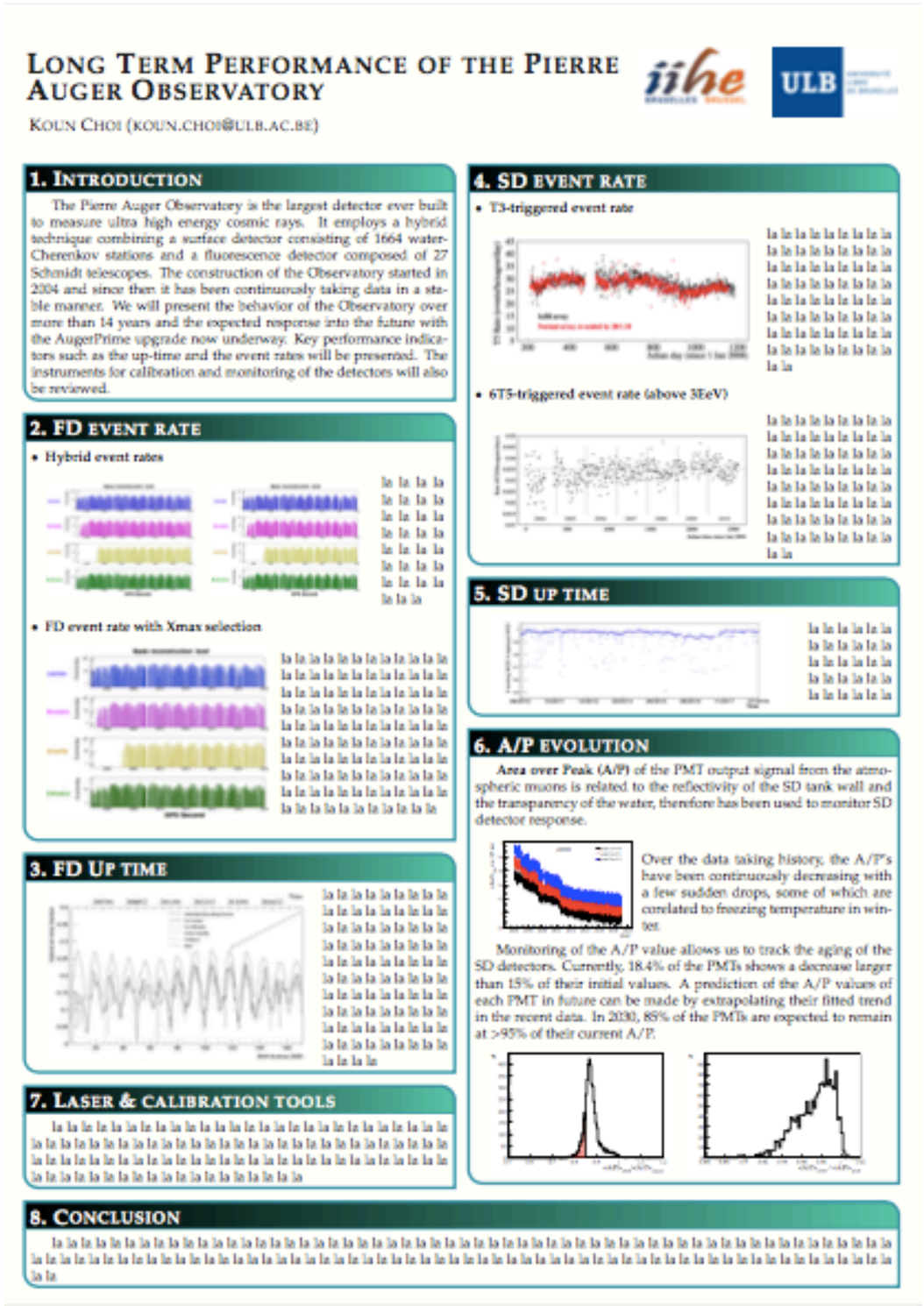
# Long term performance
# ICRC2019 poster preparation

190509 LTP meeting
Koun Choi (Université Libre de Bruxelles)

# Poster design



## Long Term Performance of the Pierre Auger Observatory

Koun Choi (koun.choi@ulb.ac.be)

### 1. Introduction

The Pierre Auger Observatory is the largest detector ever built to measure ultra high energy cosmic rays. It employs a hybrid technique combining a surface detector consisting of 1664 water-Cherenkov stations and a fluorescence detector composed of 27 Schmidt telescopes. The construction of the Observatory started in 2004 and since then it has been continuously taking data in a stable manner. We will present the behavior of the Observatory over more than 14 years and the expected response into the future with the AugerPrime upgrade now underway. Key performance indicators such as the up-time and the event rates will be presented. The instruments for calibration and monitoring of the detectors will also be reviewed.

### 2. FD event rate

- Hybrid event rates
- FD event rate with Xmax selection

### 3. FD Up time

### 4. SD event rate

- T3-triggered event rate
- 6T5-triggered event rate (above 3EeV)

### 5. SD up time

### 6. A/P evolution

**Area over Peak (A/P)** of the PMT output signal from the atmospheric muons is related to the reflectivity of the SD tank wall and the transparency of the water, therefore has been used to monitor SD detector response.

Over the data taking history, the A/P's have been continuously decreasing with a few sudden drops, some of which are correlated to freezing temperature in winter.

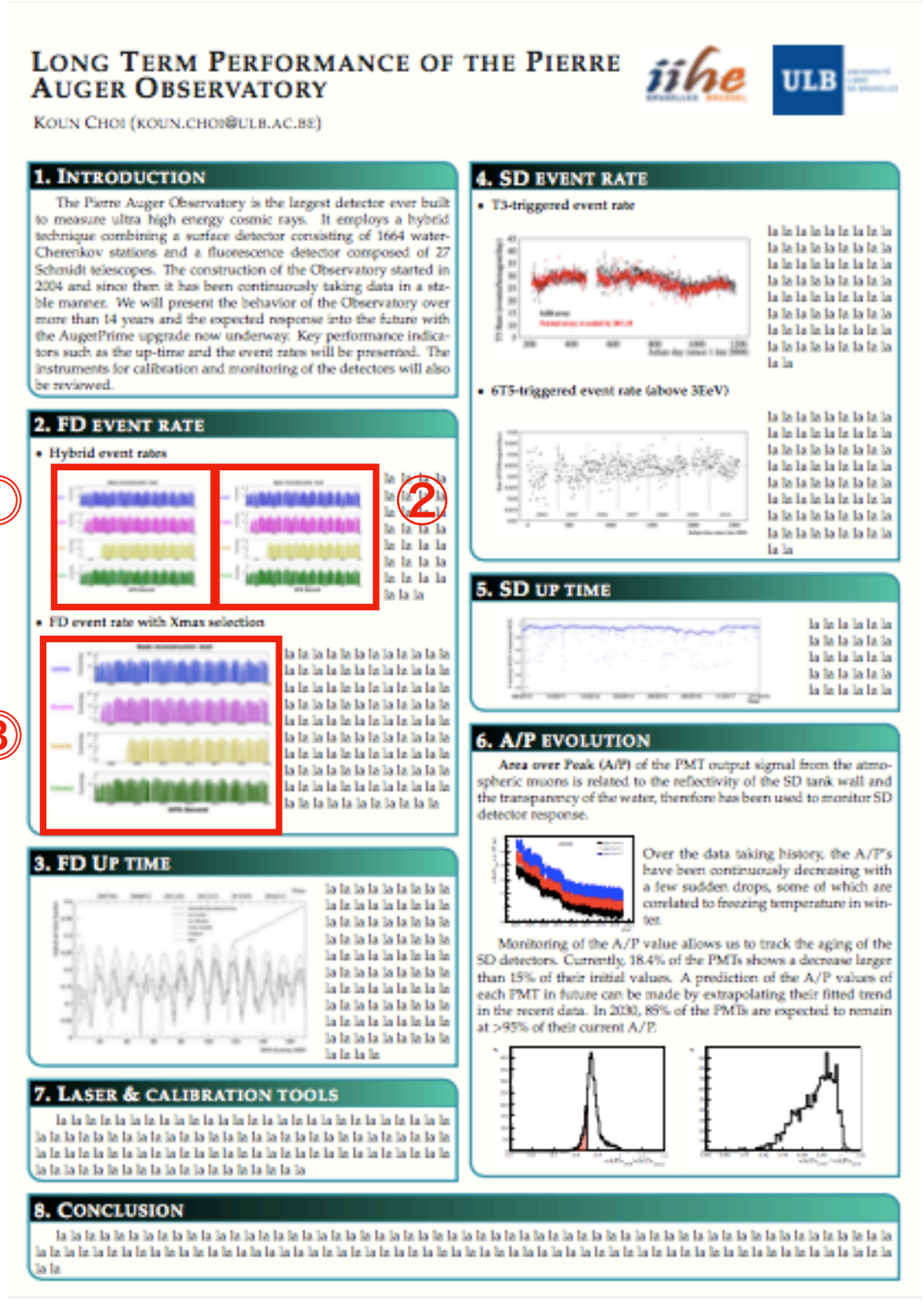
Monitoring of the A/P value allows us to track the aging of the SD detectors. Currently, 18.4% of the PMTs shows a decrease larger than 15% of their initial values. A prediction of the A/P values of each PMT in future can be made by extrapolating their fitted trend in the recent data. In 2030, 85% of the PMTs are expected to remain at >95% of their current A/P.

### 7. Laser & calibration tools

### 8. Conclusion

**two columns of which:**
**1. left column for introduction + FD**
**2. right column SD + laser**
**would have a good visibility.**
*(in current version, laser part is in the left column…)*

# Plots to be generated



LONG TERM PERFORMANCE OF THE PIERRE AUGER OBSERVATORY

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2. FD EVENT RATE

- Hybrid event rates

①

②

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③

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7. LASER & CALIBRATION TOOLS

8. CONCLUSION

**FD event rate plots:**

**#1 hybrid raw event rate**

**#2** cumulative # of FD events (if we need a text space for plot #1, maybe hard to squeeze in)

**#3 FD event rate with Xmax selection**

who can generate?

F.Salamida, L.Perrone, …

# Plots to be generated

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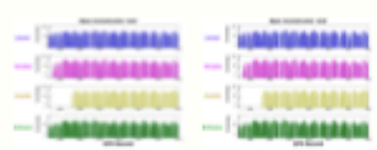
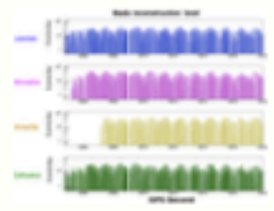
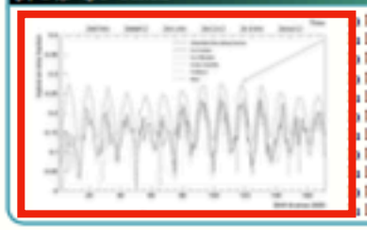
- Hybrid event rates



- FD event rate with Xmax selection

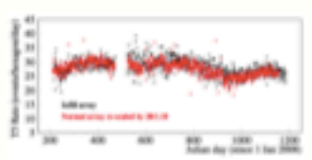


### 3. FD UP TIME

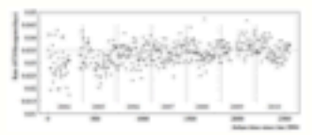


### 4. SD EVENT RATE

- T3-triggered event rate



- 6T5-triggered event rate (above 3EeV)



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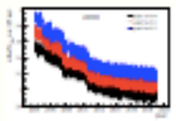

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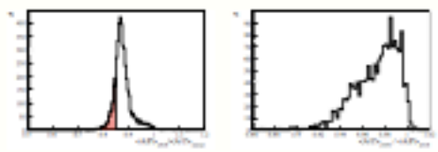
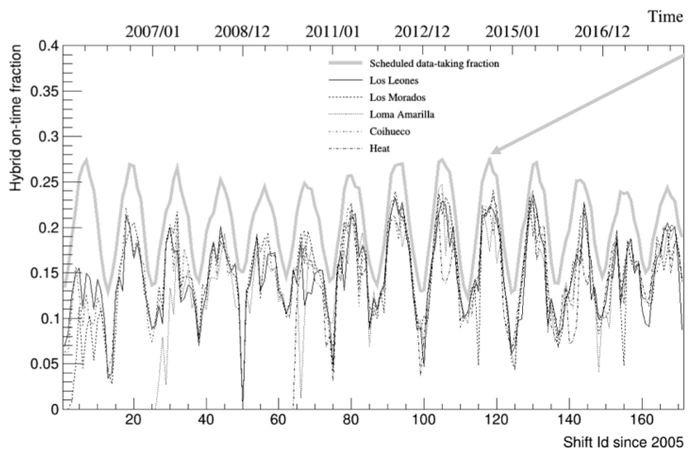


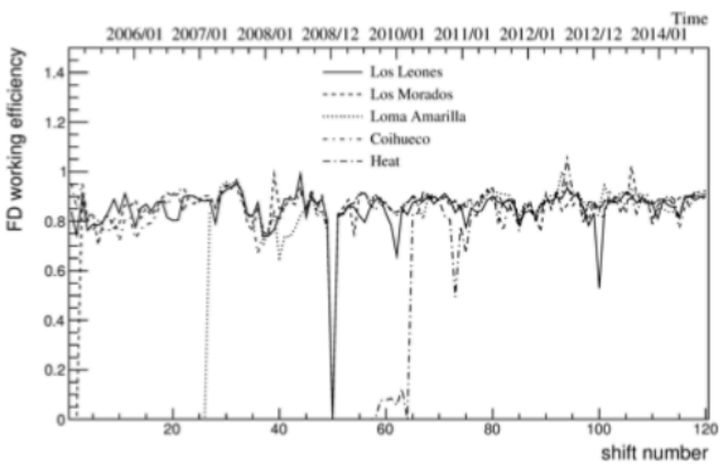
### 7. LASER & CALIBRATION TOOLS

### 8. CONCLUSION

④

## #4 FD uptime plot:



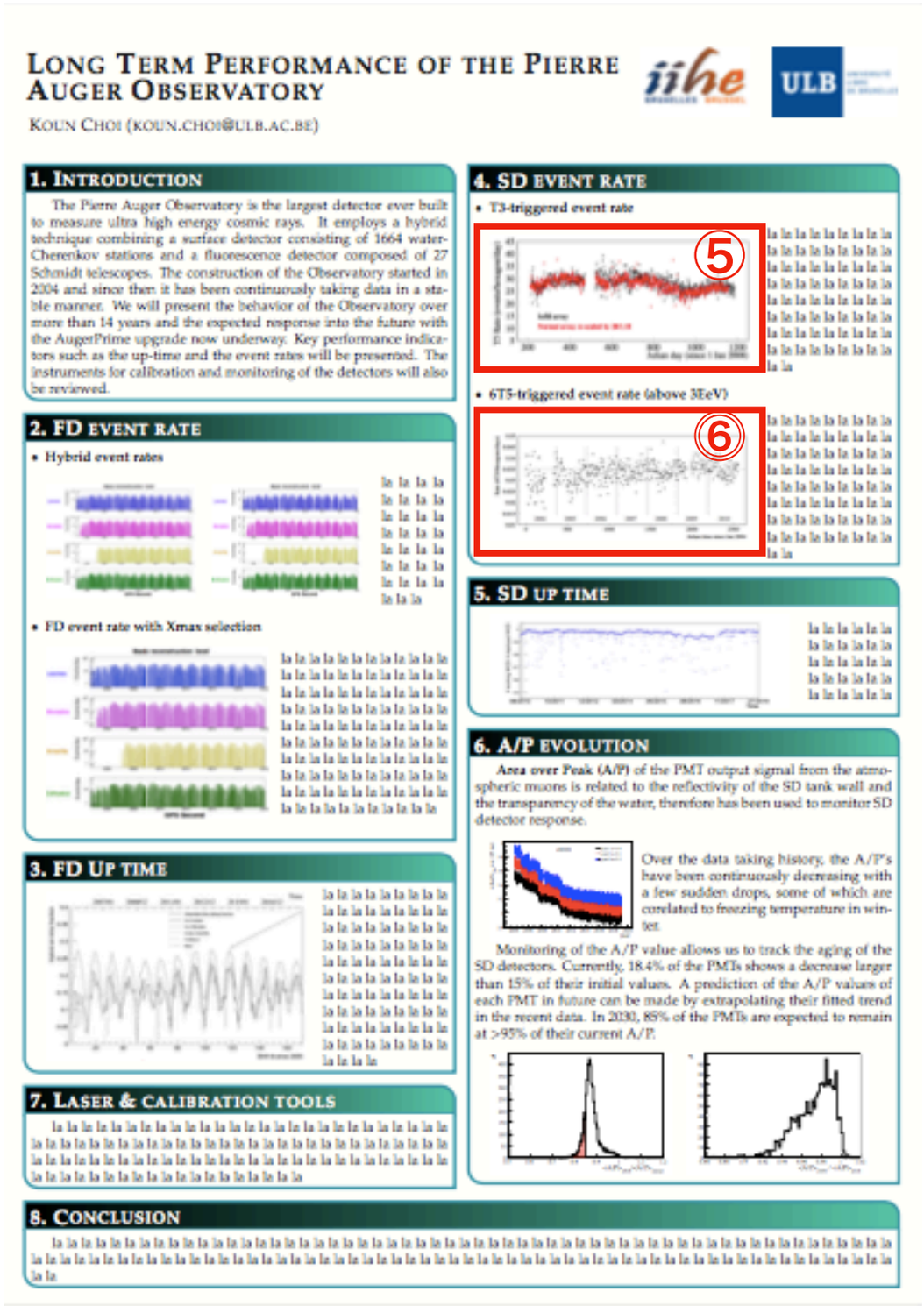




**I suggest to merge the two plots in the NIM paper ("on-time fraction" & "working efficiency") into a single plot.**

who can generate?

F.Salamida, L.Perrone, …

# Plots to be generated



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**SD event rate plots:**
(superposed plots of 750(rescaled)/ 1500 m arrays)

**#5 T3 event rate**

**#6 6T5 event rate (>3 EeV)**

* seems there will be not enough space for the cumulated # of SD events.
1) we could generate and see what happens
2) if we decide to omit it, we can omit the FD one too for consistency

who can generate?

K.Choi, I.Maris, R.Sato,

C.Bonifazi, I.Lhenry-Yvon, …

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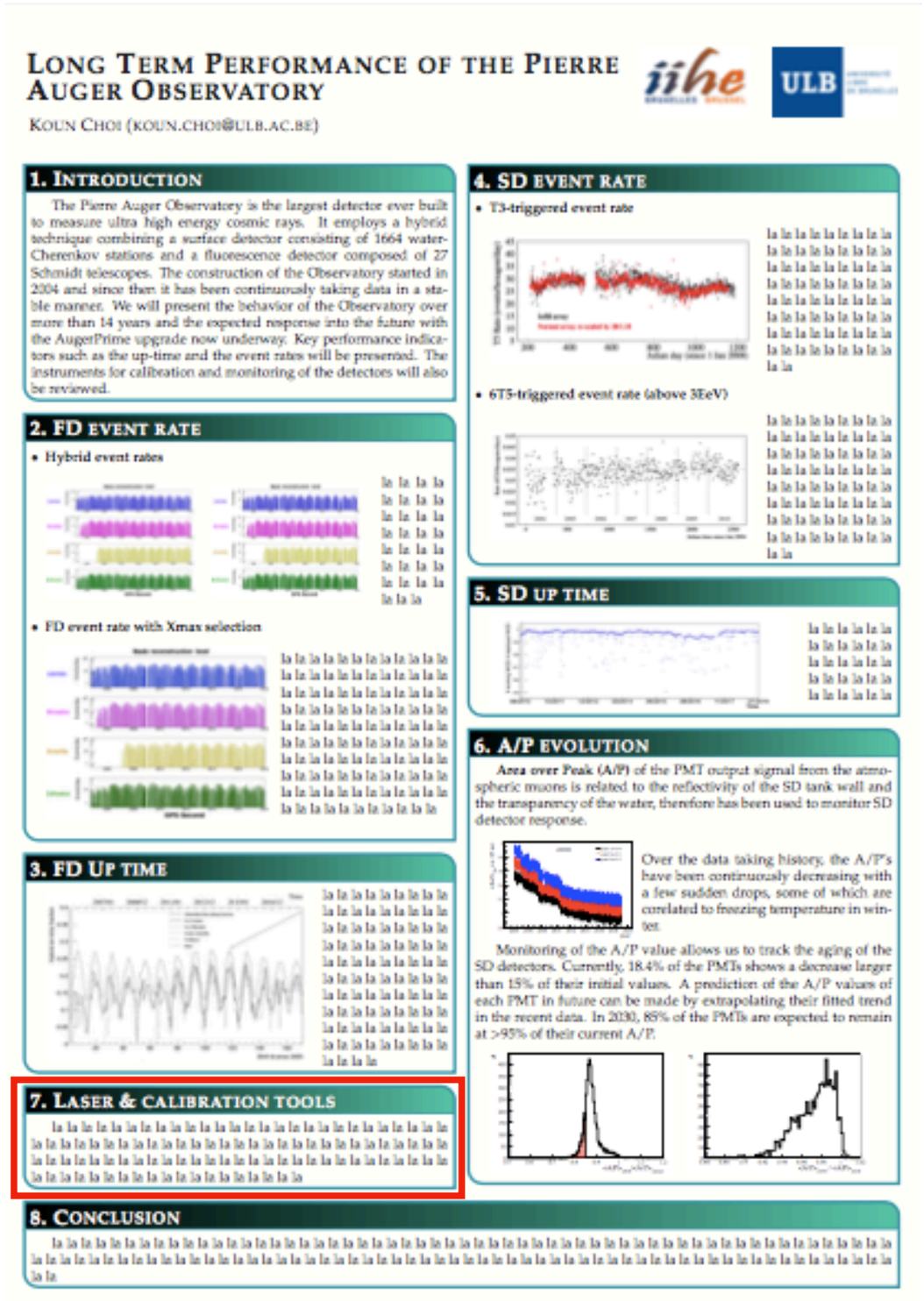

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**#11 Laser & calibration tools**

# Other candidates discussed

- mean A/P of air showers
- battery/solar panel lifetime
- attenuation parameters (deduced from CIC) vs time
- Time trend of $X_{max}$ : a plot showing the mean $X_{max}$ as a function of time (or just in two time intervals)

# Notes

- Suggestion for a EB (seems to be a single person?) to be done soon
  (confirmed participants in the last meeting: Rossella, Isabelle, Corinne, Bruce)
- Internal (CB) proceeding dead line: 6/16
  (question: can we only include plots that were shown in the poster?)

# Back up

## Plots presented in ICRC2011 (7 plots)

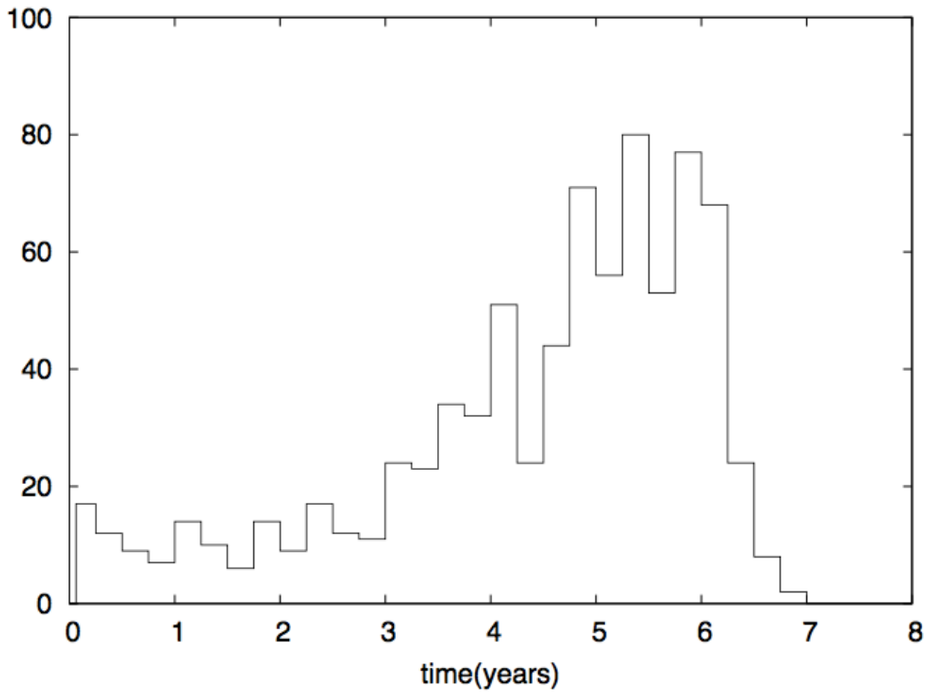


Figure 1: Histogram of the battery lifetime (see text).

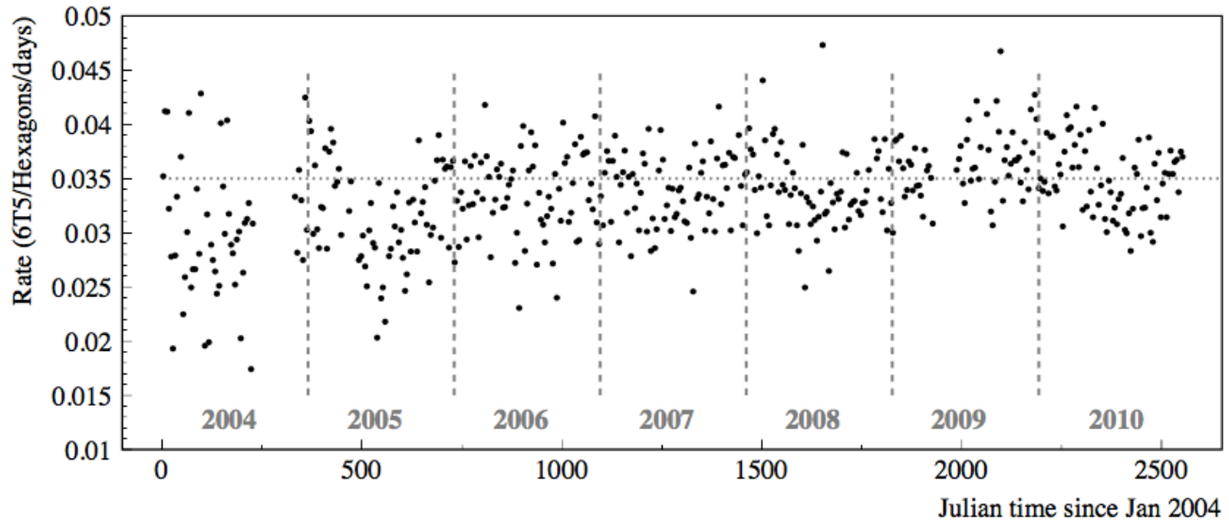


Figure 7: Event rate as function of time.

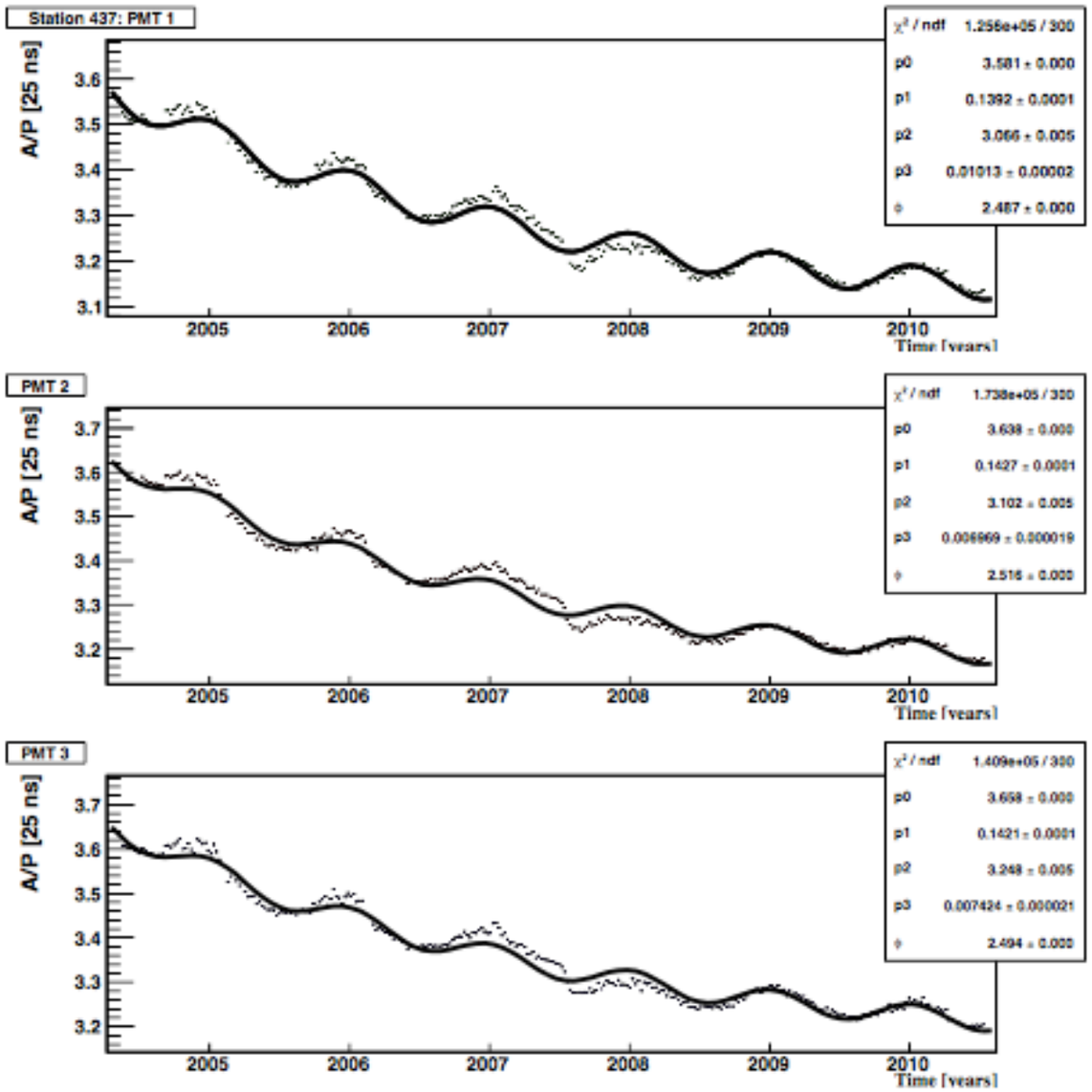


Figure 3: A/P as a function of time for station 437. The dots are the average of the A/P over 7 day and the continuous line is the fit of the equation 1.

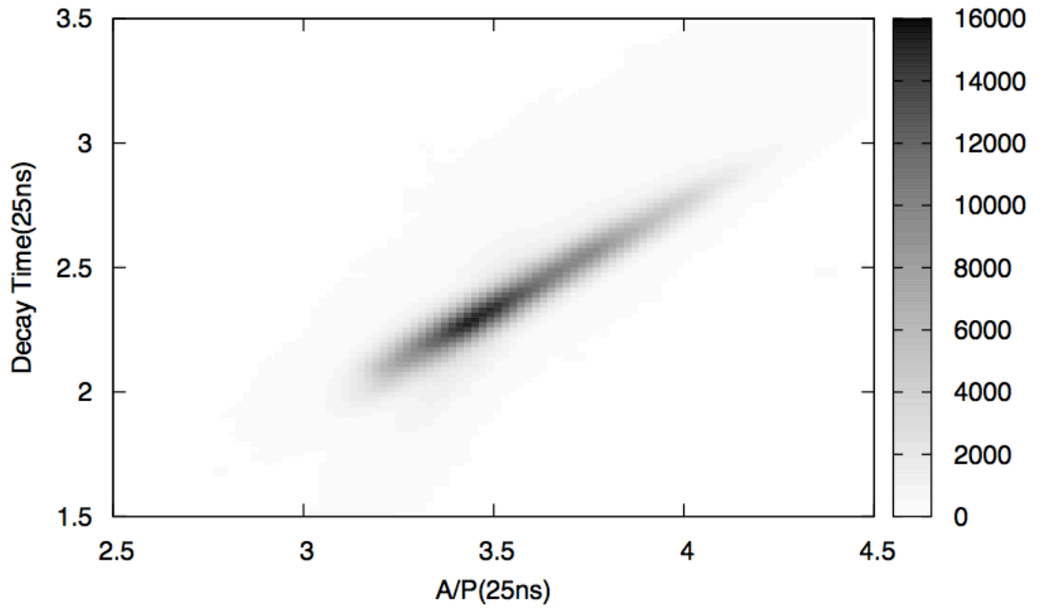


Figure 2: Histogram of correlation between the area to peak ratio ($A/P$) and signal decay constant for muon signals in SD array.

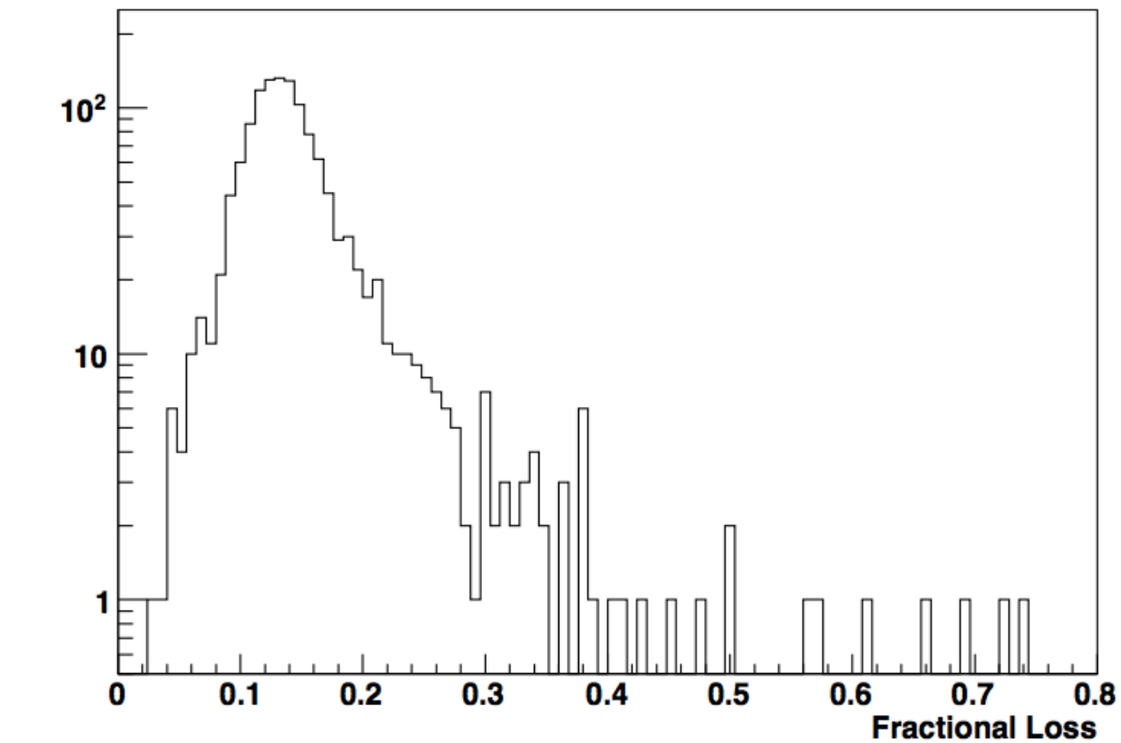


Figure 4: Values of the fractional loss $p_1$ 1.

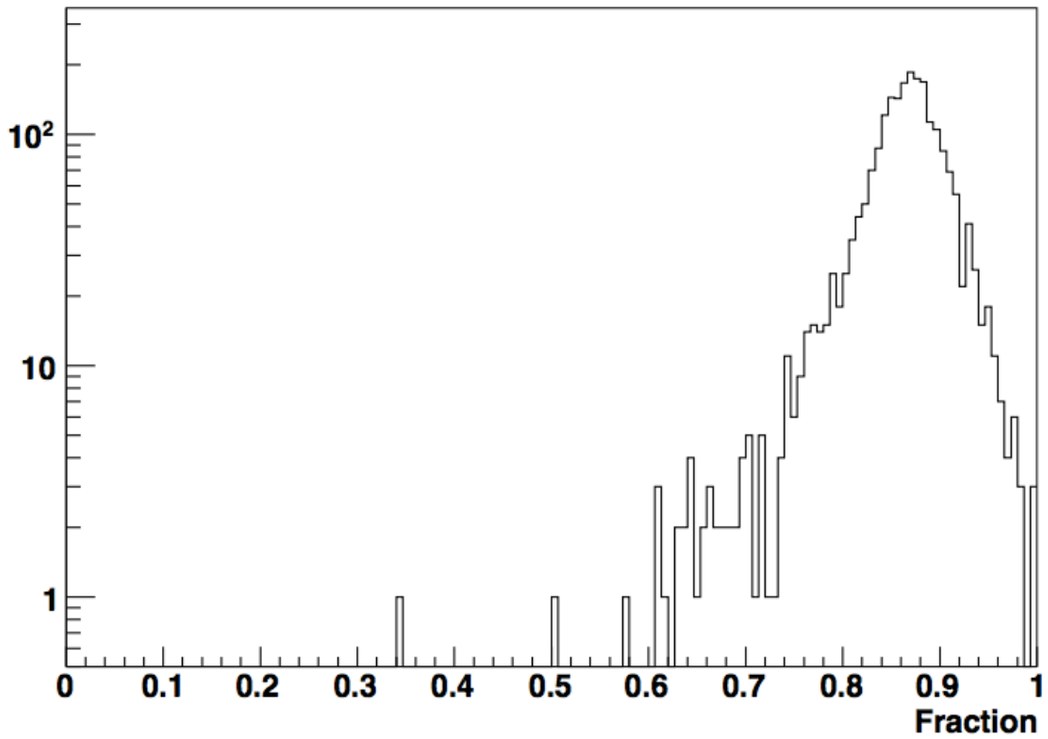


Figure 5: Estimated relative values (Fraction) of $A/P$ after 10 years of operation with respect to its initial value.

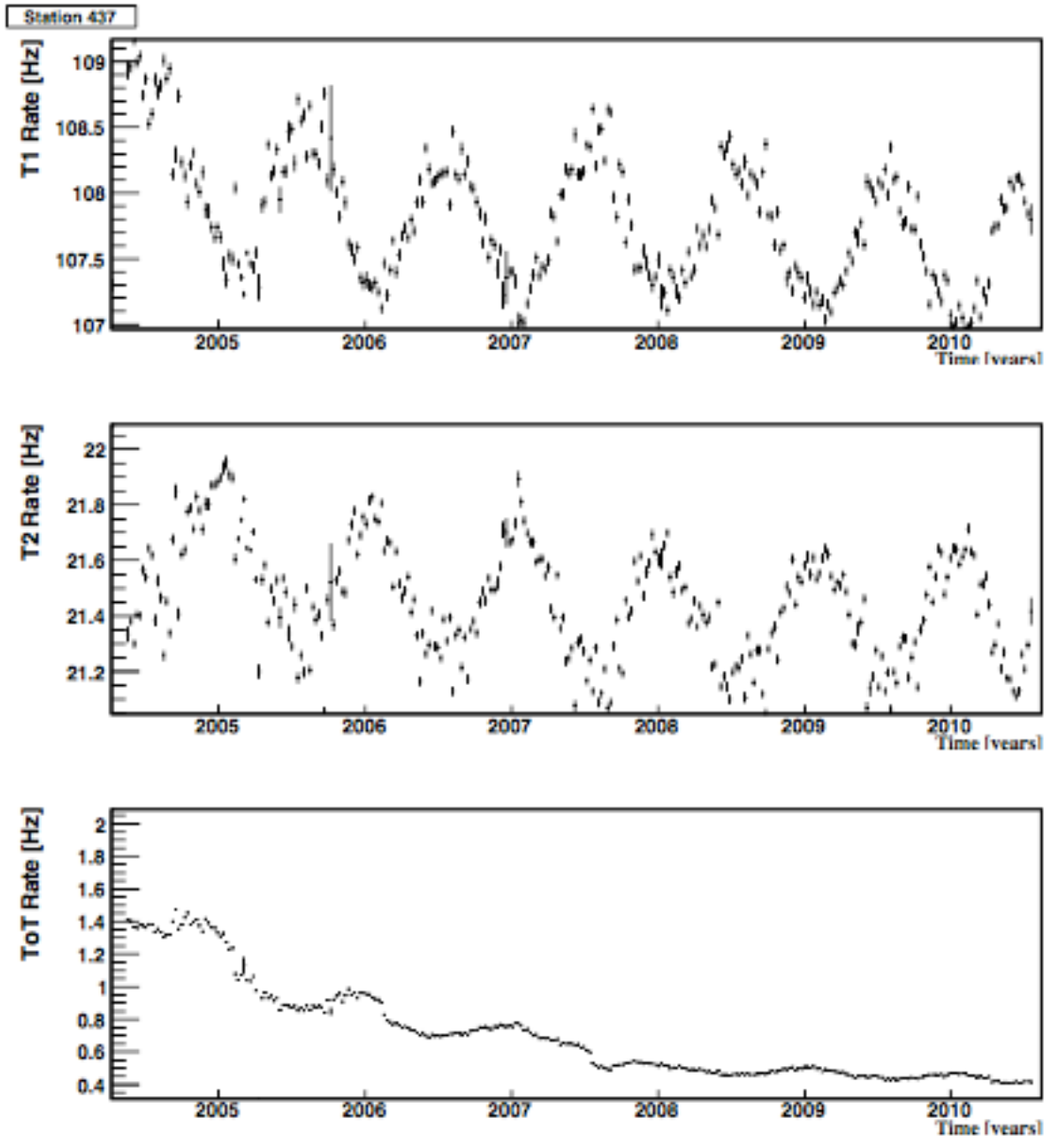


Figure 6: Trigger rate T1, T2 and ToT for the station 437 as function of time.