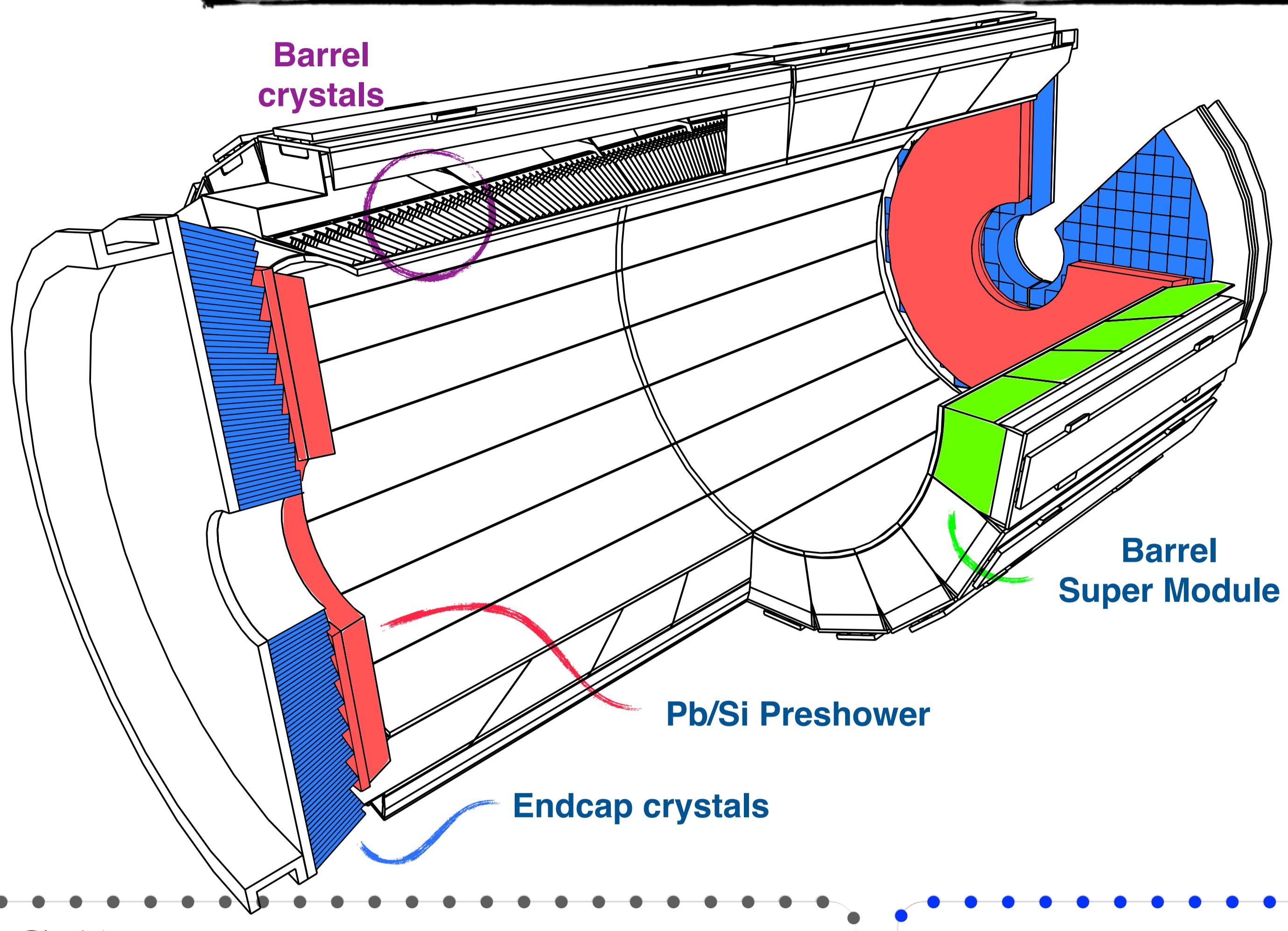




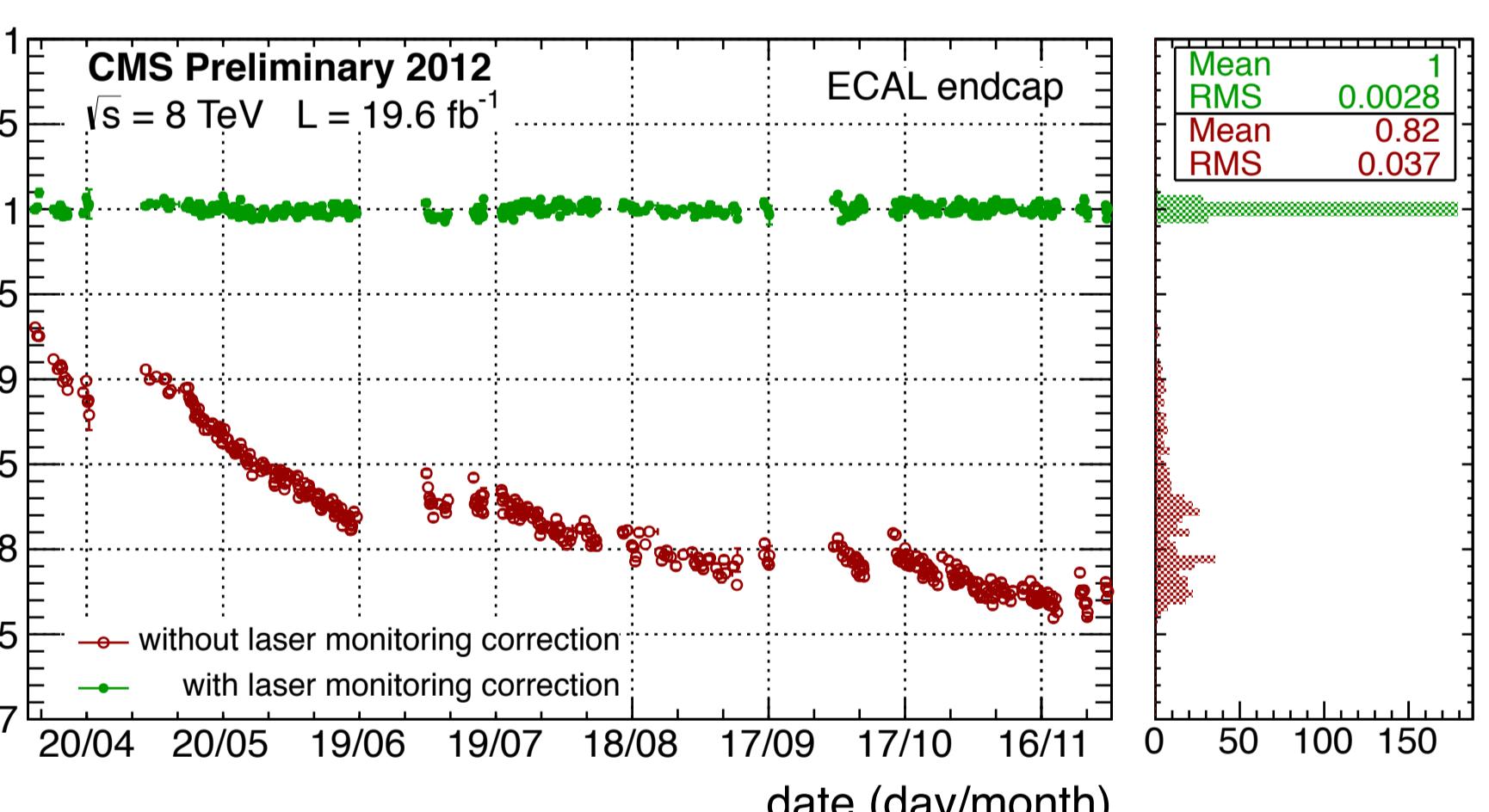
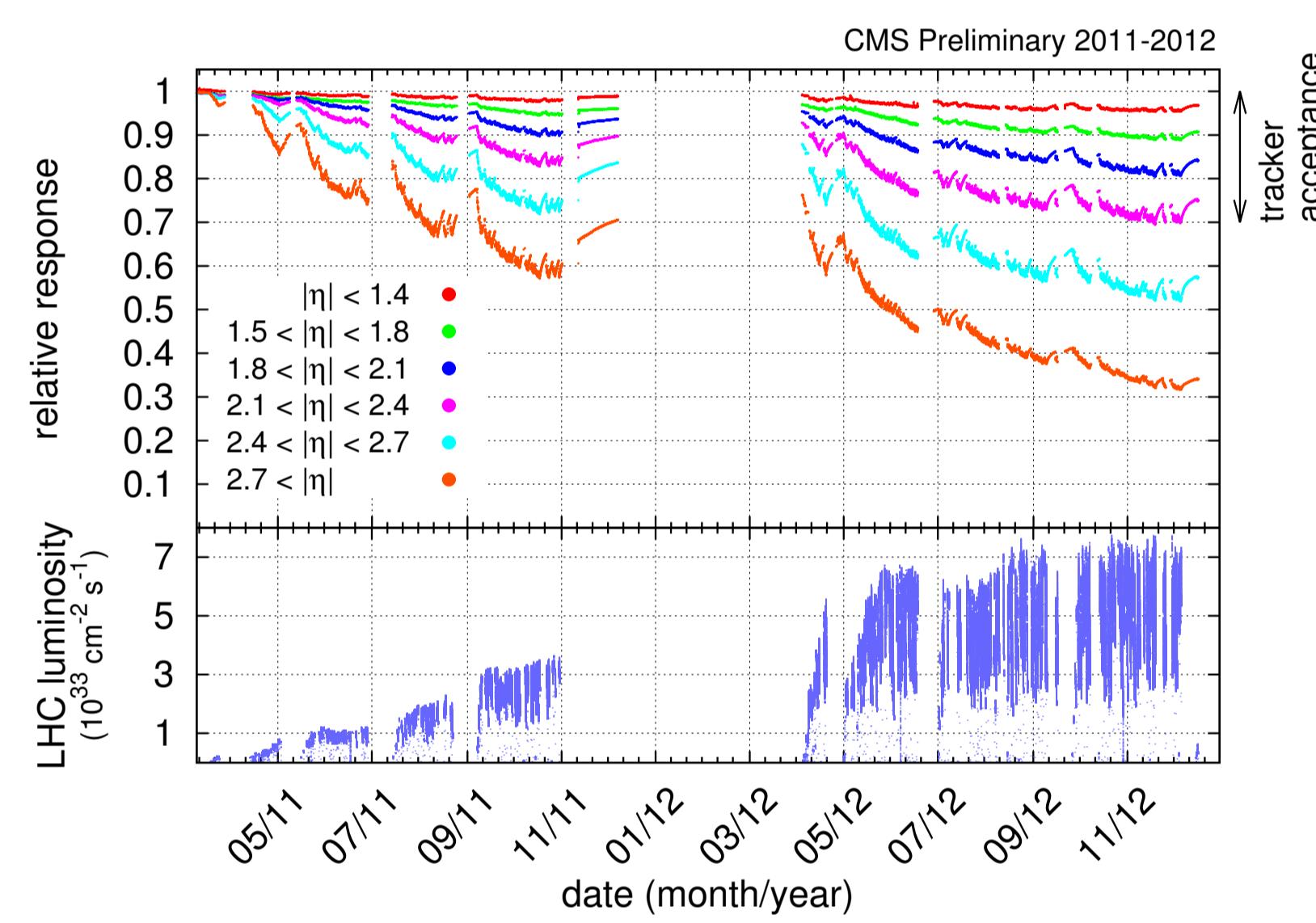
CMS Electromagnetic Calorimeter Calibration and Performance

Rafael Teixeira de Lima, on behalf of the CMS collaboration
Northeastern University



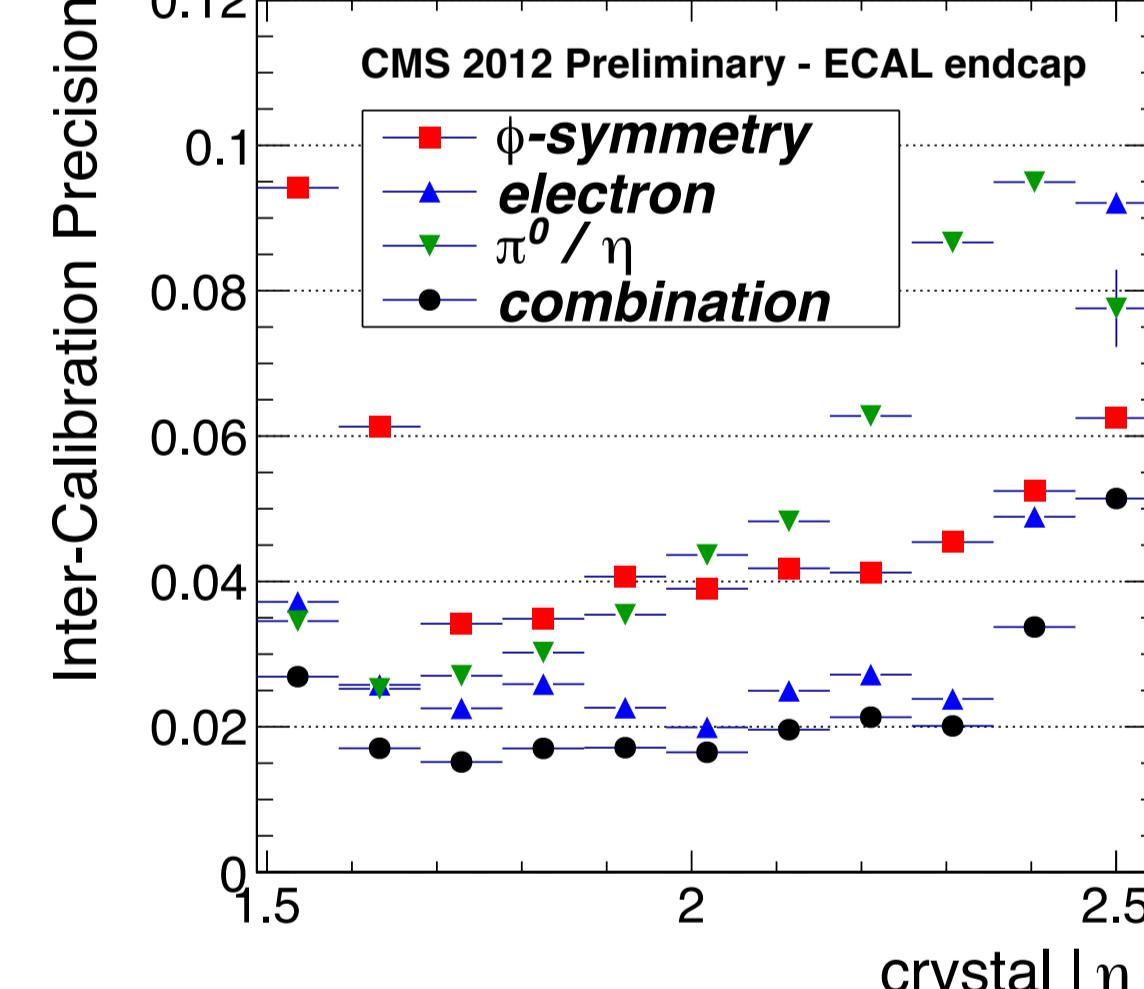
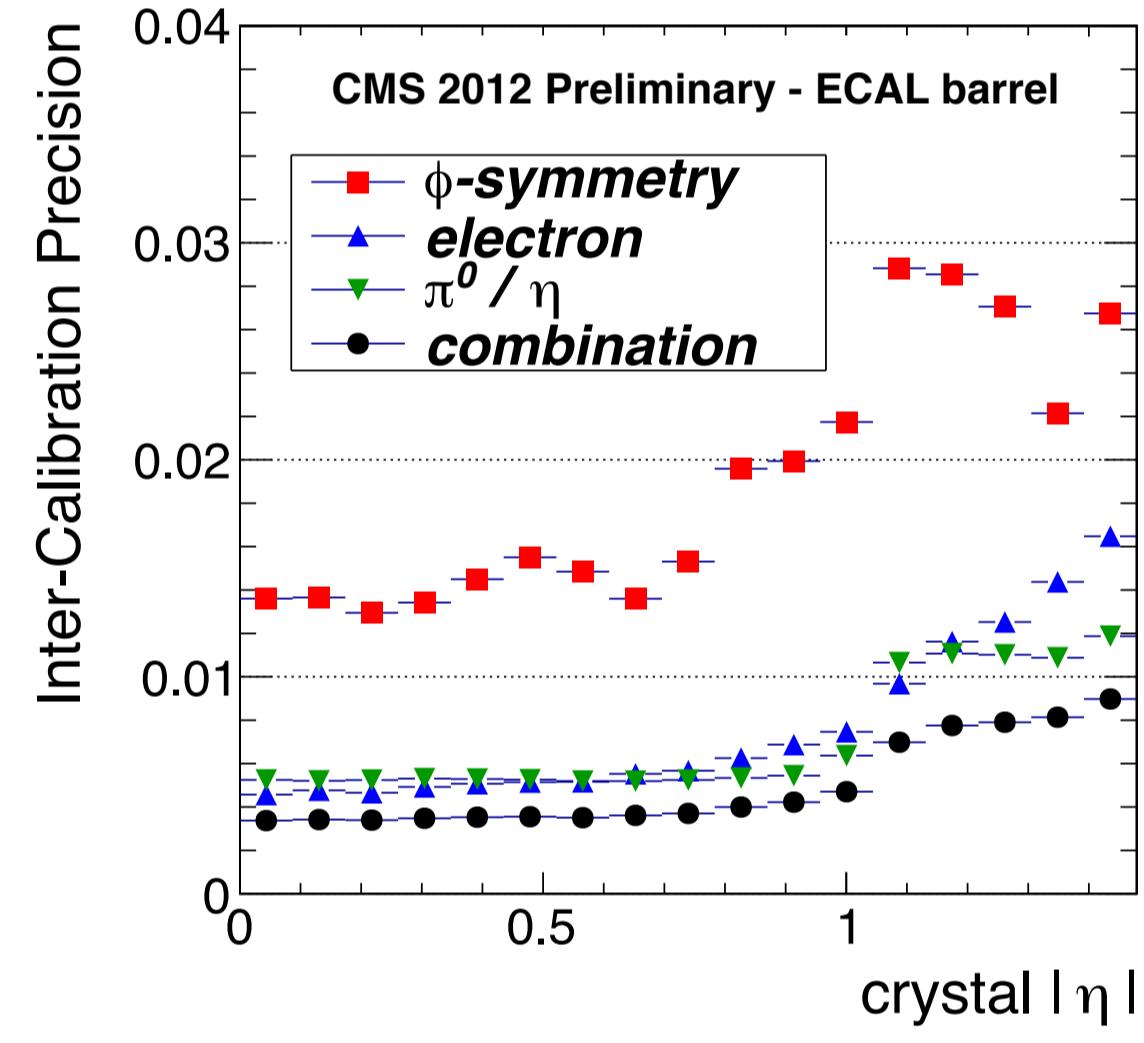
$S_i(t)$: Single channel time dependent correction for response variations

- Time dependency of crystal response comes from transparency loss;
- Transparency monitored through injection of laser light in each ECAL channel;
- Corrections for the variations in response (LM) are calculated and applied in a prompt reconstruction (~48 h).

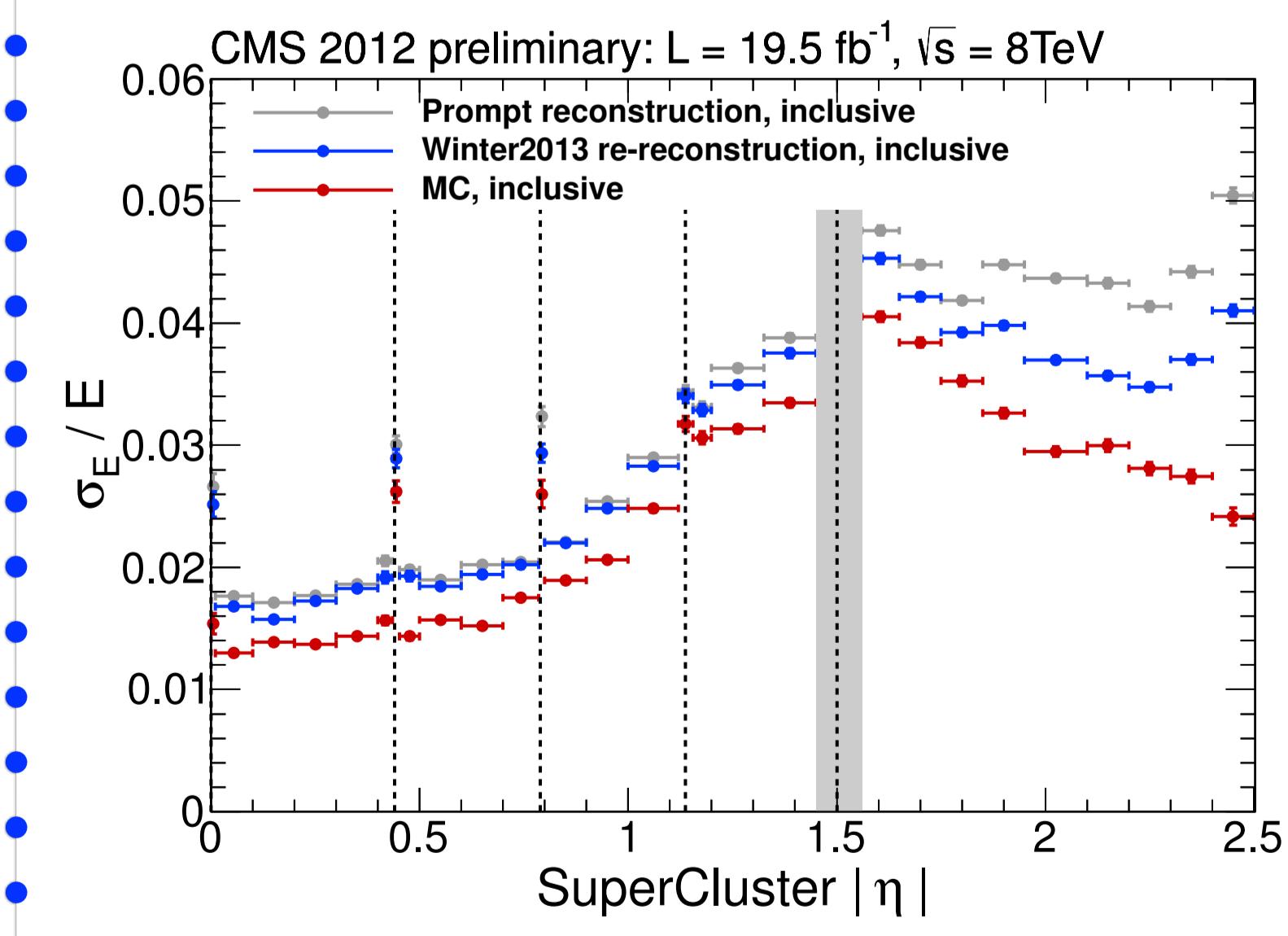


c_i : Relative calibration of the single channel response

- Aims at equalizing the response of each single crystal to the deposited energy.
- **φ-symmetry Method:** energy flux along ϕ -rings of same η should be symmetric;
- **$\pi^0/\eta \rightarrow \gamma\gamma$ Method:** reconstruct invariant mass peak for unconverted photons;
- **E/p Method:** compare isolated electron energy from ECAL and tracker.

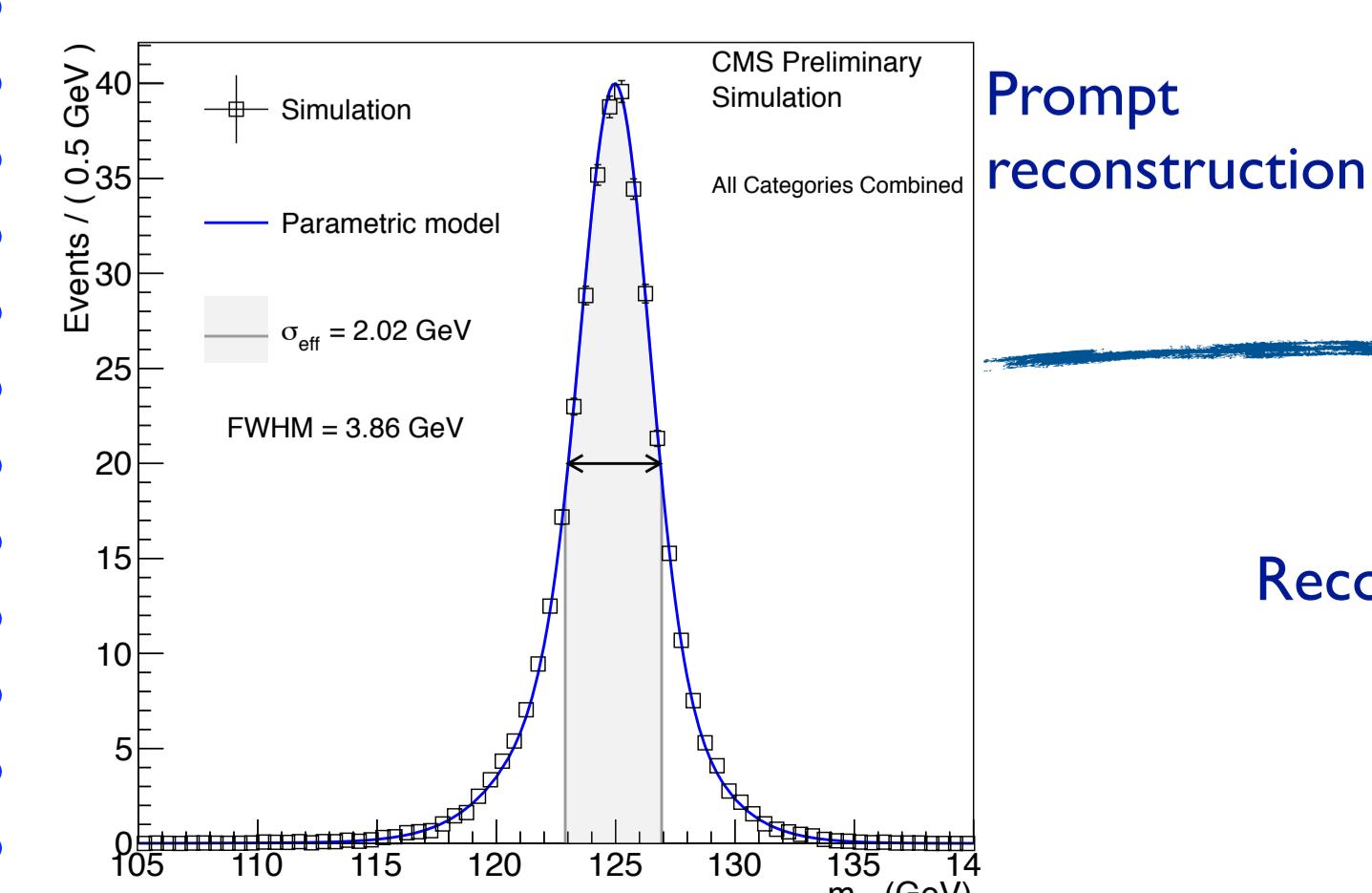


ECAL Performance



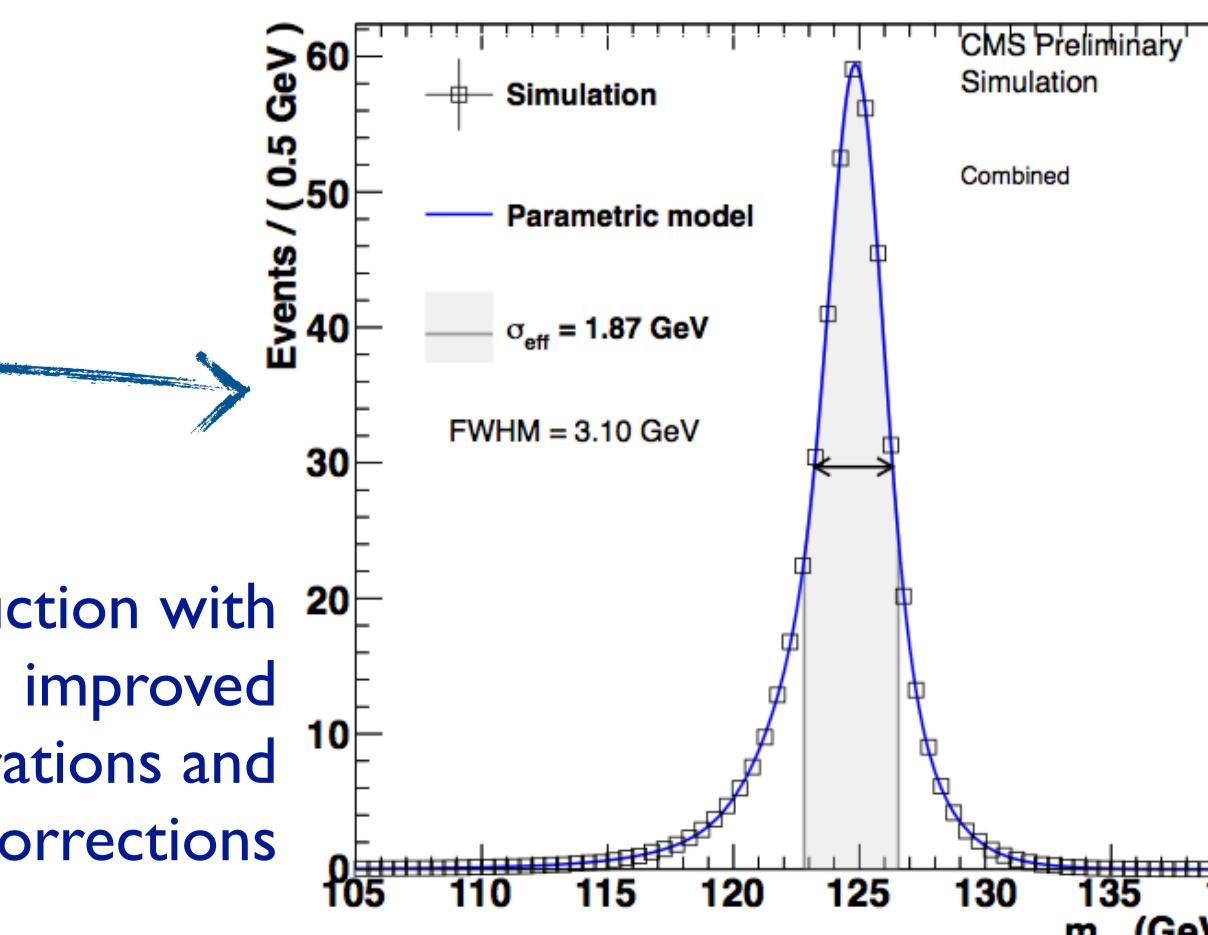
Precise and reliable calibration and monitoring of ECAL provides:

- Calibration precision better than 0.5% (EB) and 1.5% (EE);
- Stability better than 0.1% (EB) and 0.3% (EE).
- Energy resolution necessary for very precise Higgs measurements, such as $H \rightarrow \gamma\gamma$.



Prompt reconstruction

Reconstruction with improved calibrations and corrections



ECAL Characteristics			
Barrel (EB)	$ \eta < 1.48$	61200 PbWO ₄ Crystals	$\sim 26X_0$
Endcap (EE)	$1.48 < \eta < 3.0$	14648 PbWO ₄ Crystals	$\sim 25X_0$
Preshower	$1.65 < \eta < 2.6$	137200 Pb/Si strips	$\sim 3X_0$

$$E_{e,\gamma} = \sum_i [S_i(t) \times c_i \times A_i] \times G(\eta) \times F_{e,\gamma}$$

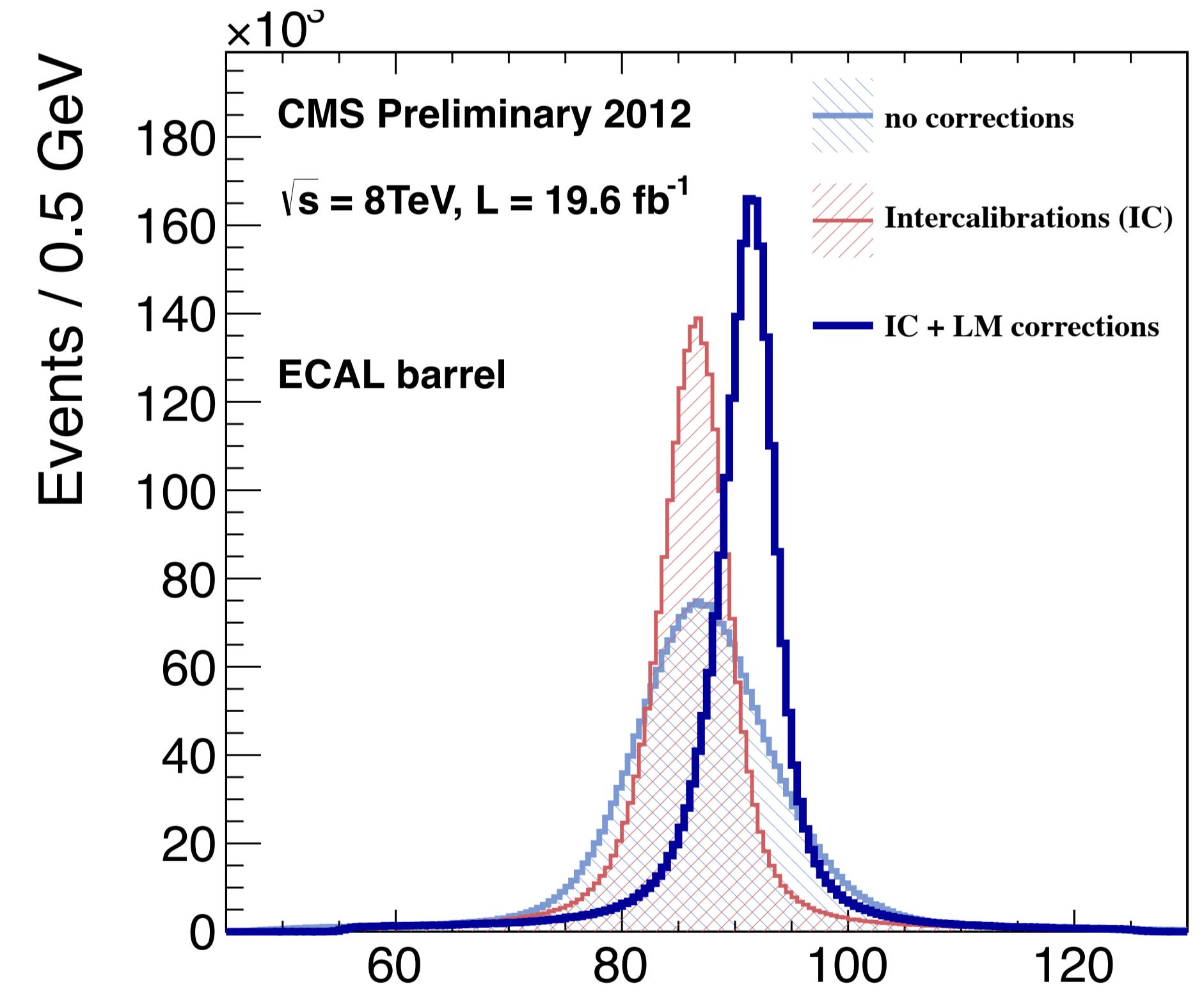
A_i : Single channel amplitude

$F_{e,\gamma}$: Particle energy corrections (clustering, reconstruction...)

$G(\eta)$: Calibration along η and global scale

- Determined employing the Z peak in the invariant mass of di-electrons.
- η calibration: Z mass on ϕ -rings of same η .
- Global scale: determined separately for EB and EE, and defined such that the peak position measured in data matches a detailed simulation of the detector.

Calibration Effects on Z Mass Measurement



Run II Plans for ECAL Calibration

- Relative calibration methods relies on high statistics and can be constrained by the number of events/crystal.
- $\pi^0/\eta \rightarrow \gamma\gamma$:
 - Accurate and fast method for relative calibration, but is limited by statistics.
 - Online selection being re-optimized for Run II conditions;
 - New trigger streams being designed specifically to supply the method, possibly at both L1 and HLT trigger levels, to keep high rate of π^0/η candidates;
- E/p:
 - New trigger stream also being developed employing HLT regional readout to maintain high rate.
- New methods being developed for the calibration of high η region and calculation of time dependent corrections.

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