Measurements campaign aboard the Amerigo Vespucci ship

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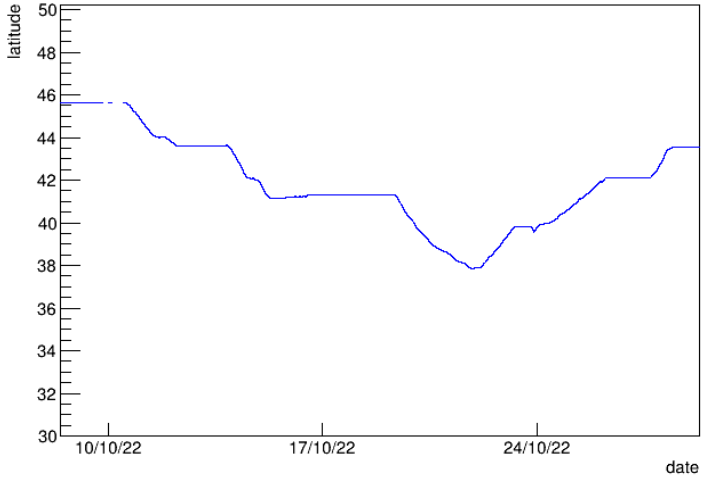
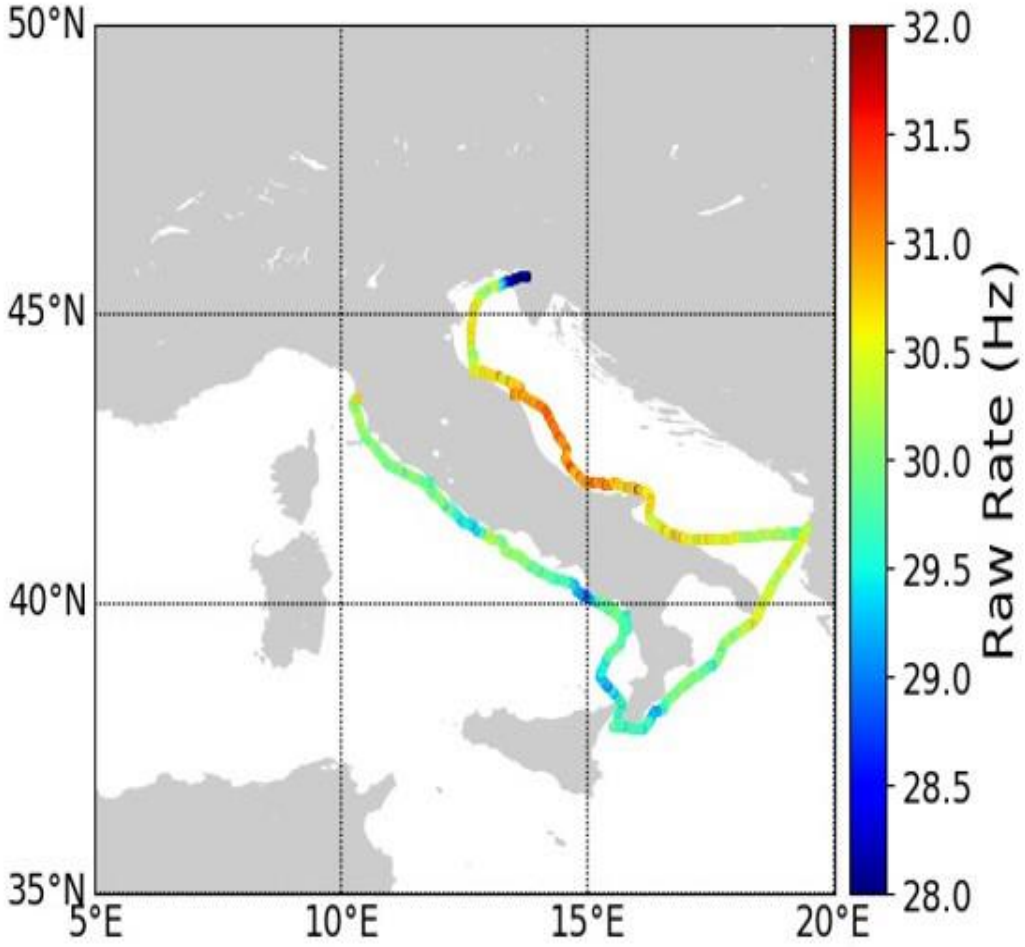
EEE Analysis Meeting – 14/10/2024

The trip

- 2022, 8 October: POLA-02 installation in Trieste
- 2022, 29 October: end of the trip in Livorno
- Latitude interval covered: 38° N-45° N
- Minor issues: direct sun light

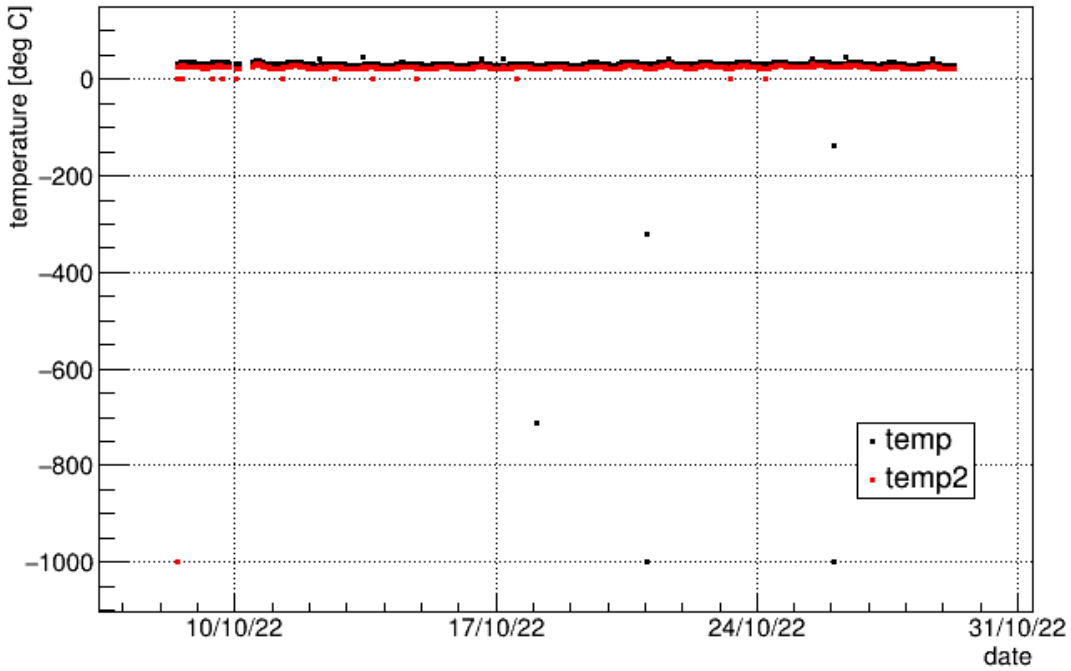


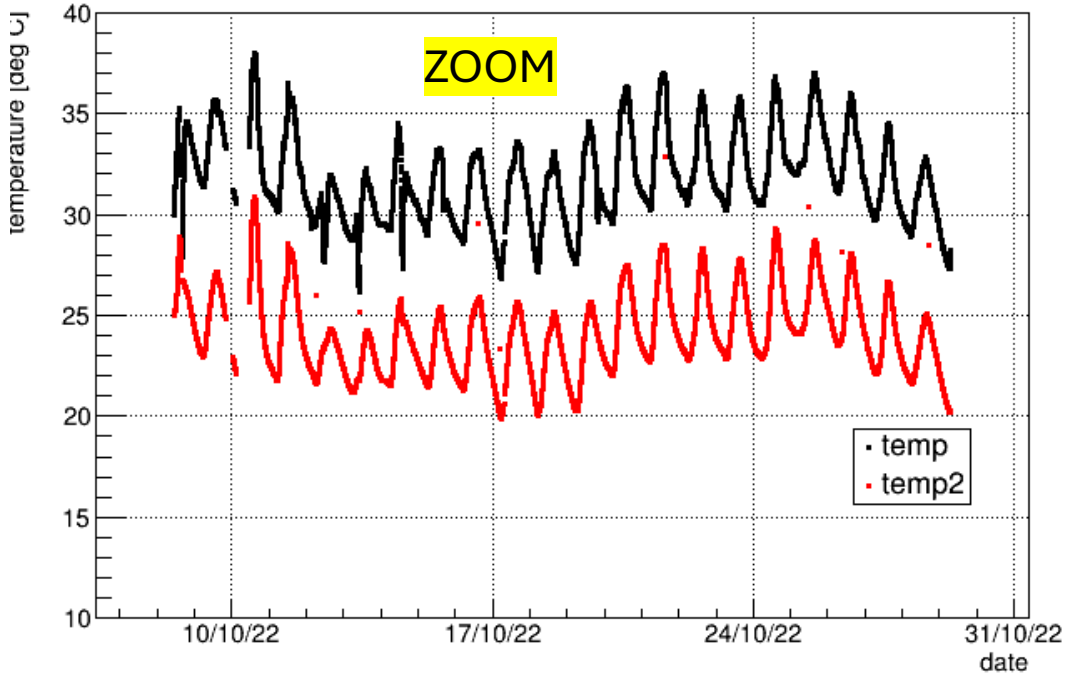


The data set

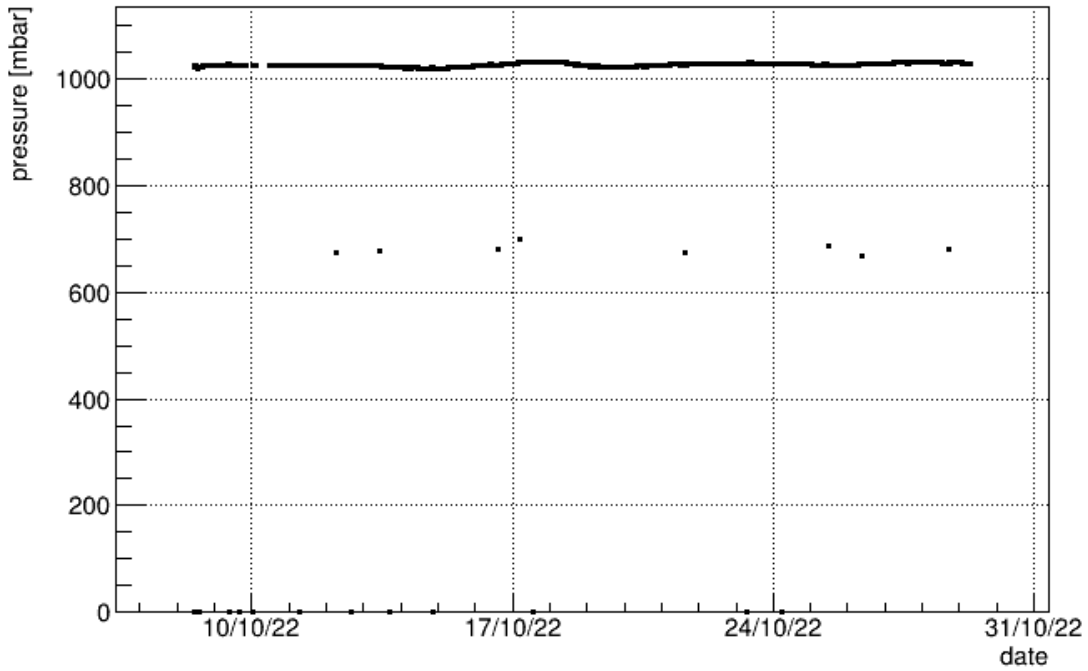
- Continuos readout (only a short interruption at the beginning)
- Standard data format (see Ombretta's presentations in the last meetings)
- Variable used in the analysis:
  - ts // timestamp from 1 Jan 2007
  - status // status (0=good minute)
  - rateRaw // raw rate (=trigger rate) (majority condition)
  - rate // rate majority condition + 1 single track
  - rate4c // rate requiring all 4 SiPMs fired + 1 single track
  - ratePair[16] // rate for each pair of plates (majority condition + 1 single track)
  - ratePair4c[16] // rate for each pair of plates (4AND condition + 1 single track)
  - pres // pressure in mbar
  - lat // latitude
  - lon // longitude
  - temp // temperature
  - temp2 // temperature2
  - eff[16] // pseudo-efficiency for each channel 4AND/majority
  - parRates[2] // rates from slot control output

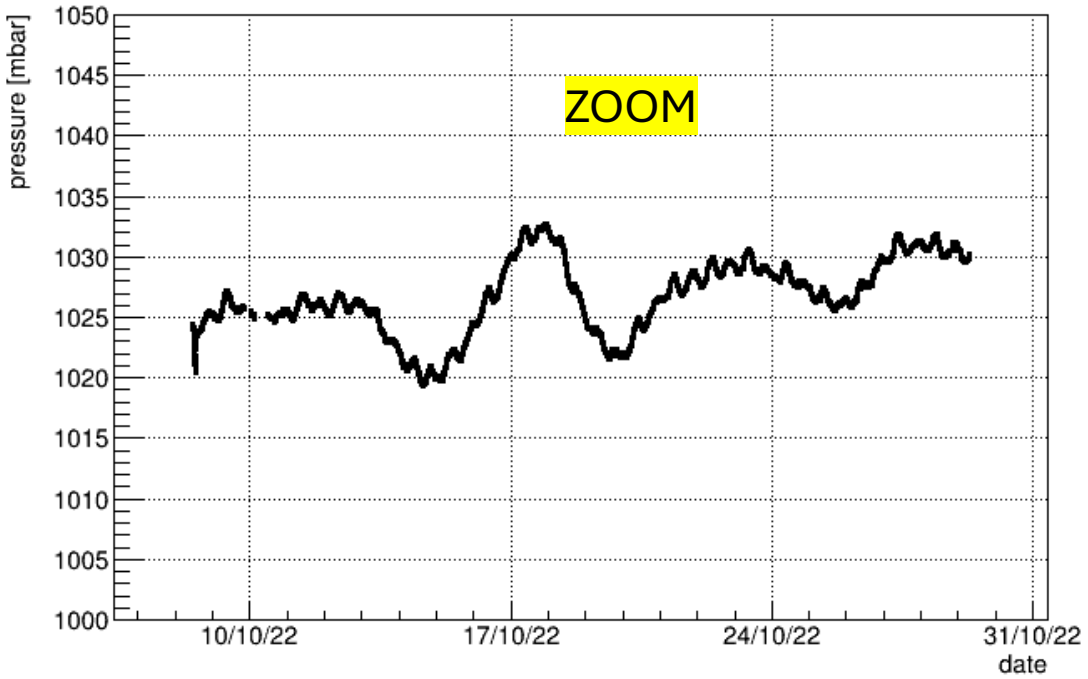
Environmental parameters – temperature





Environmental parameters – atm. pressure





Basic quality cuts

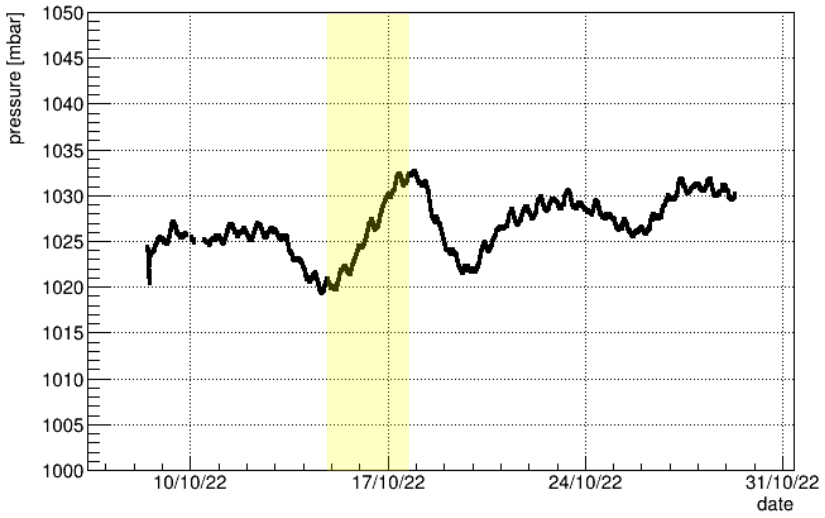
Number of 1 minute measures = 28699

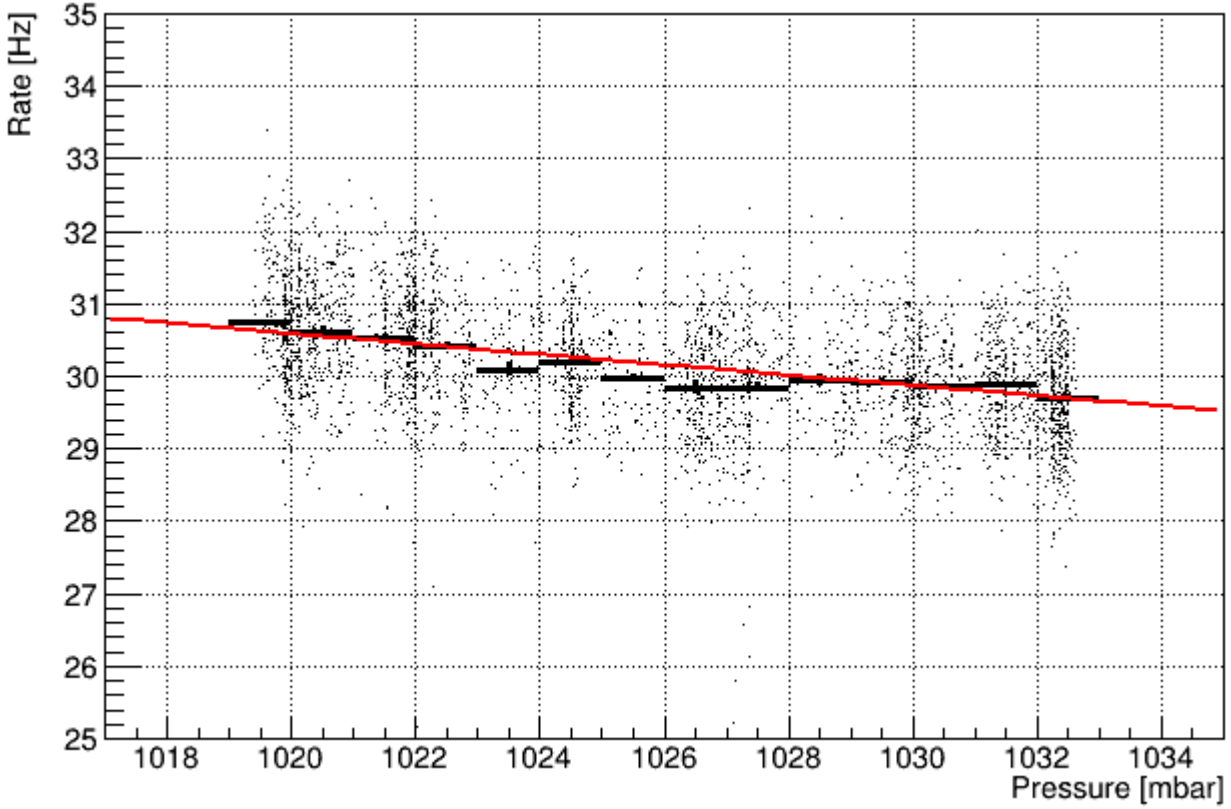
- **status** = 0 (rejected 4863 measures, 17%)
- **pres** > 800 && < 1100 (rejected 0 measures, 0%)
- **temp** AND **temp2** > 15 && < 40 (rejected 9 measures, 0.04%)
- abs(**rateRaw** - parRates[0]) < 2 (rejected 339 measures, 1.4%) comparison between the raw rate and the slow control value

Total number of rejected measures 5211 (18%)

Barometric coefficient

Time interval 14/10/2022 h 15:00 → 17/10/2022 h 22:10 ($\Delta P \sim 10$ mbar)





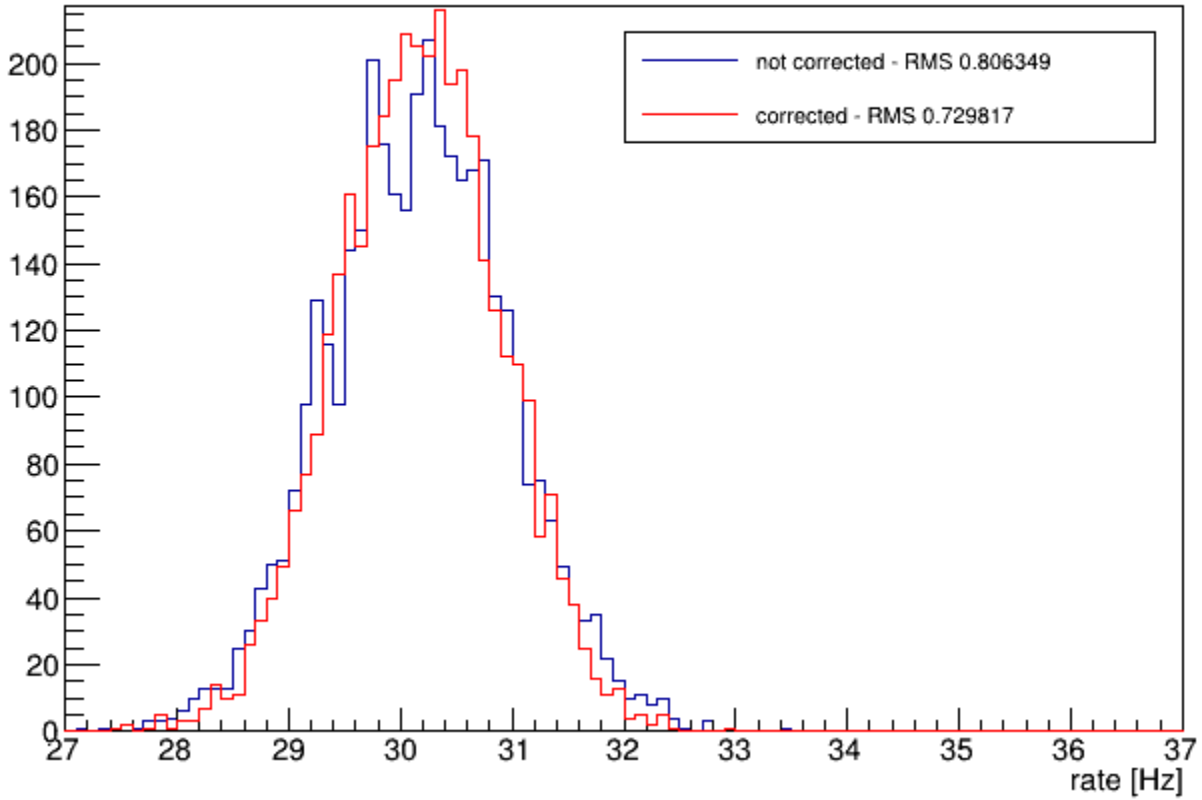
Fit function $R = \exp[\alpha + \beta(p - p_{ref}^*)]$

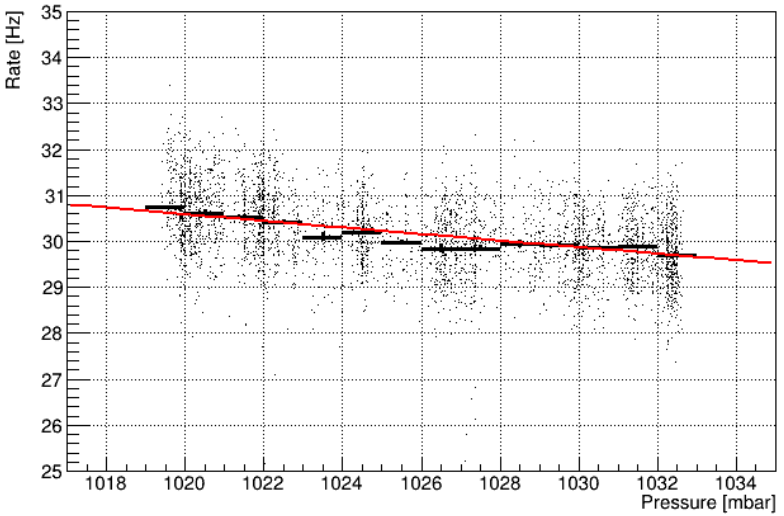
→ β = **(-0.236 ±0.009) %/mbar**

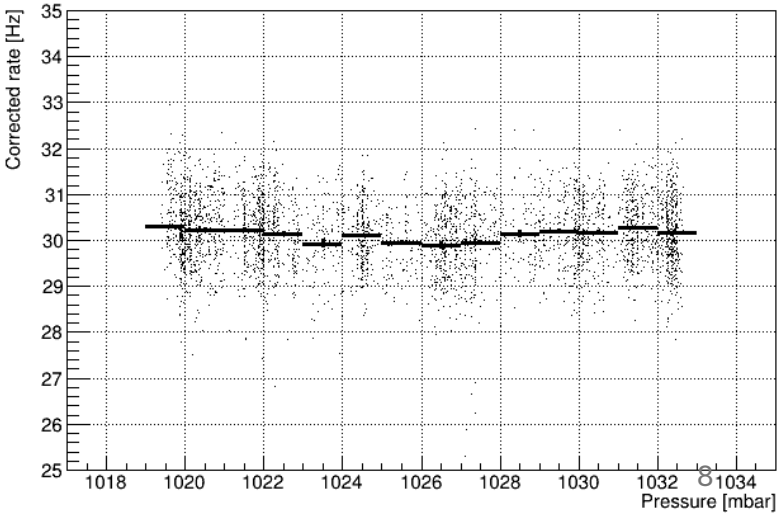
Rate4c → β = (-0.23 ±0.01) %/mbar

(*p_{ref} = average pressures during the whole data taking)

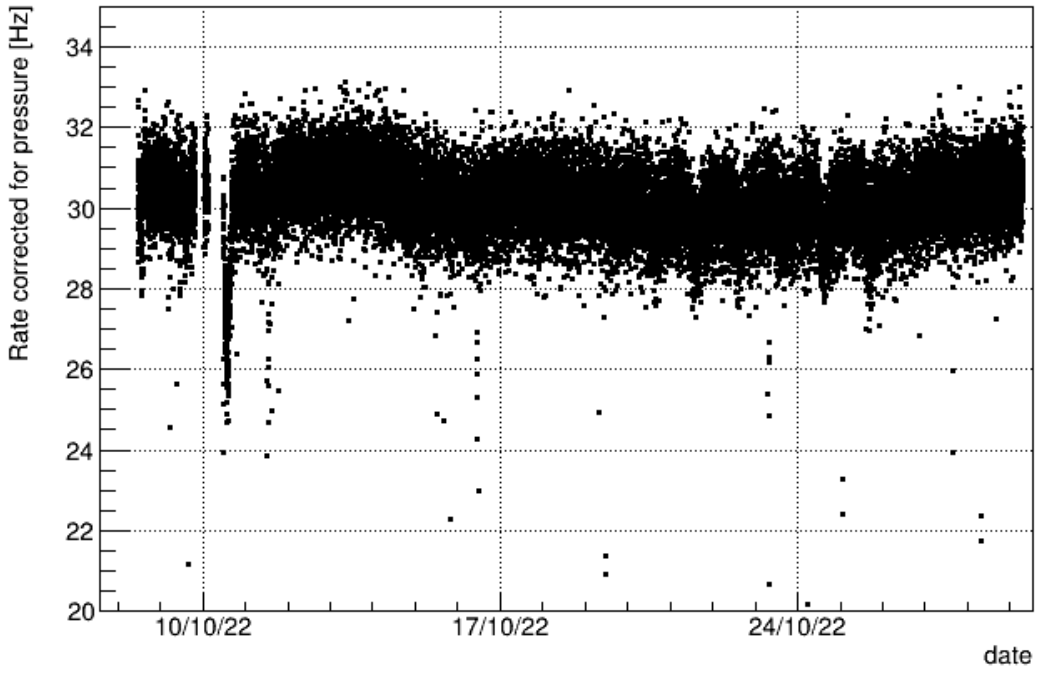
Correction for atmospheric pressure

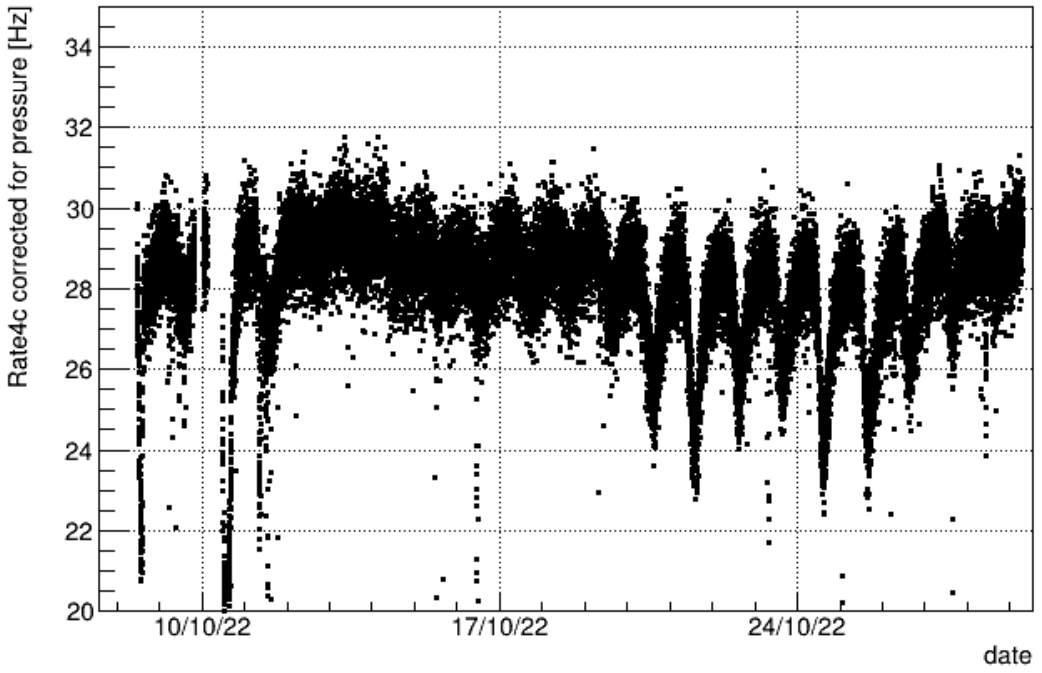






Rate and Rate4c (both corrected for pressure) trends

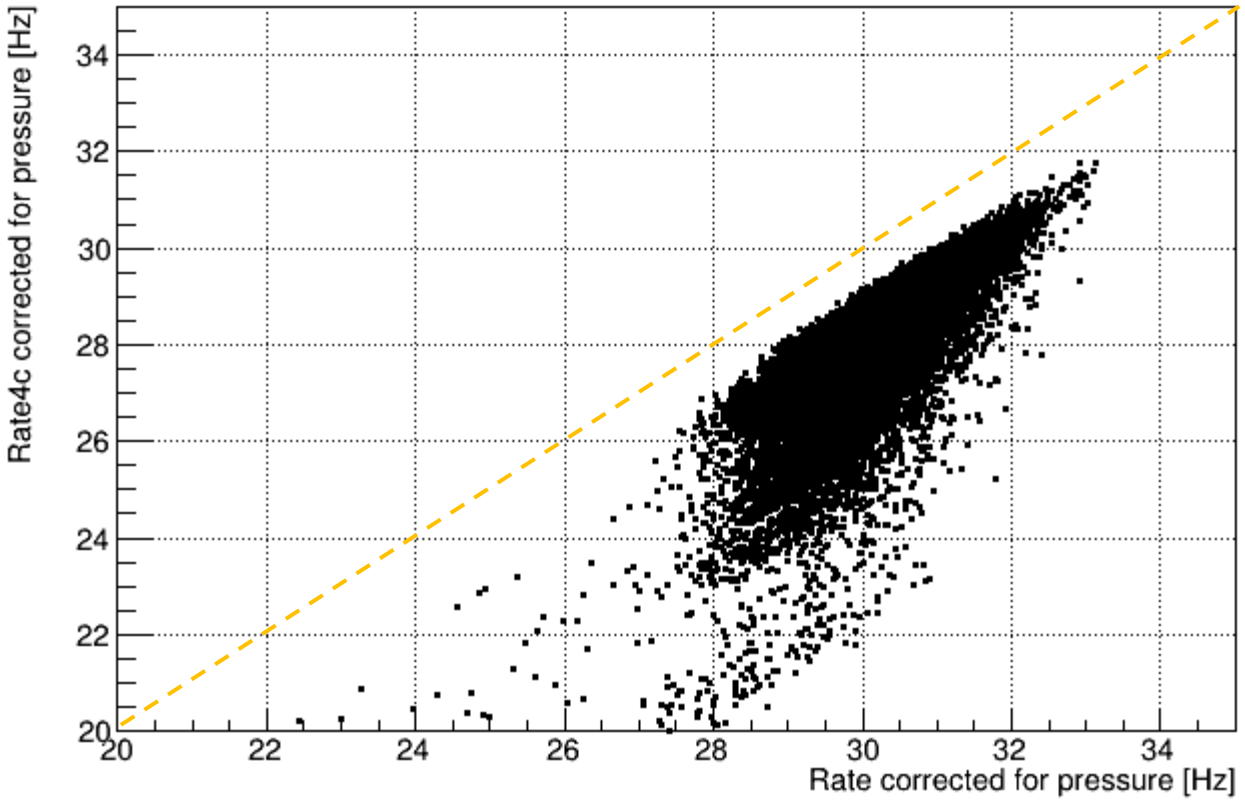




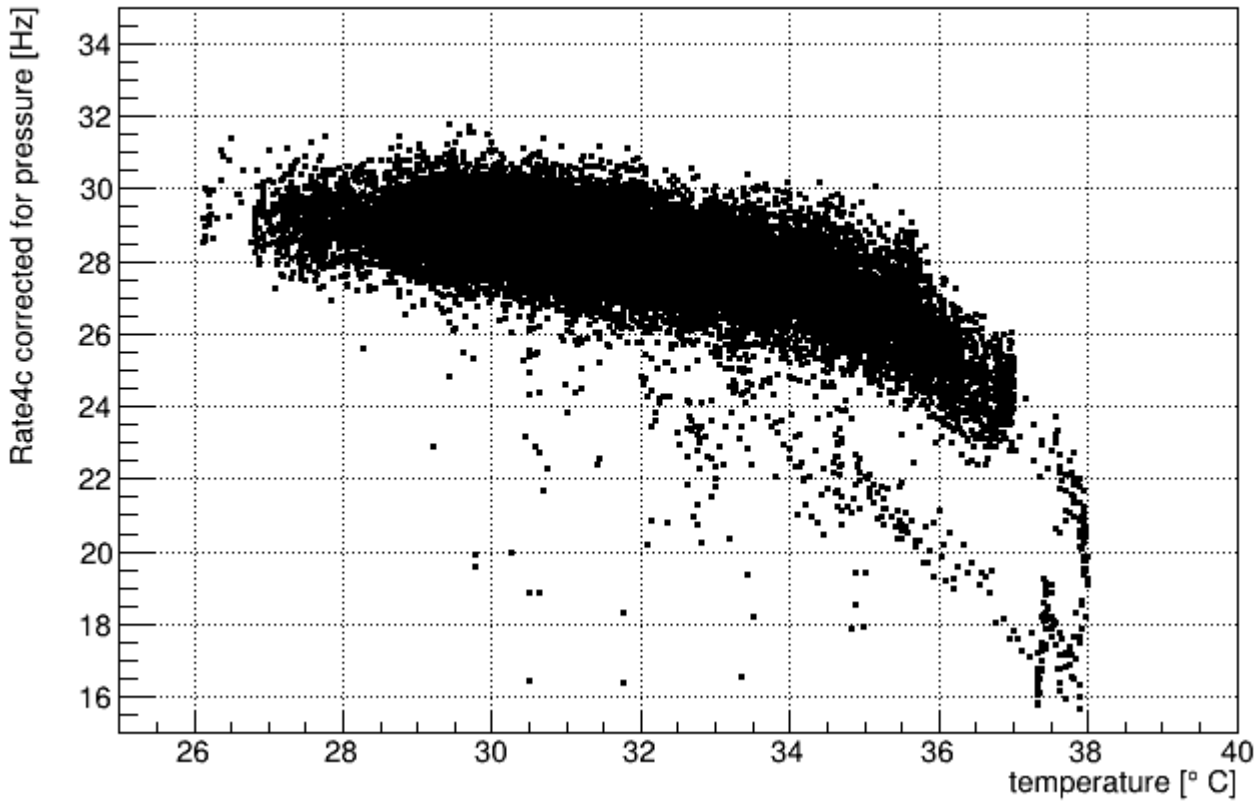
- Rate is more stable in majority wrt 4AND condition
- Rate in majority is on avarage higher than rate in 4AND condition

→ rate includes more spurious coincidences than rate4c

Rate VS Rate4c (both corrected for pressure)



Effect of temperature



- Slight dependance on temperature
- Taken into account by applying a efficiency correction (see next slides)

Pseudo-efficiency correction

From now on, rate from pairs of tiles is considered in order to apply a correction for pseudo-efficiency

- 4AND condition (4 SiPMs fired + 1 single track): rate4c → ratePair4c[16]
- Majority condition (3 out of 4 SiPMs fired + 1 single track): rate → ratePair[16]

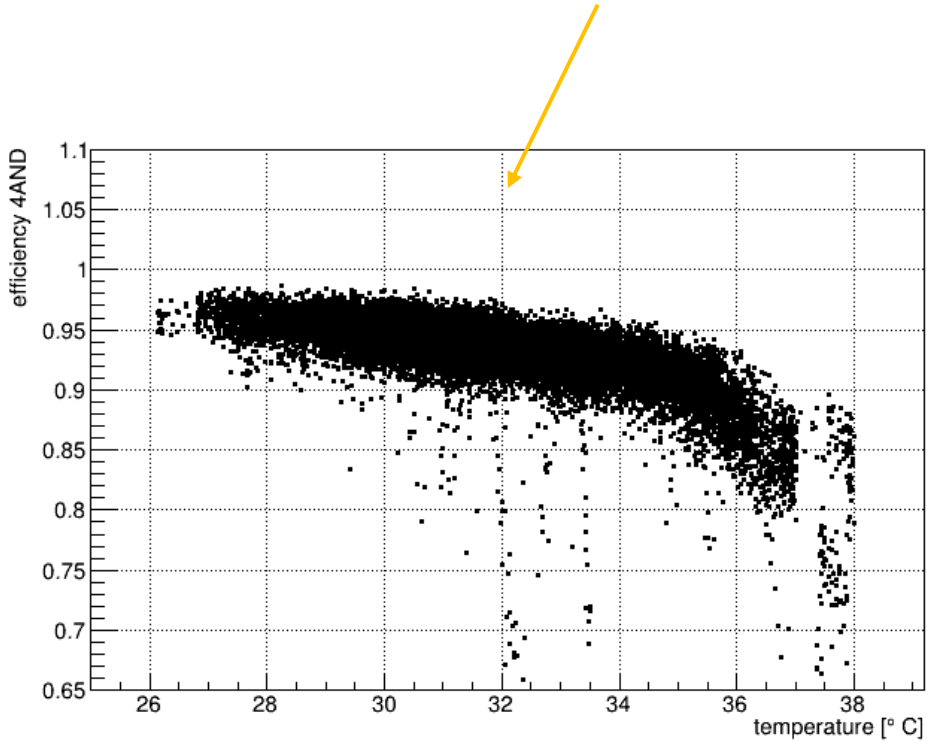
(N.B. rate4c = $\sum_{i=0}^{15}$ ratePair4c[i] and rate = $\sum_{i=0}^{15}$ ratePair[i])

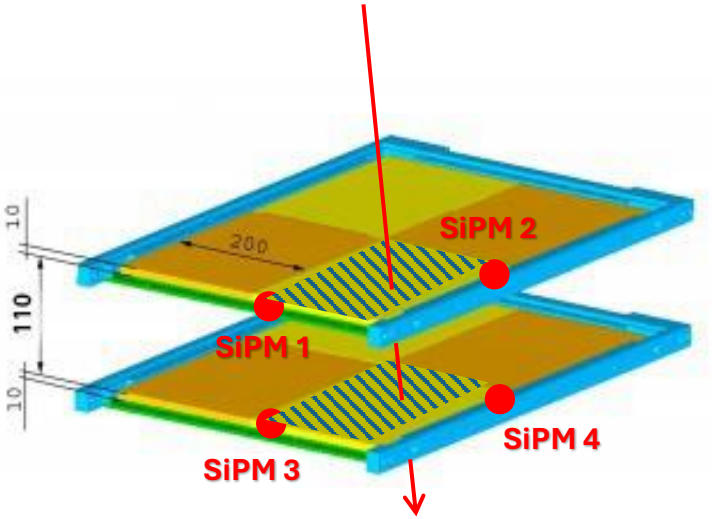
Efficiency correction in 4AND condition

For a given pair *i-th* of tiles, the efficiency is:

$\varepsilon[\,i\,] = \varepsilon_1[\,i\,] \times \varepsilon_2[\,i\,] \times \varepsilon_3[\,i\,] \times \varepsilon_4[\,i\,]$

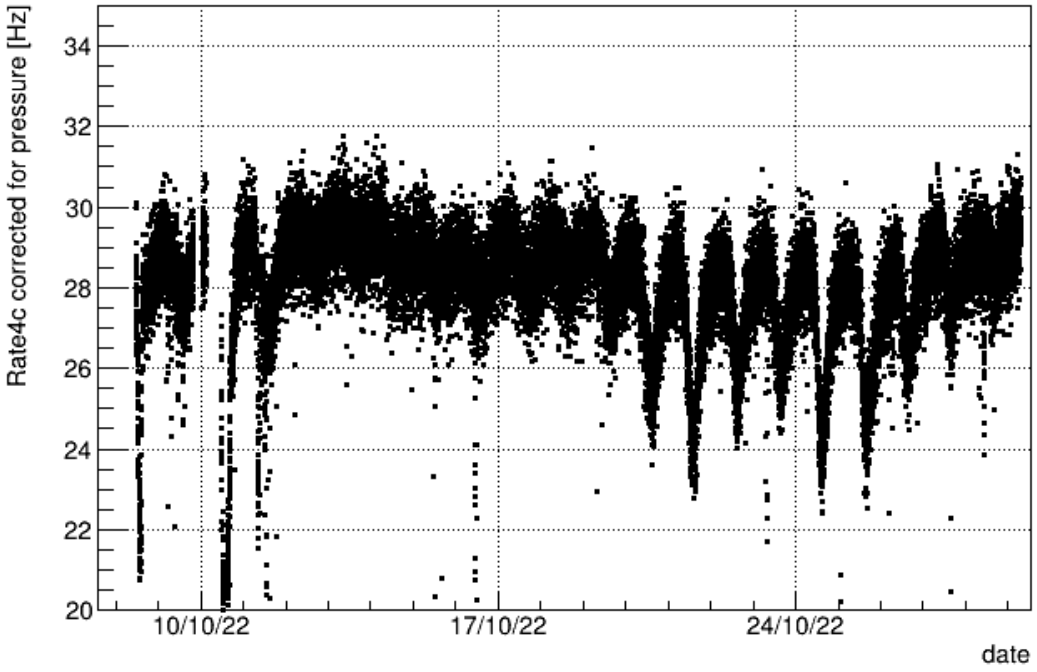
Efficiency in 4AND depends on temperature



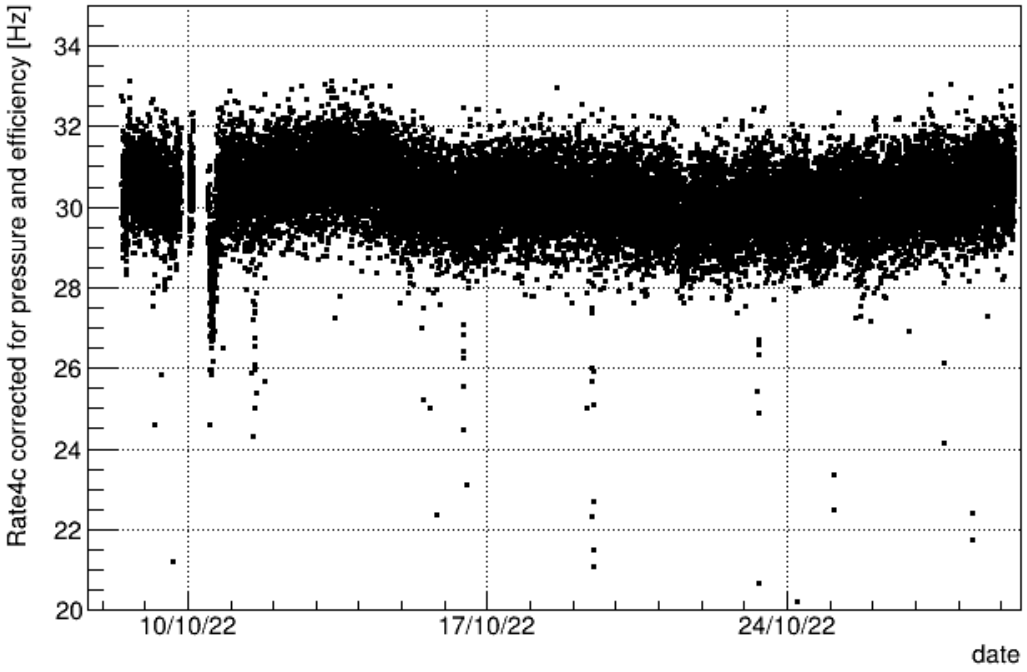


Efficiency correction in 4AND condition

Rate4c corrected for efficiency = $\sum_{i=0}^{15}$ ratePair4c[i] / ε[i]



Corrected for barometric effect

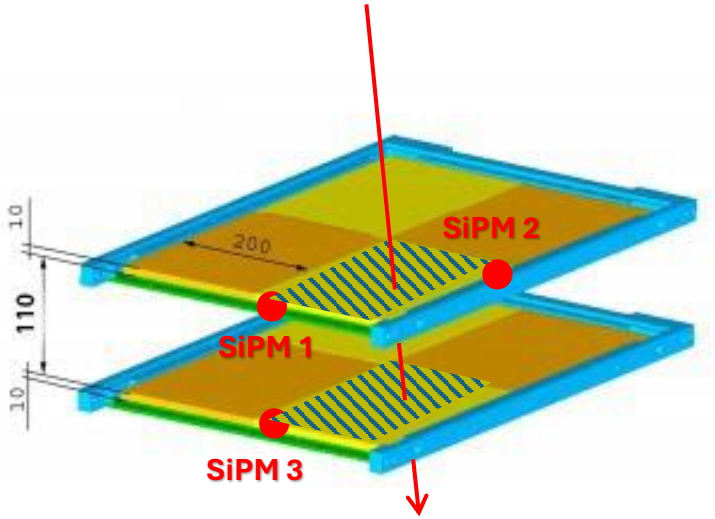


Corrected for barometric effect and efficiency

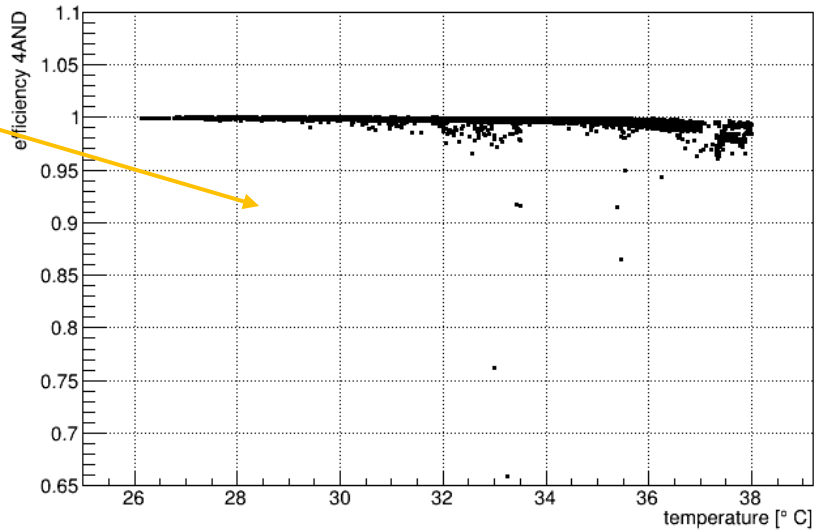
Efficiency correction in majority condition

For a given pair *i-th* of tiles, the efficiency is:

$$\varepsilon[i] = \varepsilon_1[i] \times \varepsilon_2[i] \times \varepsilon_3[i] + \varepsilon_1[i] \times \varepsilon_2[i] \times \varepsilon_4[i] + \varepsilon_1[i] \times \varepsilon_3[i] \times \varepsilon_4[i] + \varepsilon_2[i] \times \varepsilon_3[i] \times \varepsilon_4[i] - 3 \times \varepsilon_1[i] \times \varepsilon_2[i] \times \varepsilon_3[i] \times \varepsilon_4[i]$$



No dependance on temperature

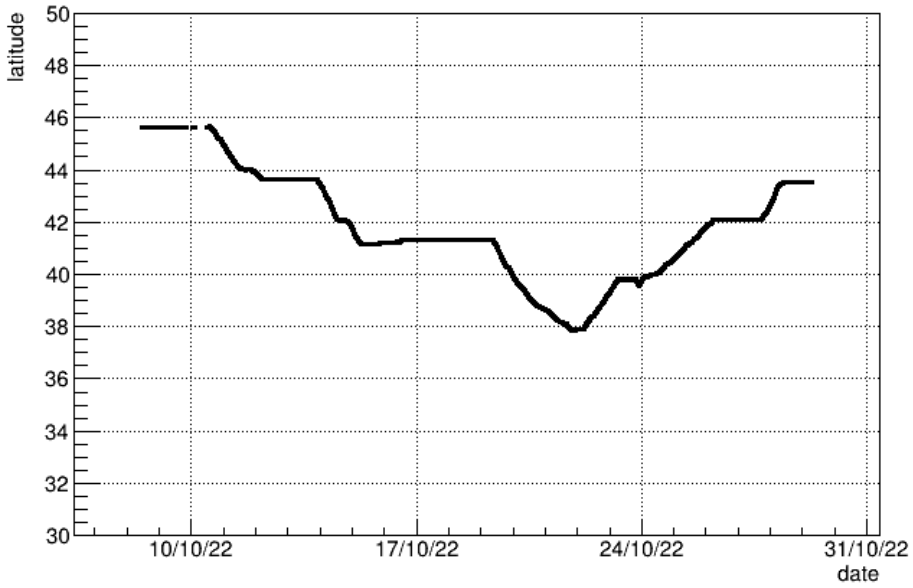


Rate4c corrected for efficiency = $\sum_{i=0}^{15}$ ratePair[i] / ε[i]

Rate dependance on latitude

Quality cuts were modified:

- **status** = 0
- **pres** > 800 && < 1100
- **temp** AND **temp2** > 15 && < 40
- abs(**rateRaw** - parRates[0]) < 2
- **rate** > 10
- **(rate -rate4c)/rate** < 0.1
- **Efficiency[ipair]** > 0.2
- **corrRate4c** > 15
- **rate4c/corrRate4c**>0.95



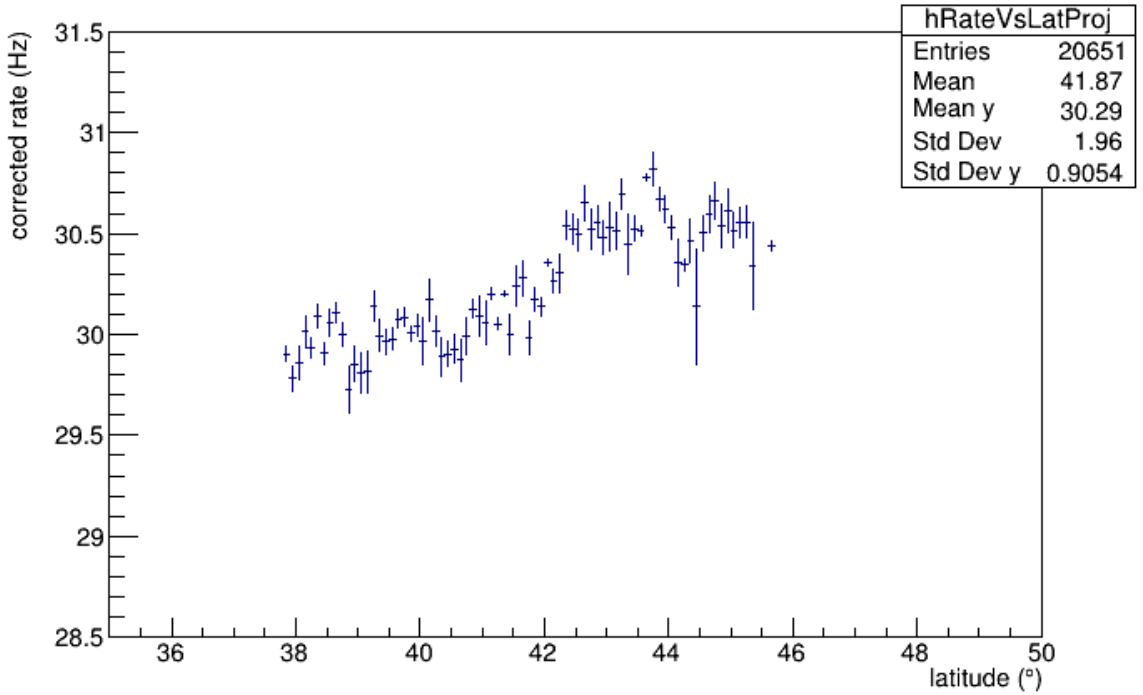
Total number of rejected measures 8048 (28%)

Dependance on latitude studied in:

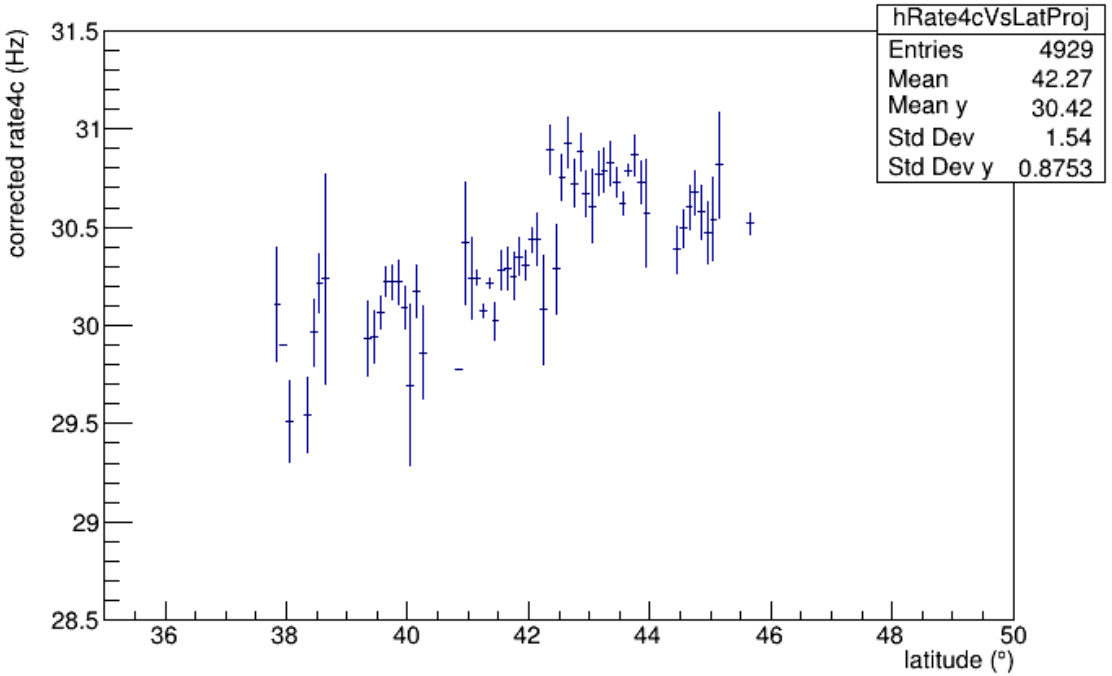
- 4AND condition (4 SiPMs fired + 1 single track)
- Majority condition (3 out of 4 SiPMs fired + 1 single track)

Rate dependance on latitude

0.1 deg steps



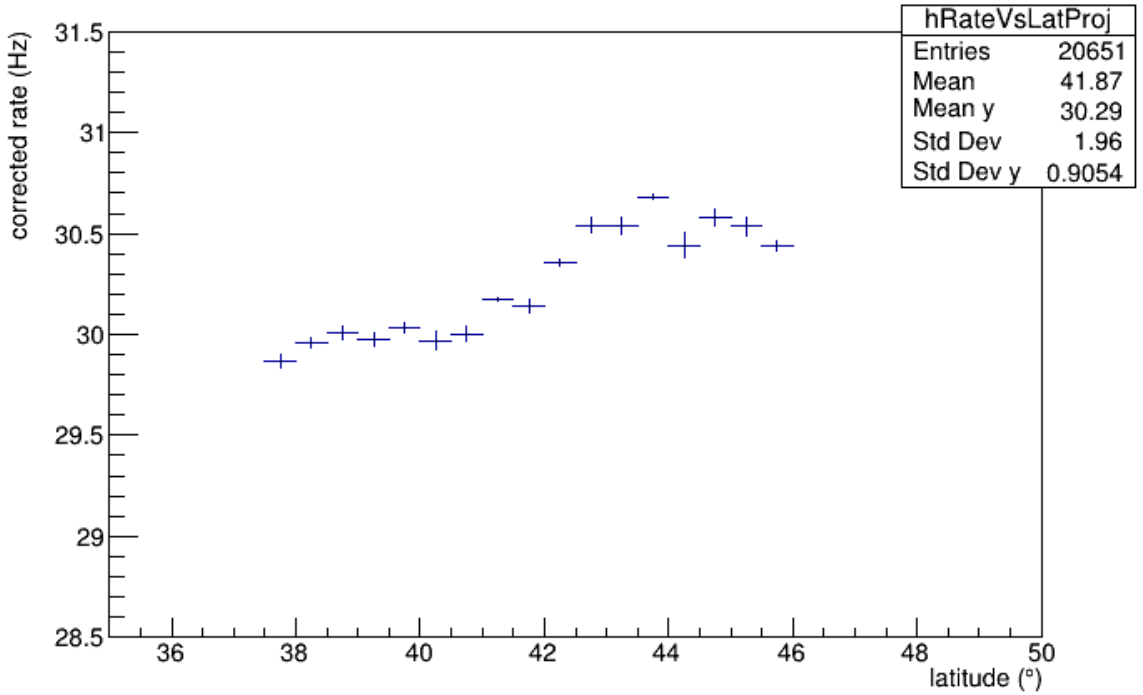
Majority condition



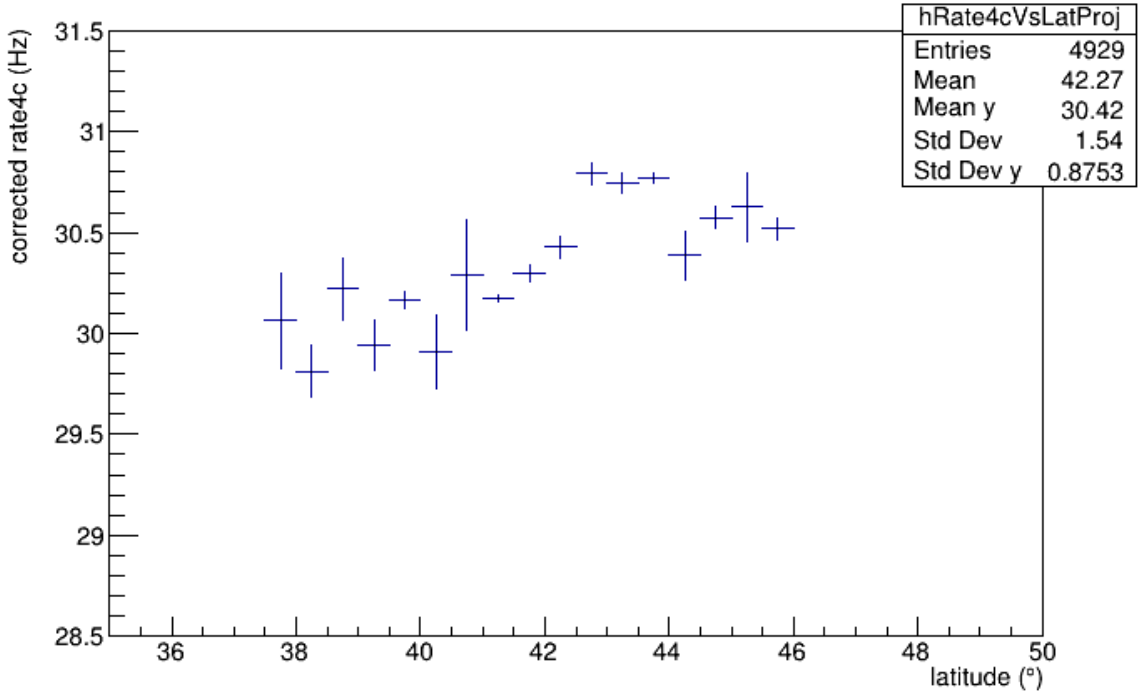
4AND condition

Rate dependance on latitude

1 deg steps



Majority condition



4AND condition

Conclusions

- Cuts to be optimized (check with previous analysis on POLA-01 data)
- Improve correction for efficiency (depending on Francesco's presentation today)
- Include rate VS lat points from POLA-02 in the published plot