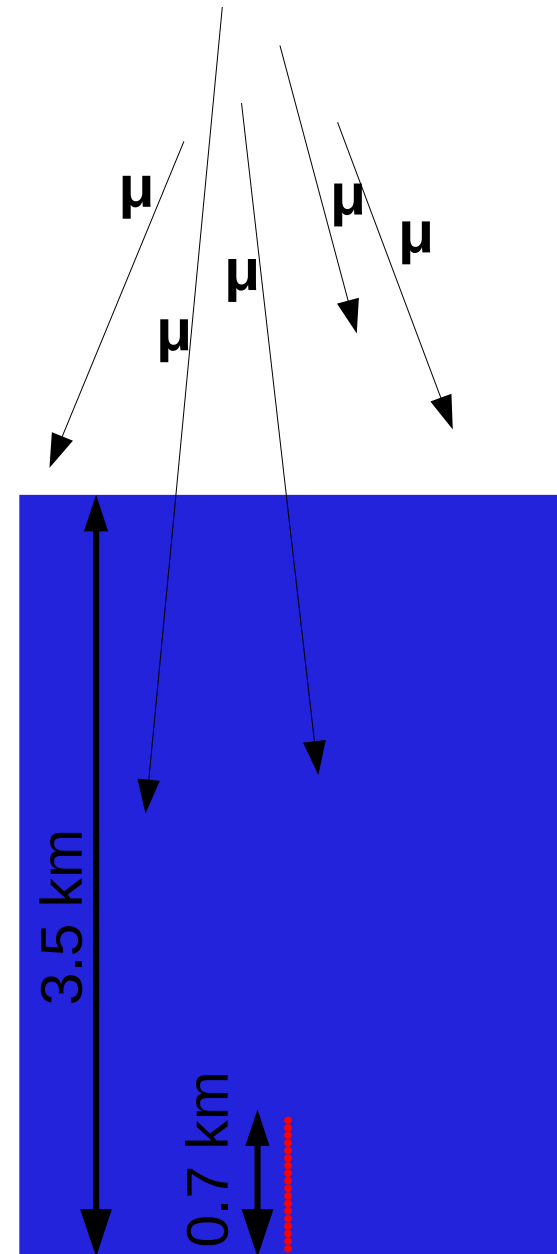


Depth dependence of the atmospheric muon flux

Martijn Jongen
group meeting 21 October 2016
Nikhef

Introduction

- ~630 m of sea water between upper and lower DOM on an ARCA DU
- atmospheric muon flux reduces along the line
- first study by Jurriën van der Loo (Leiden University Bachelor student)
 - *“Analysis of the muon flux depth dependency with the KM3NeT detector”*
 - result: counting rate reduces by ~0.5 along the string



Plan

- extend study
- good MC (**Karel**)
 - including PMT efficiencies from K-40
- using new high-quality 2-string data
- data quality: perform strict frame selection
- goal: go for a publication

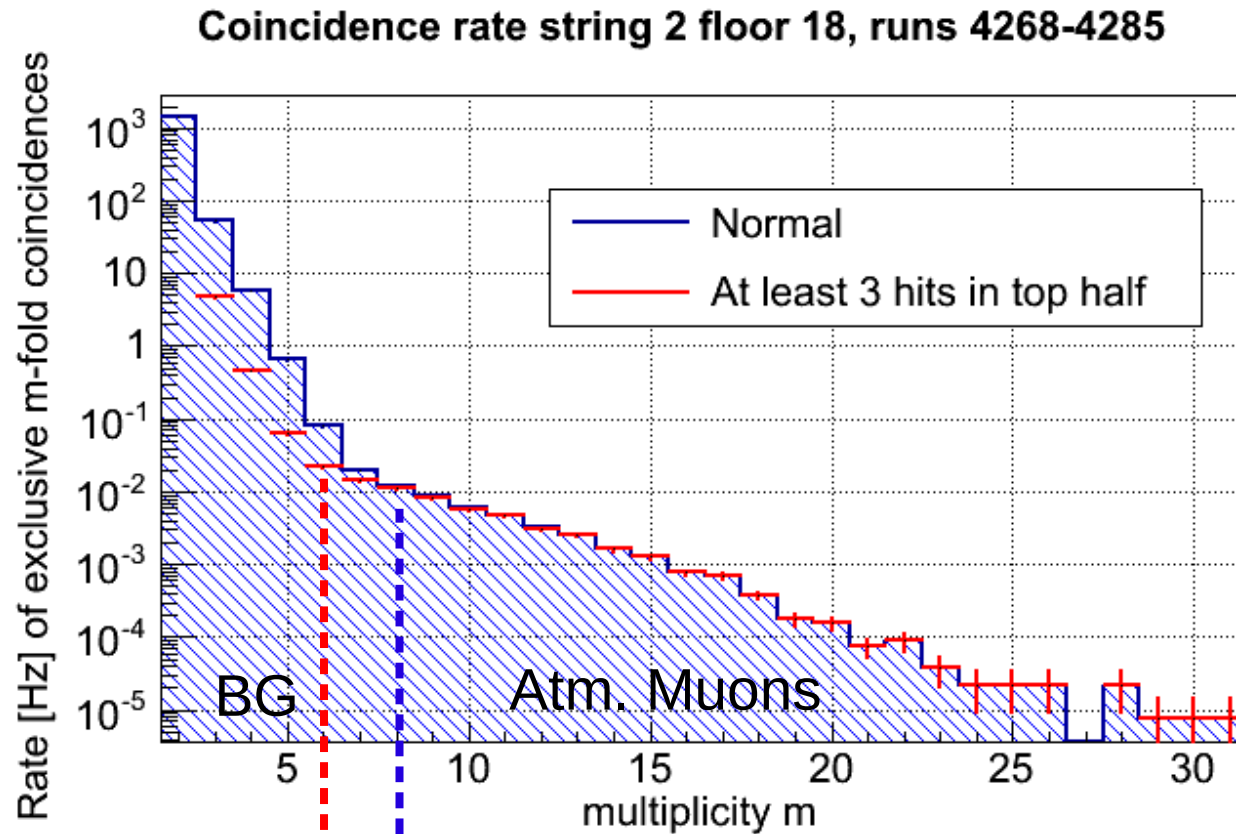
Run selection

- Runs 4268 - 4285
 - ~1.5 days of data
 - taken 2-4 august
 - runsetup
PHYS.1607v3-TUNED.HV-SFP.Power-XTRA.100ns
 - t0set A01501148 (includes intra-DOM time calibration)
 - UDP packet loss negligible

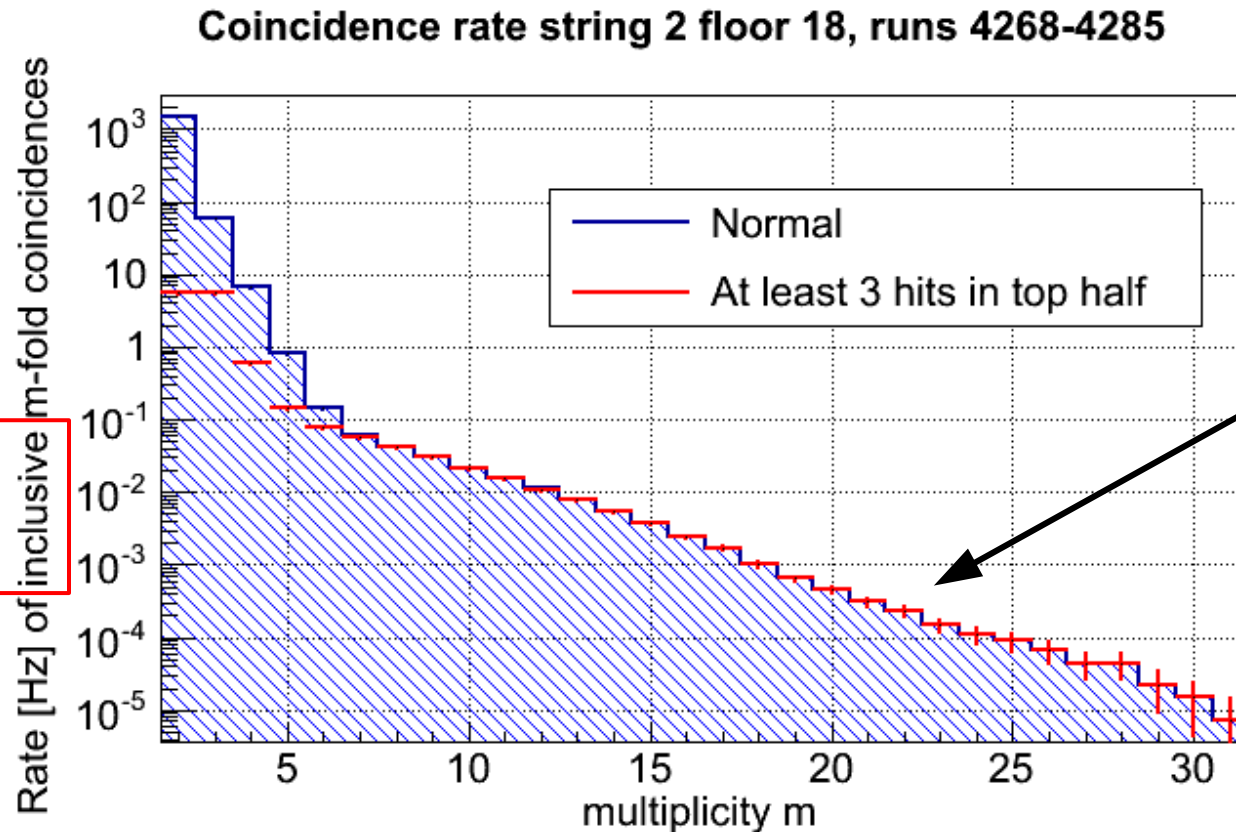
Data selection

- HRV status and FIFO full
- UDP status
- Optional check on max PMT summary slice rate
- Optional min and max L1 rate
- Checking that L1 hits are really L1 hits
- Checking for correct hit time ordering
- If a frame looks suspicious, ignore it

Coincidence clusters

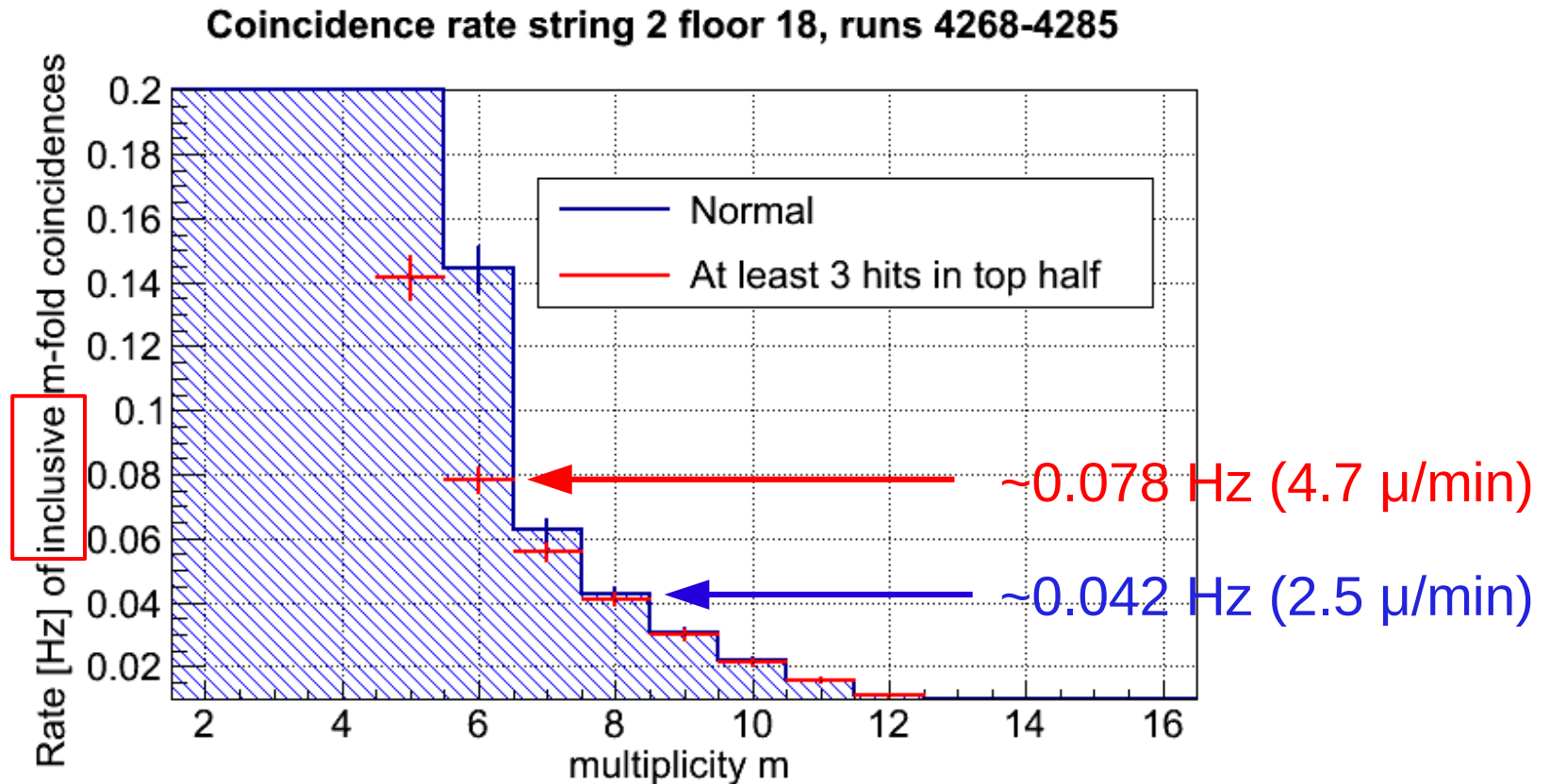


Coincidence clusters

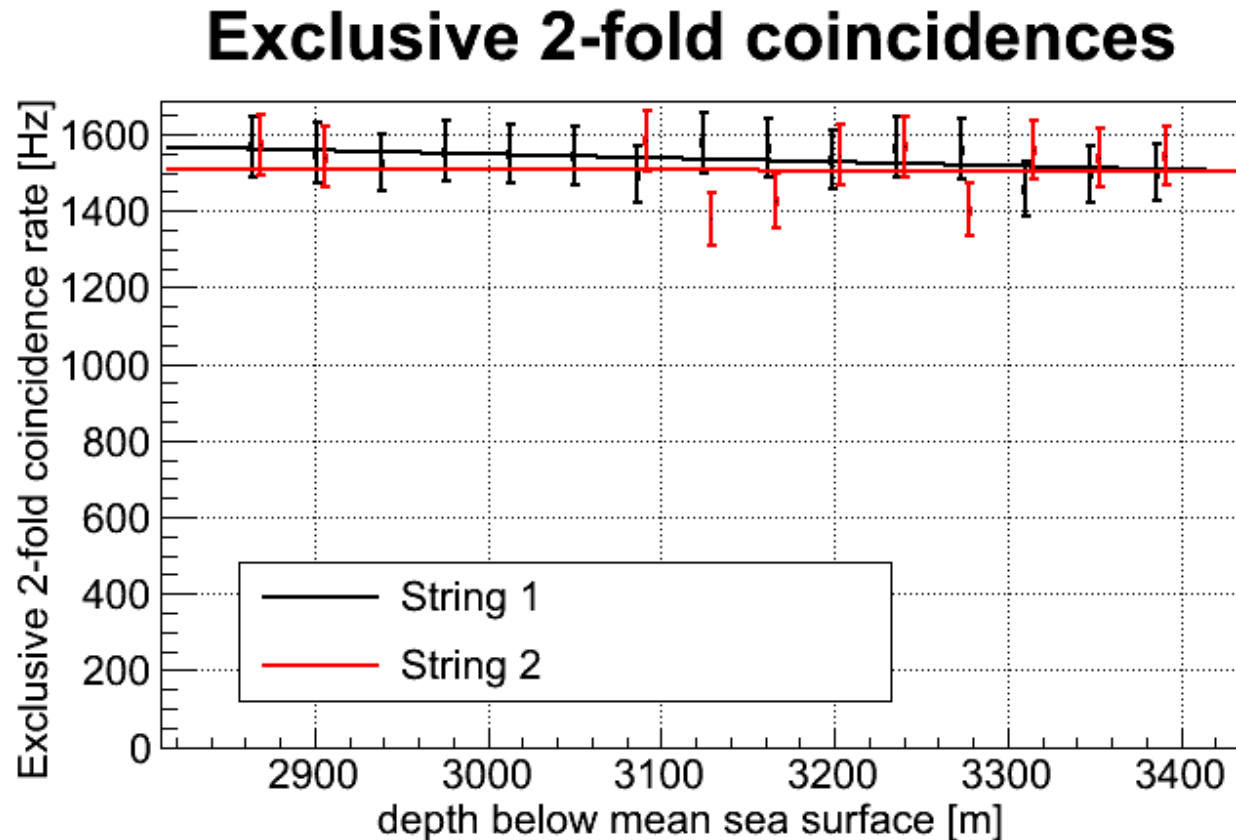


Inclusive rate reduces by approx. **0.69** at every increase in multiplicity

Coincidence clusters

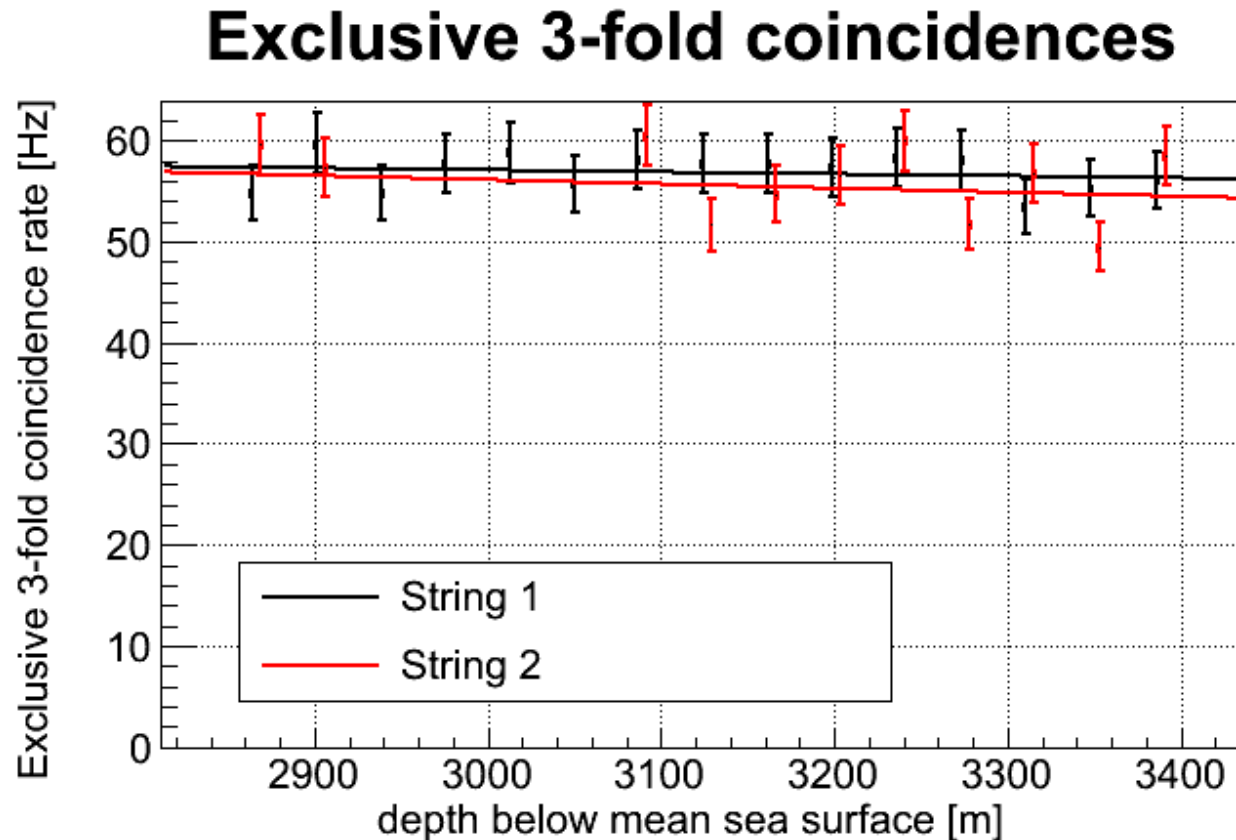


Exponential fit of depth dependence

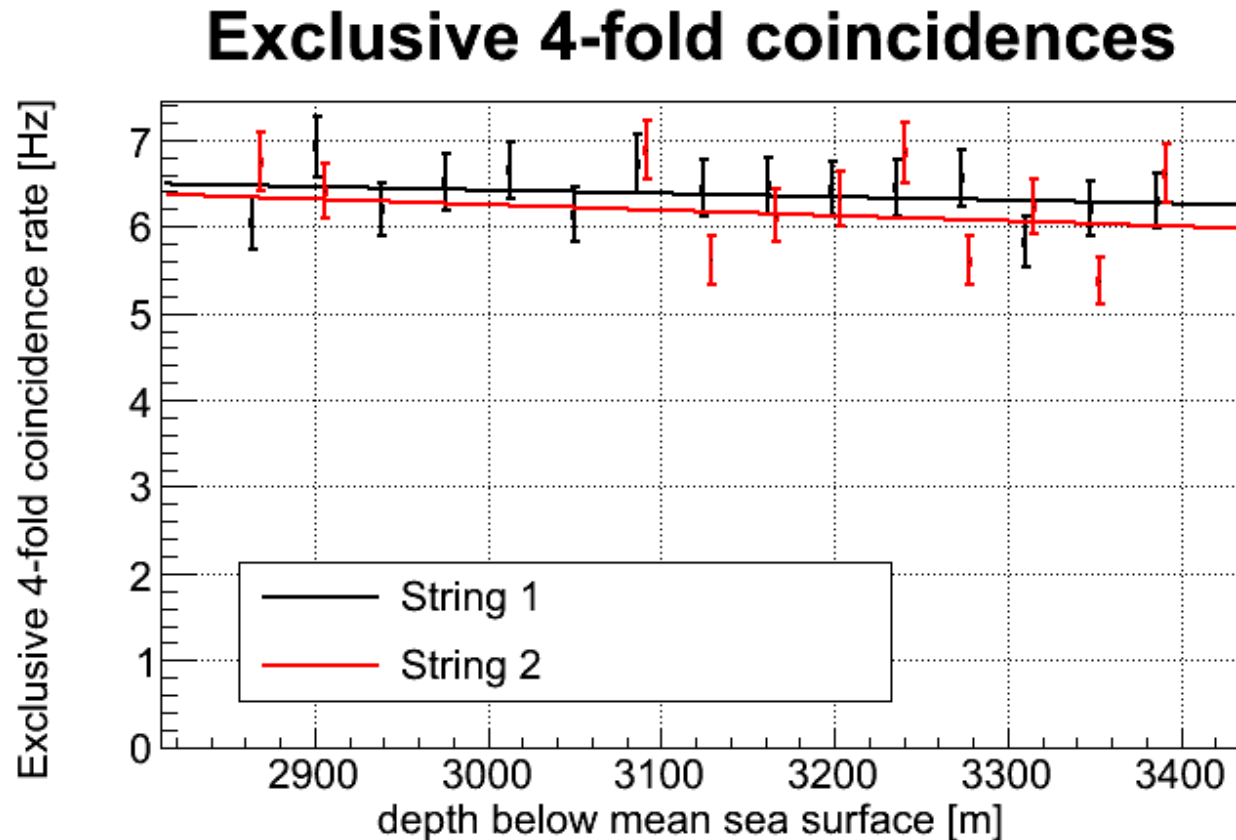


Note:
errors are
statistical error +
an ad hoc 5%
systematic error

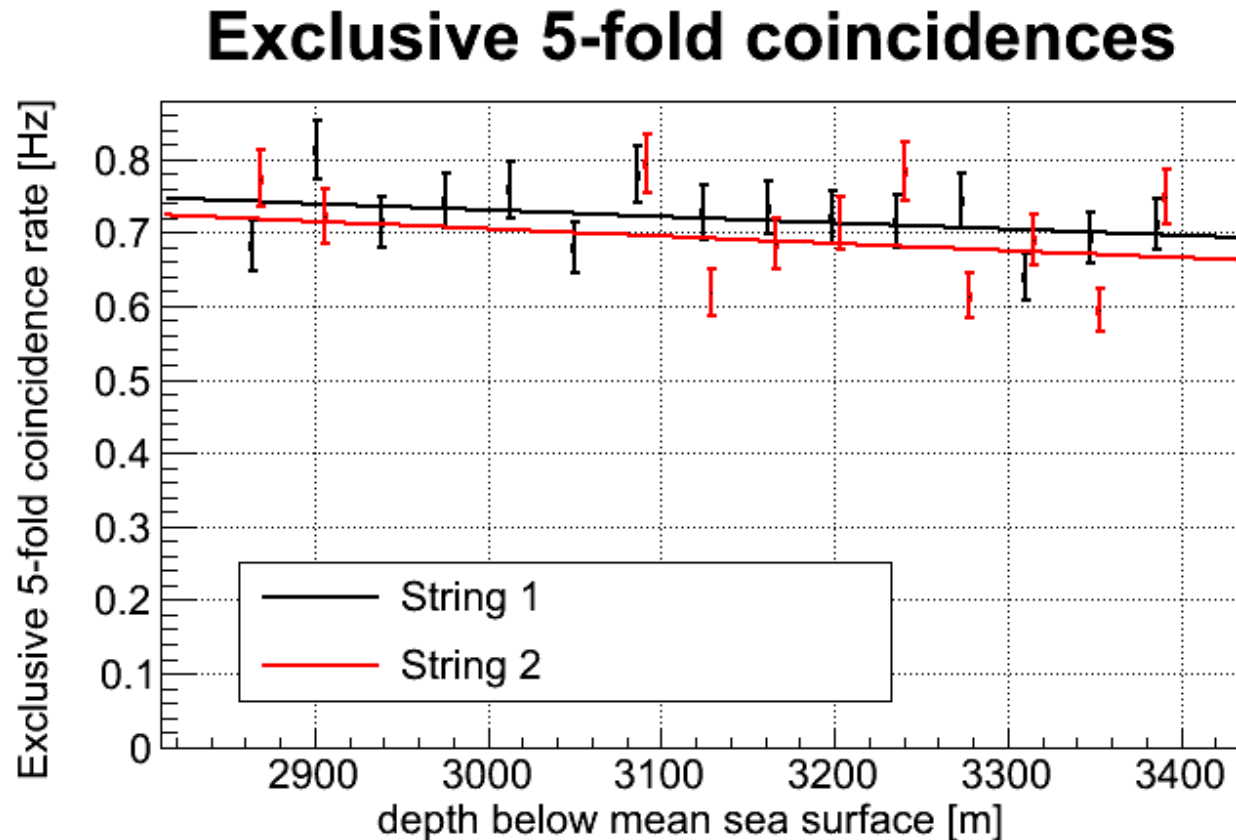
Exponential fit of depth dependence



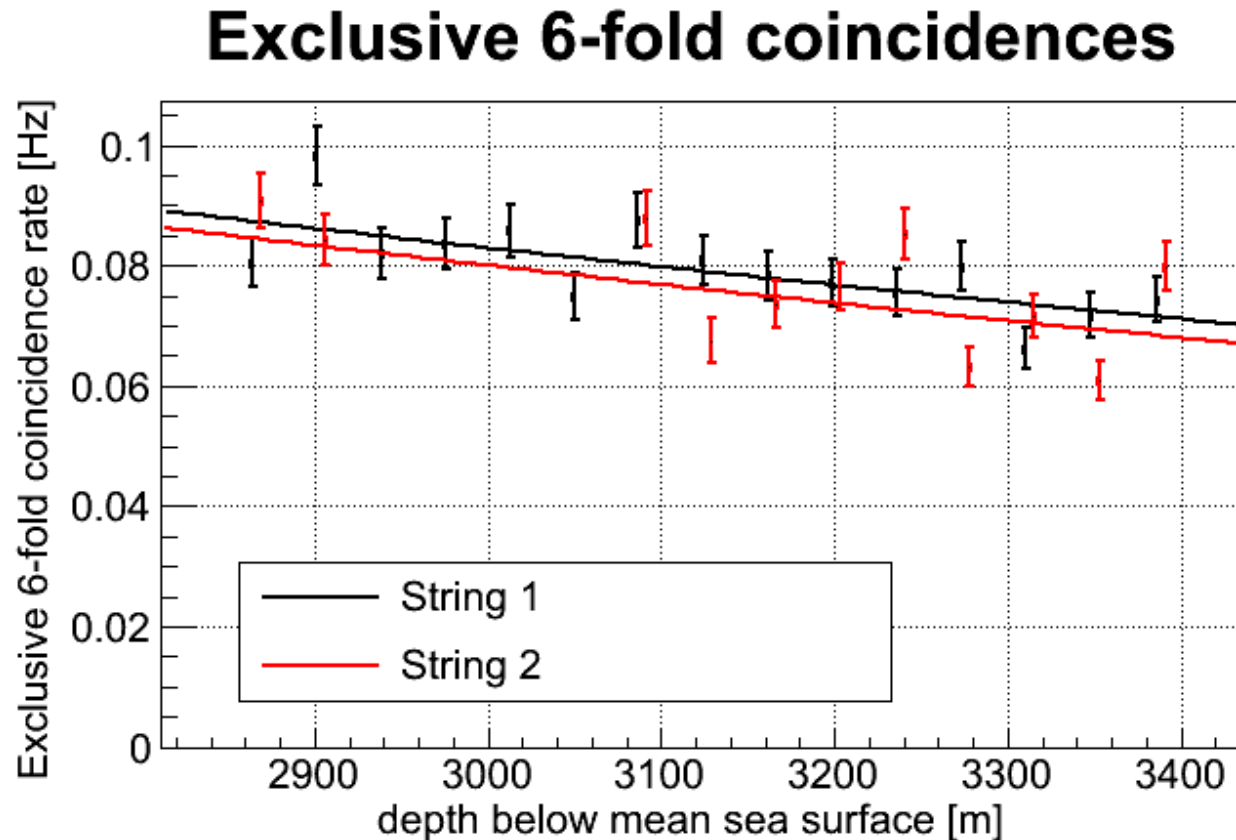
Exponential fit of depth dependence



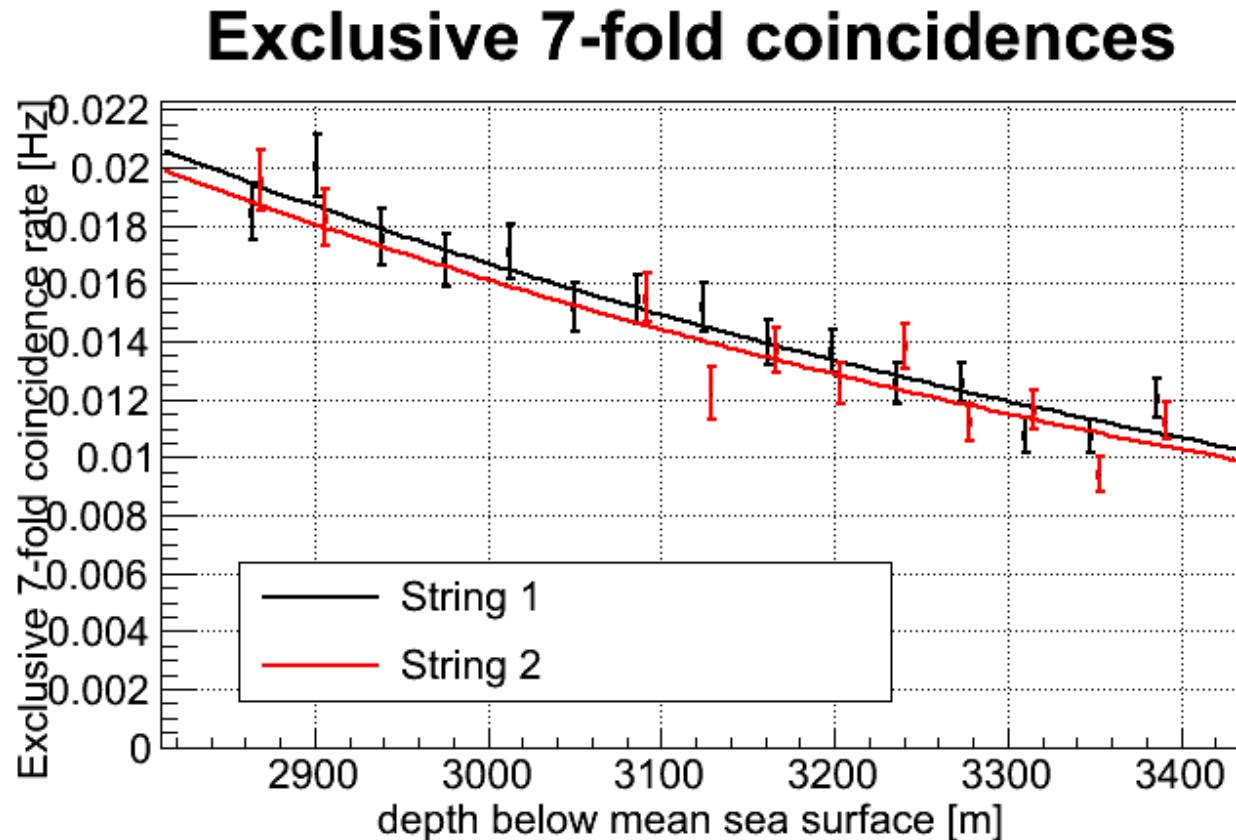
Exponential fit of depth dependence



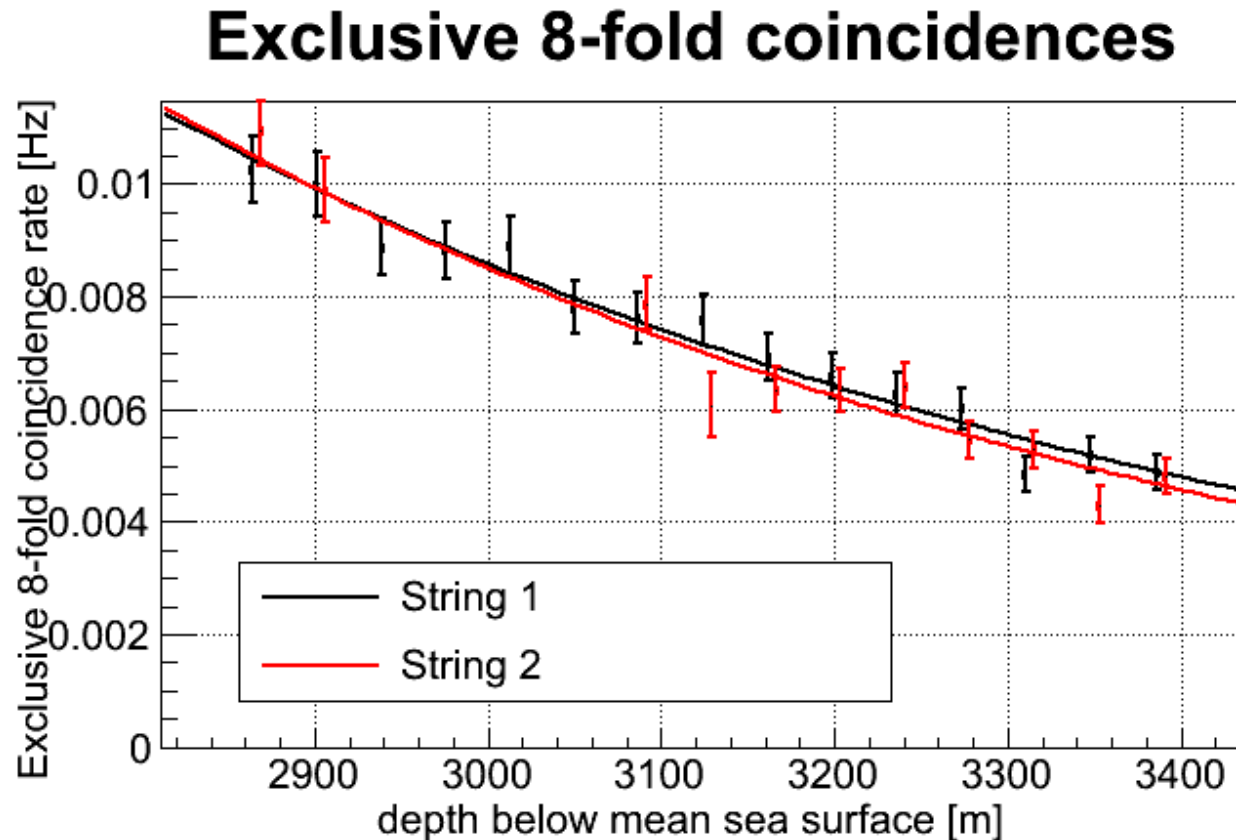
Exponential fit of depth dependence



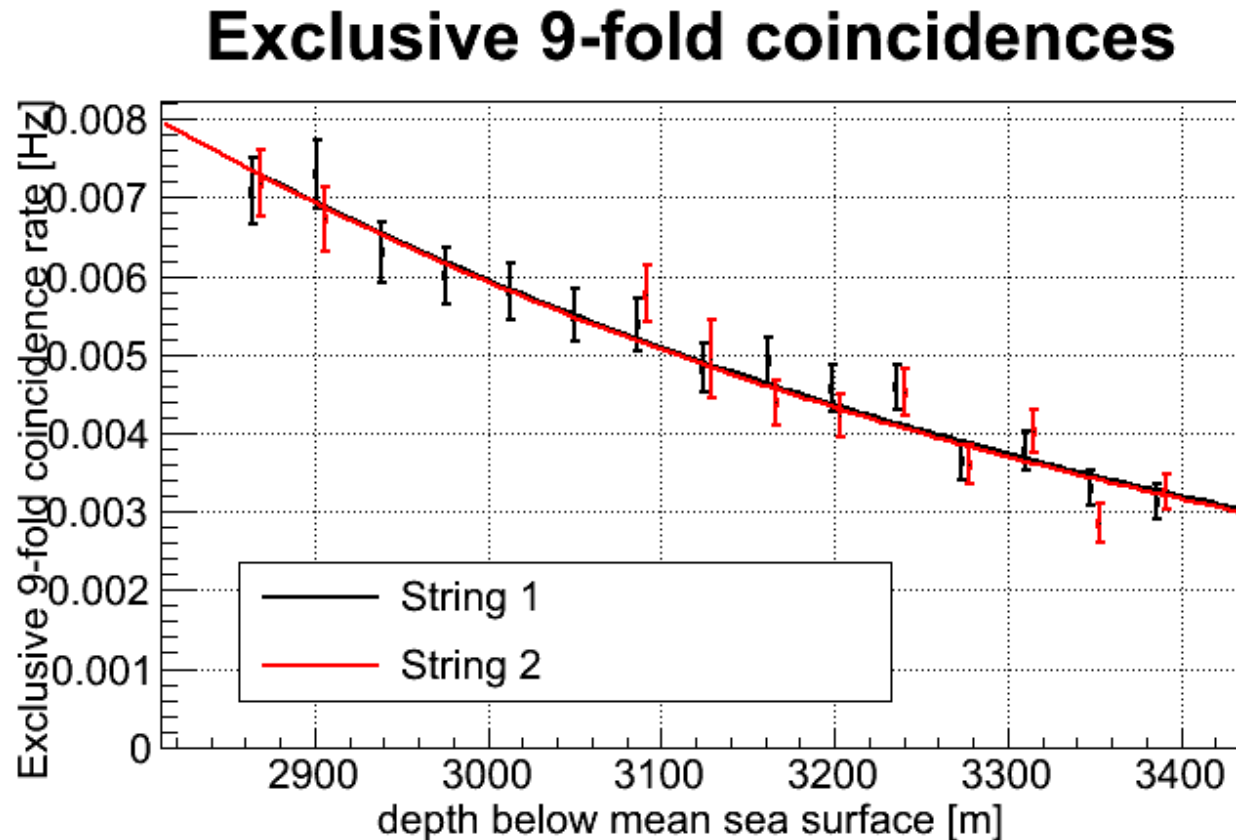
Exponential fit of depth dependence



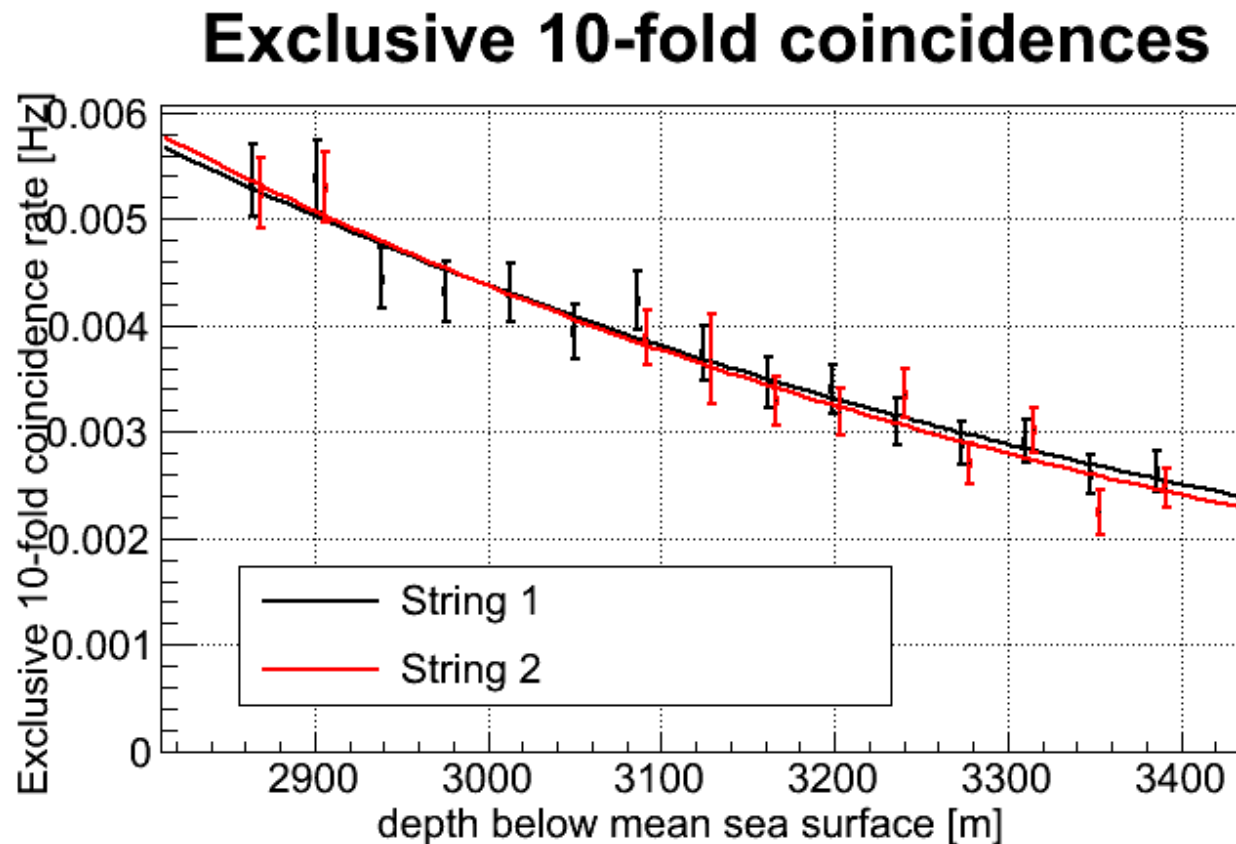
Exponential fit of depth dependence



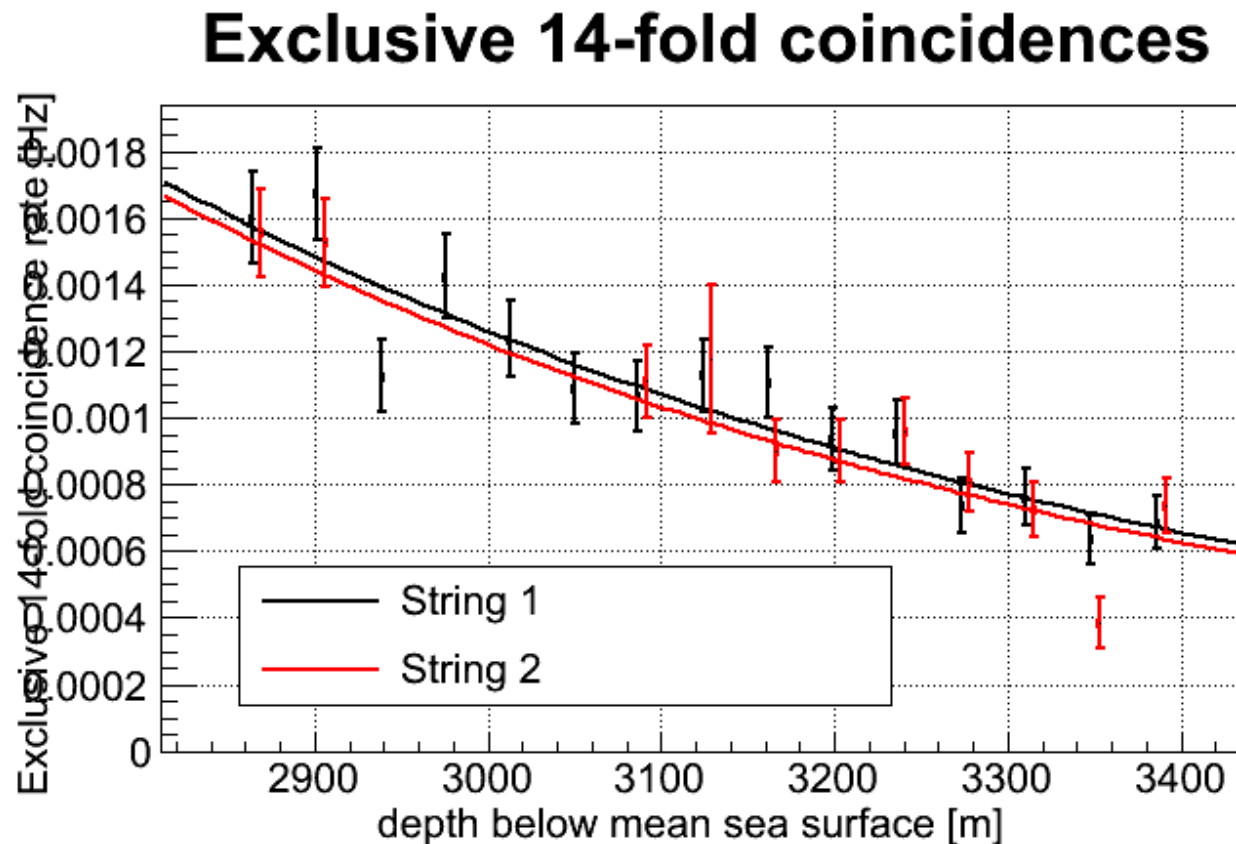
Exponential fit of depth dependence



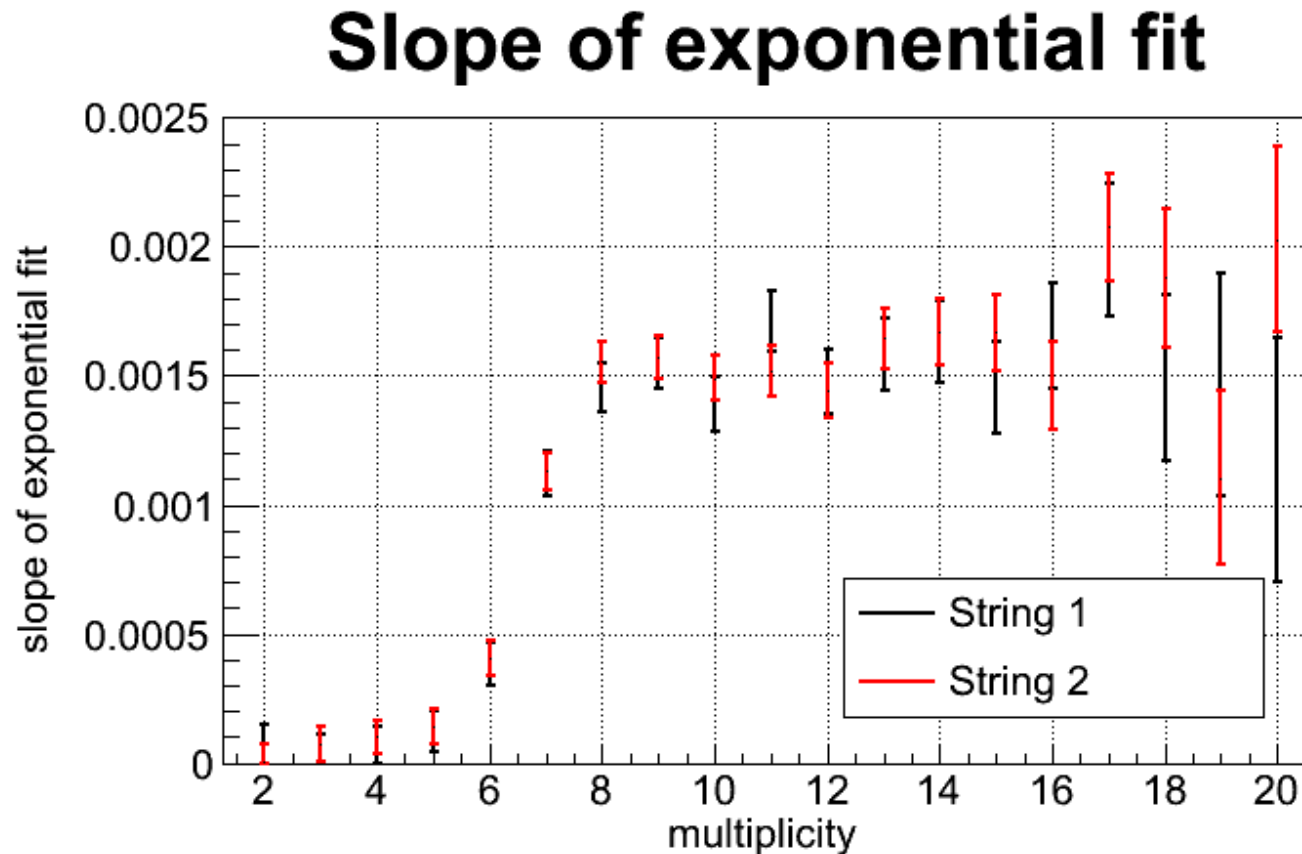
Exponential fit of depth dependence



Exponential fit of depth dependence

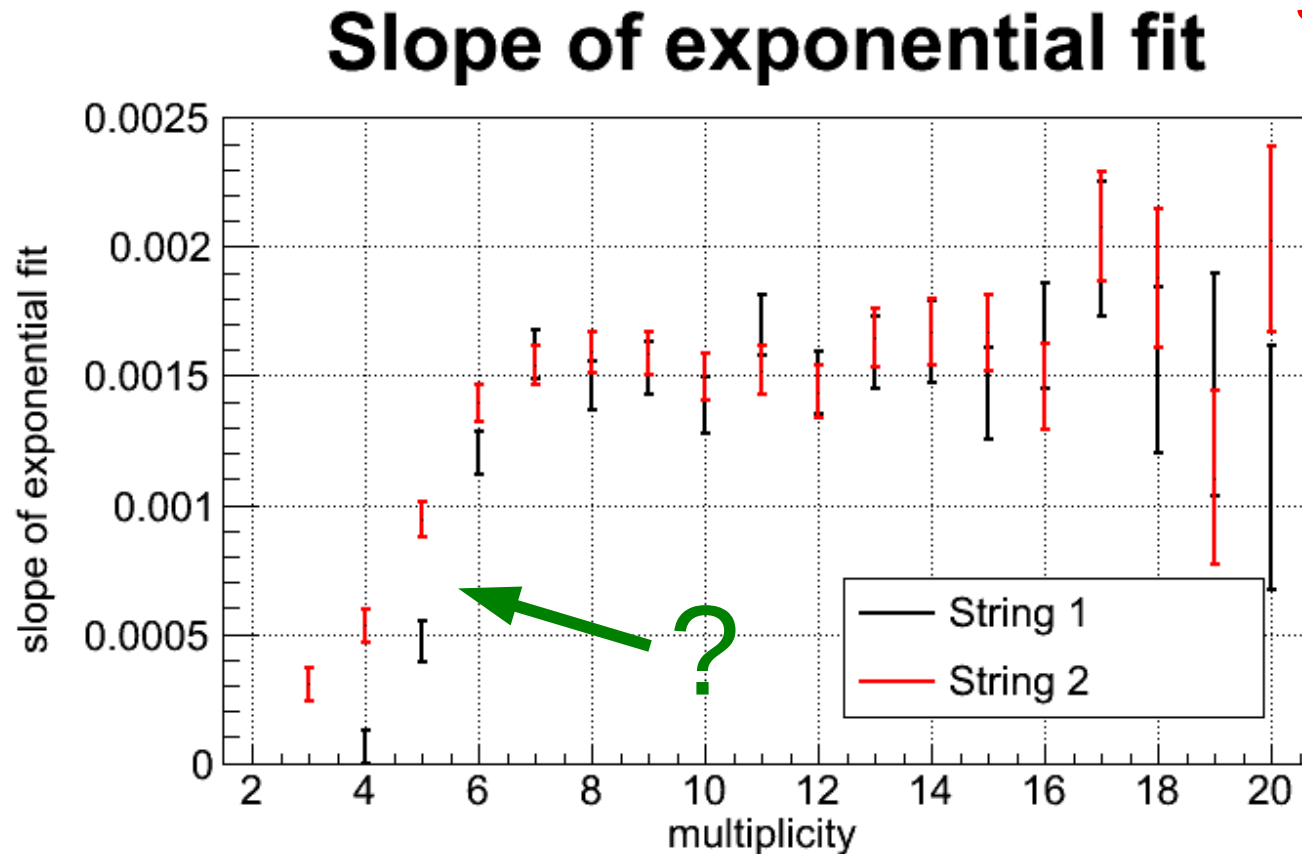


Exponential fit of depth dependence

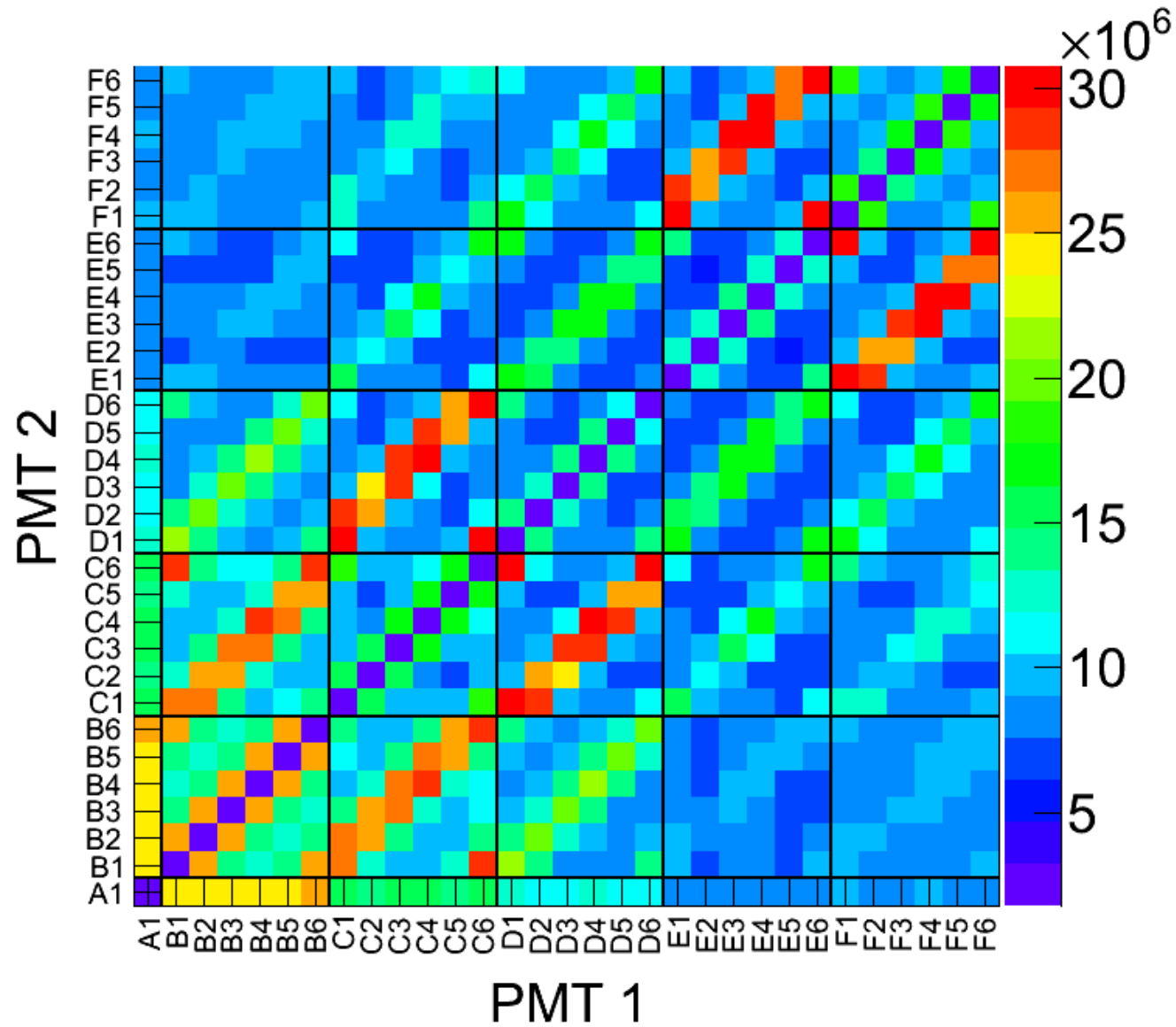


Exponential fit of depth dependence

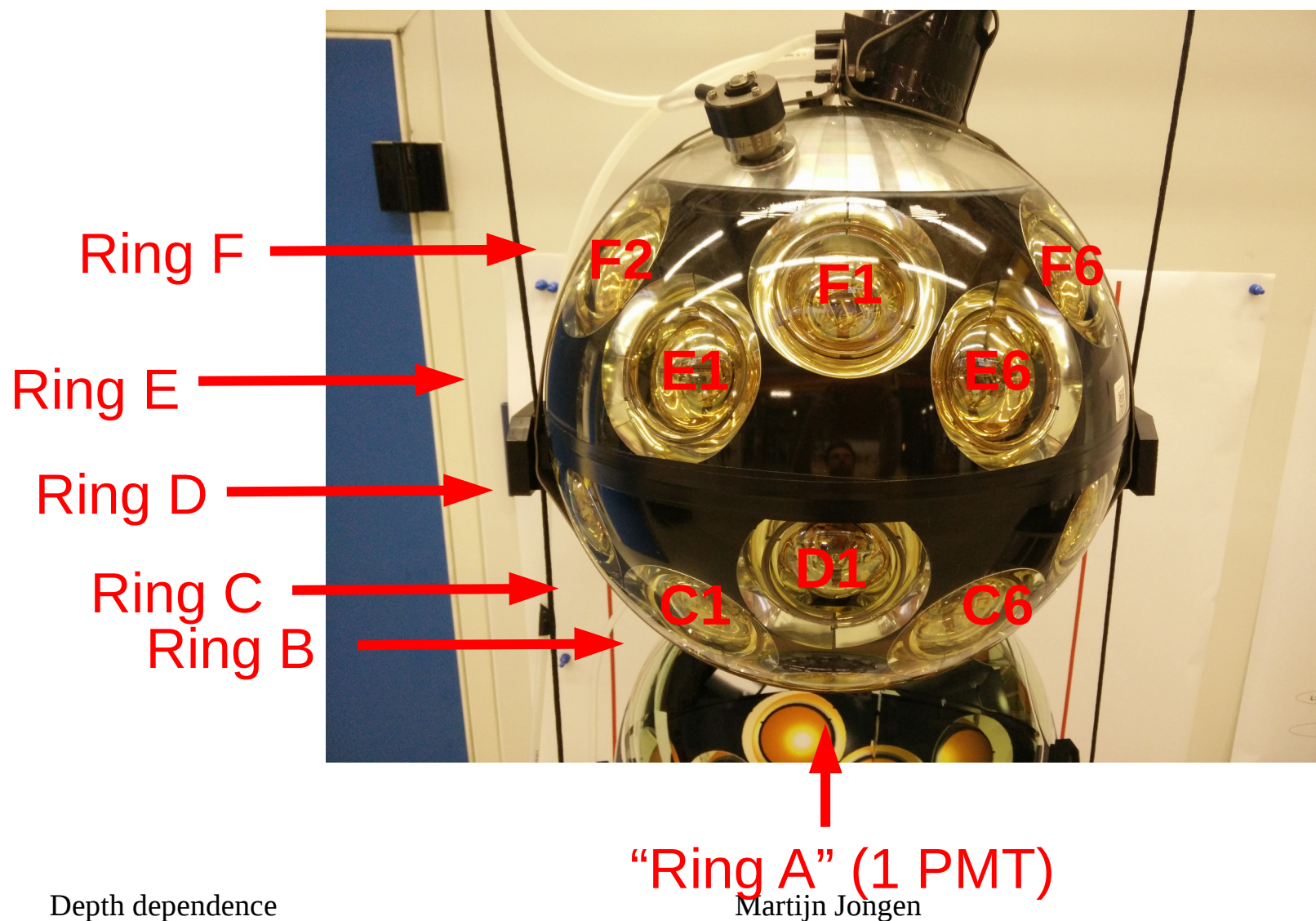
Requiring at least
3 hits in top half of
DOM



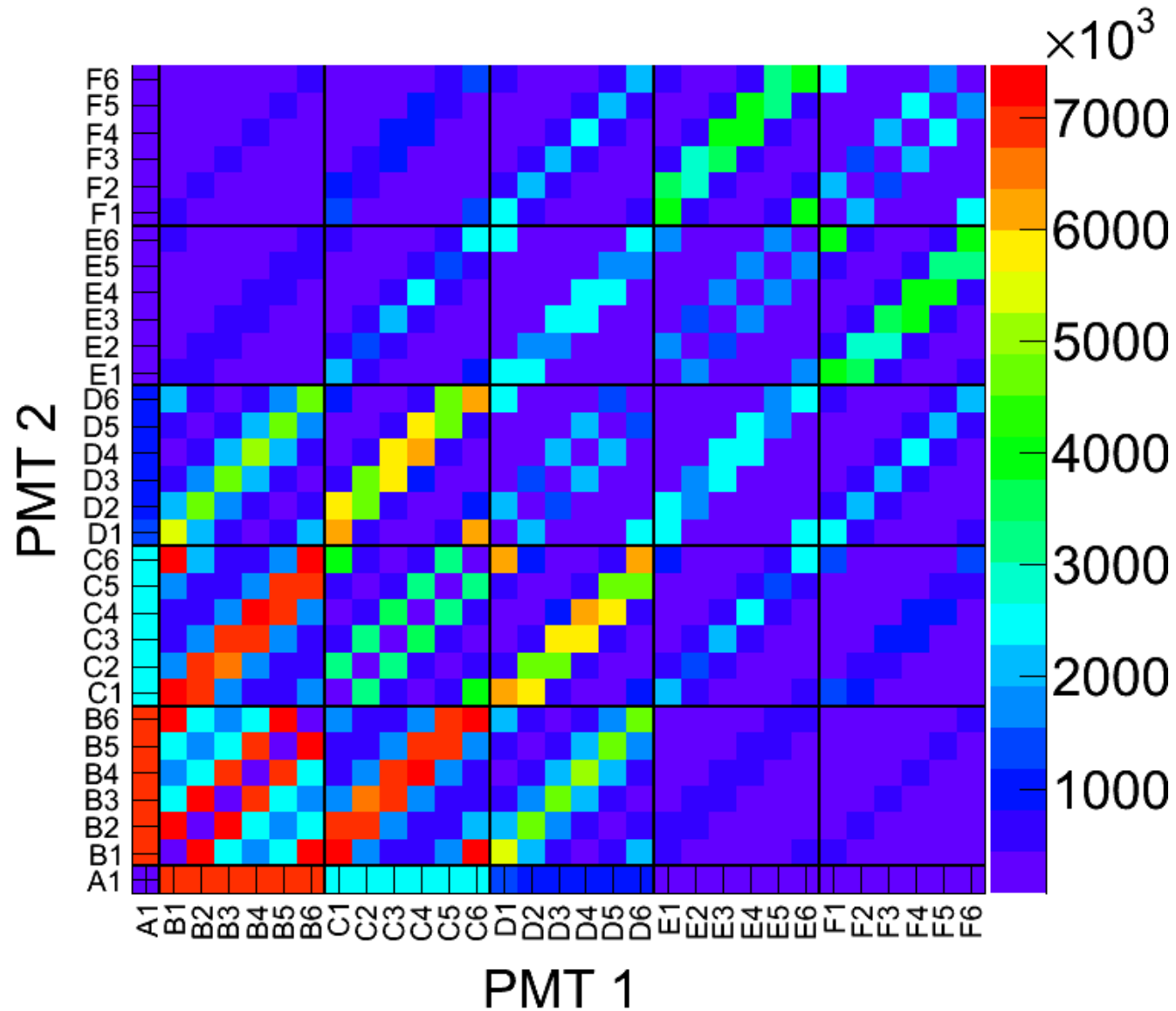
Exclusive 2-fold coincidences



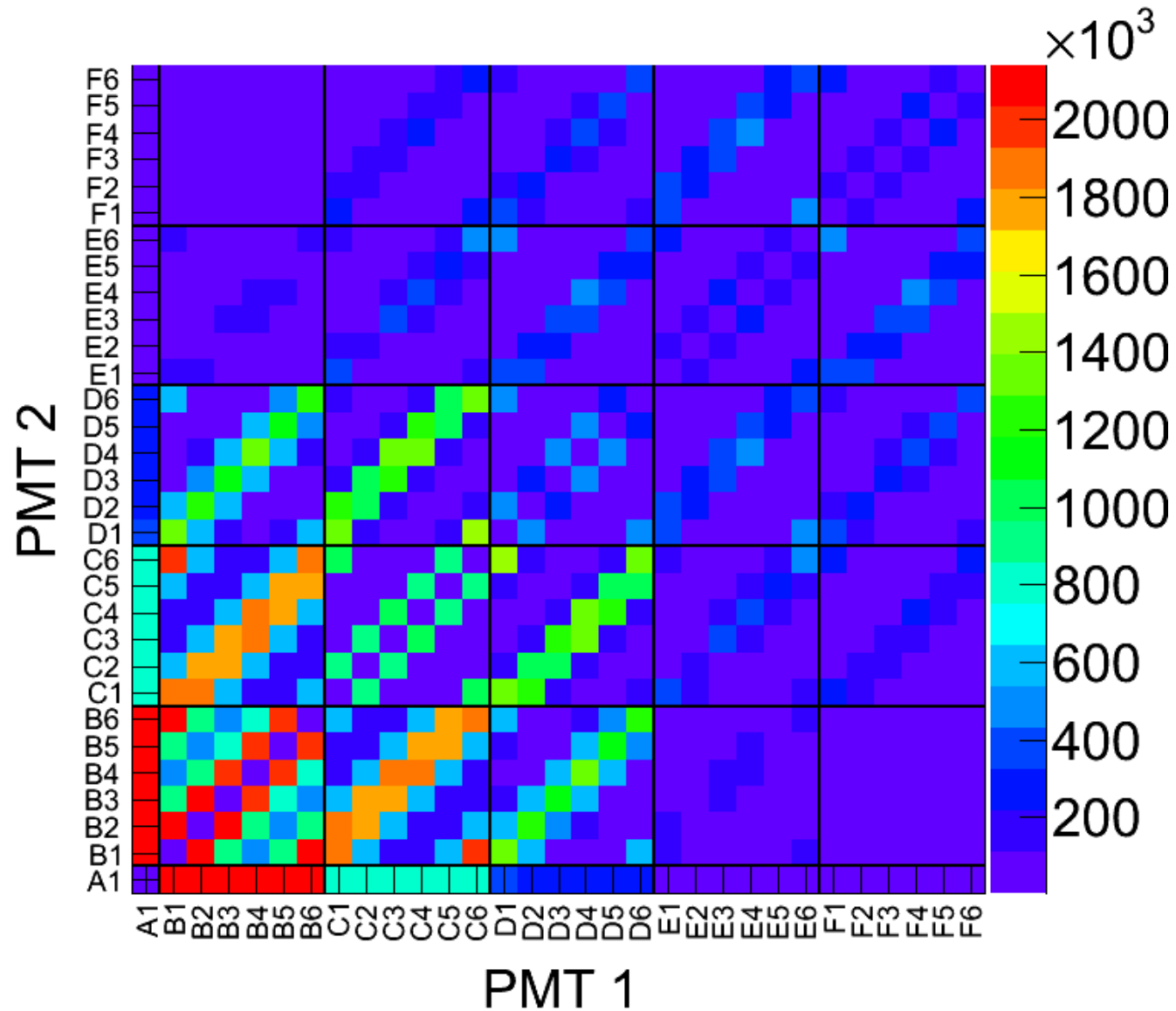
Reminder: PMT numbering



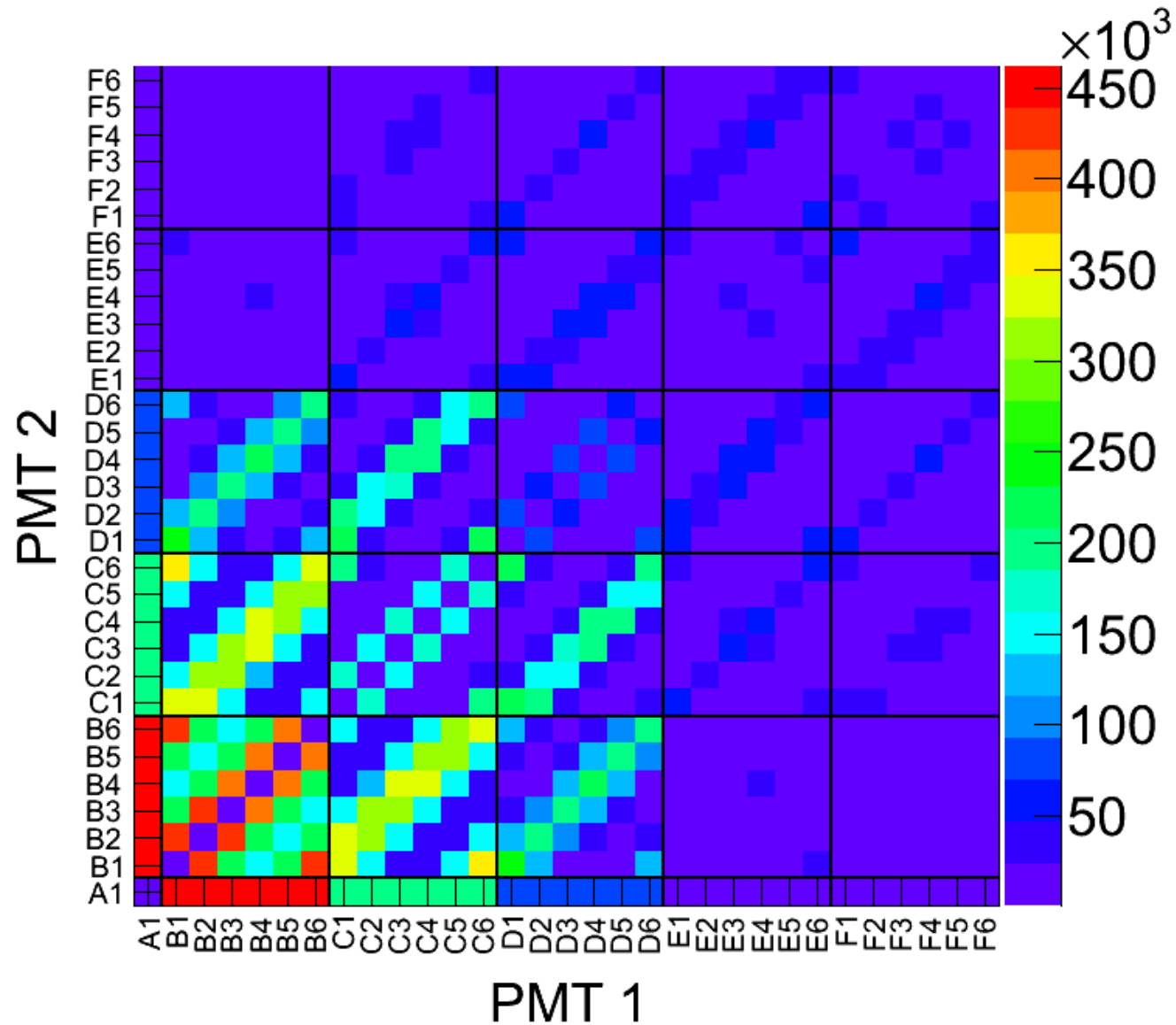
Exclusive 3-fold coincidences



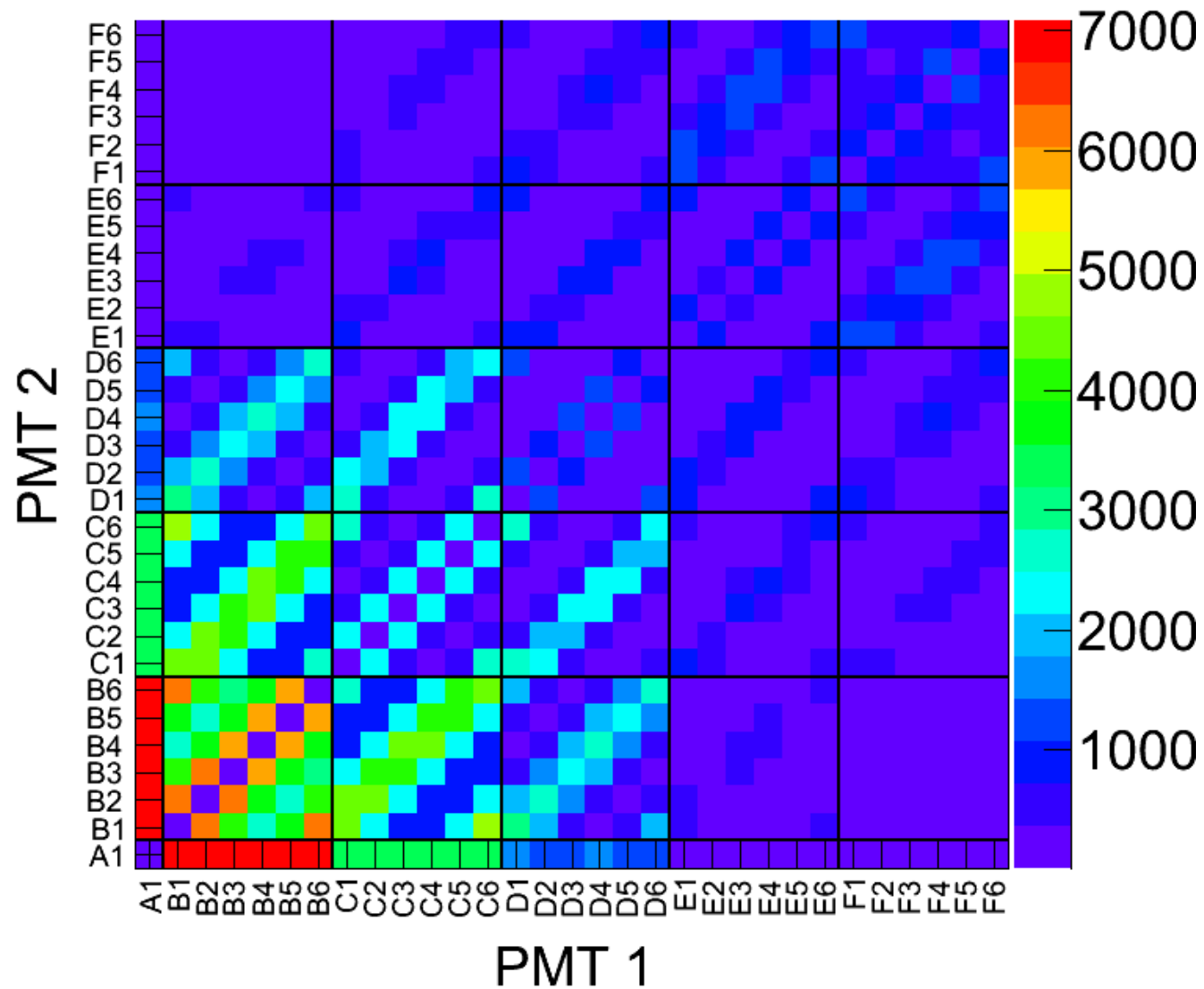
Exclusive 4-fold coincidences



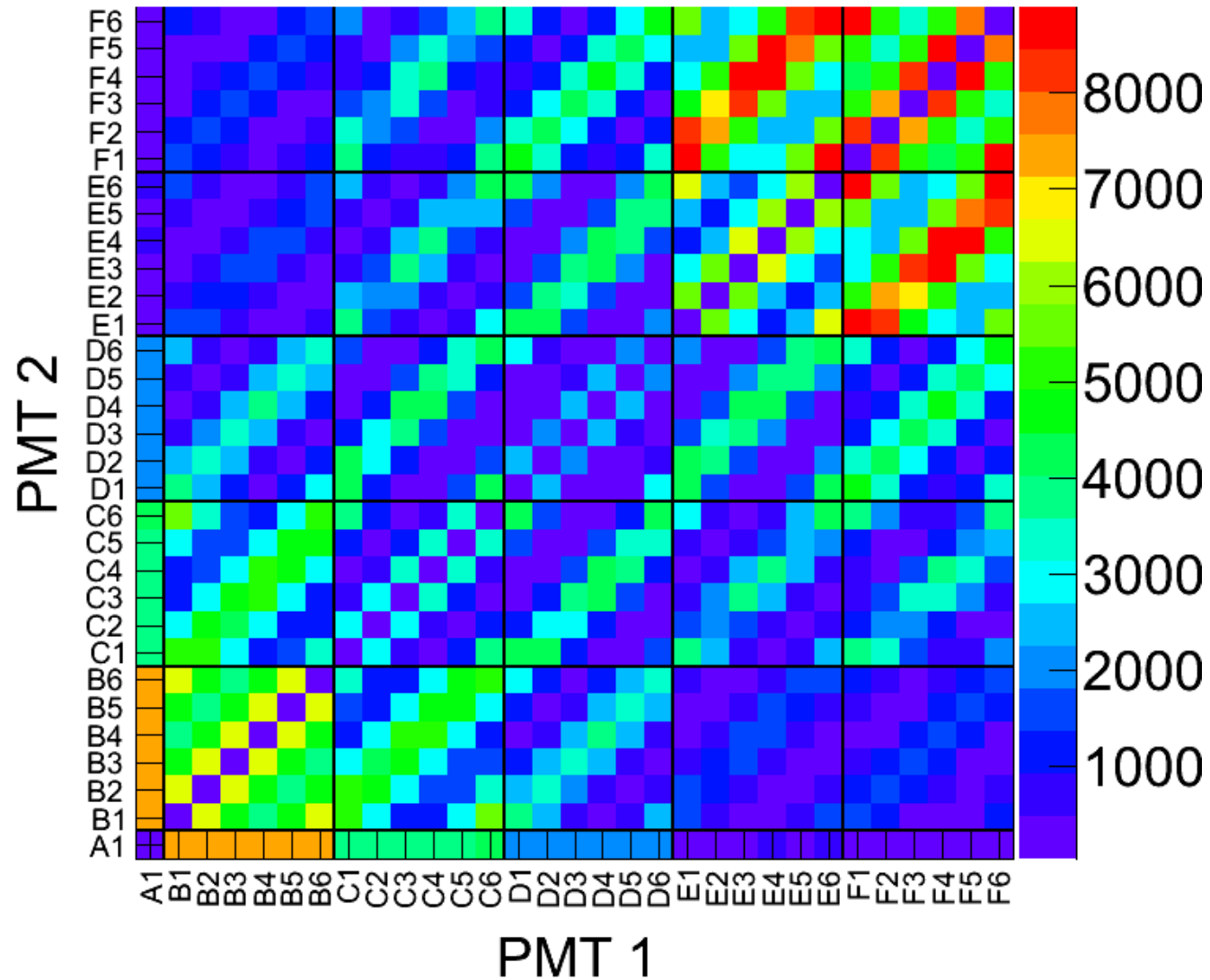
Exclusive 5-fold coincidences



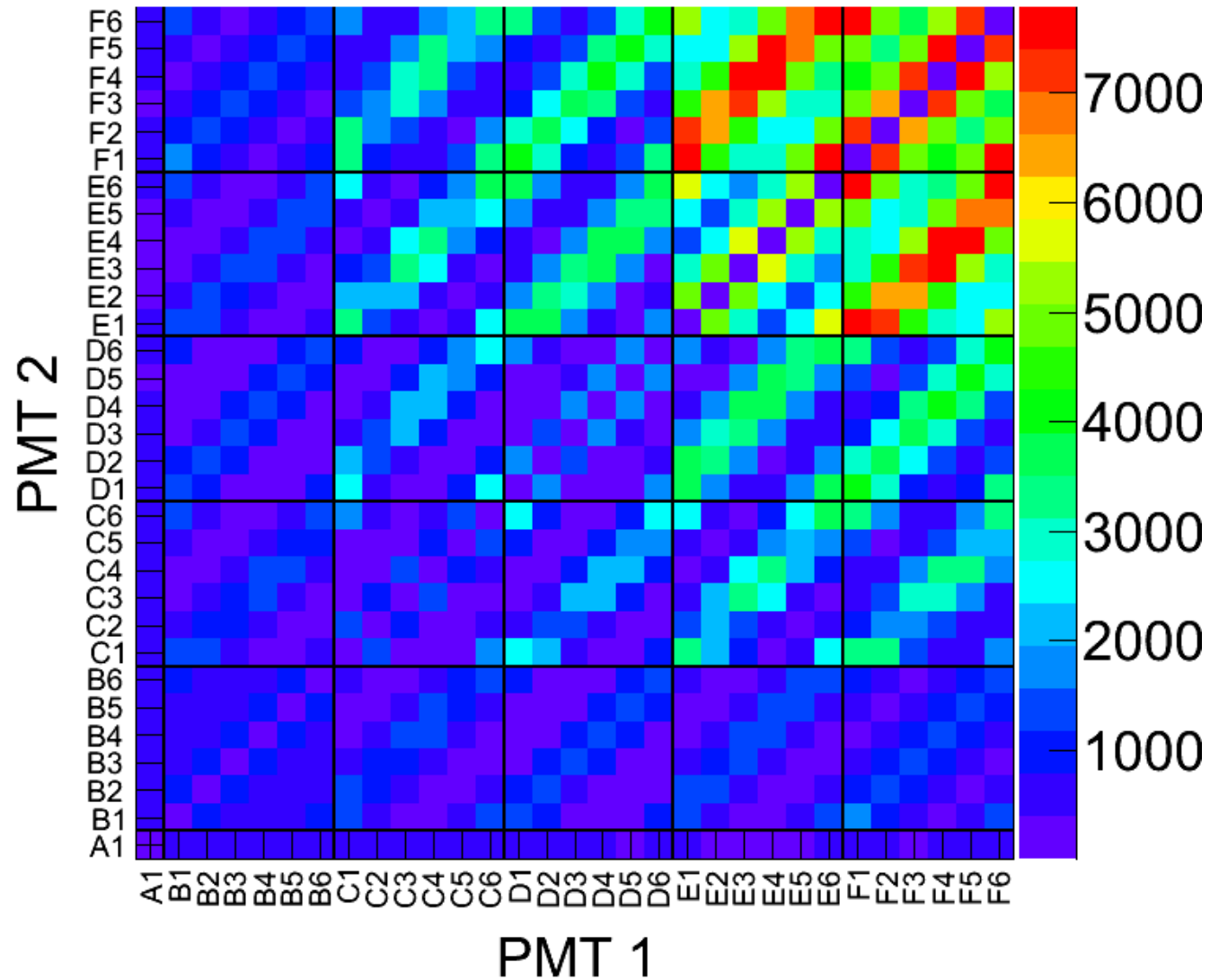
Exclusive 6-fold coincidences



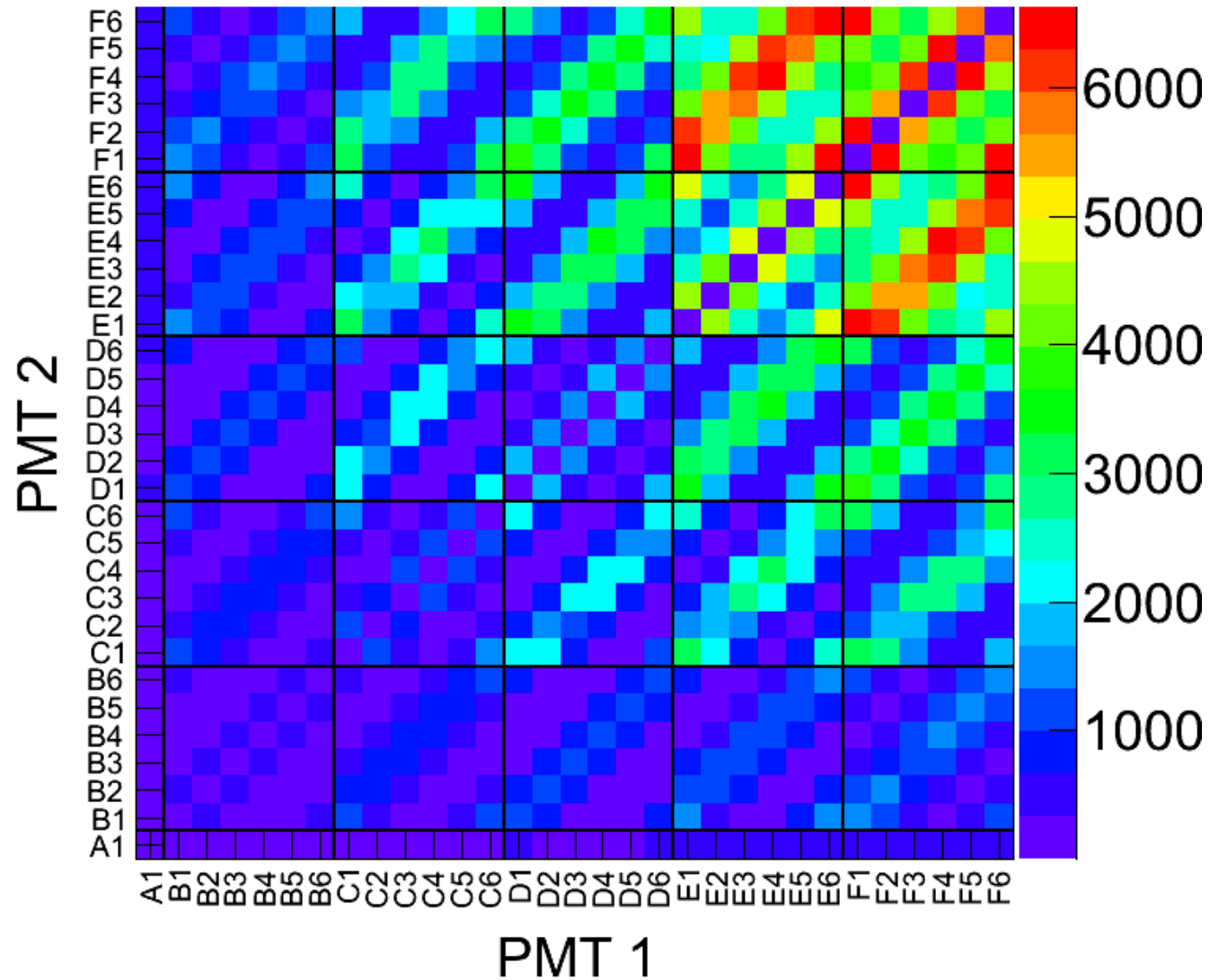
Exclusive 7-fold coincidences



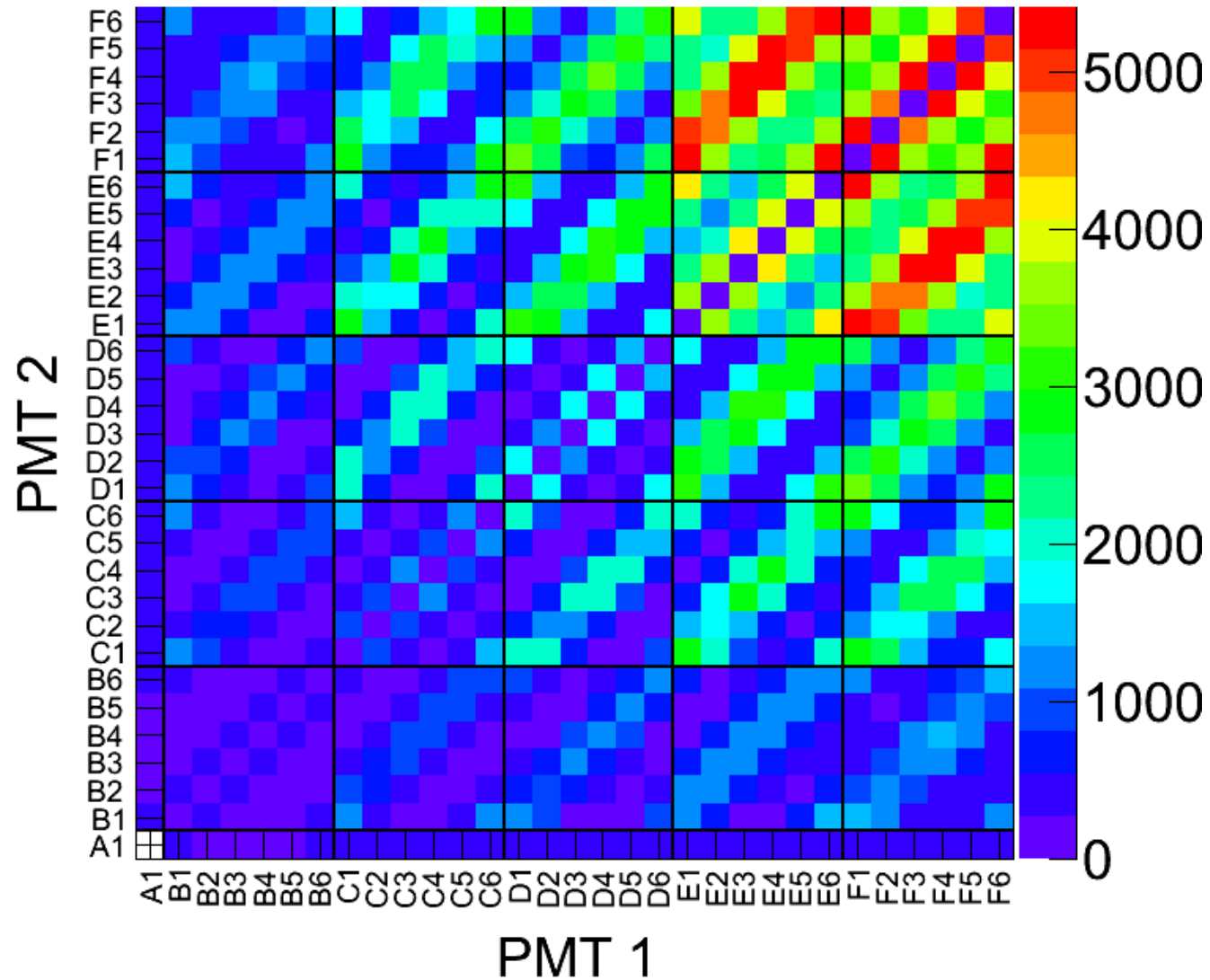
Exclusive 8-fold coincidences



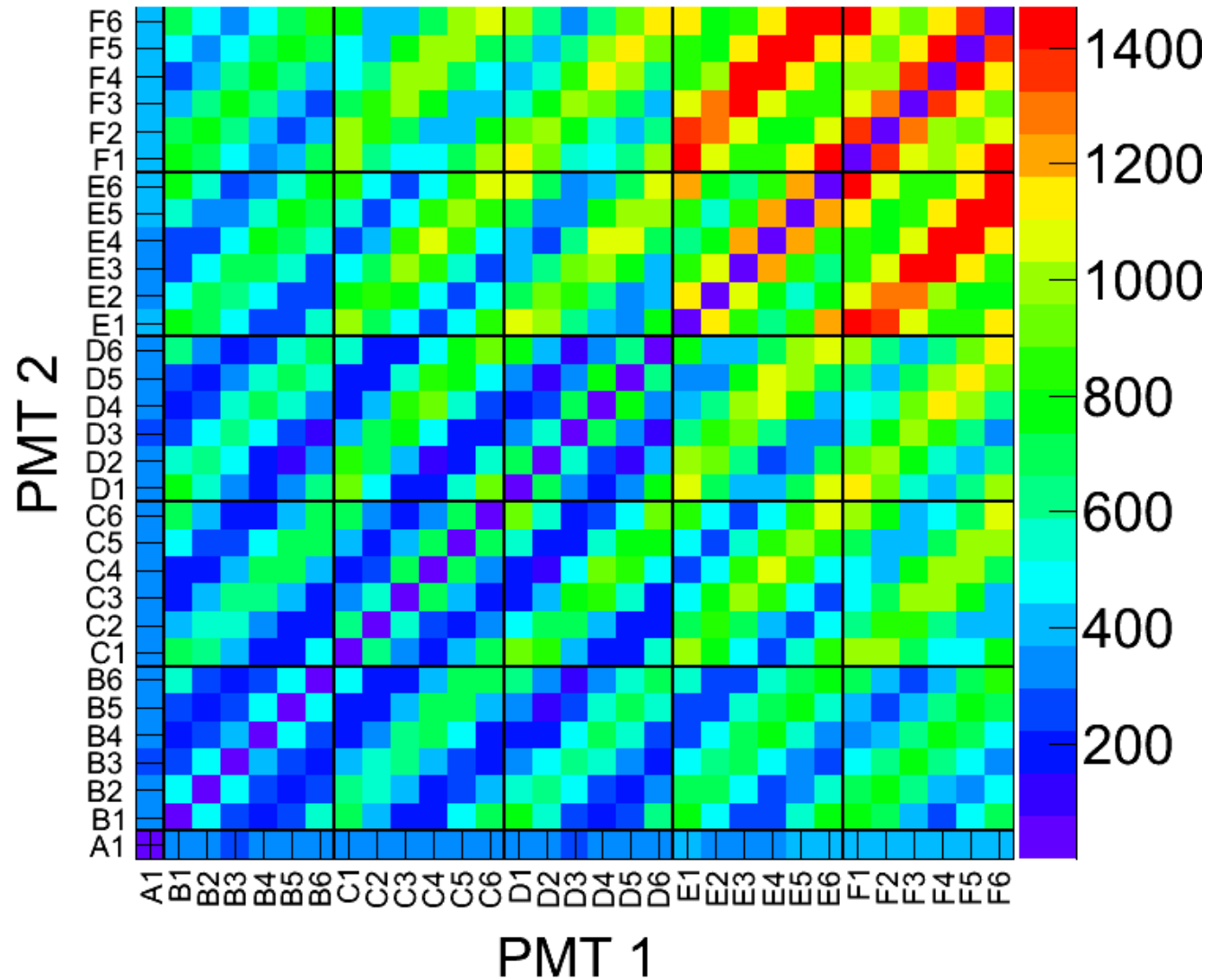
Exclusive 9-fold coincidences



Exclusive 10-fold coincidences



Exclusive 15-fold coincidences

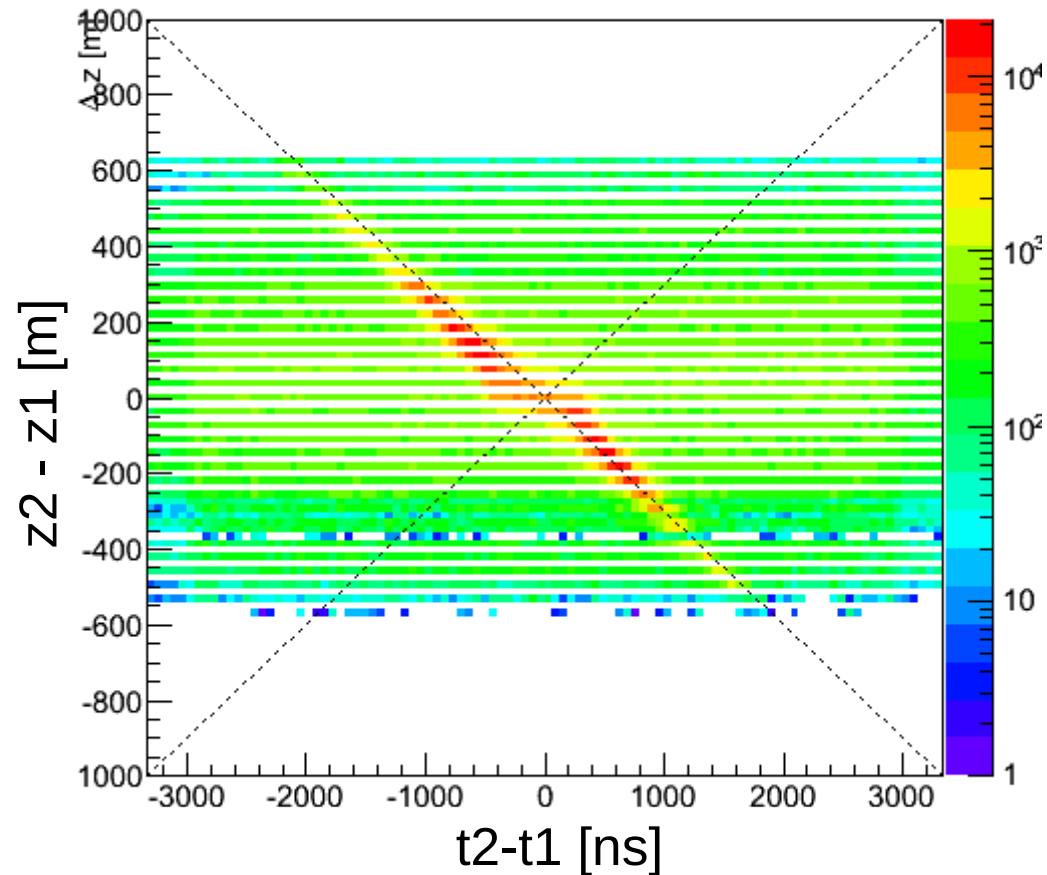


Inter-DOM coincidences

- Evidence that we are really seeing muons
- Retriggered files with JTriggerProcessor
 - $L2_{\min} = 8$
- Then, for each pair of snapshot hits on different DOMs, I plot Δz versus Δt
- Several runs (2-4 august, 19 october)

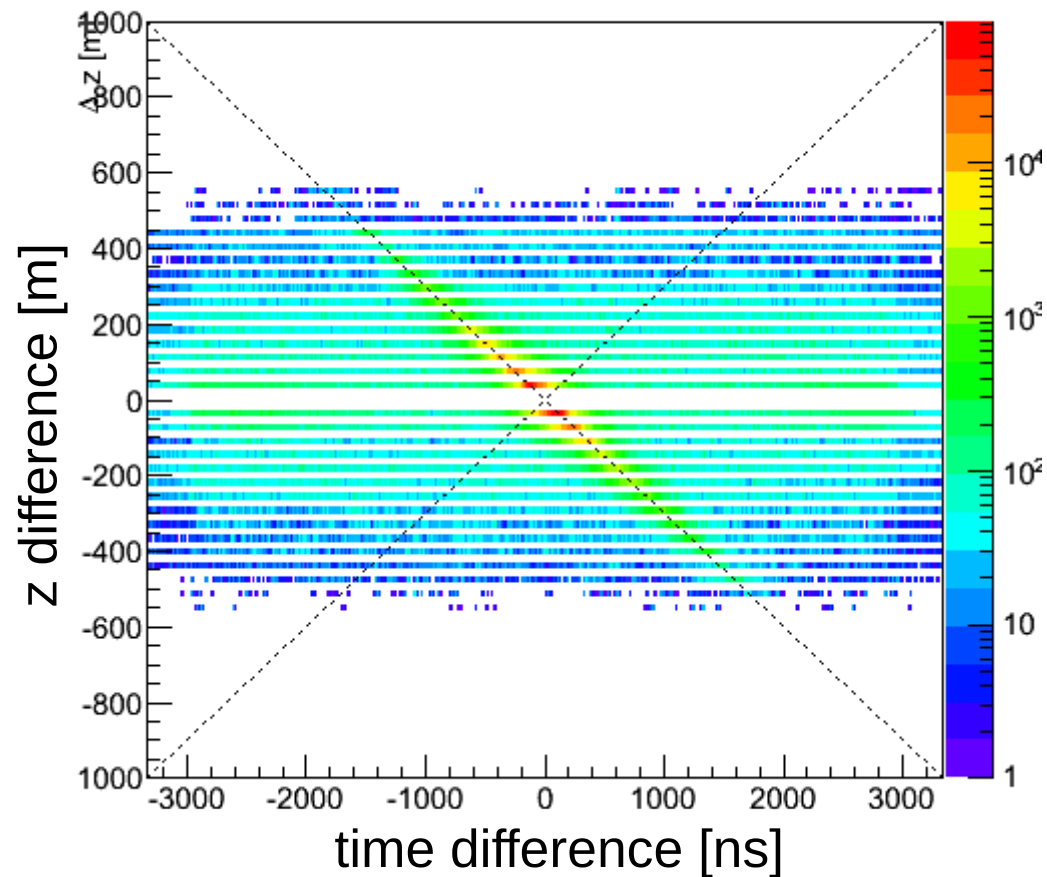
Inter-DOM coincidences

Hit pairs on ARCA-DU1 and ARCA-DU2

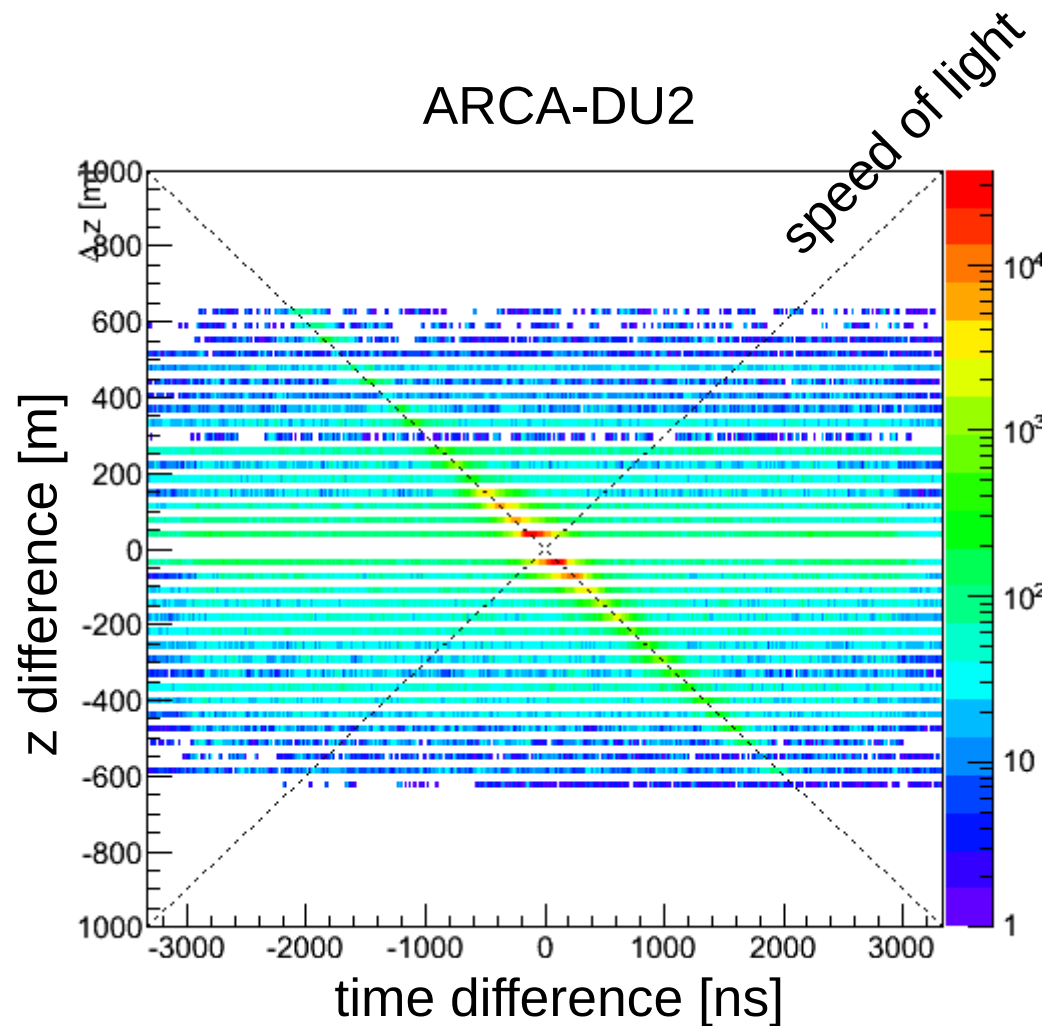


Inter-DOM coincidences

ARCA-DU1



Inter-DOM coincidences



Inter-DOM coincidences

Hit pairs on ARCA-DU1 and ARCA-DU2

