

# Hybrid lessons from a radio perspective

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# Radio lessons from Hybrid & Calibration

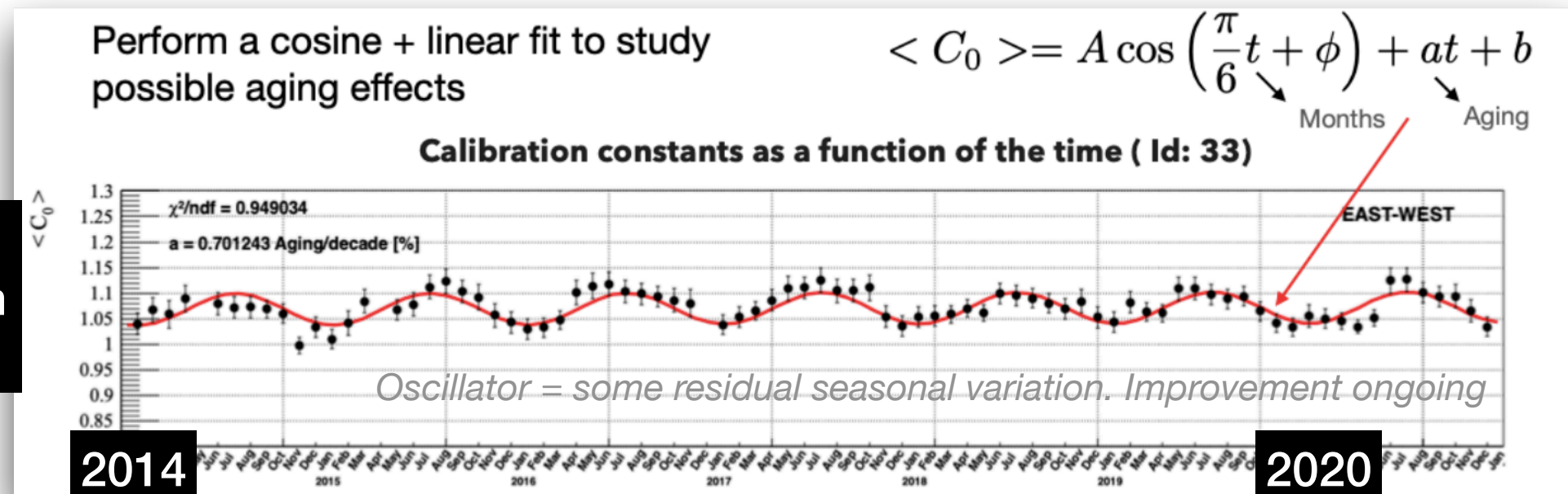
Lessons learned about hybrid at Auger (from the perspective of a Radio Xmax/calibration person):

- RD and FD probe the EM cascade but have **wildly different systematic dependencies**.  
(FD: fluorescence yield, aerosol monitoring vs RD: galactic sky, GDAS atmosphere, RFI)  
—> independent methods that work great with SD to probe shower (muonic/hadronic-EM hybrid)
- RD and FD **independently measure the big physics parameters**: Energy [Aab+2016], Xmax [in prep], (muon-em together with SD) [in prep], ...  
—> Hybrid checks have been crucial. If we will probe new regimes, hybrid once again will be crucial (complementary RD-FD with decent overlap)

Lessons learned from calibration

- **No ageing** expected for Radio. Measurements of Galactic background restricts it at <2%/decade [work-in-progress]. SD has PMT ageing, FD has dust accumulation and PMT ageing.  
—> Radio can provide calibration for particle/fluorescence/... detectors = long-term stability

**Absolute  
calibration  
factor**



Diego C. dos Santos and Rogério M. de Almeida

**Depending on data subsets: ~ between -1 and +2% per decade. All compatible with 0.**