Update on the current measurements and calculations of the CMS Preshower

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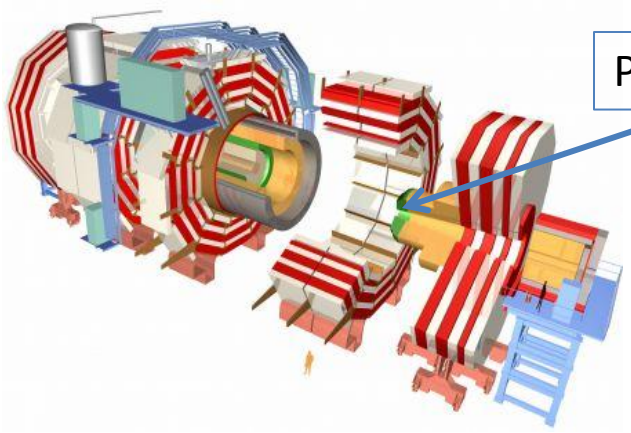
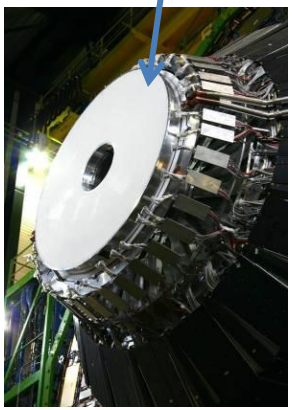
1. Preshower
2. Current measurements on sensors and comparison with calculations as a function of fluence
3. Current monitoring and comparison with the Hamburg model
4. Conclusions

The CMS Preshower: part of the end cap el. calorimeter

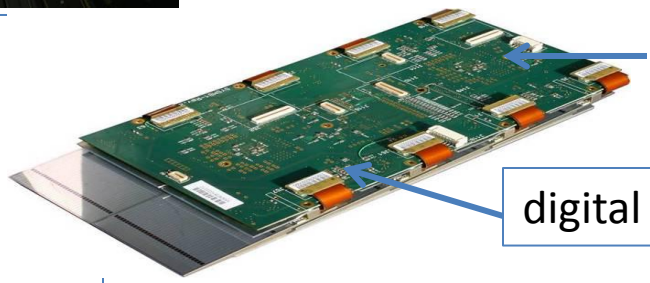


Preshower + ECAL



2 layers of lead absorbers
each followed by Si sensors
and digital electronics
Z = ± 304, ± 309 cm
45 cm < R <121 cm

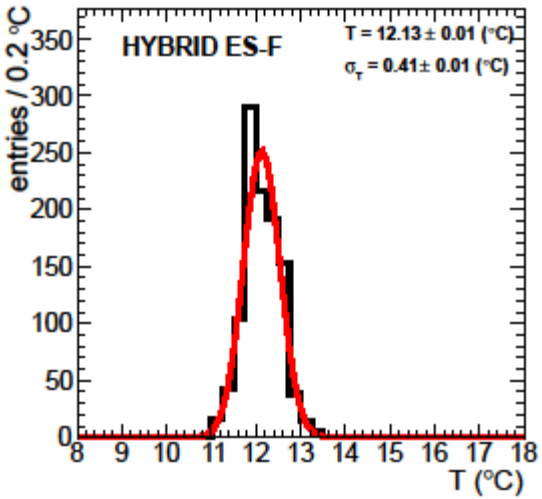
Si sensors, p-on-n , DC coupled, 63×63×0.32 mm^3
32 strips 1.8 mm wide at a pitch of 1.9 mm
4288 total, 1072/absorber
Sensors mounted on Al tiles and
assembled into “ladders” of 6 to 10 tiles
Bias voltage supplied to pairs of sensors (some singlets)

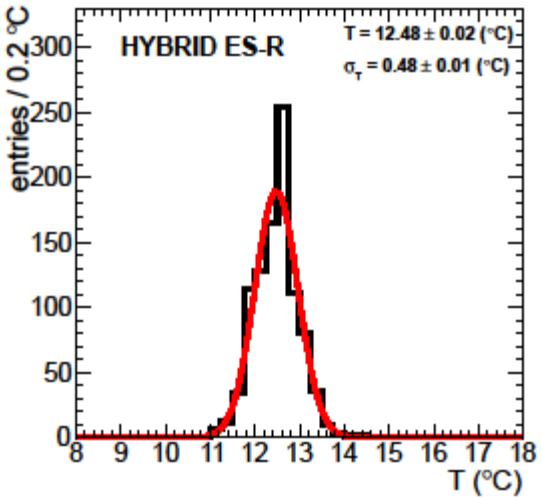


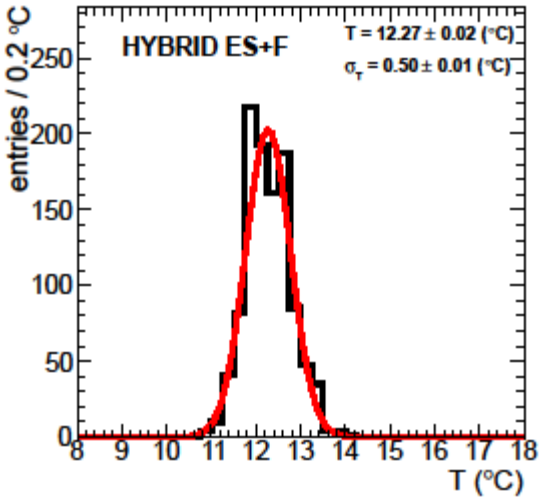
ladder

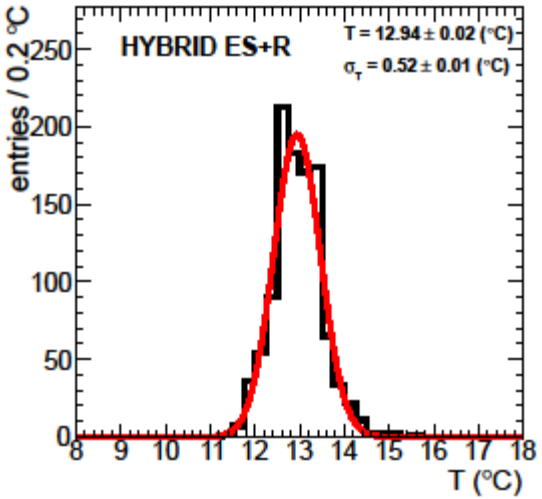
digital electronics

Ladders mounted on the absorber, cooled with C_6F_{14}
Temperature measured by the detector control units on the hybrids
1072 measurements per absorber plane









Temperature uniform to ± 0.5° C across the absorber

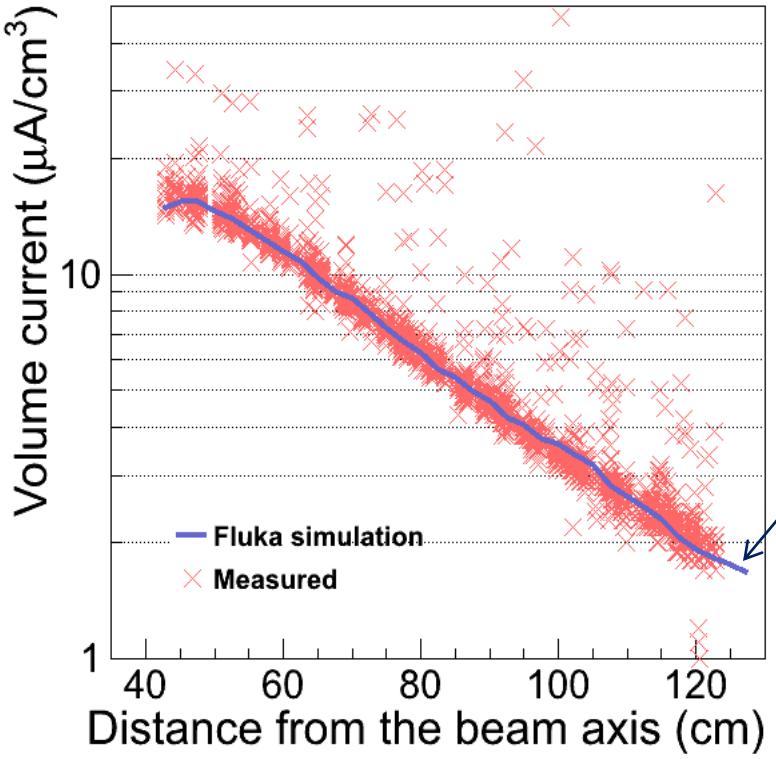
⇩

Easy calculation of the current evolution with luminosity (1 variable)

Volume current vs. radius

Measured on December 14, 2011, after 6.17 fb^{-1} on single sensors and pairs (2216 lines)

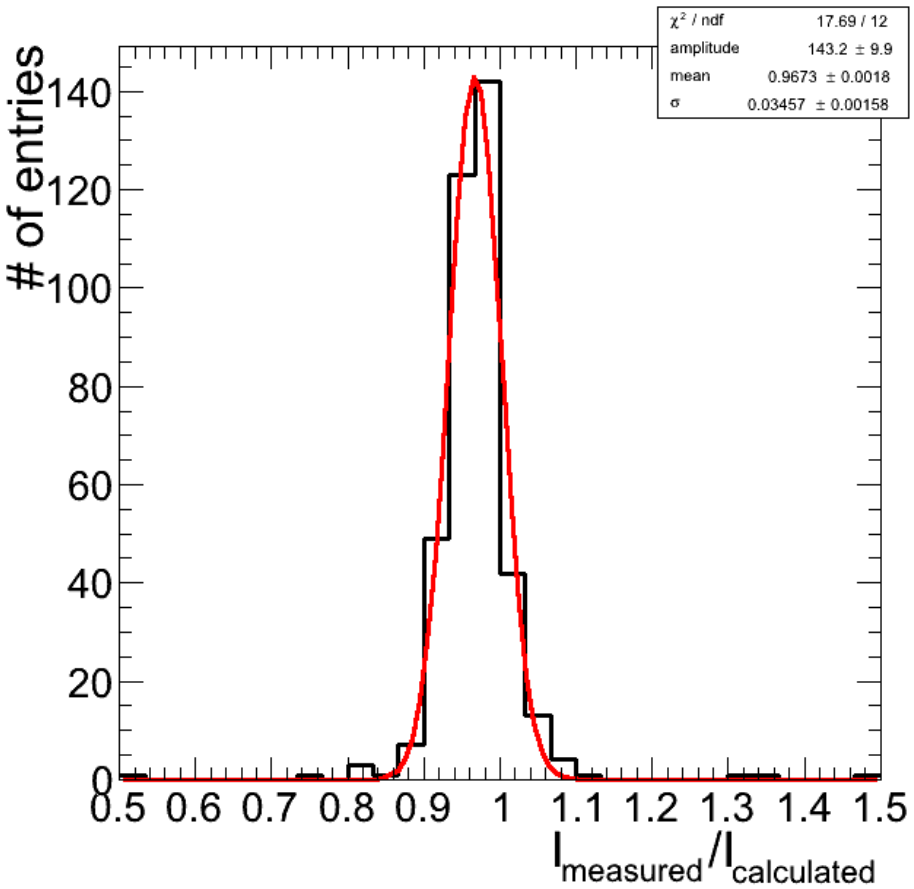
Measurement done at ~19° C, converted to 0° C



Particle fluence calculated using Fluka fed into the Hamburg model to estimate the current on December 14, 2011

Volume current vs. radius

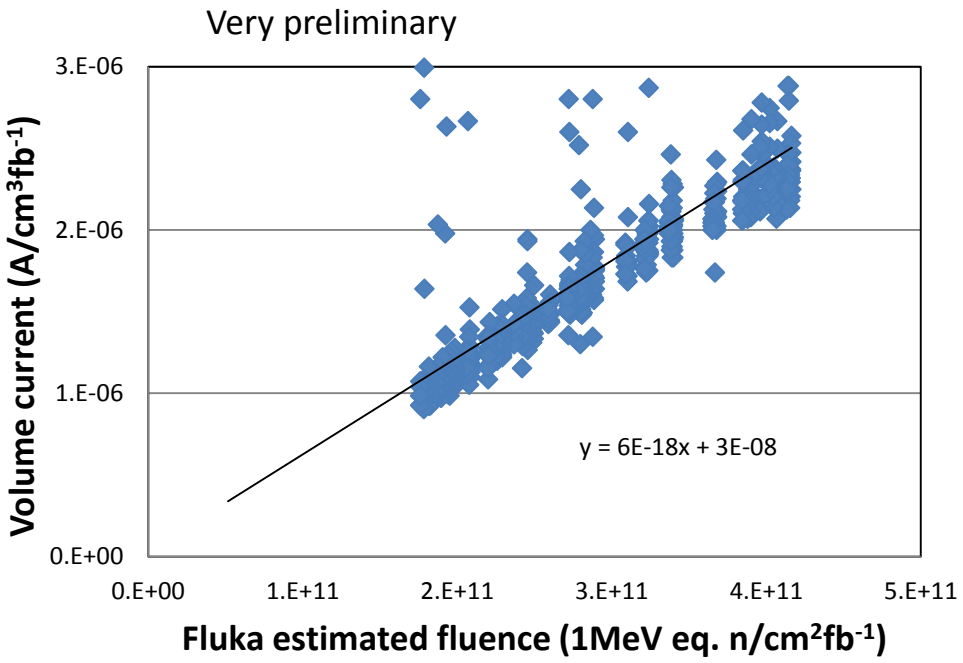
Ratio of measured-to-calculated current (as a function of distance to the beam axis)



Preshower material well described in Fluka, good agreement with the measurements

mean = 0.97 ± 0.03

Damage constant



$\alpha \approx$ 6e-18 A/cm

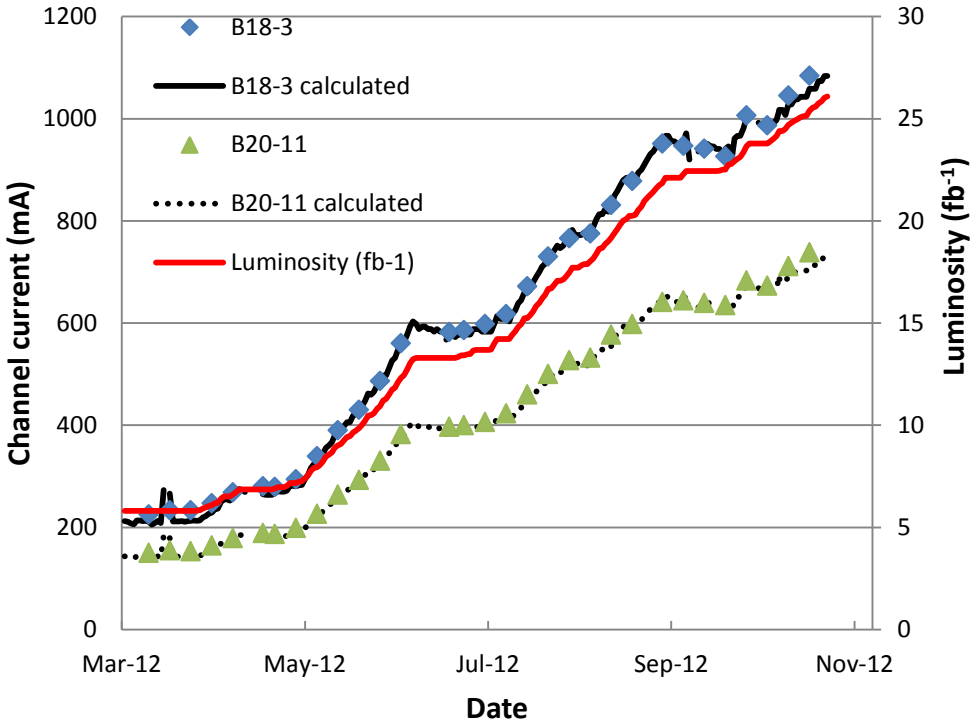
Based on measurements on December 14, 2011 after 6.17 fb^{-1}

Comparable to the Tracker

Very preliminary

need to select sensors with no surface currents

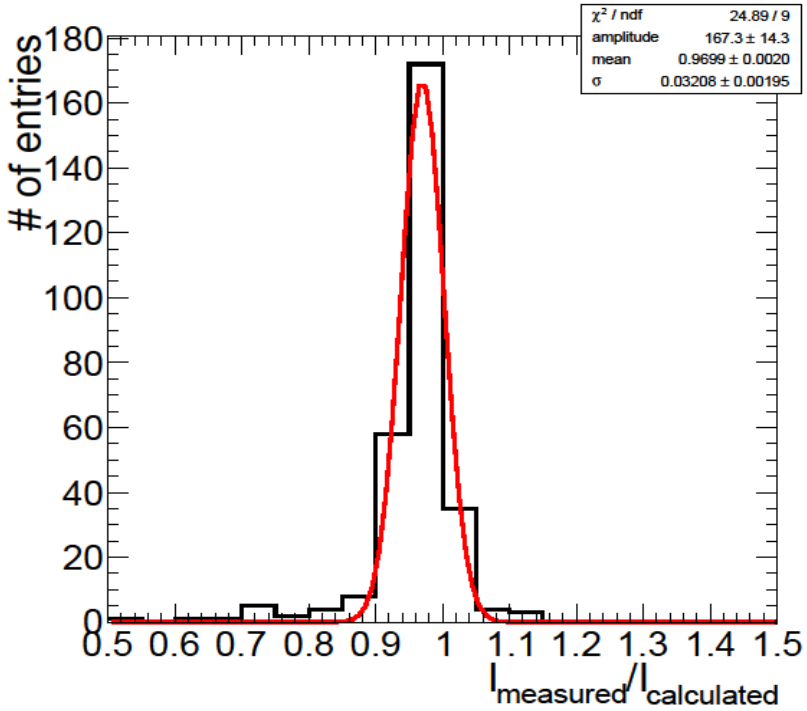
Current evolution



Current is monitored at the power supplies. Hamburg model is used to calculate the evolution with the luminosity, time and temperature.

Current evolution

Ratio of measured-to-calculated channel current (as a function of time)



The Hamburg model describes Precisely the evolution of the current with radiation, time and temperature.

mean = 0.97 ± 0.03

Conclusions

- The Preshower material is well modeled in Fluka.
- The calculated current dependence on the distance to the beam axis agrees well with the measurement with $\mathbf{I_{measured}/I_{calculated} = 0.97 \pm 0.3}$
- The current is monitored at the power supplies.
- The Hamburg model describes well the current evolution with luminosity, time and temperature with $\mathbf{I_{measured}/I_{calculated} = 0.97 \pm 0.3}$
- The model and simulation can be used to predict the future evolution of Preshower currents
- First estimate of the damage constant $\mathbf{\alpha = 6e\text{-}18\ A/cm}$
- Assuming that the LHC will restart in 2015 at 14 TeV centre-of-mass energy and will eventually deliver a total of 500 fb-1, the total fluence predicted at a distance of 45 cm from the beam axis is around 3×10^{14} 1 MeVeq n/cm^2.