Acoustic (pre-)calibration in KM3NeT

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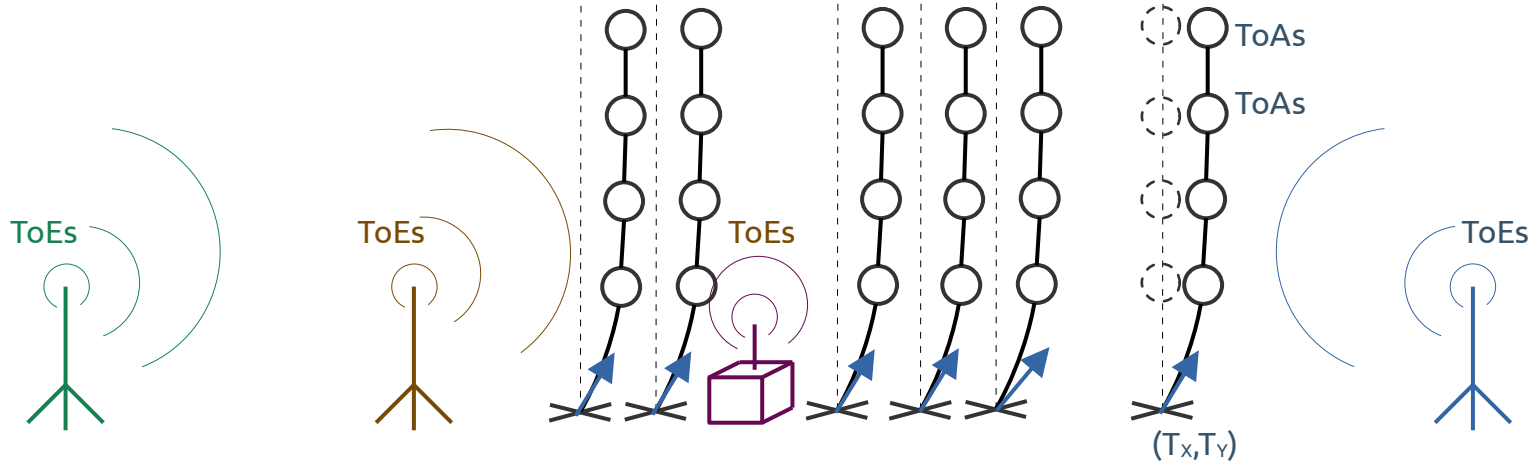
Work done essentially with Maarten de Jong

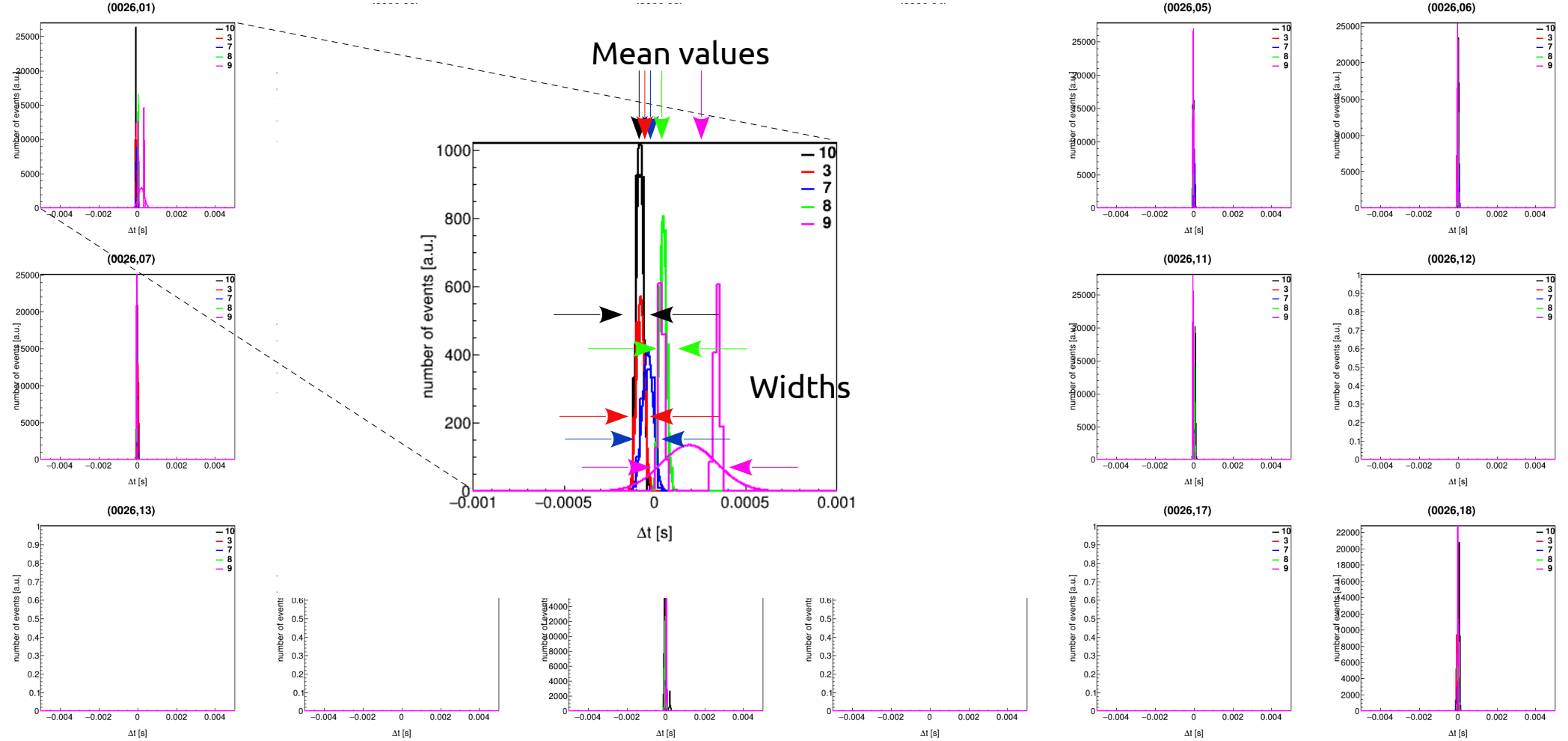
Acoustic positioning

ToE : Time of Emission
ToA : Time of Arrival



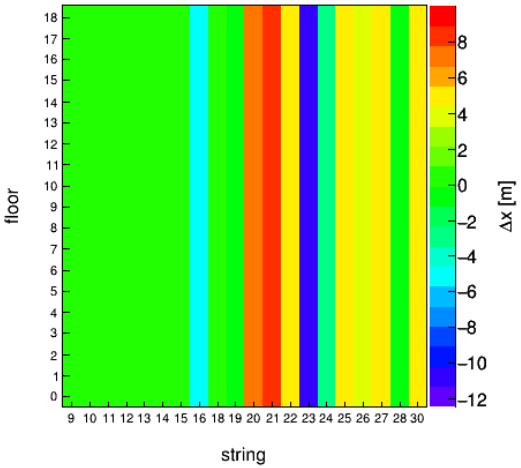
- Fit parameters: # ToEs + # strings x 2 tilt angles ~ 50 + 40 = 90 for D0ARCA020
- Measurements: # ToAs ~ # ToEs x # receivers ~ 50 x 360 = 18 000 for D0ARCA020
- Assumptions:
  - The detector does not move within a given time window (600 s)
  - The line shape under the sea current is well described by a mechanical model
  - The static parameters (X,Y,Z of the anchors, emitters, Z of the modules, time offsets) are precisely known
- A global fit is performed to deduce the actual line shapes
- Static parameters must be determined first : global fit of global fits – which ones first ?

ToA residuals : ARCA.0026

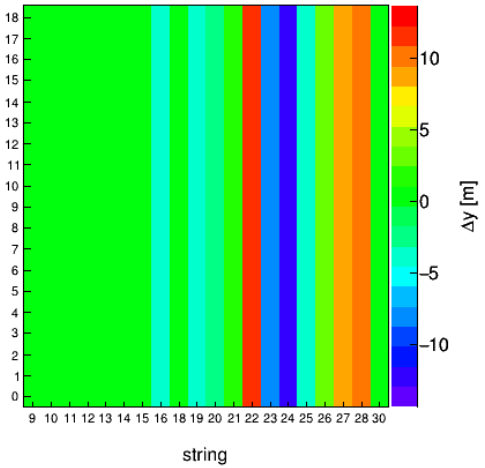


From uncalibrated to calibrated detector

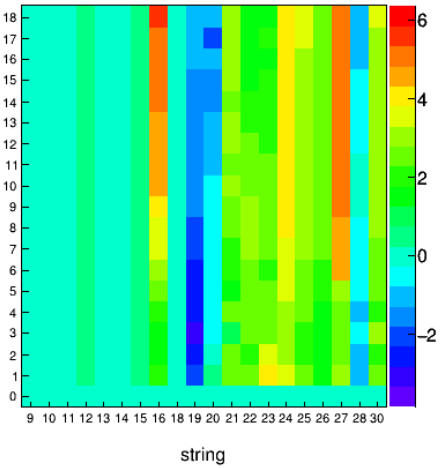
ΔX



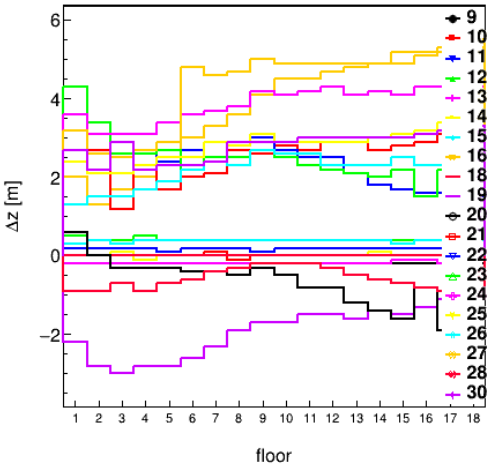
ΔY



ΔZ

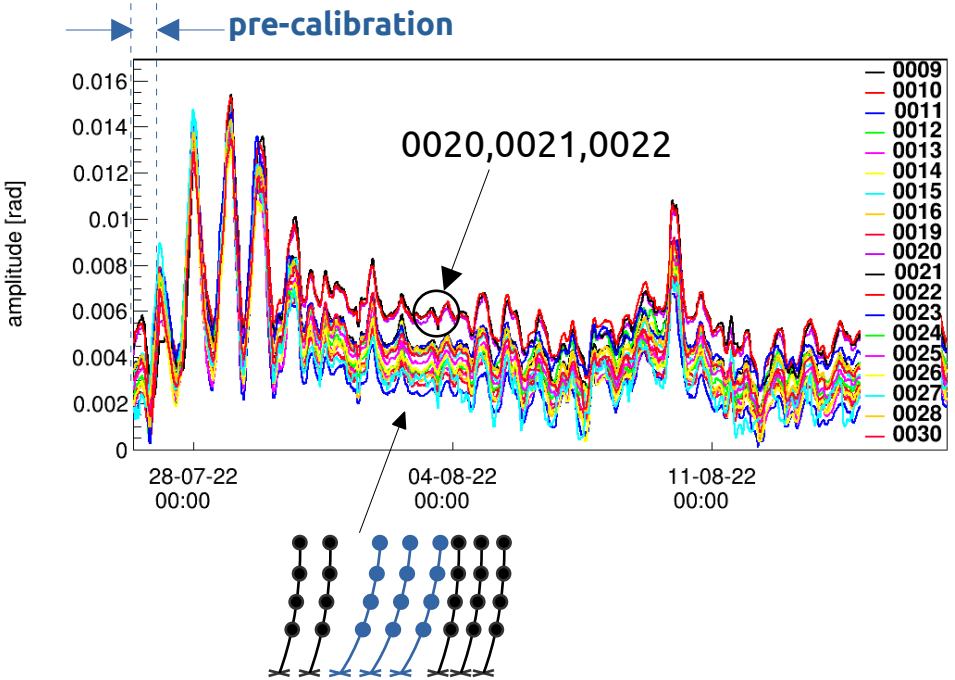


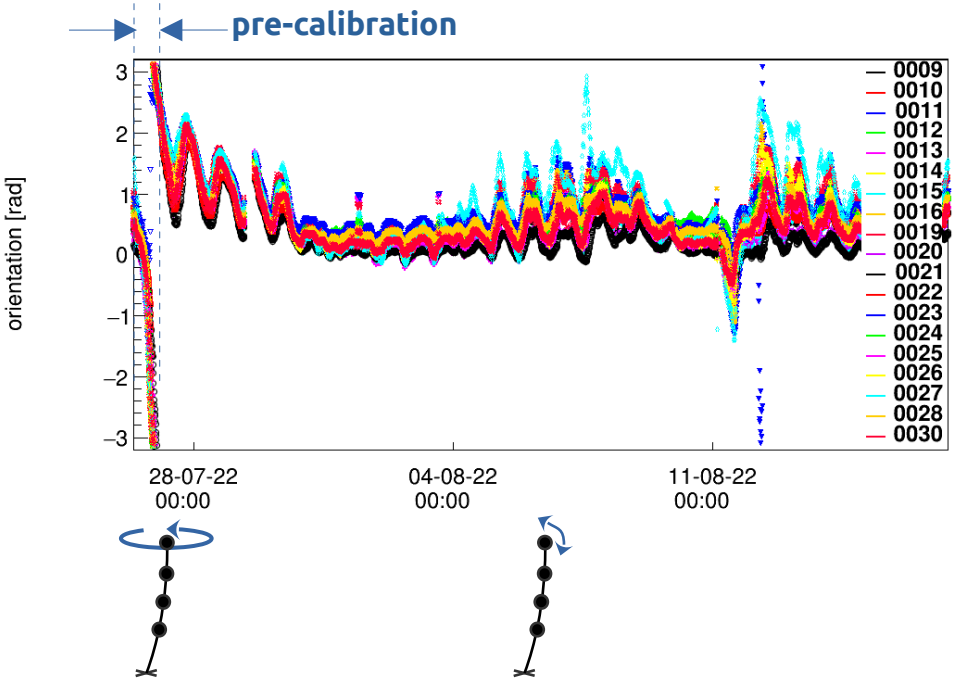
ΔZ



- Large horizontal offsets (~ 10 m) for the new lines
- Old lines very slightly moved
- Large offsets also for the new emitters
- ARCA.0016 needs some stretching
- ARCA.0027 need a larger gap between the floors 5 and 6 ??

Calibration : tilt behaviors





- Collective behaviors and « daily » oscillations are observed
- Large systematic dispersion (several mrad) of amplitudes
- Particular behaviors of the (ARCA.0020,ARCA.0021 and ARCA.0022) triplet
- Systematic to be understood and confirmed by other analysis (muons, SN hits...)

KM3NeT Acoustic positioning

- Achievements :
  - (Pre-)calibration procedure and software are being developed, adapted and improved
  - Global fits converge. Overall mimina are obtained to determine fixed parameters
  - Tilt behaviors (dynamic positioning) are consistent
- Issues :
  - Detectors are changing too often (lines and emitters)
  - Lines are incomplete (dead piezos, dead DOMs)
  - Deployment positions of ARCA elements are too approximative
  - Acoustic Data Filter should be improved (ToA errors are strongly non gaussian, quality Factor is not normalized)
  - Final chi2 is still high for ARCA (mechanical model ? ToA values ?)
  - CPU time is getting enormous with increasing detector size