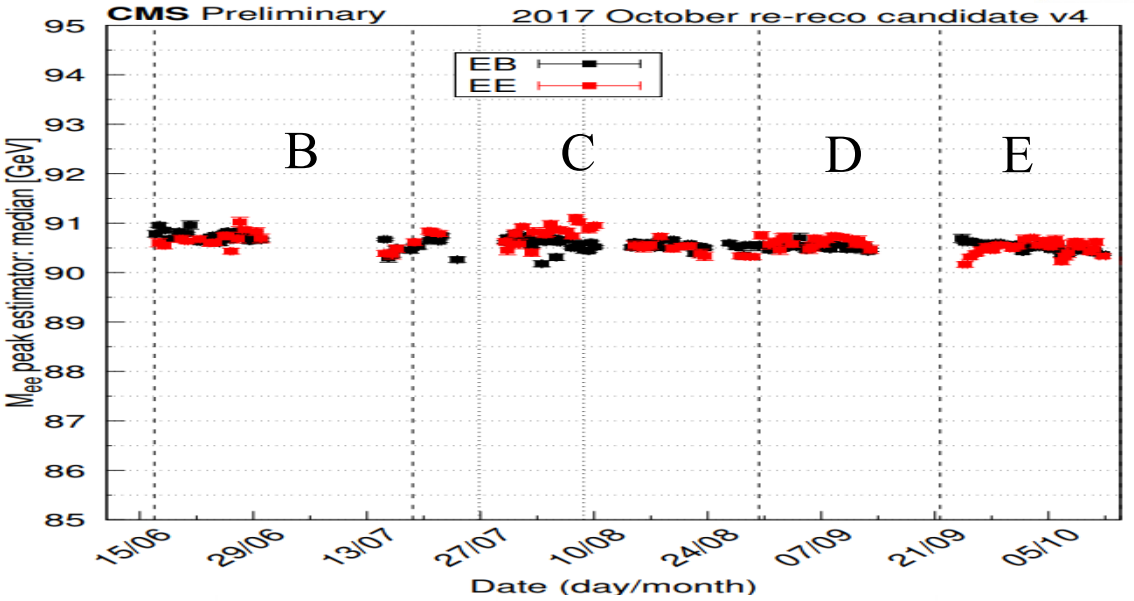




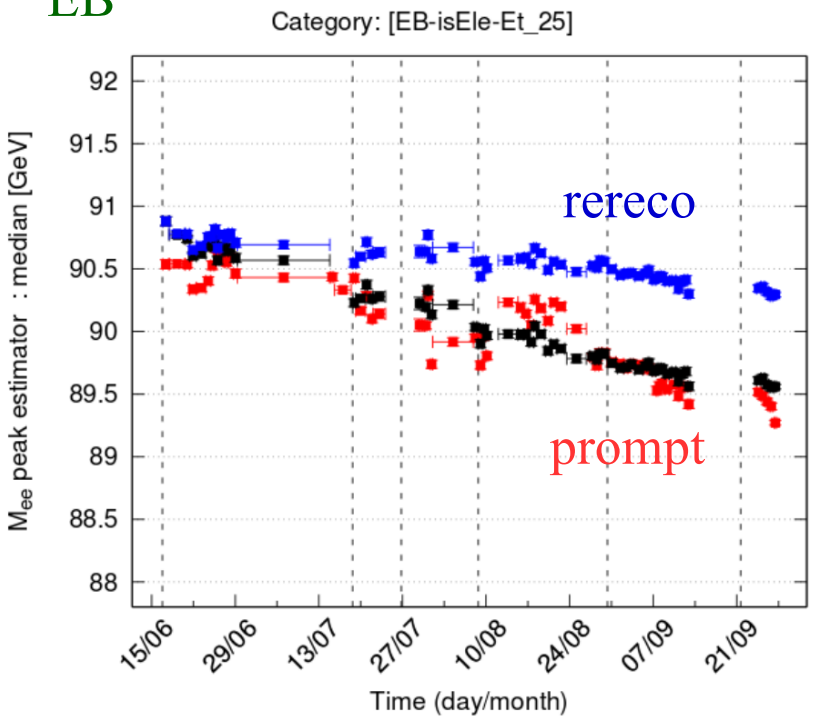


ECAL Stability for rereco 2017

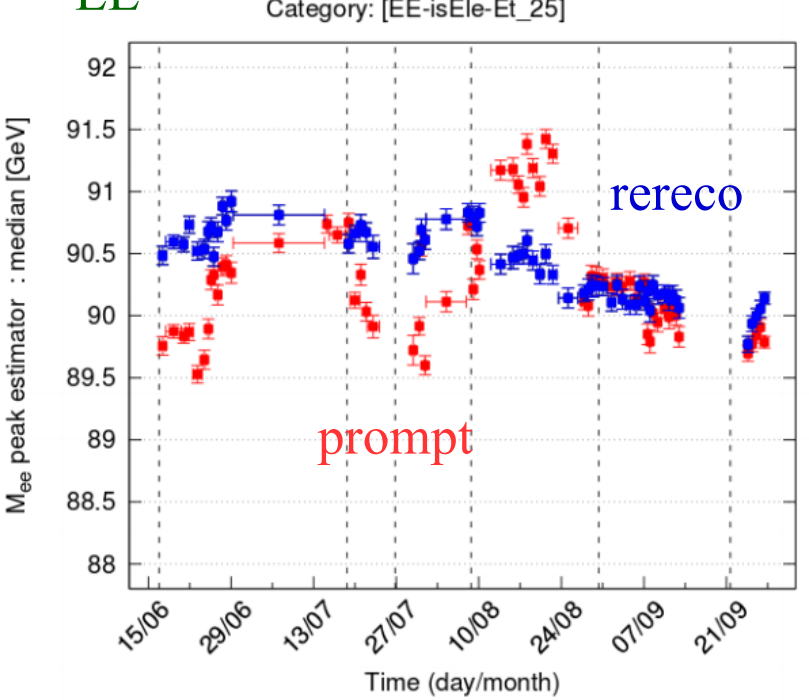
- Condizioni per 2017 re-reco
  - **Pedestalli** 1-IOV per Run
  - **Pulse Shapes**
  - Correzioni **shift energia** per PN-regions
  - **Fixes** rispetto alla prompt



EB



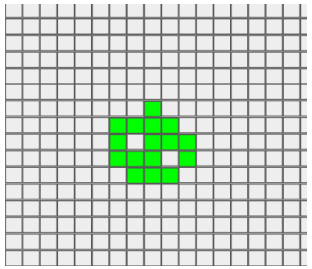
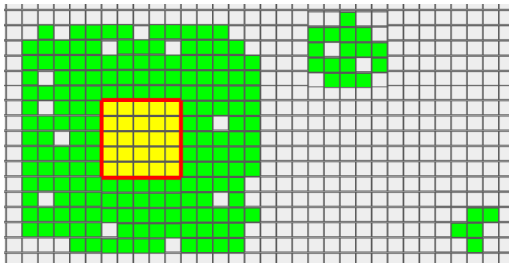
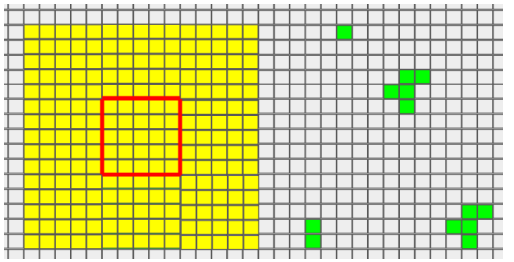
EE



Offline

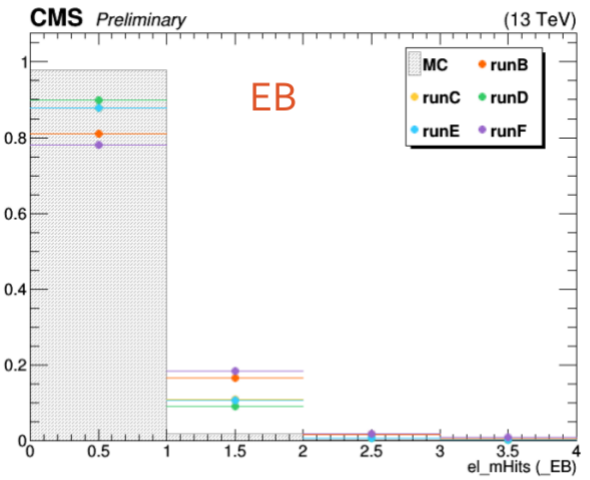
SR@PF

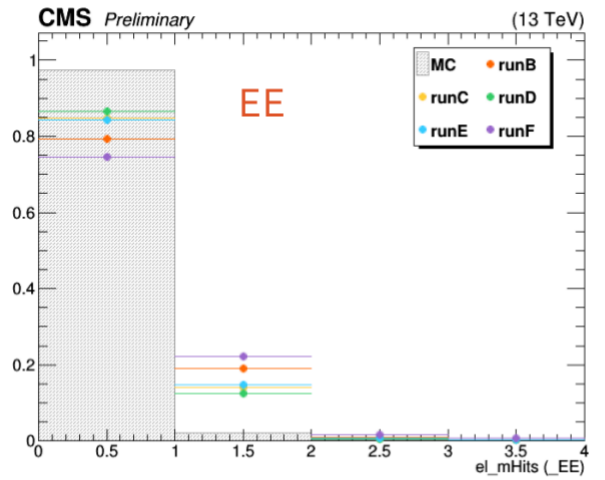
- Novita' in 2017: **Selective Readout** al **Particle Flow** (SR@PF)
- Selezione online di Zero Suppression propagata **offline** con un taglio in **energia calibrata** sui **PF-rechits**
  - **Rimuovere dipendenza temporale** (perdita di trasparenza) delle selezioni online
- Clienti:
  - **Egamma**
  - **Tau**
  - **JetMet** → problemi principalmente nella regione ad alto η
    - Work in progress per mitigare gli effetti per la ricostruzione di jet
- Energy **regression** per **PF-clusters** by **Egamma**: training sfruttando il metodo di lettura di ECAL, ZeroSuppression o fullReadout

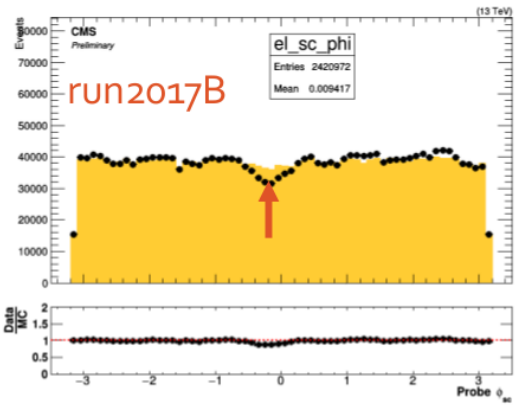




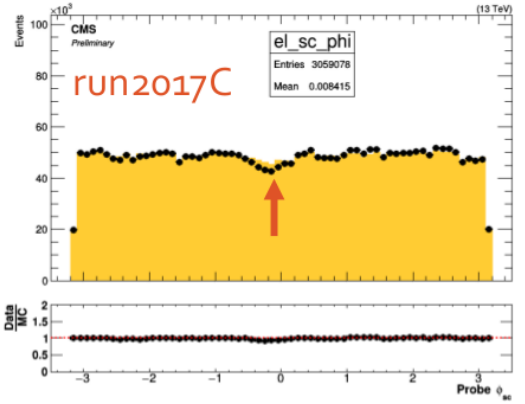
Electrons and Photons: aka EGamma

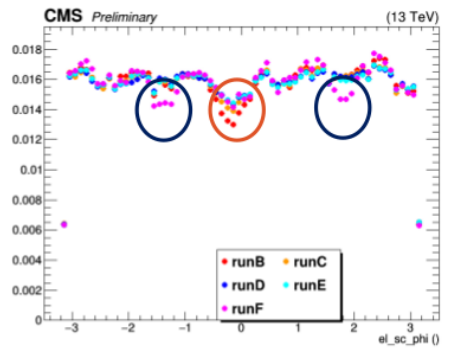
- *Non solo ECAL*
- Nuovo **pixel**
  - Selezioni Pixel matching aggiornate durante il 2017 @ **HLT**
  - Discrepanze e variazioni vs tempo osservate
    - Missing hits
    - ϕ elettroni
- Contatto **HLT (L3)**
  - Da Gennaio 2018 posizione disponibile

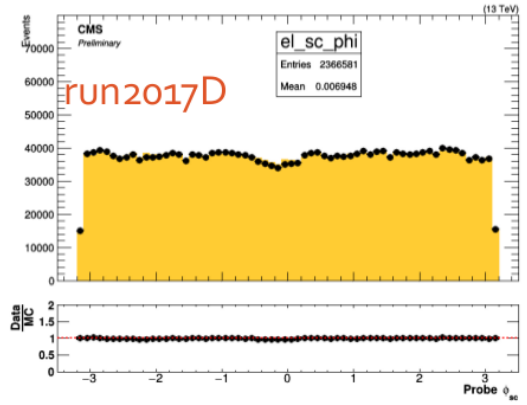


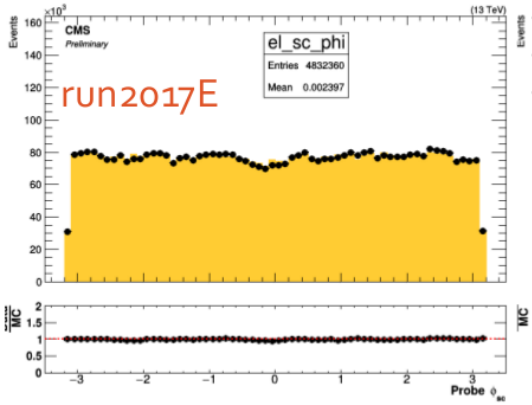


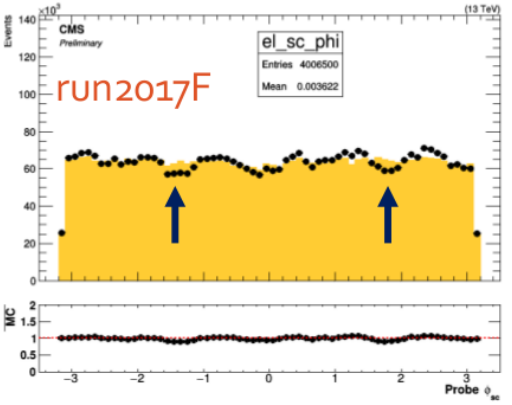










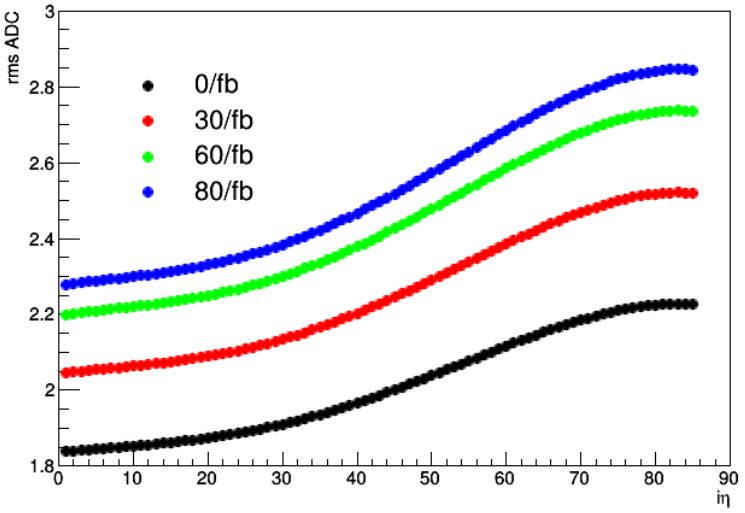


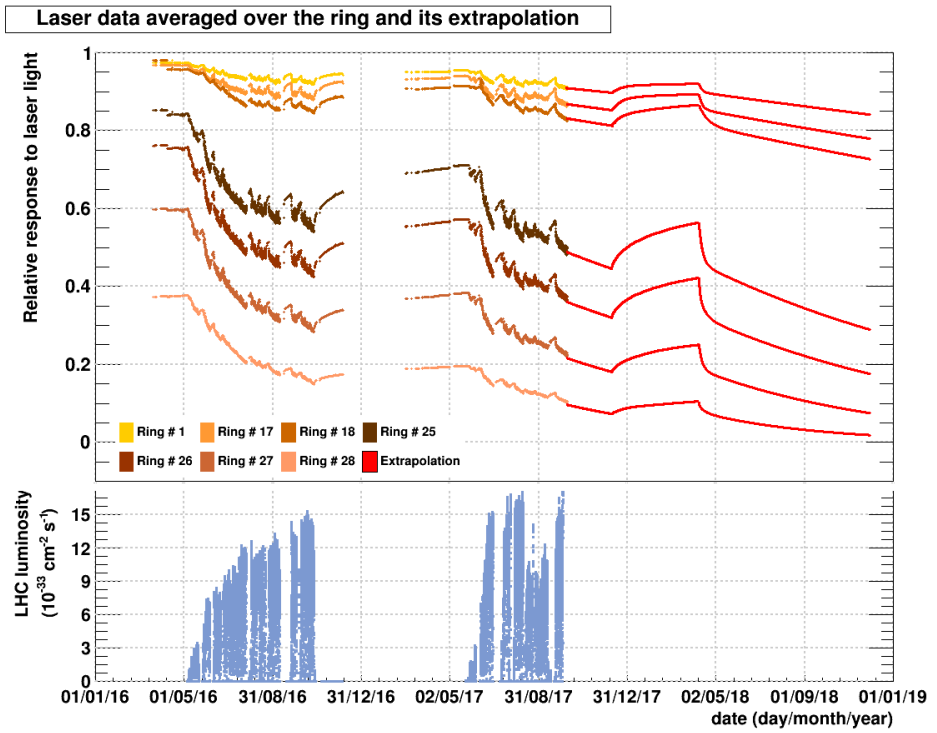
Futuro

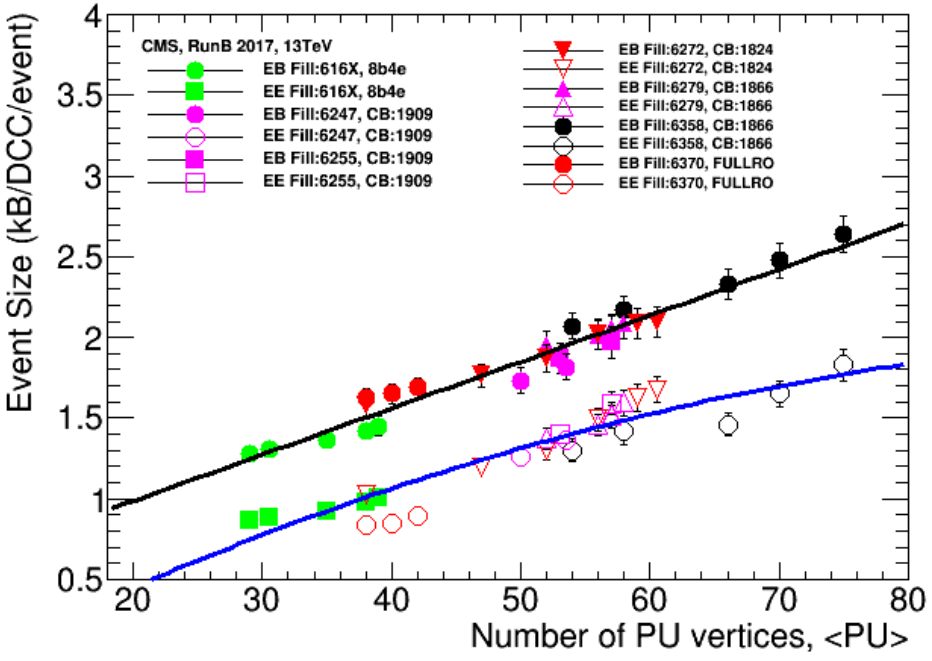
Uno sguardo al futuro …

- Perdita di **trasparenza** estrapolata per l'anno 2018
  - Estrapolazione simulando ~ 3/fb a settimana
- Nuove **soglie** per readout (SR/ZS) in studio → diversi working point e possibili diverse configurazioni per l'anno 2018 → MC run dependent
  - Soglia ZS da alzare a causa dell'aumento del noise
  - Interazioni fra **DPG** e **POGs** estremamente importante per ottenere performance migliori

Noise in EB







Passato, presente e futuro in una slide

- Le **eccellenti performance** di **ECAL** e **EGamma** sono il frutto del lavoro di molte persone
  - Un grande **grazie** a tutti coloro che sono coinvolti in questo enorme sforzo:
    - PM, TC, RC, Shifters, DQM, DAQ, PFG, MoCa, DPG, …
    - Egamma conveners, contatti, sviluppatori, ...

- **2017**: un anno di passaggio
  - Ancora molte osservazioni da comprendere
  - 2017 re-reco: non una “legacy” re-reco
- Target per **Legendary ReReco Run II**: 2016-2017-2018

- Historia magistra vitae: **automatizzazione** nel 2018 (e.g. timing e pulse shape @ PCL)
- **ECAL e EGamma: saremo pronti per il 2018**

Backup

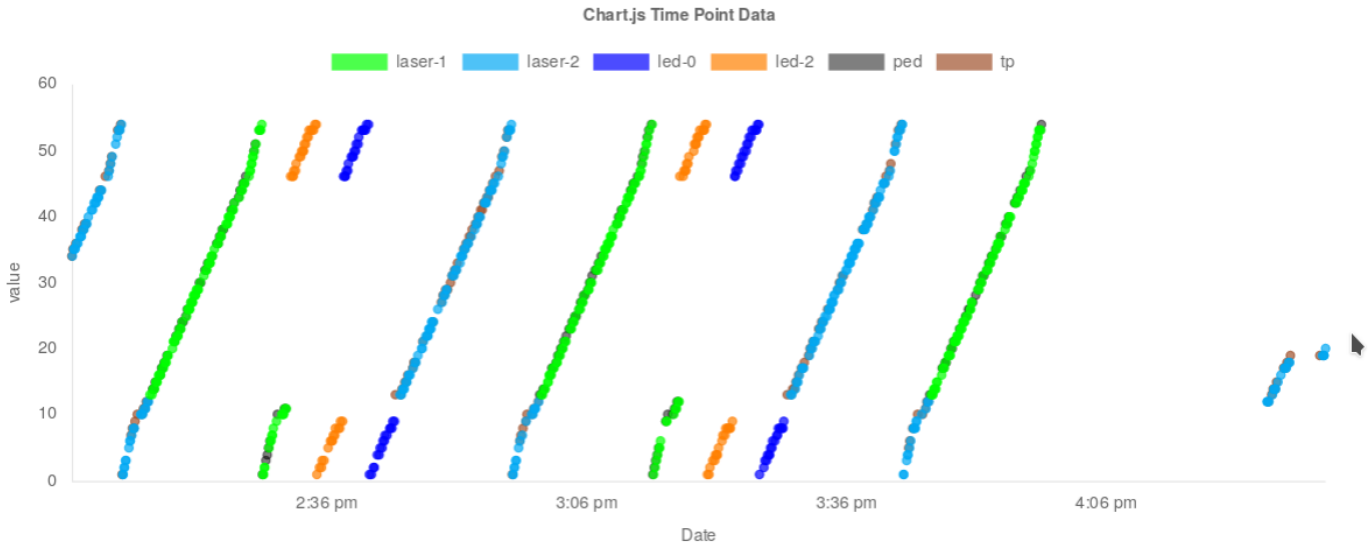
ECAL DAQ

- Riduzione degli errori legati a ECAL DAQ:
  - crash → red recycle → start: non piu' necessario
  - pause → configure → resume: SEU approach
- Nuovi monitor → migliorare la vita e l'efficacia/efficienza di ECAL DOC/DGL

Information up to date	
Time of last monitor update	23/11/2017, 16:31:24 CET
Time of last supervisor update	23/11/2017, 16:31:21 CET

Supervisor HyperDAQ link: http://ecalod-laser-xdaq.cms:26010

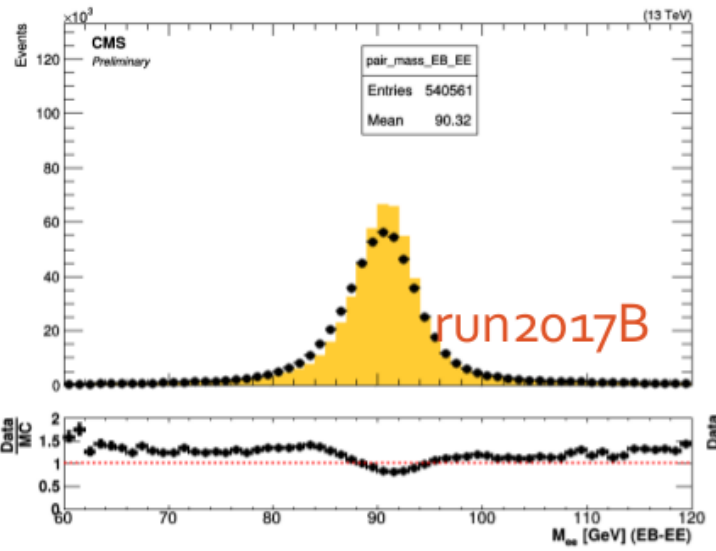
State	Initial
	Halted
	Configured
	Running
	Error
Status	OK
Listening to TCC Input 1: TTCci EE+	Laser trigger: enable

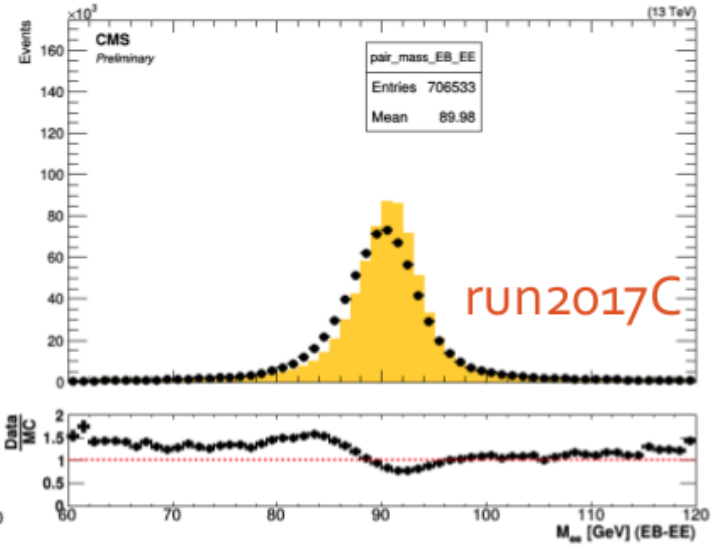


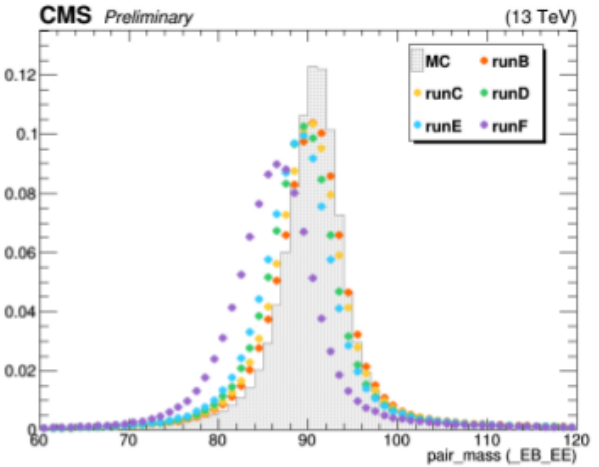
ECAL Stability

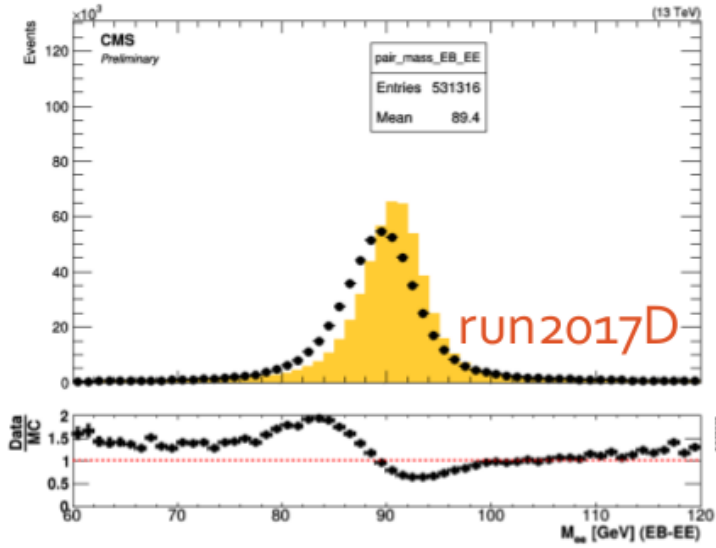
Prompt

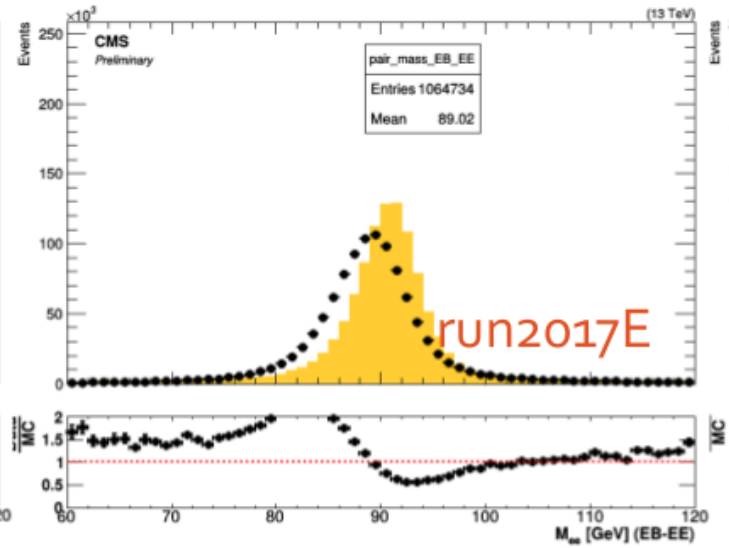
EB+EE

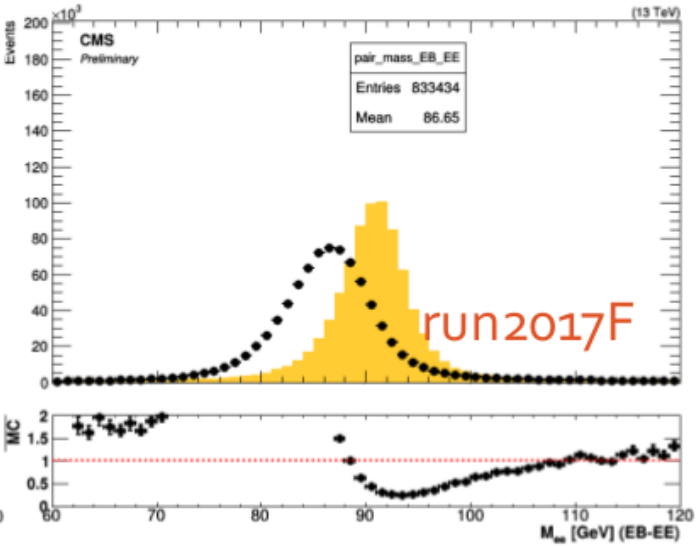








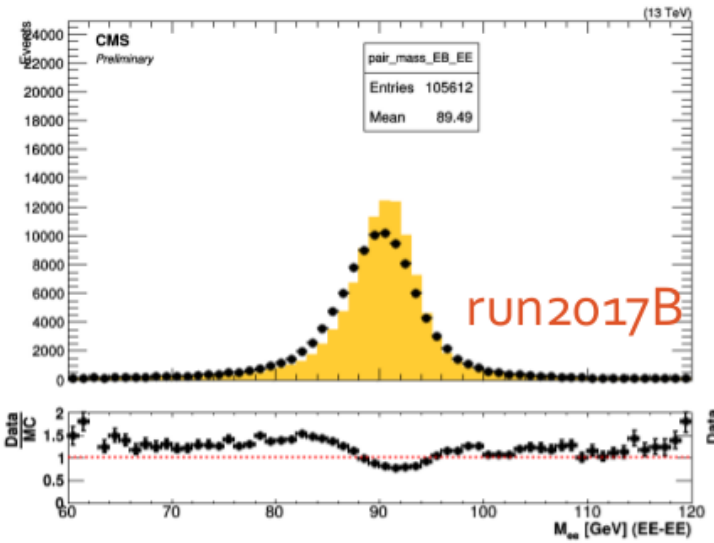


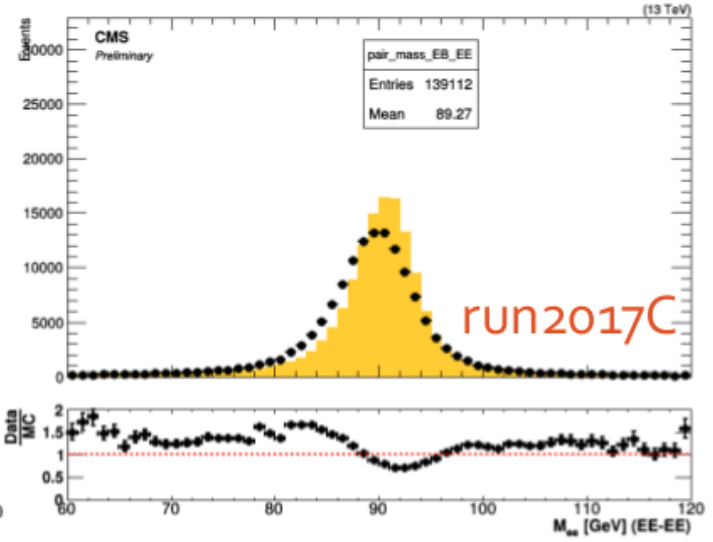


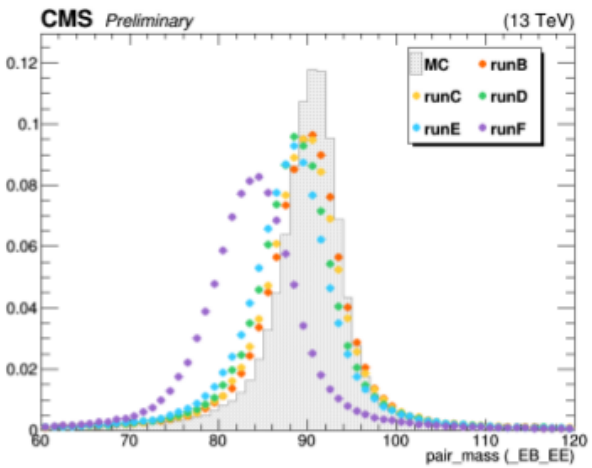
ECAL Stability

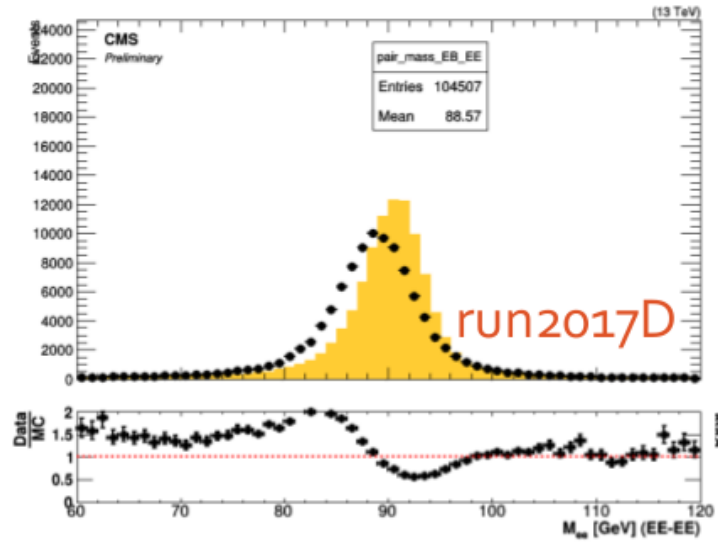
Prompt

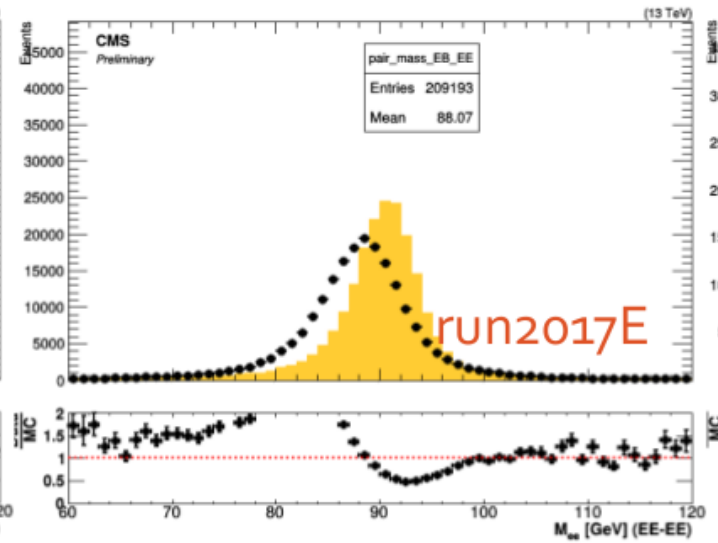
EE+EE

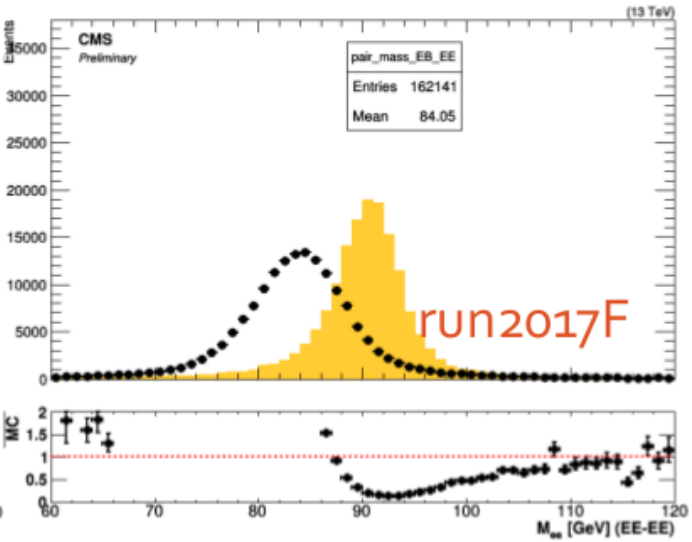




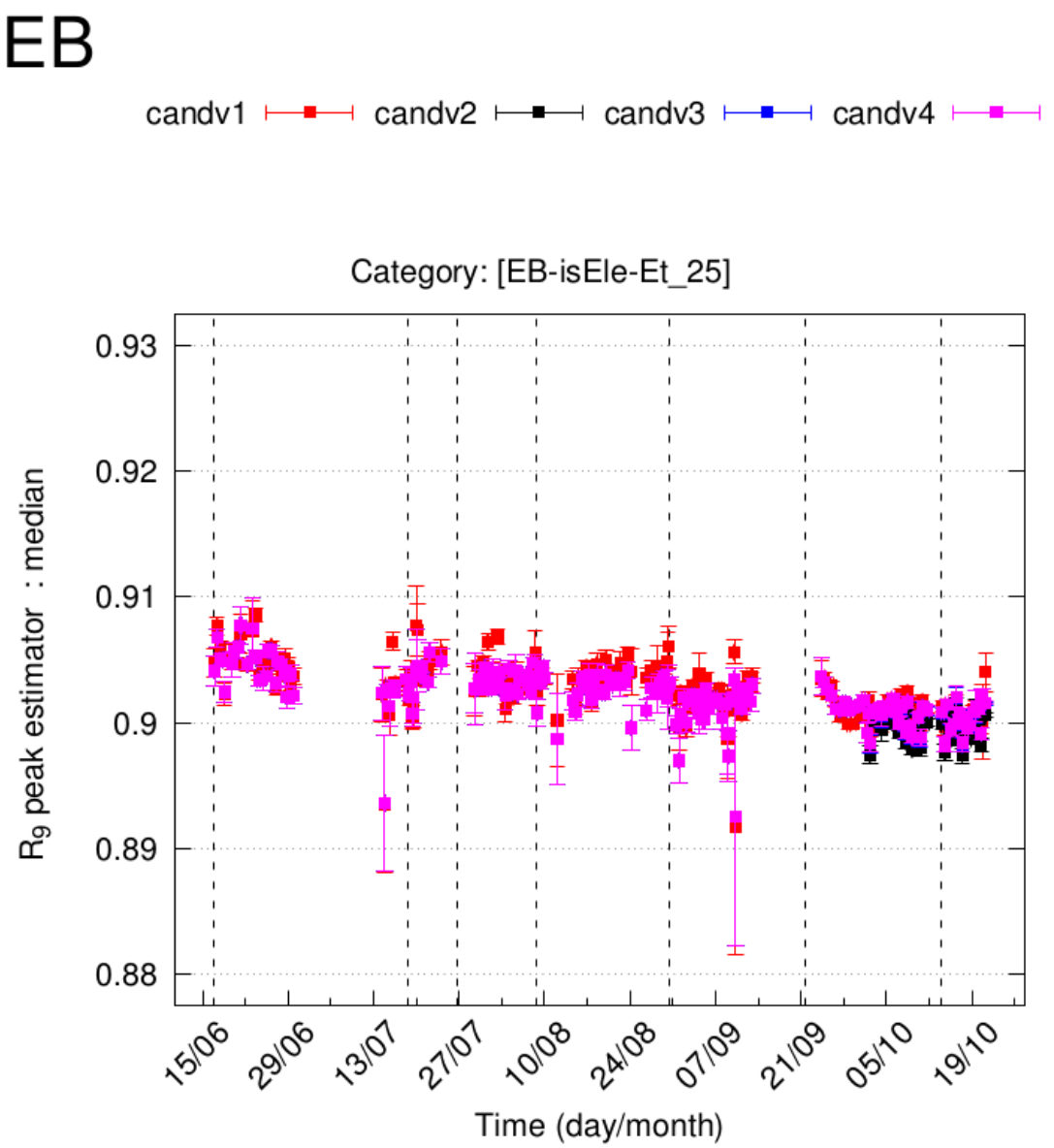








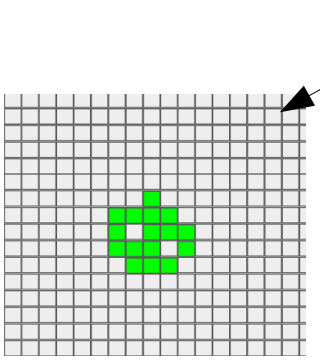
ECAL Stability



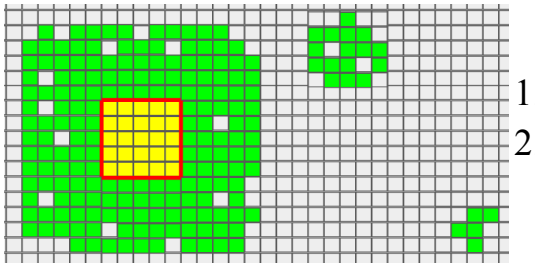
Small excursus on ECAL readout (Selective readout)

- We have >**75k crystals** in ECAL. We cannot afford to save all the crystal for every single L1-accepted event
  - Intrinsic payload limit: **2 kB/event/DCC at**

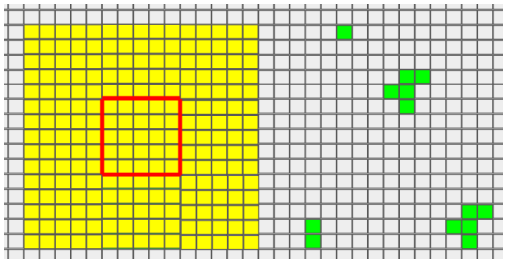
    100 kHz of L1A
- **All ECAL** is always read in Zero Suppression (**ZS**) mode
  - If pulse in ADC counts is > ZS threshold, save the crystal
  - Above an E_T threshold (Medium Interest, **MI**):
    - A trigger tower TT (i.e. 5x5 crystals in Barrel) is read in Full Readout (**FR**): it is saved, whatever is its pulse amplitude
  - Above an higher E_T threshold (High Interest, **HI**):
    - A trigger tower TT (i.e. 5x5 crystals in Barrel) is read in Full Readout (FR), and the neighbour TTs (8) are read in FR
- *Thresholds increased over years due to noise & PU*



Low Interest - **LI**
E_T < 1.5 GeV @ 2016
E_T < 2.5 GeV @ 2017



Medium Interest - **MI**
1.5 GeV <E_T< 2.5 GeV @ 2016
2.5 GeV <E_T< 4.5 GeV @ 2017

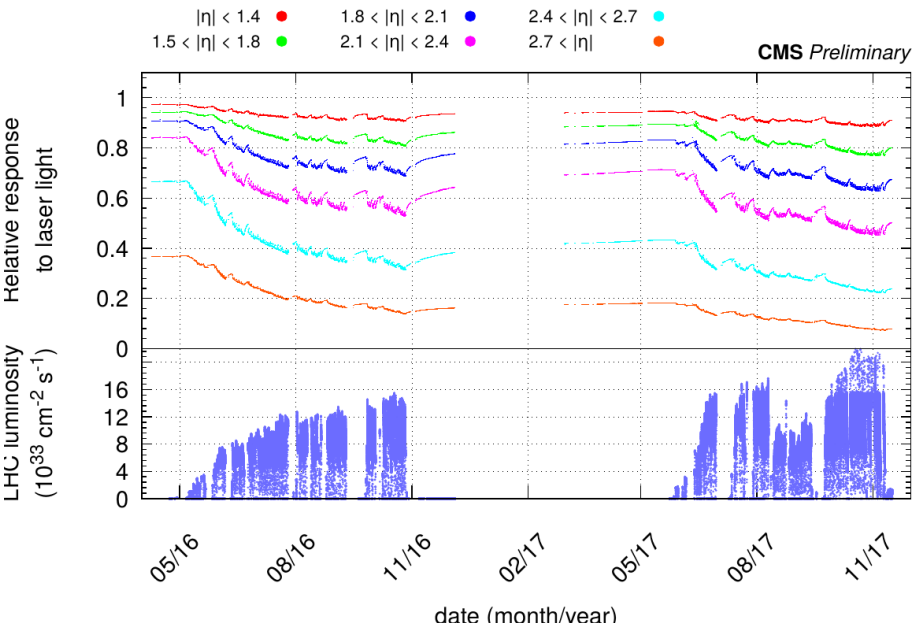


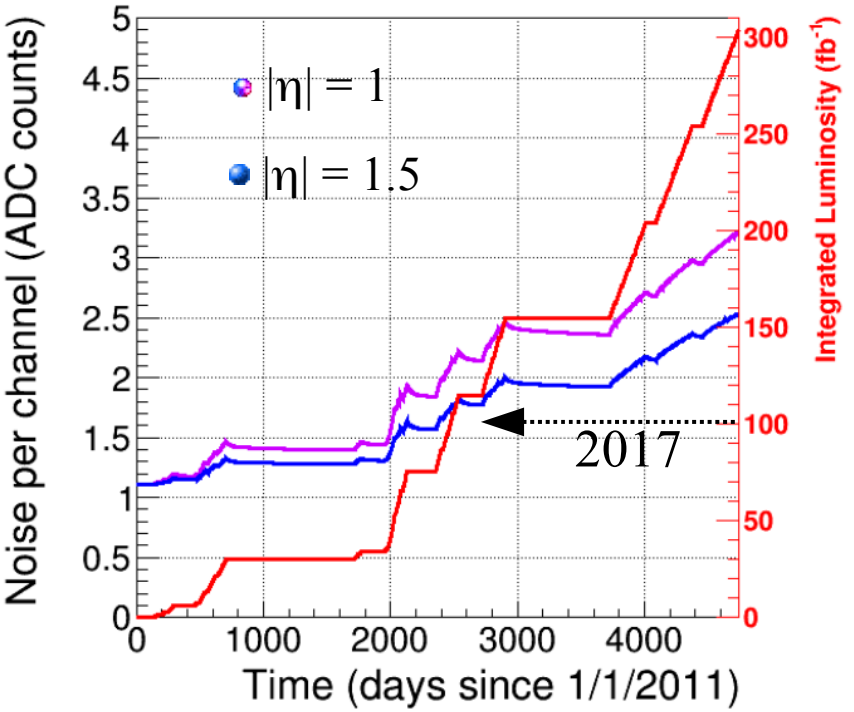
High Interest - **HI**
E_T > 2.5 GeV @ 2016
E_T > 4.5 GeV @ 2017

ZS thresholds
4.5 ADC in EB (Barrel), **6.5** ADC in EE (Endcap)
1 ADC in EB ~ **40 MeV**, 1 ADC in EE ~ **60 MeV**

DAQ conditions

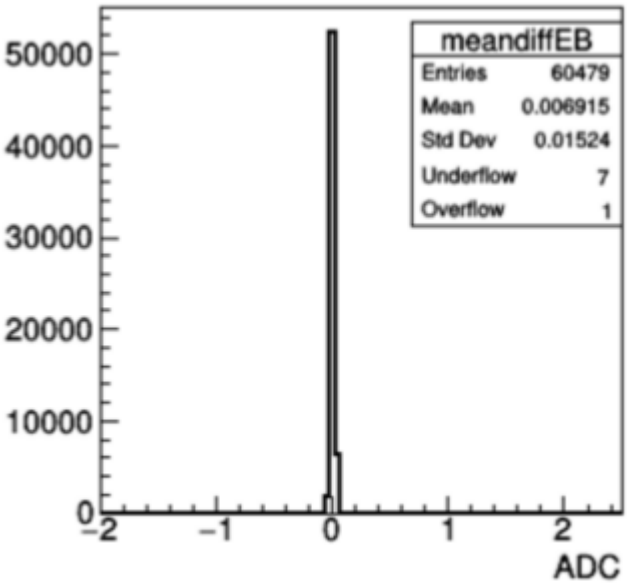
- Adattamento delle soglie online
  - 75k cristalli → non possiamo salvare tutti i cristalli per ogni evento selezionato (Full readout)
    - Limite nell'elettronica (2kB/evt/DCC payload @ 100 kHz di L1 rate)
  - Logica del **Selective Readout** (SR): definizione di zone di interesse
  - **Zero suppression**: salva cristallo se sopra ad una soglia
- Motivi per aumentare le soglie:
  - Pile-up
  - Perdita di trasparenza
  - Aumento del noise

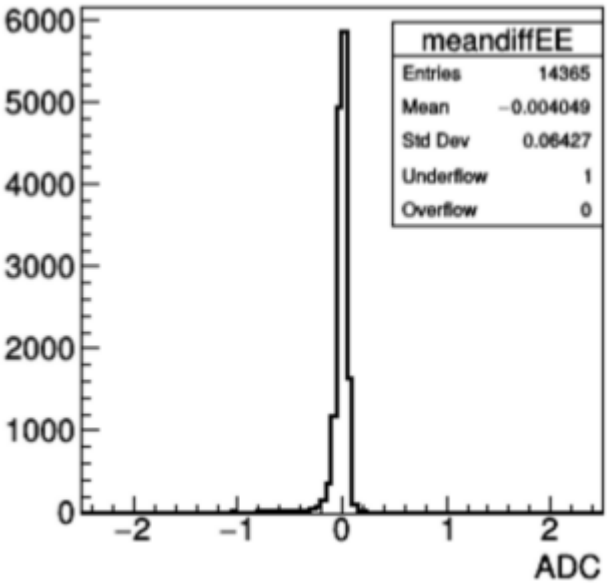


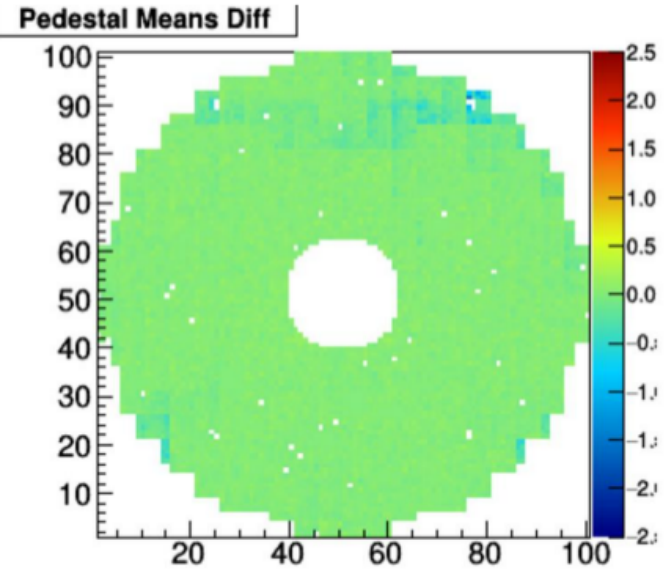


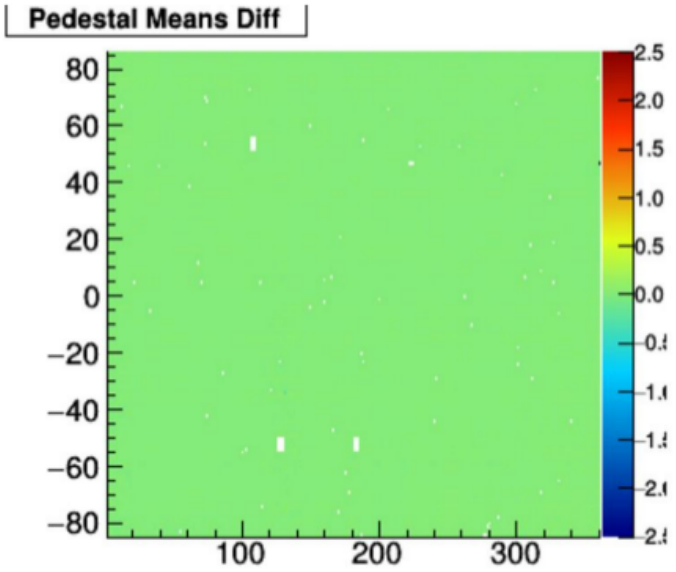
	2016	2017
SR	1.5 GeV / 2.5 GeV	2.5 GeV / 4.5 GeV
ZS	4.5 ADC in EB 6.5 ADC in EE	4.5 ADC in EB 6.5 ADC in EE

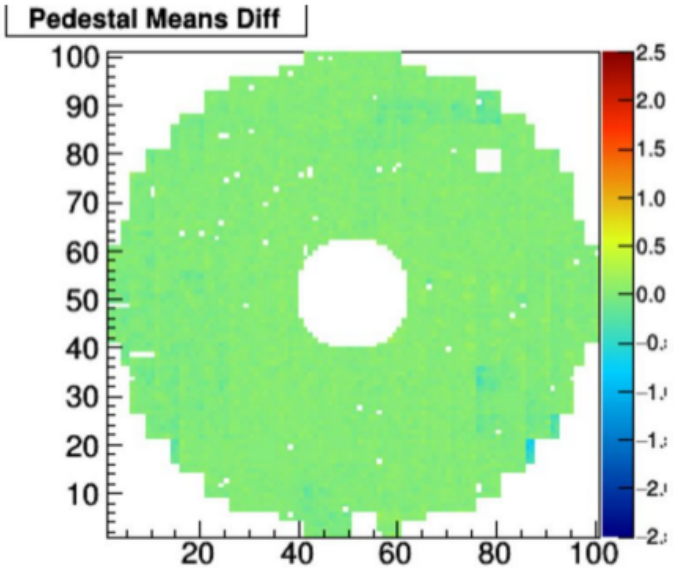
Validazione Pedestalli @ PCL







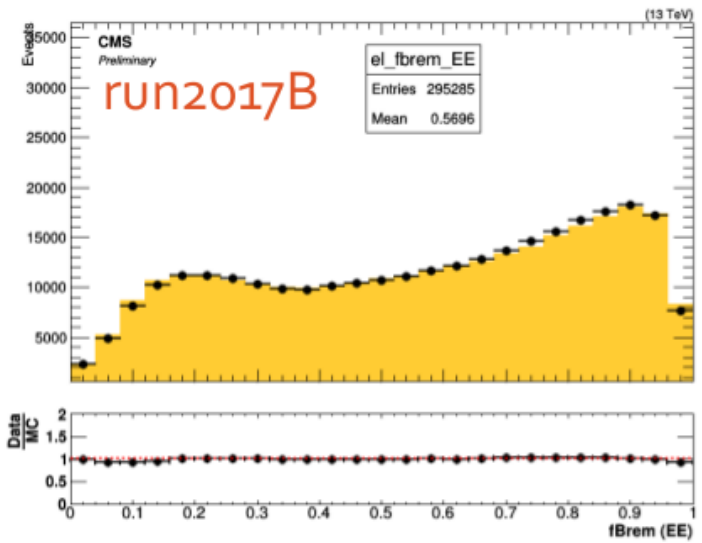


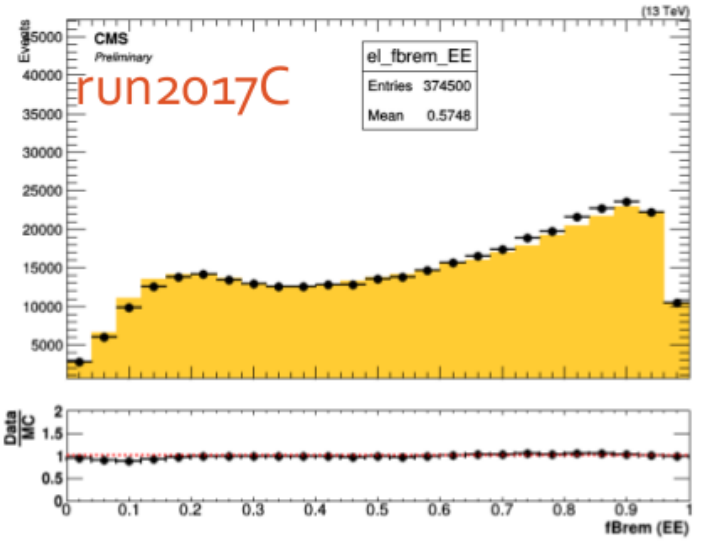


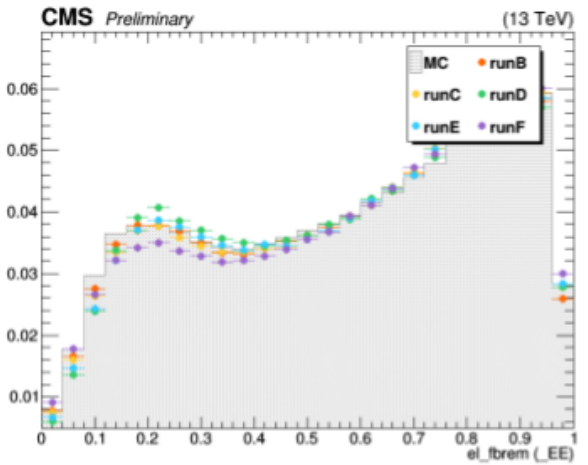
HLT menu & electrons

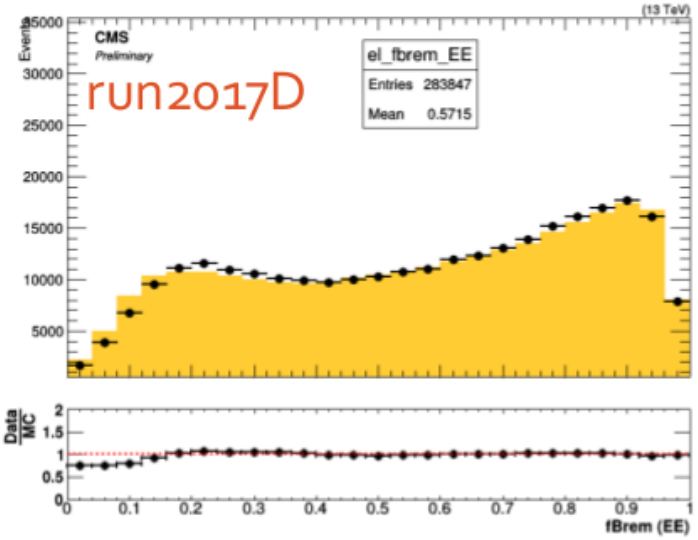
Menu	Start	End	Era	Pixel WP	Comments
V1.0	296070	297019	A	WP5	not deemed good for physics
V1.1	297046	297505	B	WP6-a	
V1.2	297557	299329	B	WP9	reverted to only doublets for pixel match
V2.0	299368	299649	C	WP6-a	new WPTight cuts (check)
V2.1	300079	300817	C	WP6-b	bug-fix, BPIX1+BPIX4 now a valid combination, increases efficiency in BPIX2+3 dead region
V2.2	301046	302019	C	WP6-c	active z region for pixel match now 0±12.5cm
V3.0	302026	302494	D	WP8	enabled nominal track – supercluster matching cuts
V3.1	302509	304738	D/E	WP8	
V3.2	304739	304777	E	WP8	
V3.1	304778	305112	E/F	WP8	
V3.2	305113	305377	F	WP8	
V4.0	305405	305967	F	WP8	gain switched xtals now properly recoed
V4.1	306029	306126	F	WP8	

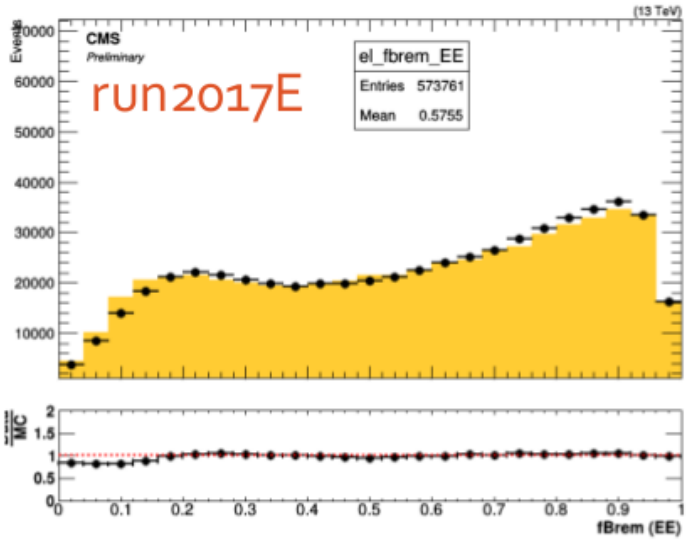
f-brem

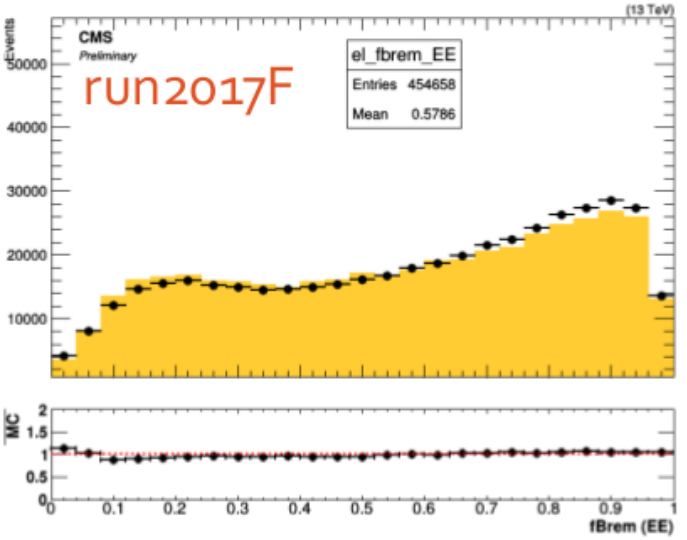








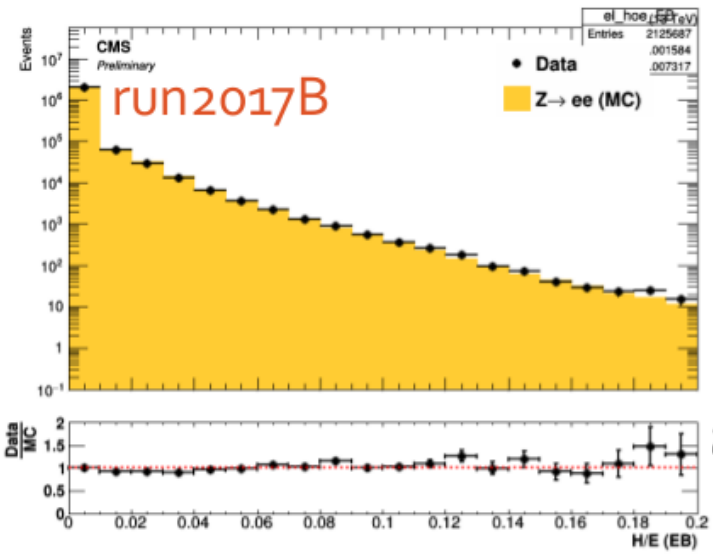


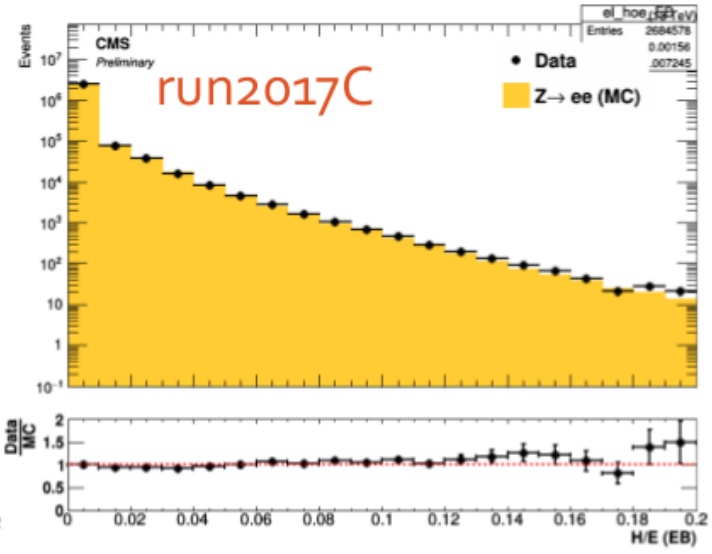


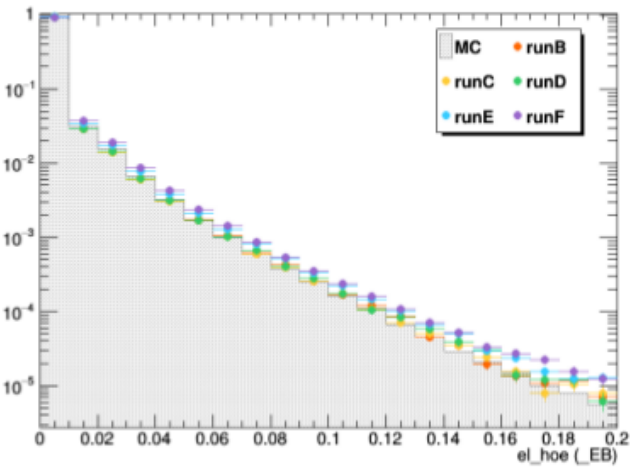
EGamma workshop

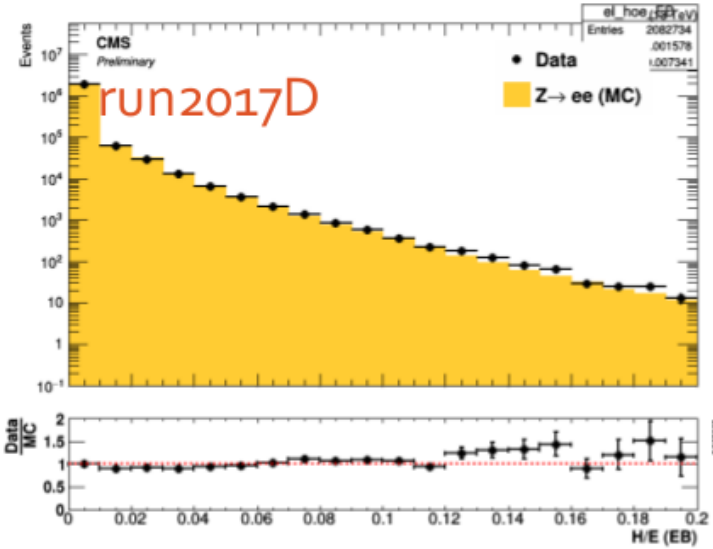
https://indico.cern.ch/event/662751/

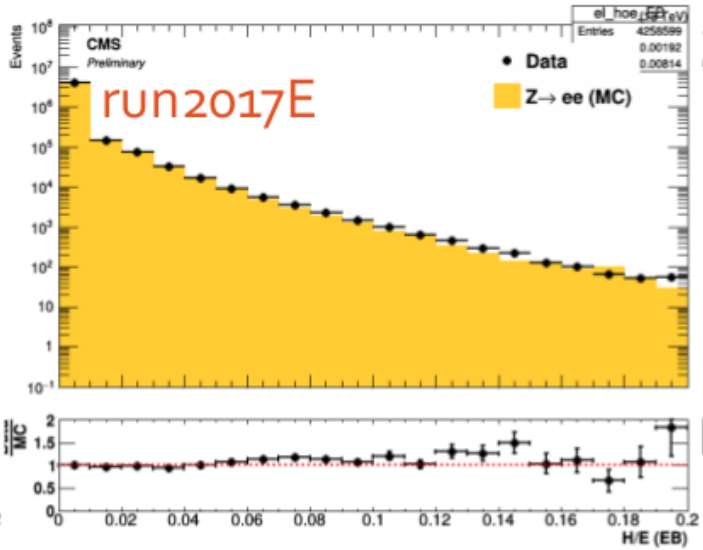
H/E

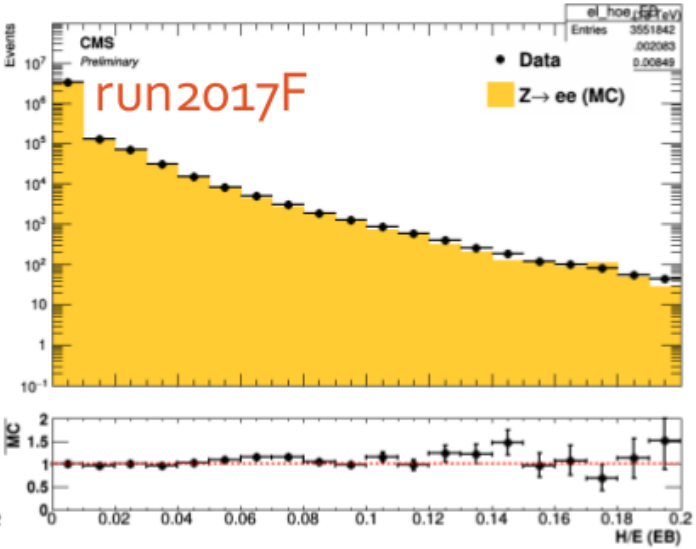








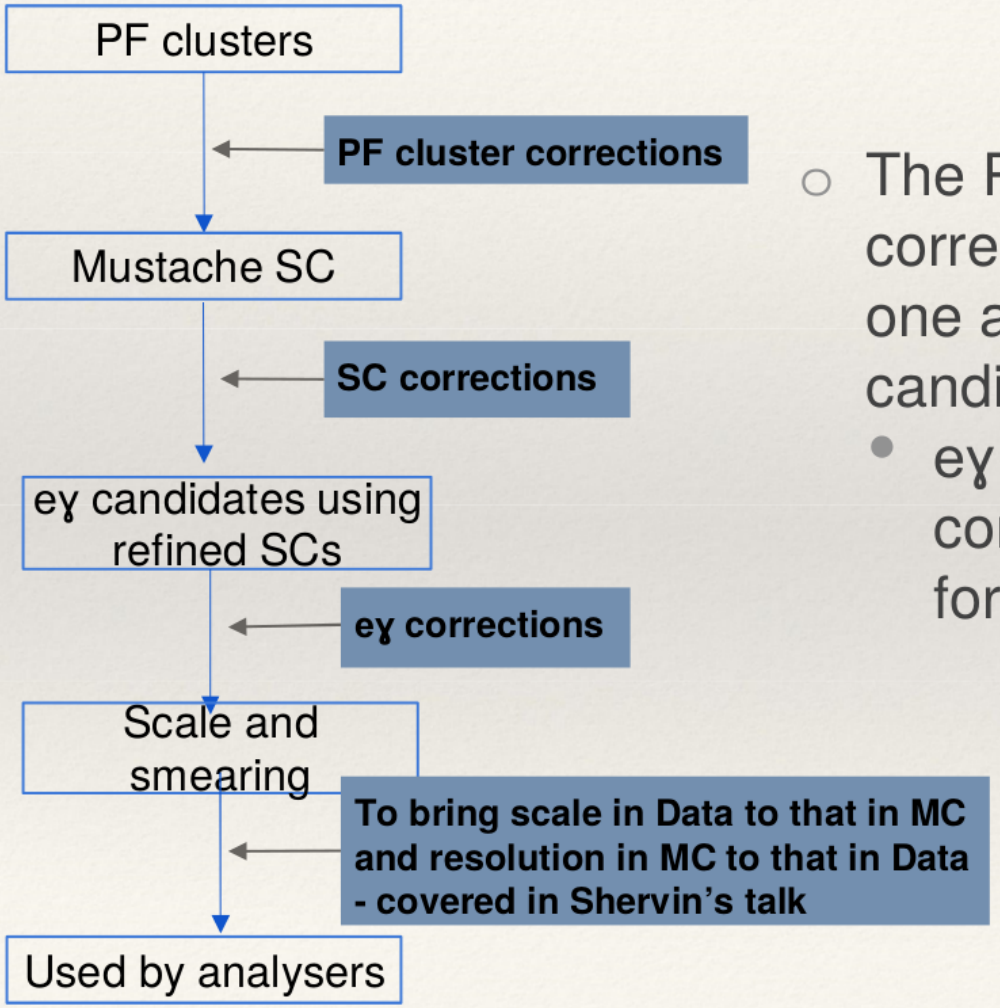




EGamma workshop

https://indico.cern.ch/event/662751/

Flow of the corrections in EGM



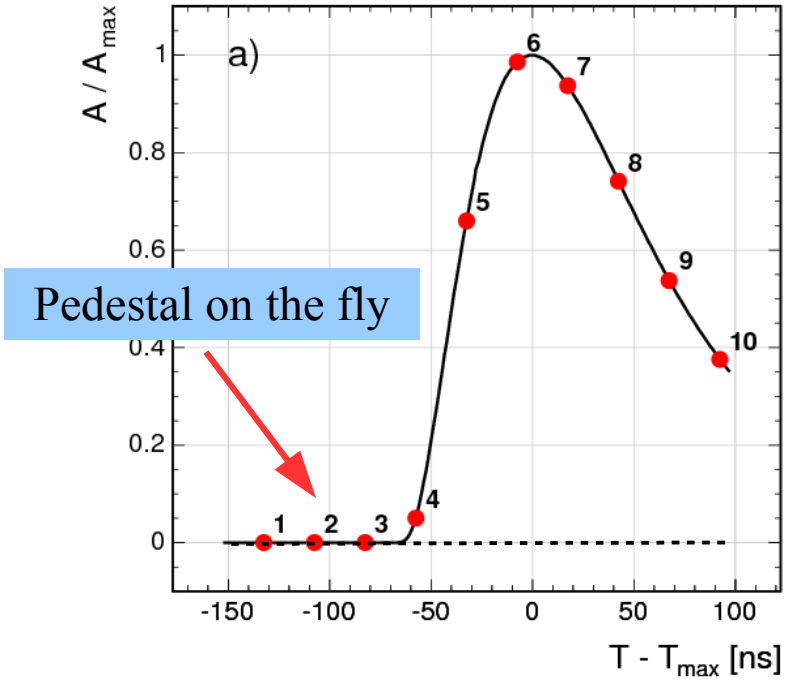
- The PF cluster and Mustache SC corrections are washed away when one applies eɣ regressions to eɣ candidates
  - eɣ regressions dominate the correction scales and resolutions for eɣ objects

Reminder on local reconstruction

- Reconstruct the energy deposit in each crystal from in-time particle

- **Weight method**
- Run I energy extraction based on a weighted sum of digitized amplitudes

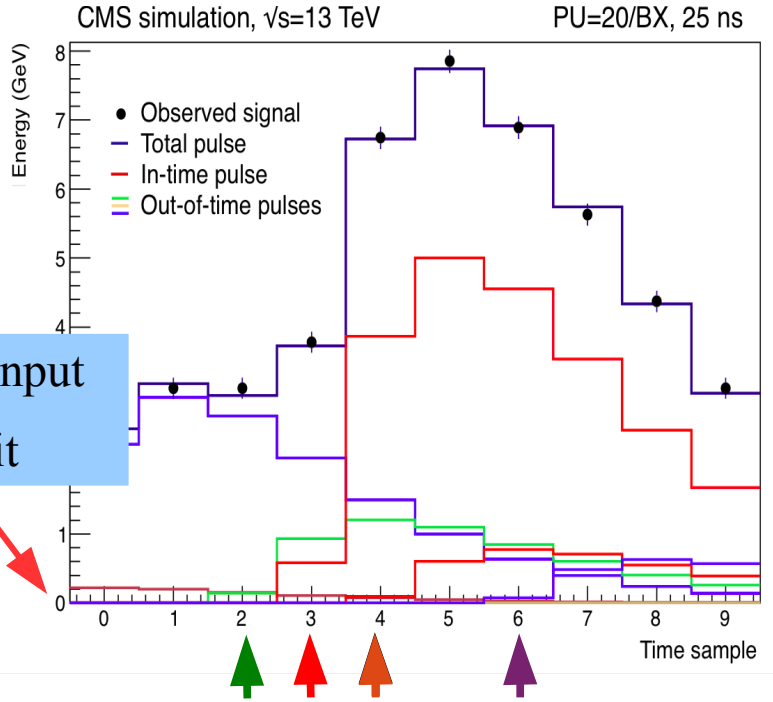
$$A = \sum_{i=1}^{10} w_i \times S_i$$



Pedestal on the fly

- **Multi-Fit**
- estimates the in-time signal amplitude and up to 9 out of time amplitudes by means of a minimization of χ^2

$$\chi^2 = \sum_{i=1}^{10} \frac{\left(\sum_{j=1}^{M} A_j \times p_{ij} - S_i\right)^2}{\sigma_{S_i}^2}$$



Pedestal an input of multifit

2016 & Pedestals