

PIERRE  
AUGER  
OBSERVATORY

# Long Term Hybrid

Lorenzo Perrone

# OUTLINE

## **Operation performance and long term**

- Detector Stability and FD/Hybrid ontime and Metrics Evolution

Status of the recovery after the crash at CNAF in November /computing center totally flooded. Basically all data lost (~700 Tera). Impact on long-term studies

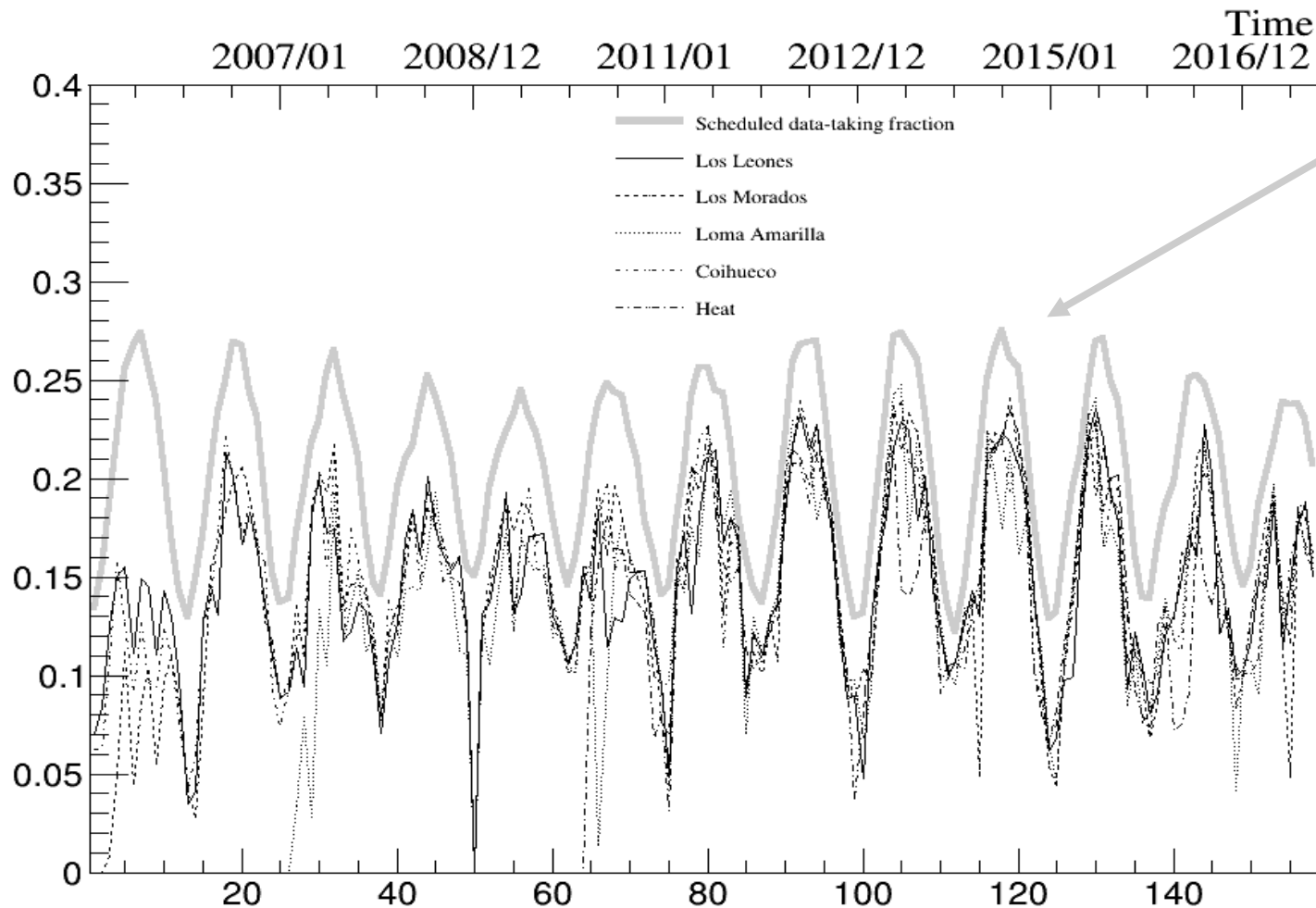
## **FD shift reports**

Status and evolution

## **Hybrid Data production**

Status of Databases for hybrid analyses

# Hybrid ontime



## NOMINAL:

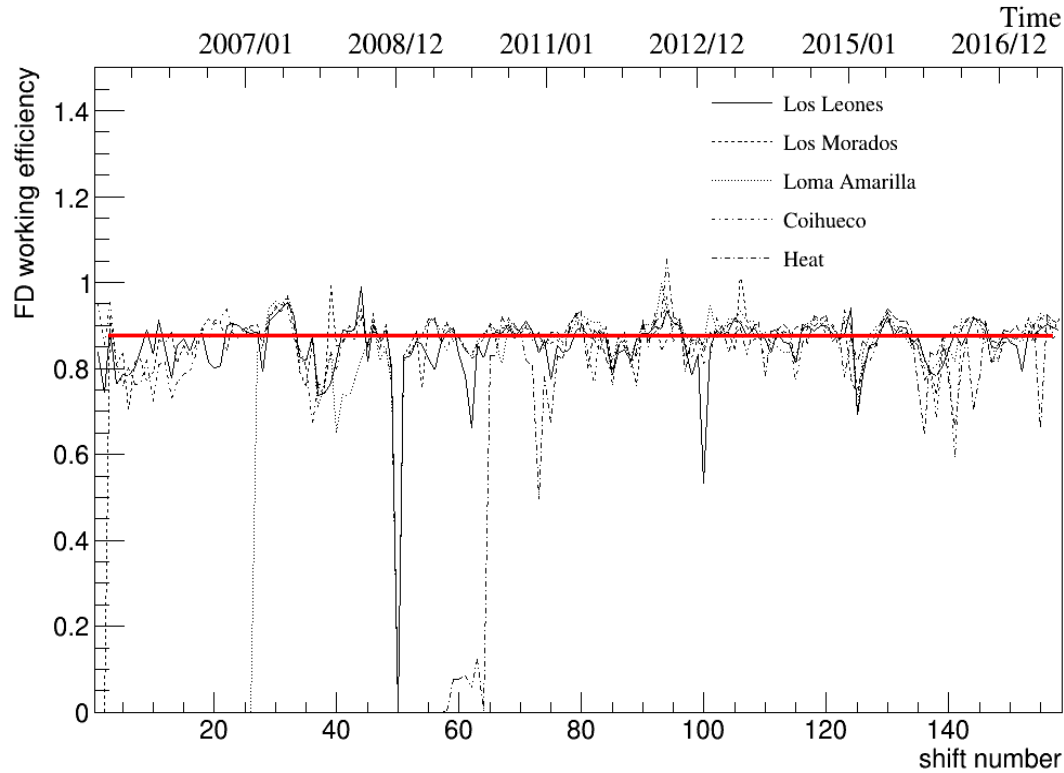
- moon fraction below 70%
- moon below the horizon for more than 3 hours

- Shutter status
- Lidar Veto
- FD Veto
- CDAS status

Monthly root-files starting since July 2007 till end of October **2017** available  
<http://paomon.physik.uni-wuppertal.de/UpTime>

**WE COULD FINALLY REPRODUCE THIS! JULIAN IS PROCESSING ROOT FILES TO UPDATE TILL END OF MAY. We should have them for Krakow.**

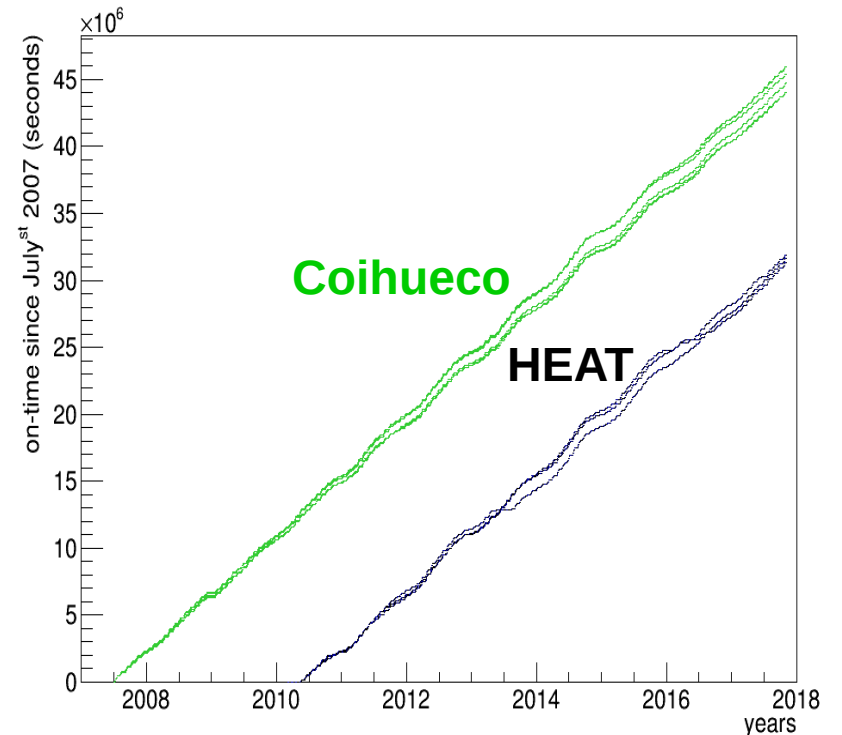
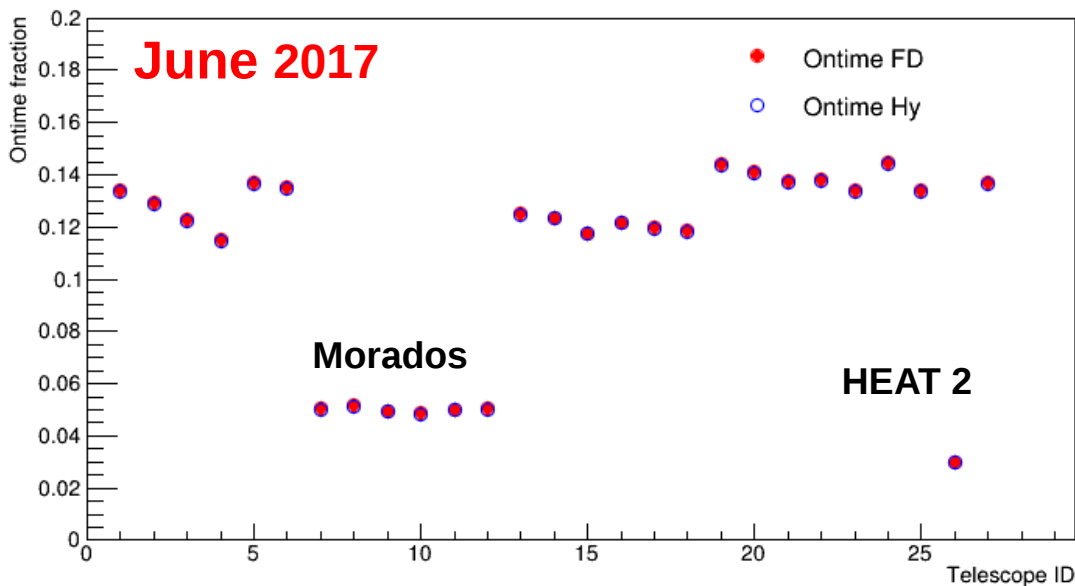
# Hybrid ontime metrics



Up to November 1<sup>st</sup> 2017

Detector readiness (normalized to the time with high voltage ON) of about 85% for all FD-sites

## Accumulated ontime



Very useful, shifters are really diligent (thanks also to Mariano for taking care of this)

**November 2017:**

**Problems with hybrid data fetching after CDAS electrical failure.**

**What has been done during the March 2018 shift:**

**General update of the software**

**New dedicated virtual machine available for shifters (thanks Ruben) and not only.**

- **offline trunk and analysis tools for FD mono and hybrid reconstruction and for displaying relevant info (rate, physics observables)**
- **Access to /Raid in Malargue (not fully reestablished after the electrical crash)**

USEFUL also for multi messengers? Contact to the task.

# FD Shift Report

## 08.03.2018 - 26.03.2018

Roberto Mussa, William Painter, Juan Pallotta, Lorenzo Perrone, Adriana C. Vasquez Ramirez, Orazio Zapparrata for the Pierre Auger Collaboration

We report a summary of the FD shift 08.03.2018 - 26.03.2018. We had few days of very strong wind (the night between March 22<sup>nd</sup> and 23<sup>rd</sup> we got wind gusts up to 70 km/h), one power cut in LA and frequent instabilities in the electronics of Los Leones. Many test of the new Lidar were performed in Loma Amarilla by Roberto, Juan and Jorge. A German team (Hermann-Josef, Kai and a student from KIT) mounted a prototype of a x-y scanner for absolute calibration in Coihueco bay 4.

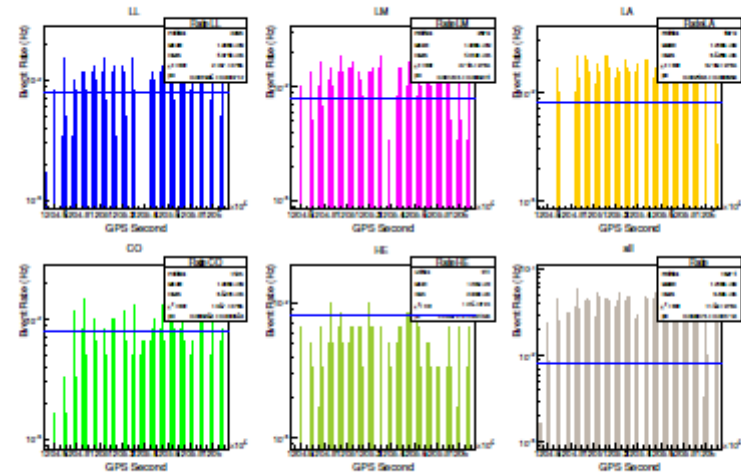
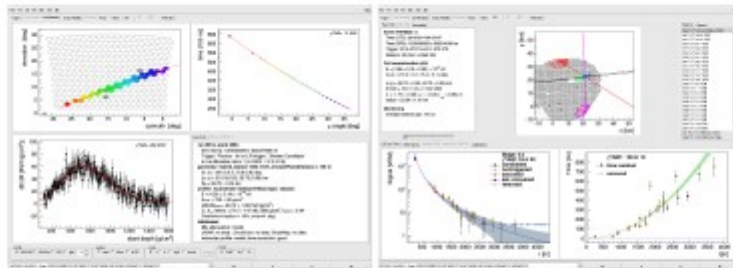


Figure 1: Rates of hybrid events observed along the FD shift. No selection cut applied.

(c) Coihueco

(d) Surface Detector

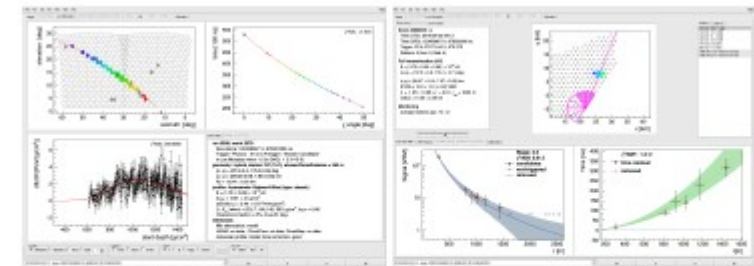
Figure 3: Event SdId=47097195 observed by 3 FD sites plus HEAT. The estimate of the energy is about 20 EeV.



(a) Los Morados

(b) Surface Detector

Figure 4: Event SdId=47076802 observed by 3 FD sites. The estimate of the energy is about 40 EeV.



(a) Los Morados

(b) Surface Detector

Figure 6: A very deep hybrid event (SdId=46993033) observed by Los Morados. The estimated  $X_{max}$  is about  $1050 \text{ gcm}^{-2}$ .

# Status of FD calibration databases

**FD\_Calib\_1\_A** released on May 12<sup>th</sup> 2016 (Wuppertal server)

- all telescopes (including HEAT) up to December 2015

**USED for ICRC 2017 Hybrid Data Set**

## What's in progress?

Gaetano has a preliminary version of the DB covering till begin of 2018  
This input is required also for producing the Aerosol DB

## Open (known and unknown) issues

Change of LCU (2016)

HEAT 3 Leones 3,4 5 behaviour since July 2016

# Status of the aerosol database

**Database till the end of 2015 released** and propagated to the master server in Wuppertal (announced to the Collaboration on April 14th 2017)

- “Bimodality” bug fixed      XLF and CLF positions switched in some case
- Phase function and multiple scattering corrections included

**Atm\_Aerosol\_1\_A**            with a new Software version  
**CSM\_NAP\_v2.0**

**Warning:** be aware of the software version.

The previous version (CSM\_roberts\_v5.0) will select the old DB

**Atm\_Quality\_0\_A**            Updated for the same data set

**USED for ICRC 2017 Hybrid Data Set**

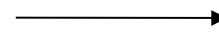
Work in progress to update the data sample using the input FD calibration constants



# Status of the other atmospheric databases

## Molecular database

Updated till Nov 2017



Ok, used also for SD analyses

Problem is the sync between Wuppertal and KIT. DB in fact available till March 2018. Problem understood

## Clouds monitoring

### GOES database

Updated till Jan 15<sup>th</sup> 2015

### CLOUD database

Updated till October 25<sup>th</sup> 2016



Gaps along 2013 and early 2014

Adelaide contacted:  
Time scale of two months for new data

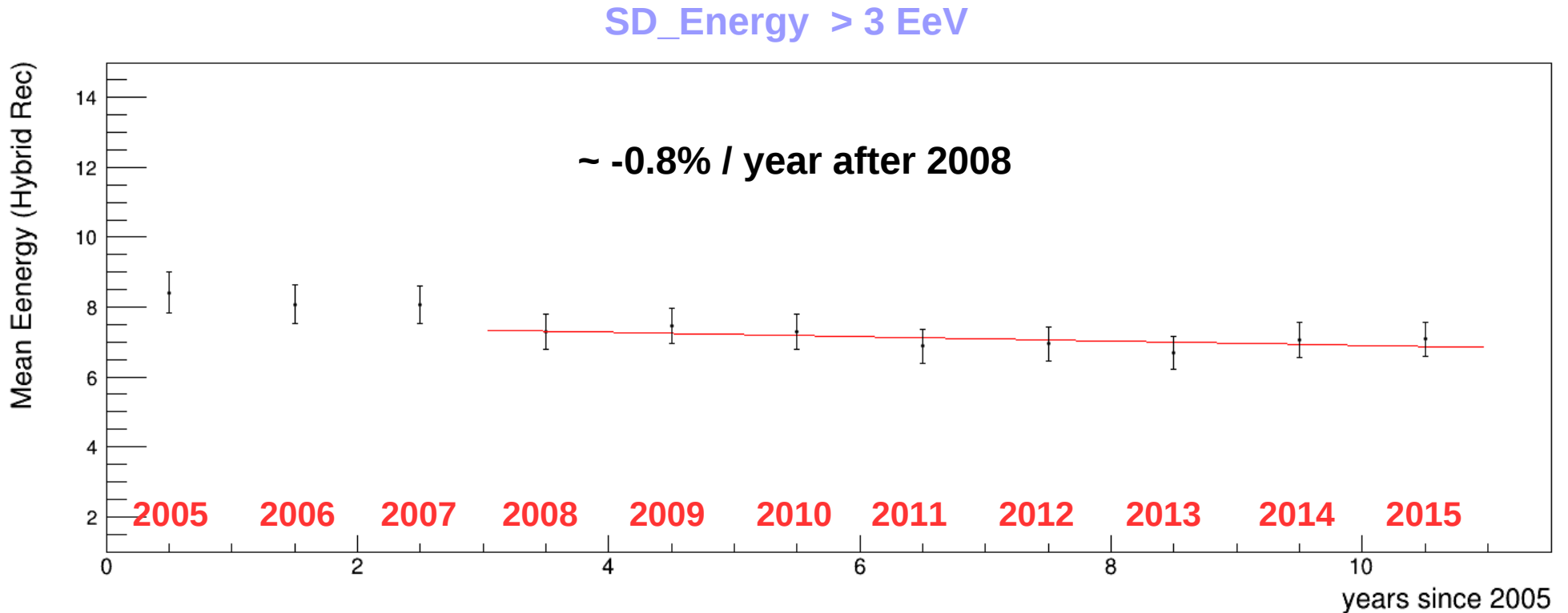
### Lidar database

Updated till March 9<sup>th</sup> 2014

For cloud rejection an approach using all information from different instruments is used in data analysis → Unified approach since ICRC 2017

# Energy scale Stability

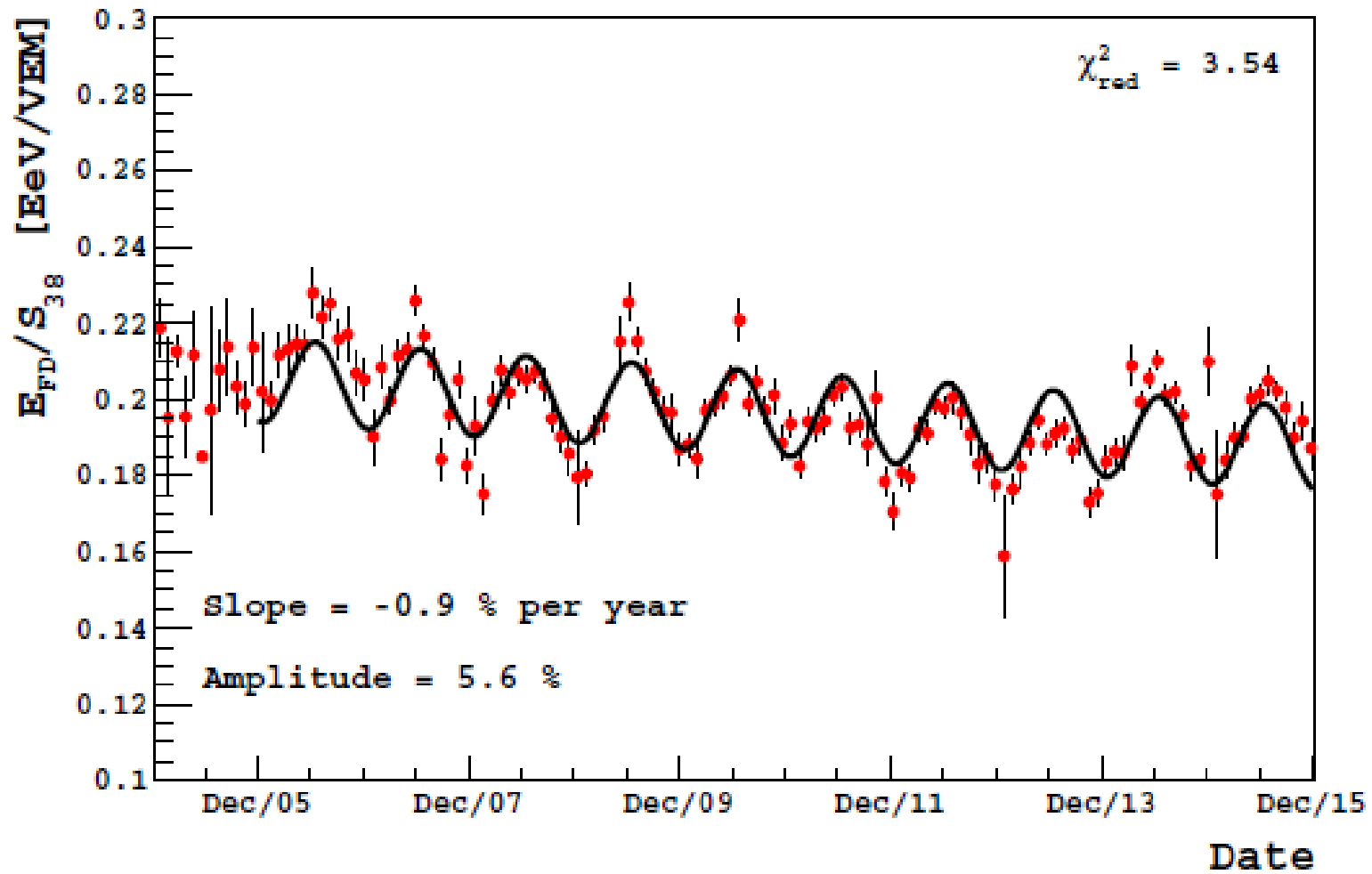
Last hybrid pre-production for ICRC 2017  
Latest Aerosol and Calibration DB  
No cloud cut



FD and SD involved (difficult to disentangle the relative contribution of each)  
A fit with a flat line is (almost) equivalent in terms of probability and  $\chi^2$

Similar indications by other studies (Adelaide group)

We quoted a related systematic uncertainty on the energy scale (ICRC 2013)



Adelaide group



THE UNIVERSITY  
*of* ADELAIDE

Energy Systematics and Long Term  
Performance of the Pierre Auger  
Observatory's Fluorescence Telescopes

Phong Huy Nguyen

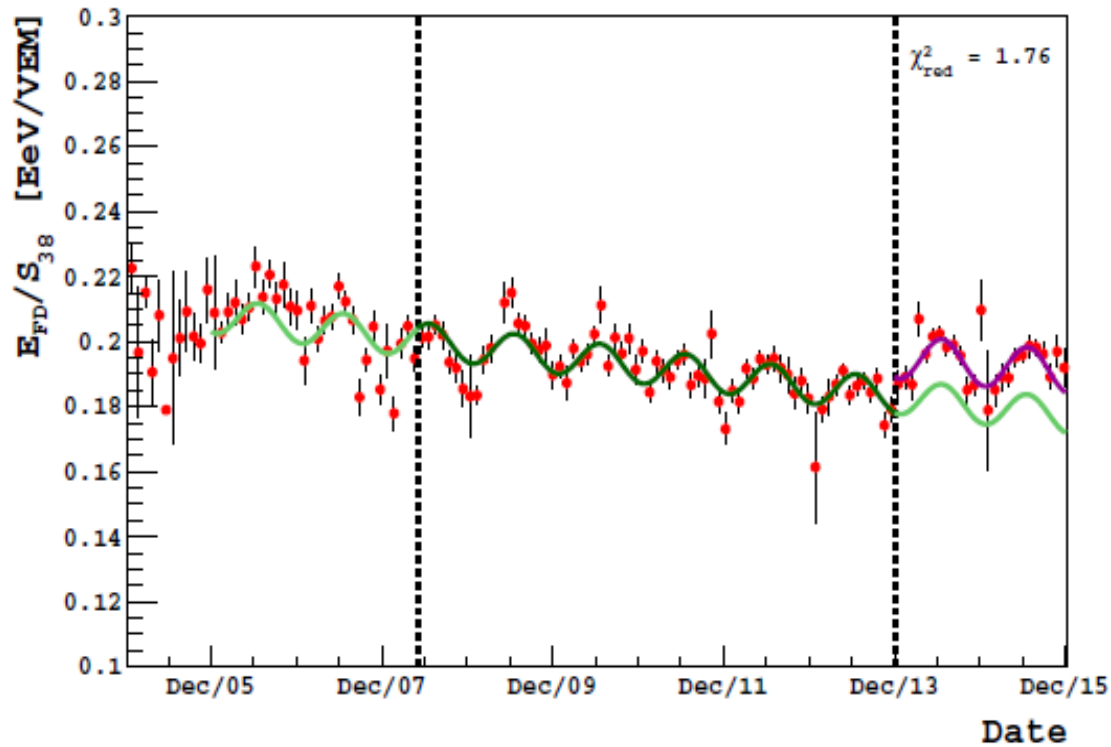
GAP 2018\_011

A valuable study of the long term performance including

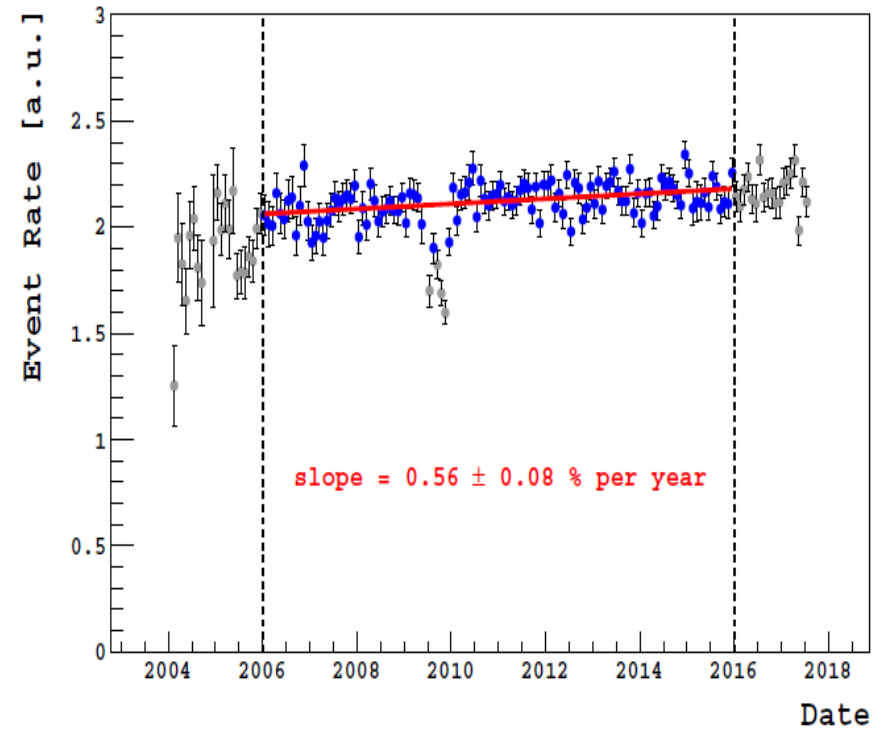
- calibration constants (and running consts)

- detector and energy scale stability

## Combined FD+SD effect



## SD contribution



	$\chi^2_{red}$	Drift [% per year] (pre 2014)	Modulation [%] (pre 2014)	Drift [% per year] (post 2014)	Modulation [%] (post 2014)
Nominal Energy Scale	1.93	$-1.6 \pm 0.2$	$5.1 \pm 0.4$	$-1.0 \pm 0.8$	$5.5 \pm 0.7$
+ Aero. DB	2.16	$-1.7 \pm 0.2$	$4.3 \pm 0.4$	$-0.6 \pm 0.9$	$4.0 \pm 0.7$
+ SD WC (old aero. DB)	1.76	$-1.6 \pm 0.2$	$2.7 \pm 0.4$	$-1.2 \pm 0.8$	$3.4 \pm 0.7$
+ Aero. DB + SD WC + Geo.	2.04	$-1.6 \pm 0.2$	$2.0 \pm 0.4$	$-0.7 \pm 0.9$	$1.7 \pm 0.7$

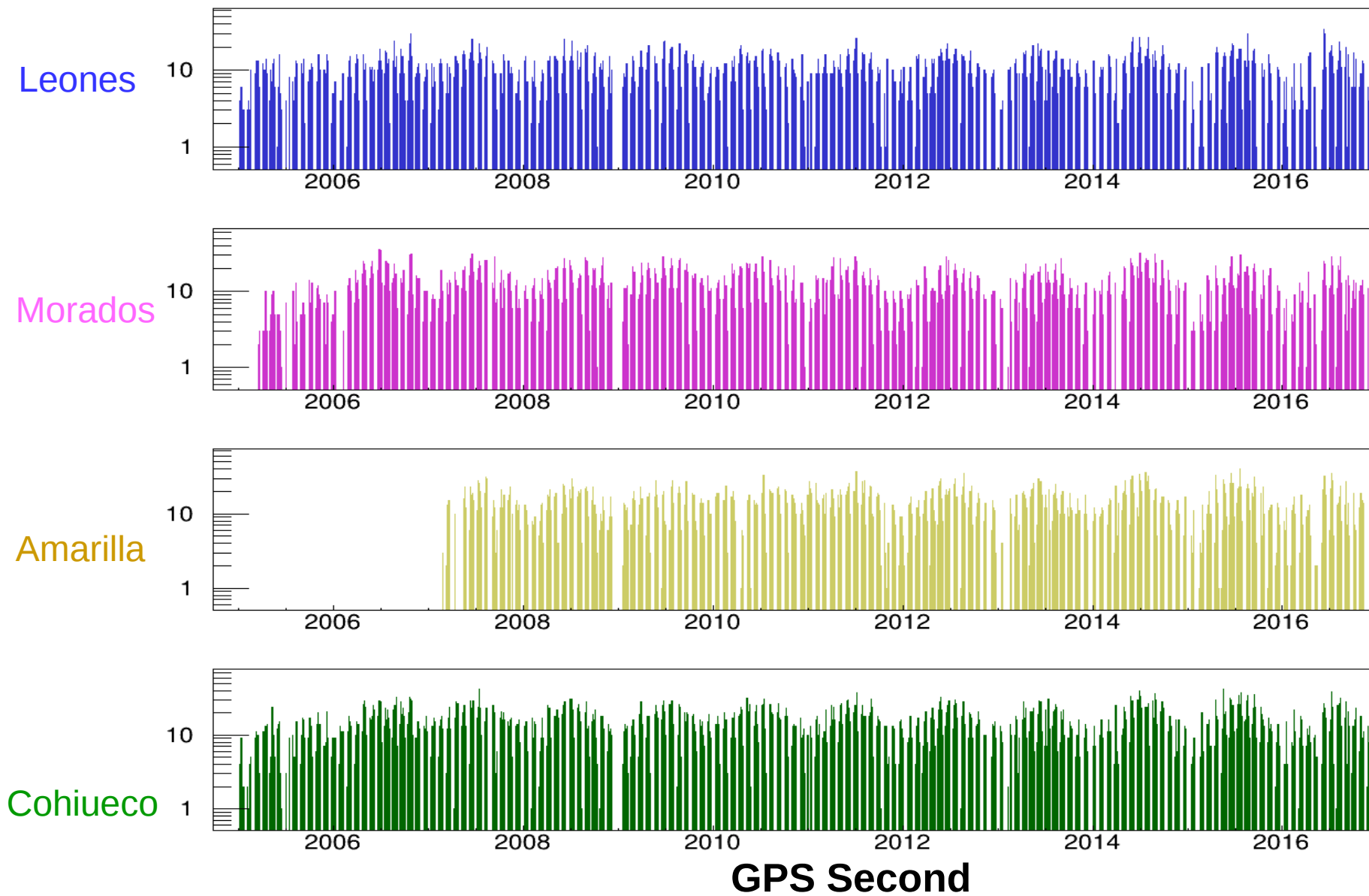
Table 5.2: Summary of the optimal broken fit parameters for different SD and FD corrections.

Jump independent of telescope/site: filter cleaning at beginning 2014?

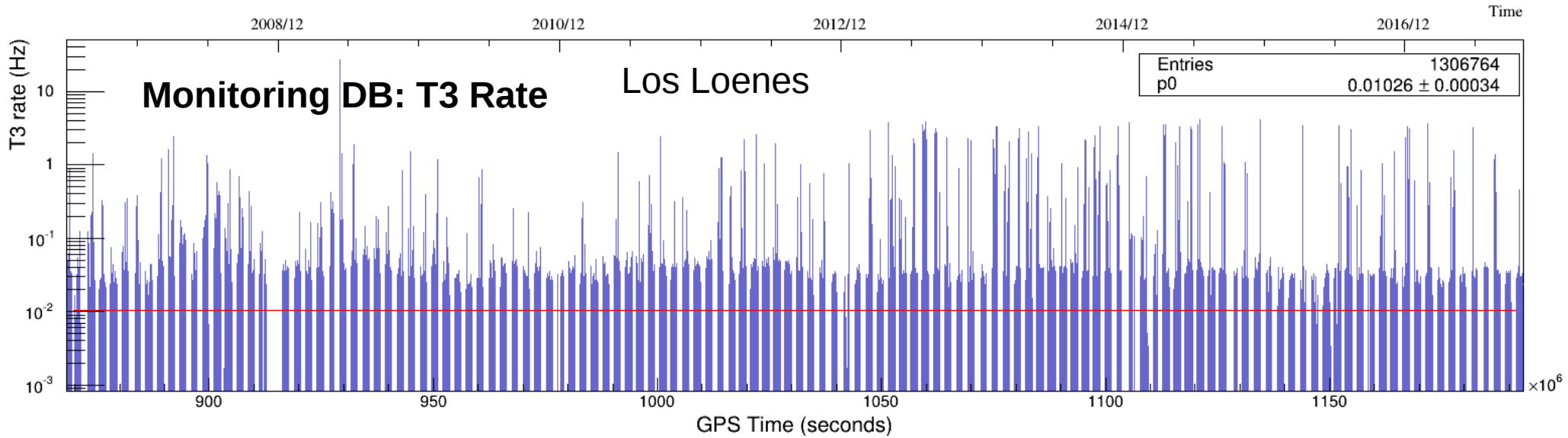
**BackUp slides**

# Daily rate of selected hybrid events

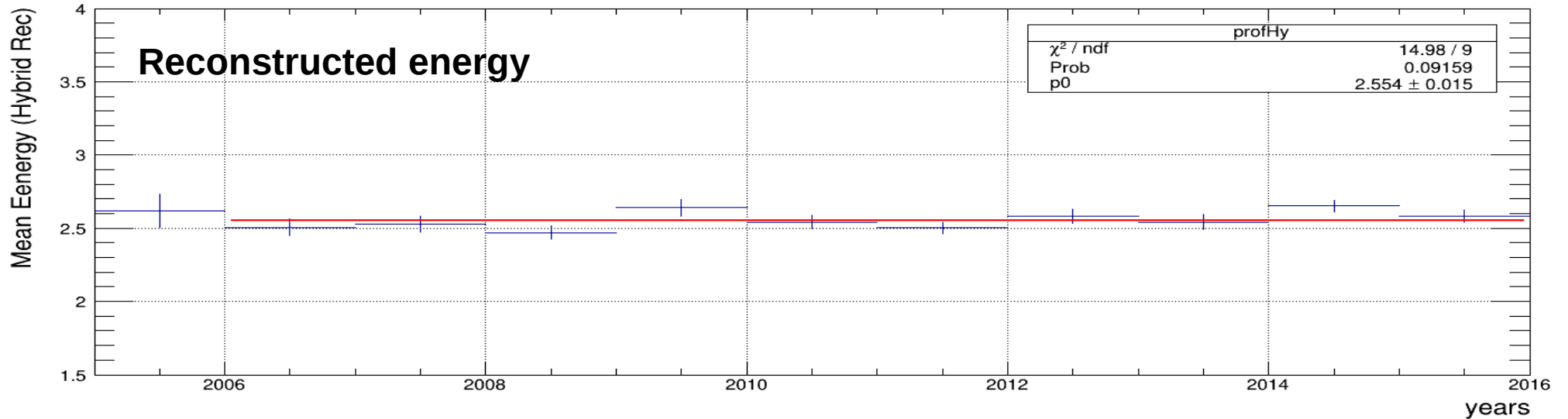
## Basic reconstruction level



# FD Detector stability



FD Energy > 1 EeV (distance to Xmax < 25 km, 90% of the total events)



Update of the NIM paper, including preliminary data of 2014 and 2015



