# ORCA/ARCA data analysis
# PMT characteristics evolution

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ERLANGEN CENTRE
FOR ASTROPARTICLE
PHYSICS

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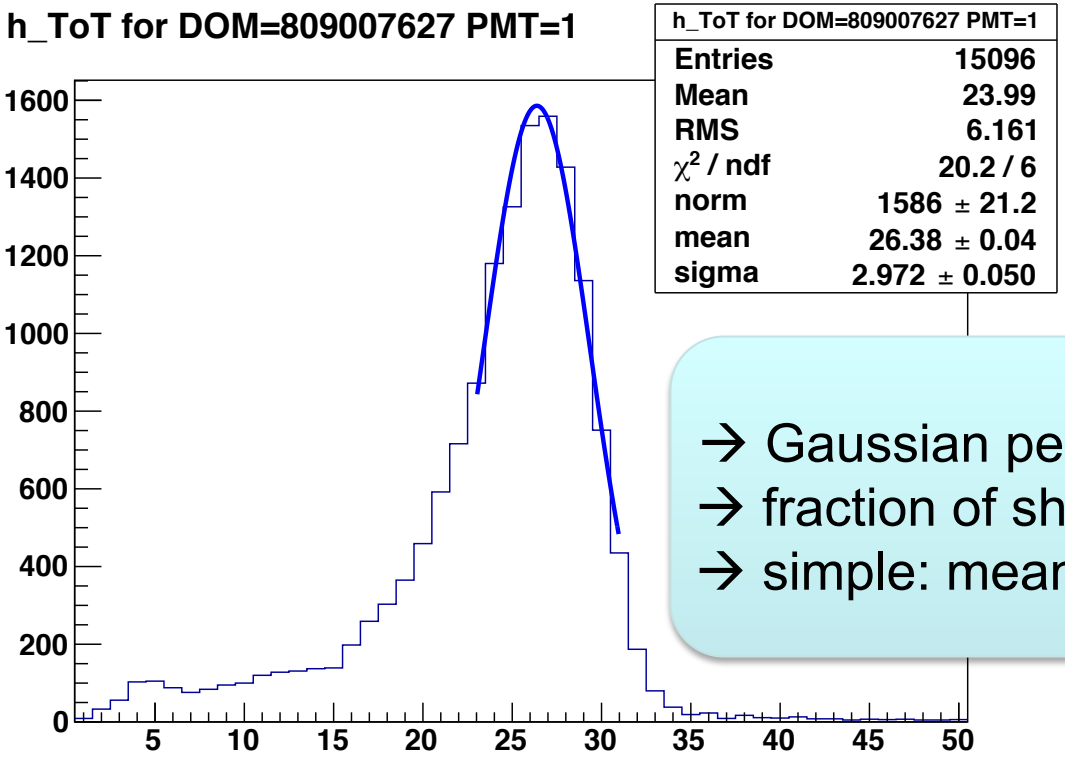
# PMT characteristics

- Which PMT characteristics are accessible/relevant from data analysis perspective?
  - detection efficiency → QE of PMT
  - ToT distribution




→ Gaussian peak position & width
→ fraction of short-ToT pulses (ToT<~10ns)
→ simple: mean / RMS of ToT distribution

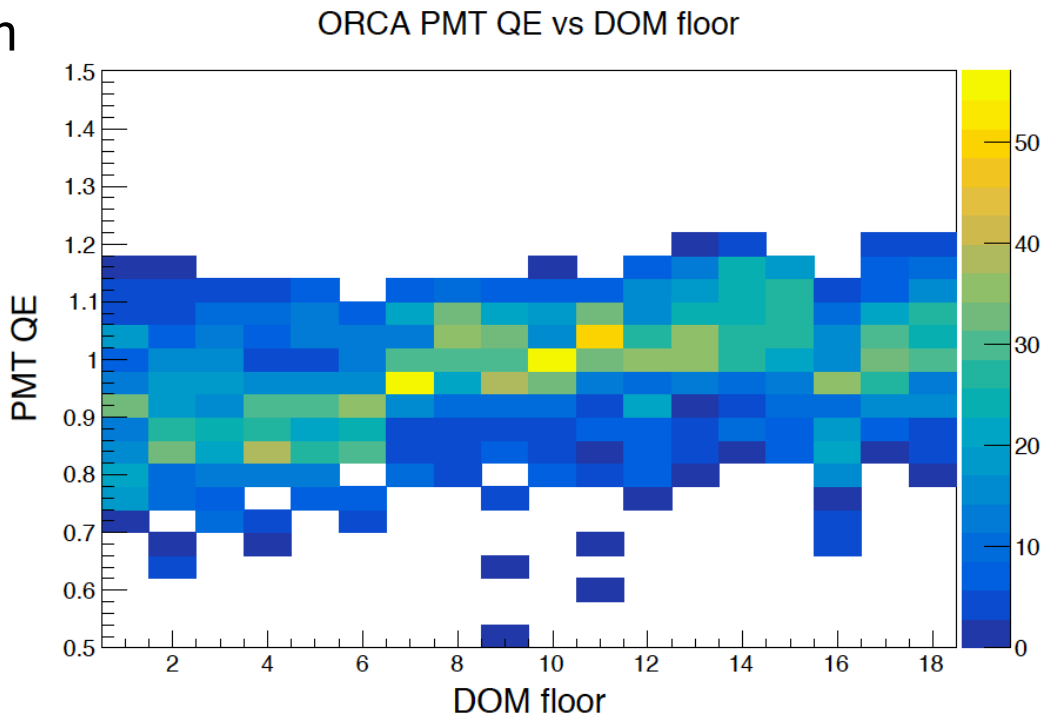
# Detection efficiencies

Slide from Bruno Strandberg, Time calibration group, 23.11.2017

## QE depth dependence - ORCA

ORCA PMT QE vs DOM floor. Each projection along y-axis has $31\,\mathrm{PMTs} \times 5\,\mathrm{runs} = 155$ entries.

- DOM 1-6&16 seem to show lower efficiencies
- Similar behaviour with an other alternative K40 analysis
- … such studies started Catania/ Naples DOM discussion



# ToT distribution characterizing variables

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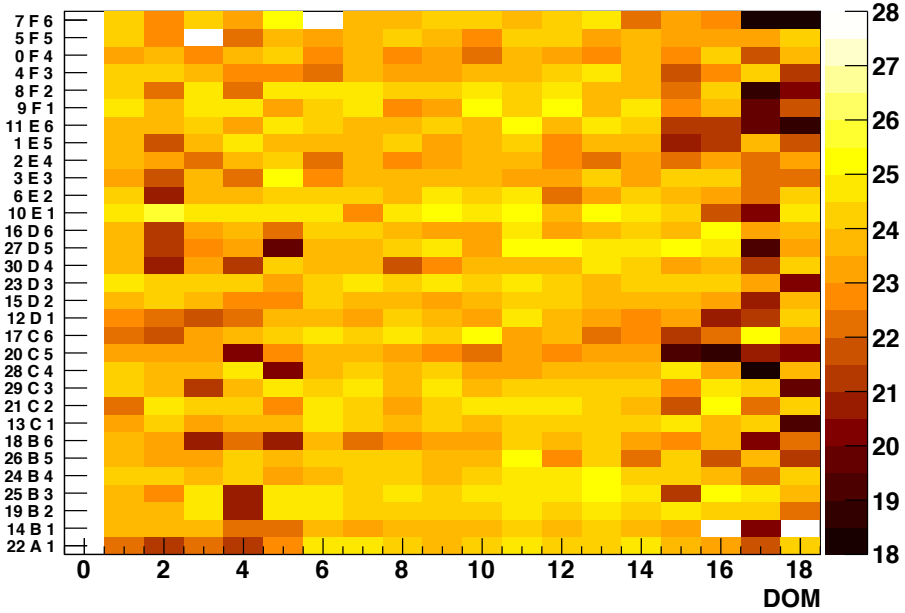
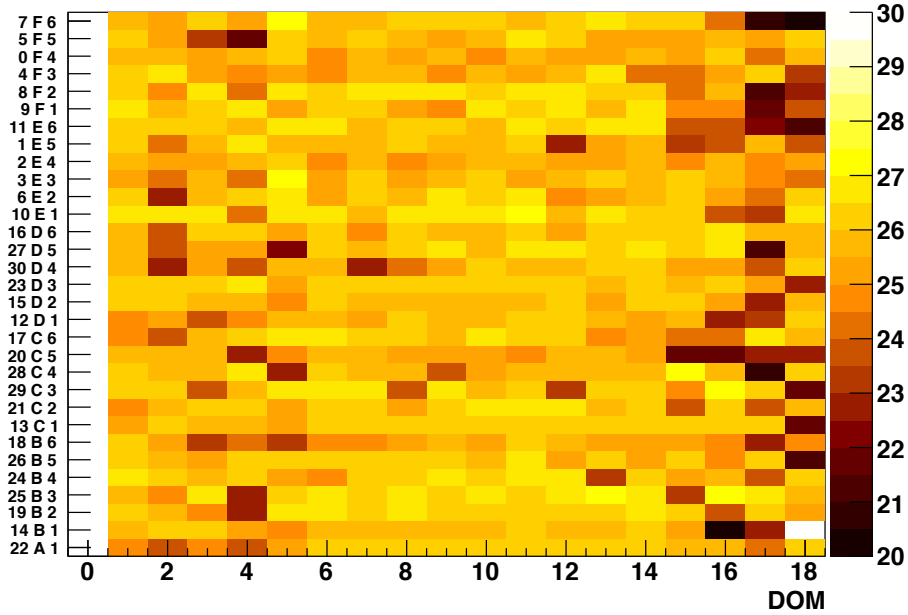
- This is for run 2755, see https://elog.km3net.de/Analysis/228

**Mean of ToT distribution**




Mean of ToT distribution

**Fitted peak of ToT distribution**




Fitted position of 1PE-peak

- (ToT distributions from L0 runs, L1 data stream and triggered events look similar)

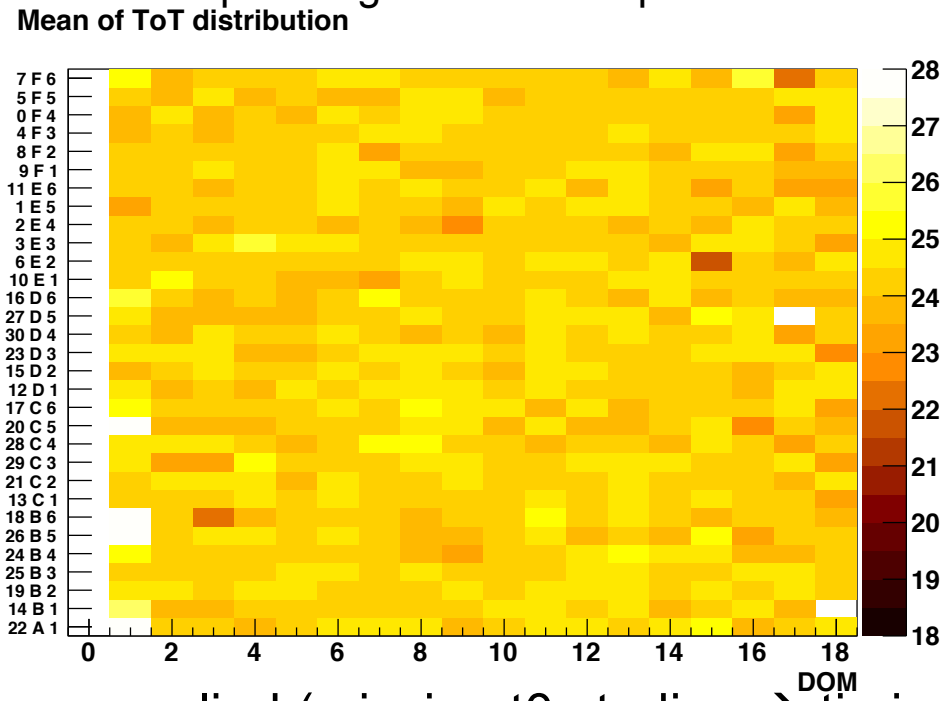
# HV setups

- Always the HV setup as tuned in the CPPM dark room was used in ORCA runs

- An in-situ HV tuning in the sea was performed but not applied
  → Alex C. re-tuned HV such that ToT distribution is uniform for all PMTs

https://elog.km3net.de/Operations+FR/1038

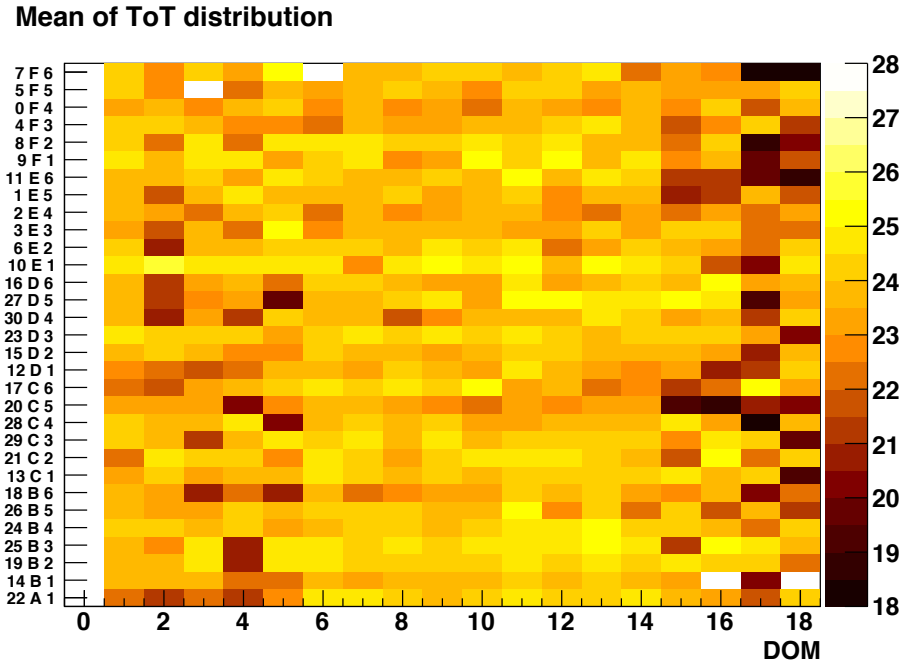
- For cross check, meanToT for run3027 only run with sea-tuned HV
  → homogeneous meanToT over all PMTs



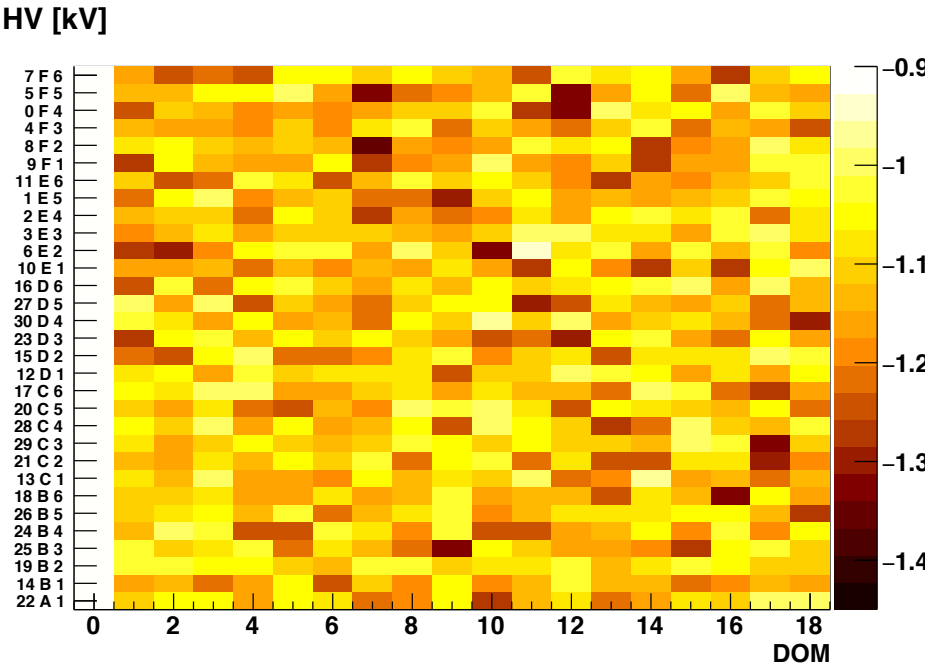

⋯ this HV setup has not yet been applied (missing t0 studies → timing)

# Correlation meanToT with applied HV?

- HV setup as tuned in the CPPM dark room




Mean of ToT distribution




HV setup

- No obvious correlation with applied HV setup

# Correlation meanToT with PMT production site?

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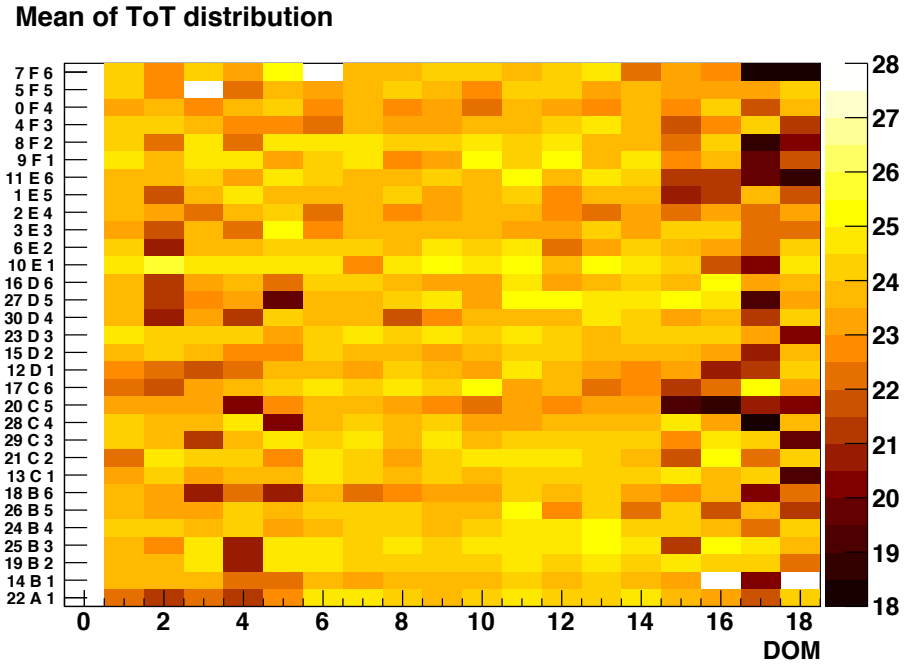
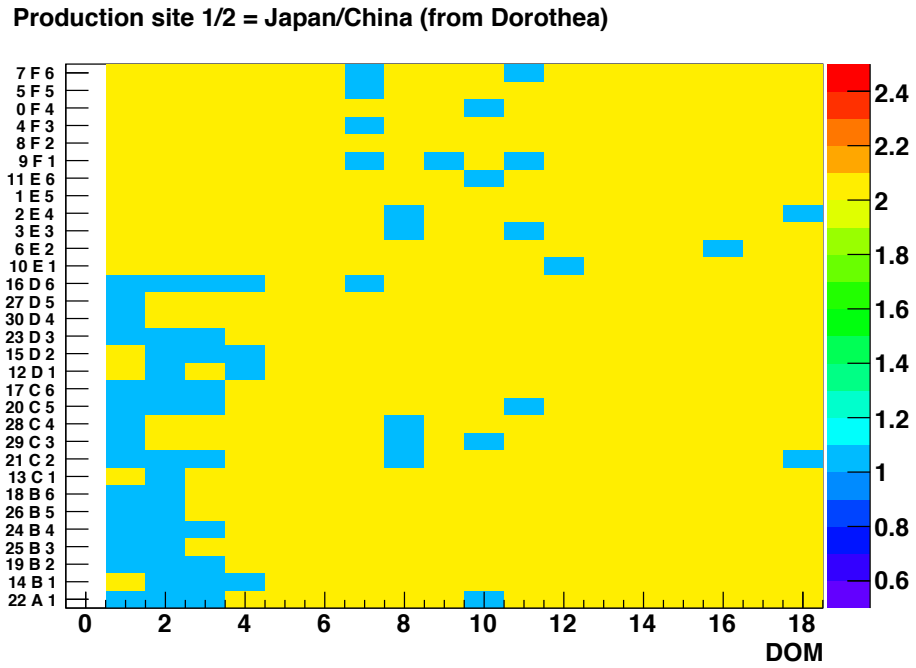
I got this information from Dorothea (serial number 1.XXXXX vs 2.XXXXX)




Mean of ToT distribution




1=blue=Japan , 2=yellow=China

- No obvious problem of PMT production site (Japanese/Chinese)

# Correlation meanToT with efficiency (from K40)

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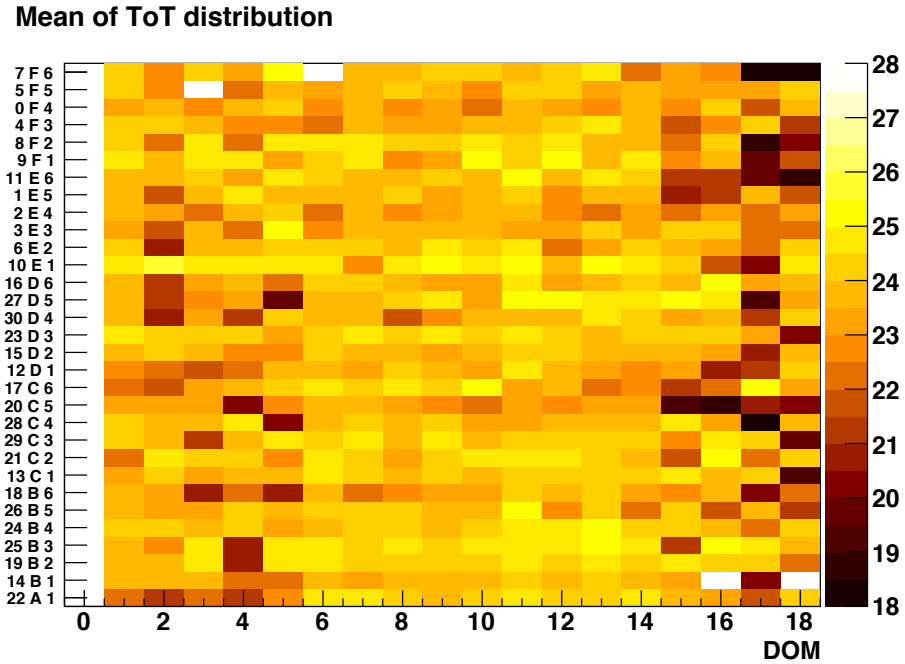
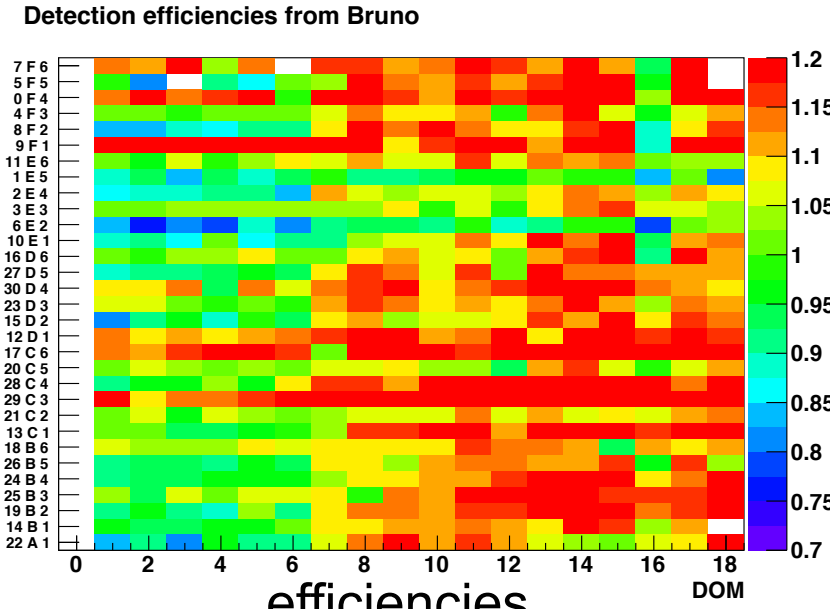
- Detection efficiencies from Bruno Strandberg (for run 2839)

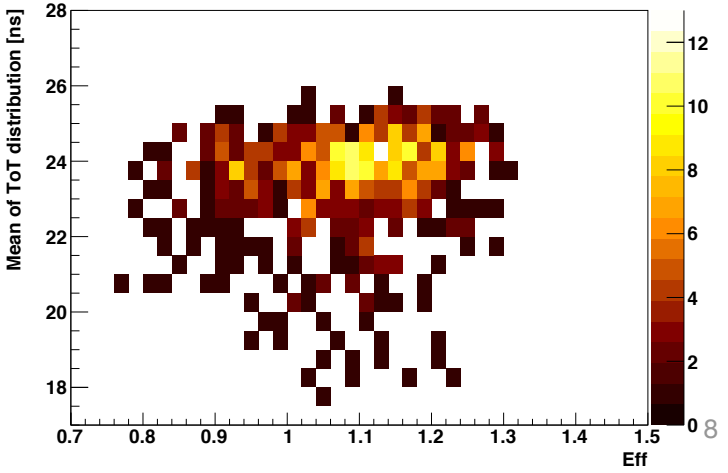



Mean of ToT distribution




efficiencies

- No strong correlation with efficiencies
- (I was expecting a stronger correlation)
- No clear to me what is going on here
- Maybe independent problems?



# Mean ToT evolution ORCA

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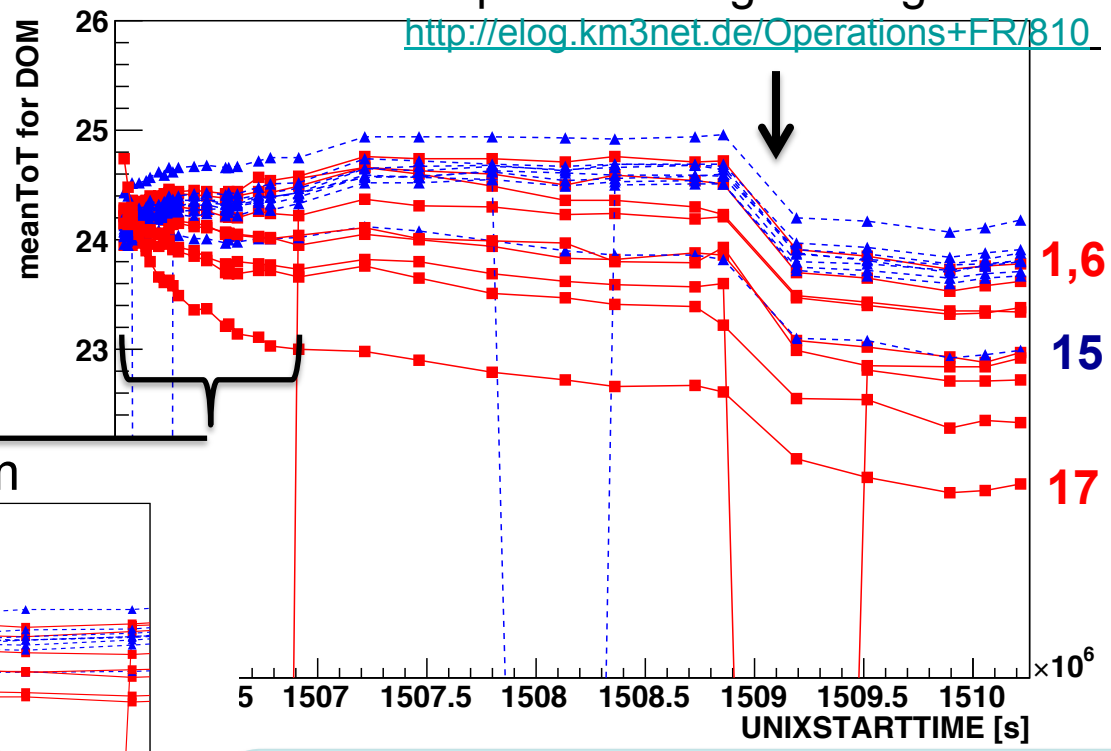
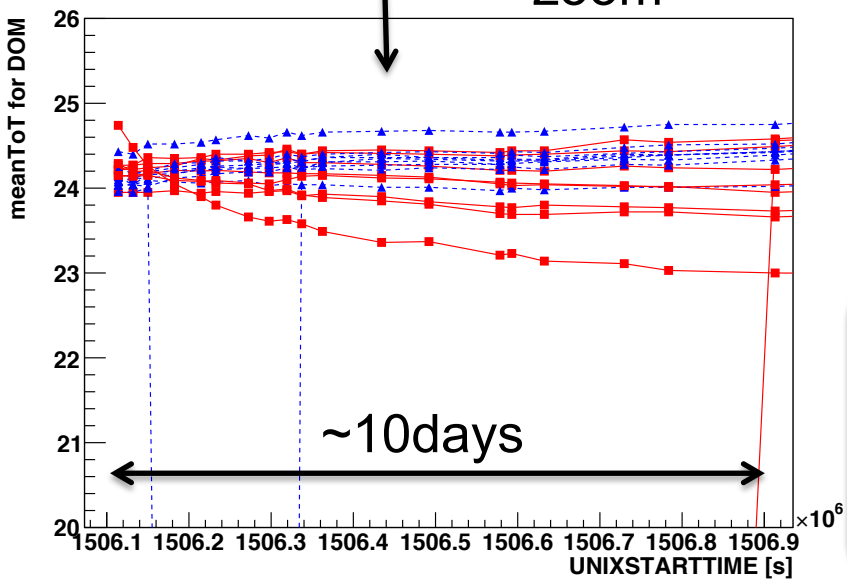
Step from change in angle-cut in JPP
http://elog.km3net.de/Operations+FR/810

**Catania DOMs (1-6 & 16-18)**

**Naples DOMs (7-15)**

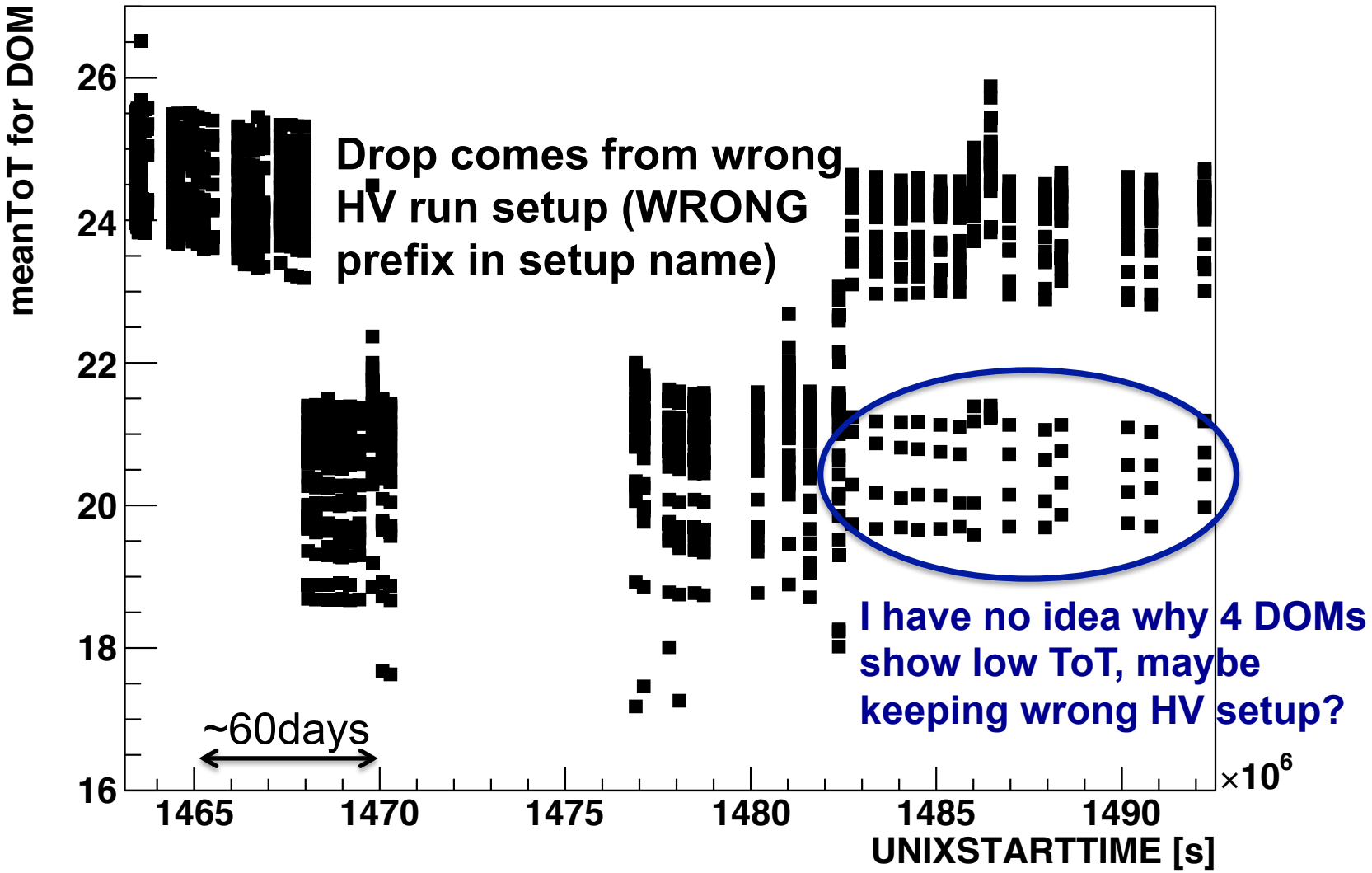



zoom




**Significant decrease of mean ToT for some DOMs, mainly Catania DOMs**
**Different: DOM 1, 6, 17, 15**

# Mean ToT evolution ARCA



# Humidity & Temperature after Deployment

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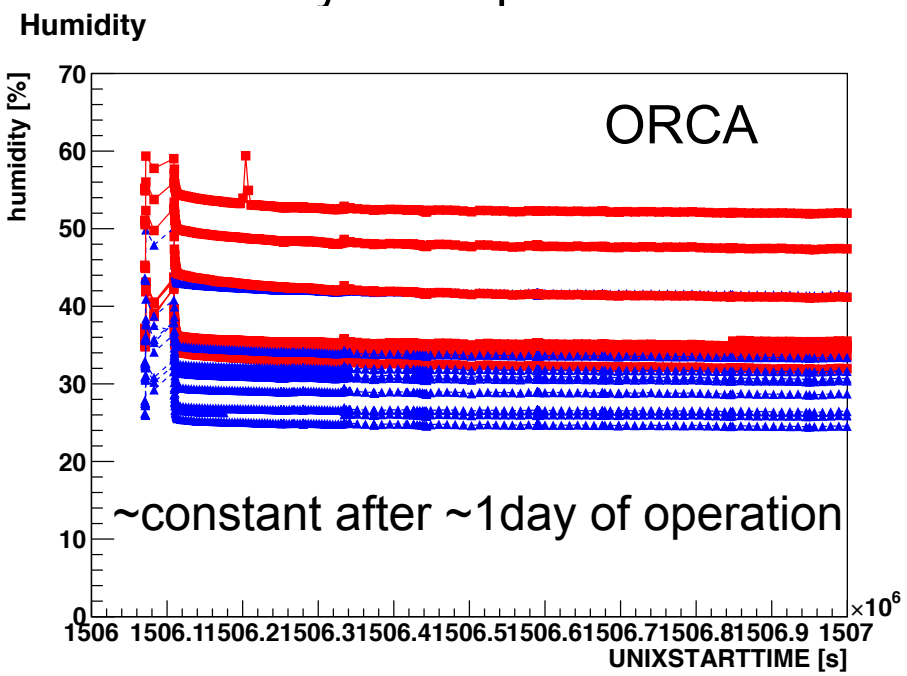
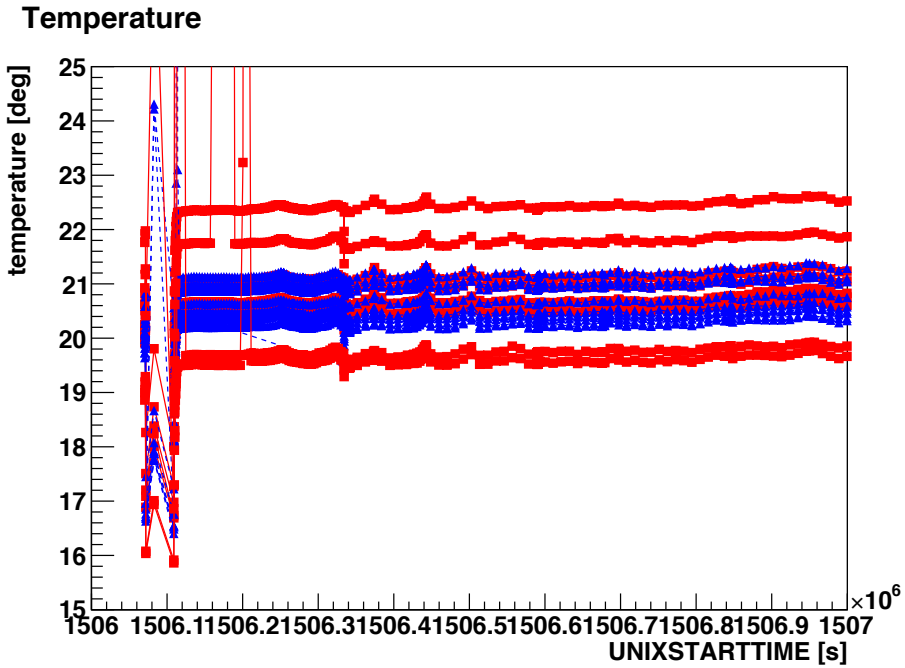
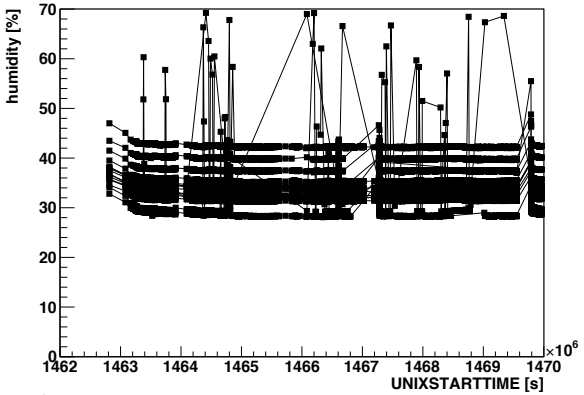
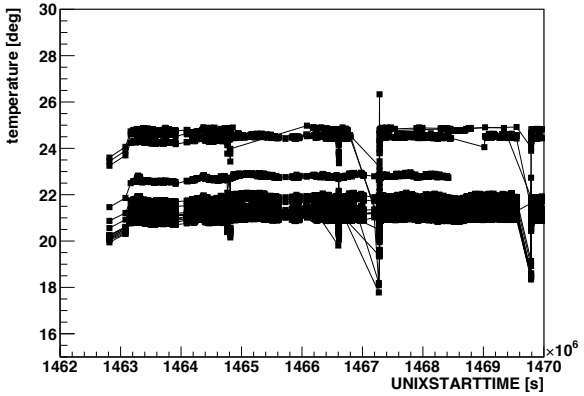
- Humidity & temperature measured with a sensor on CLB




Similar for ARCA

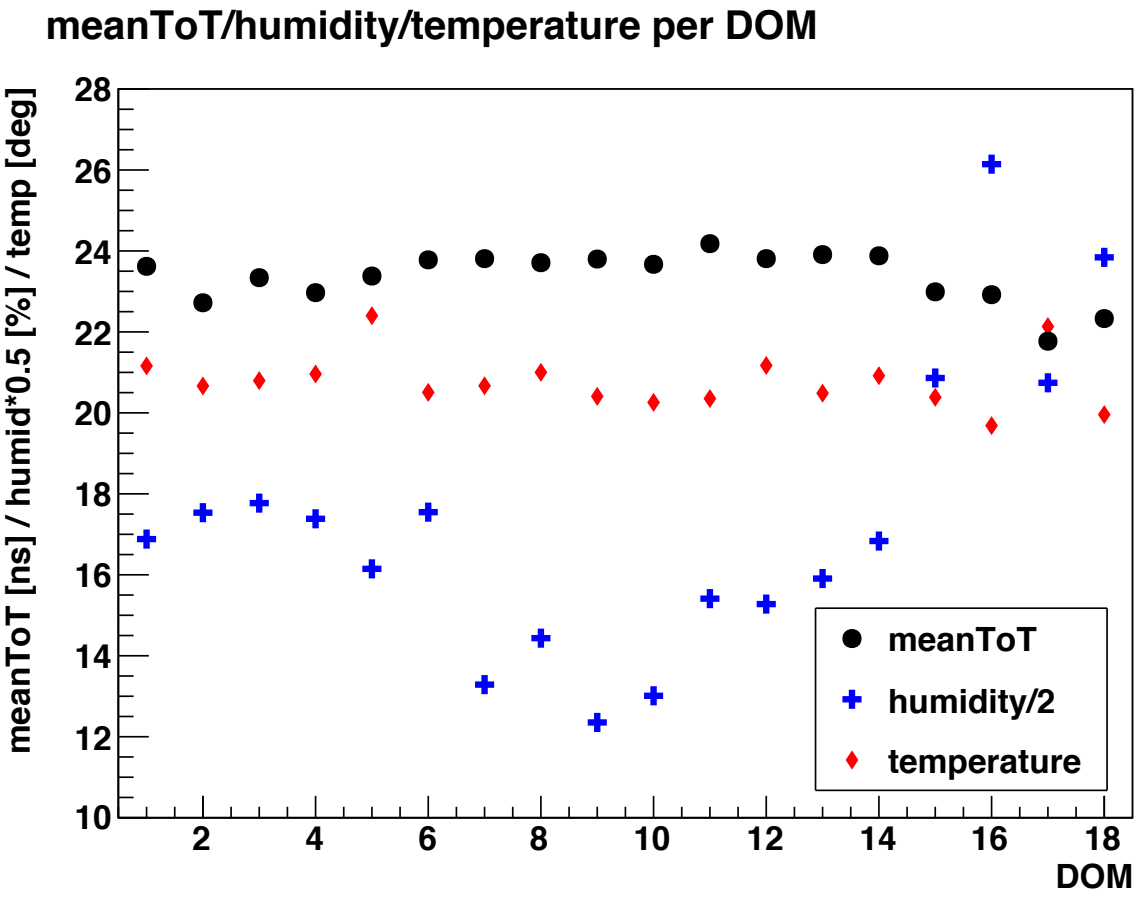


# Correlation meanToT with humidity?

- Naples DOMs on average lower humidity than Catania DOMs
- DOM 15-18 show high humidity and lowest meanToT → anti-correlated?
- DOM 2 & 4 also low meanToT but no lower humidity than DOM 1&3&5&6

…

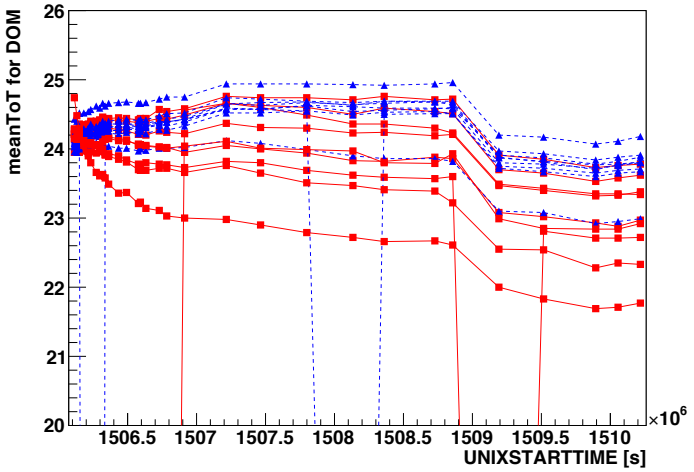
Not fully conclusive



# Summary

- **ORCA DOMs, i.e. their PMT characteristics, behave different in sea**
- **Large difference between Catania/Naples DOMs**
- **(ARCA DOMs more stable)**

- Significant decrease of meanToT for some DOMs, mainly Catania DOMs
- Might be related to humidity in DOMs (determined during DOM integration)




- **What are the differences between DOMs?**

**→ identify difference ARCA/ORCA & ORCA-Catania vs ORCA-Naples**

**→ learn for future: improve our DOM production**