Light and clarity in KM3NeT

Jordan Seneca

My goal for this presentation

Inspire, stimulate questions and discussion

- Working towards a better ARCA res
- What I find exciting about my work
- How to convey excitement to others

- Working towards a better ARCA res
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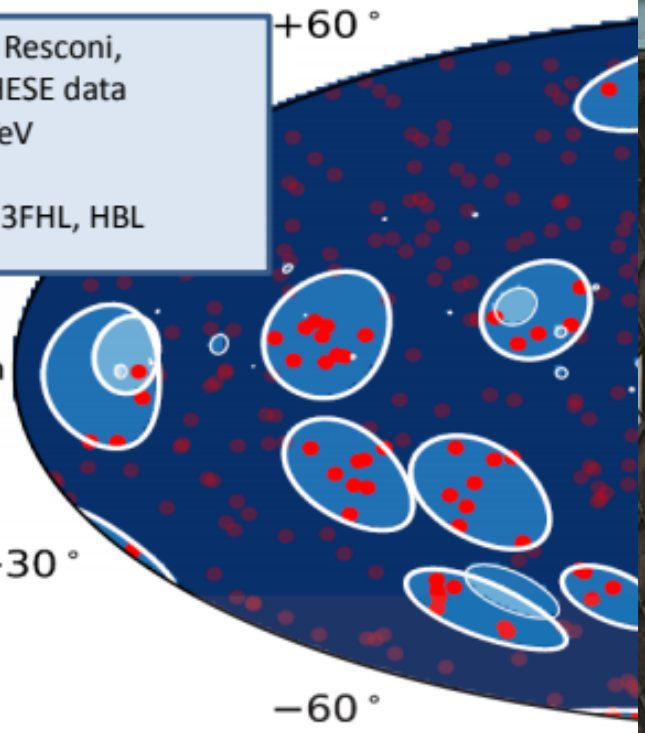
Last year, in Dalfsen

Resolution is key

From E. Resconi,
6 year HESE data
E > 60 TeV
Θ<20°
Points : 3FHL, HBL



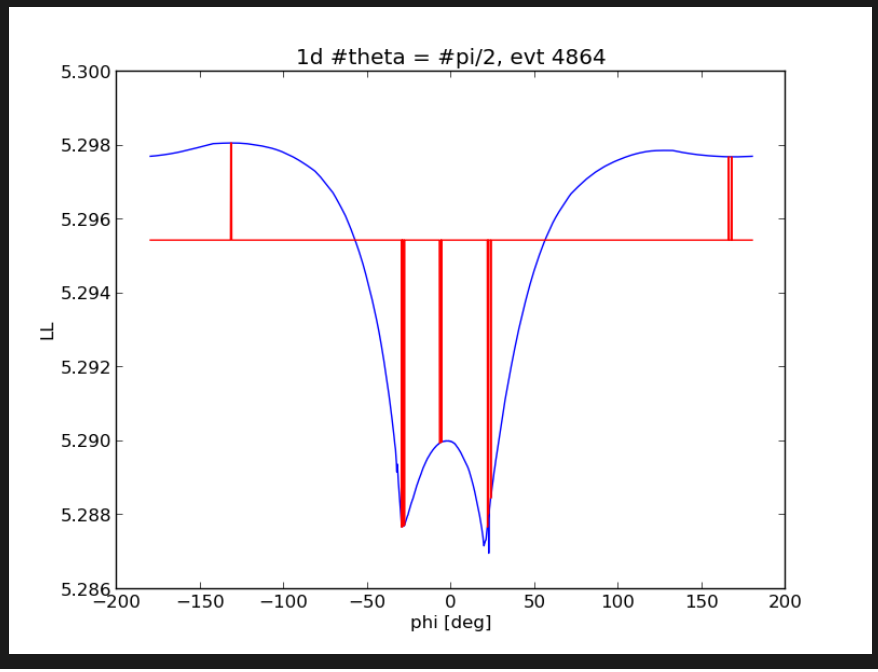
Resolution f
ANTARES
KM3NeT

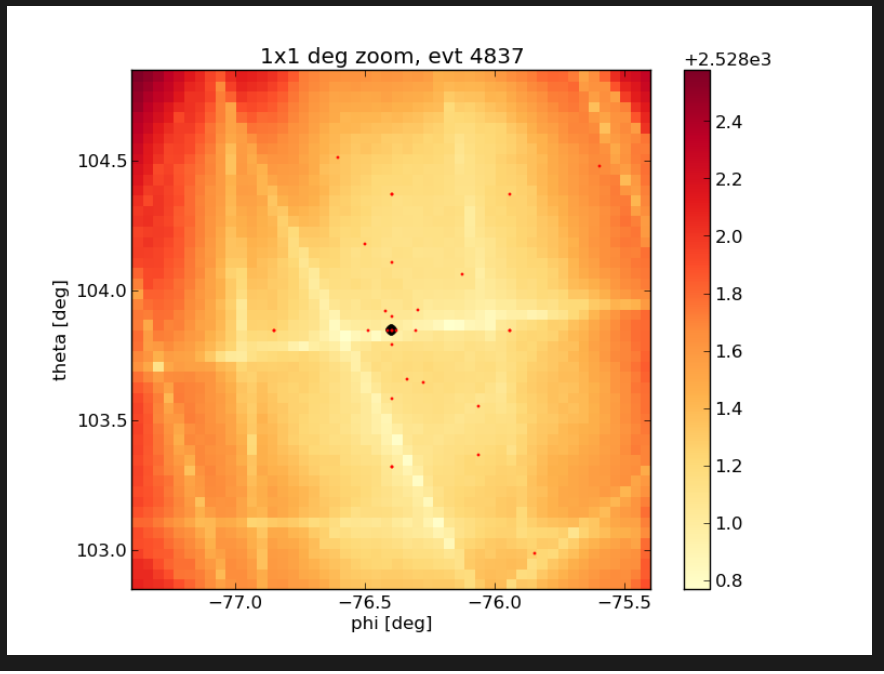
Current reconstruction Aanet PDFs

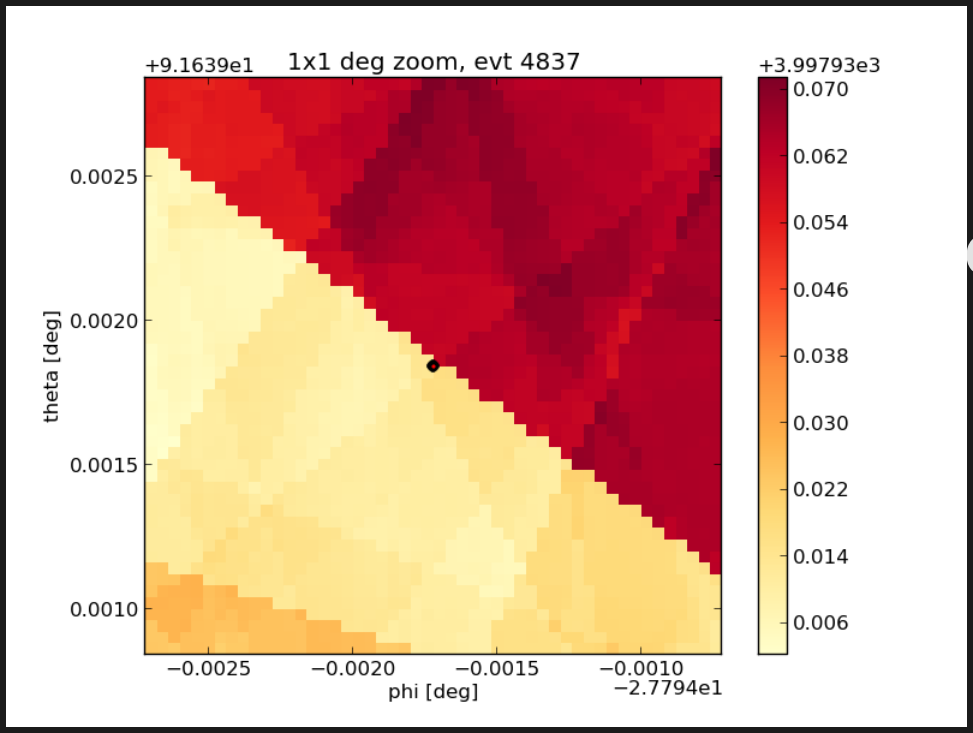
PMT position
1 PMT direction
Reception angle

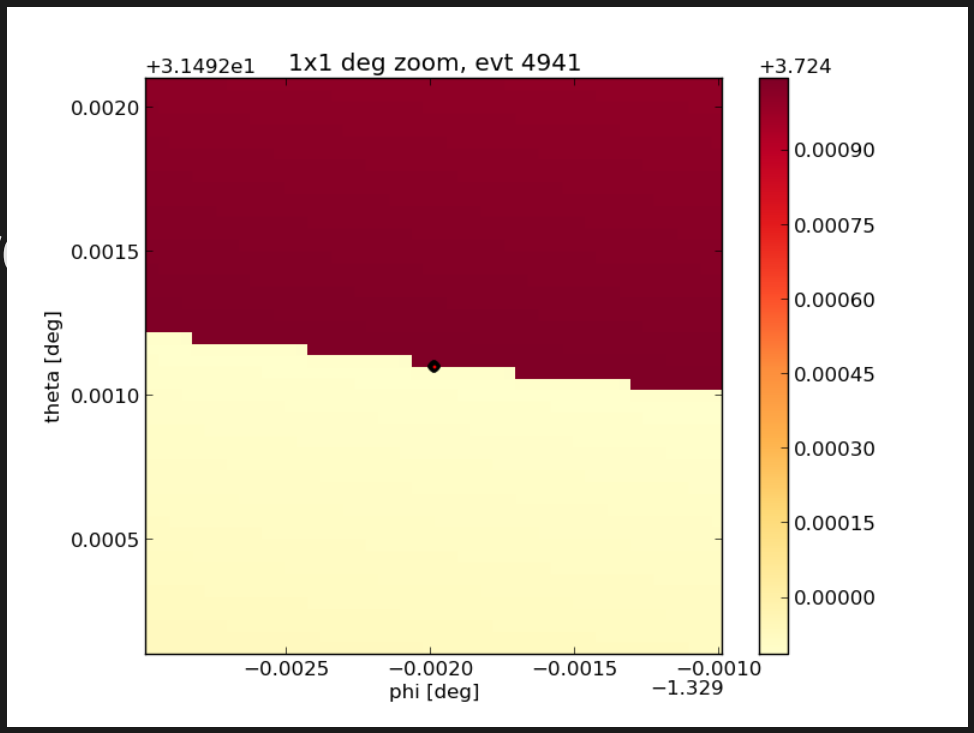
New reconstruction Jpp PDFs

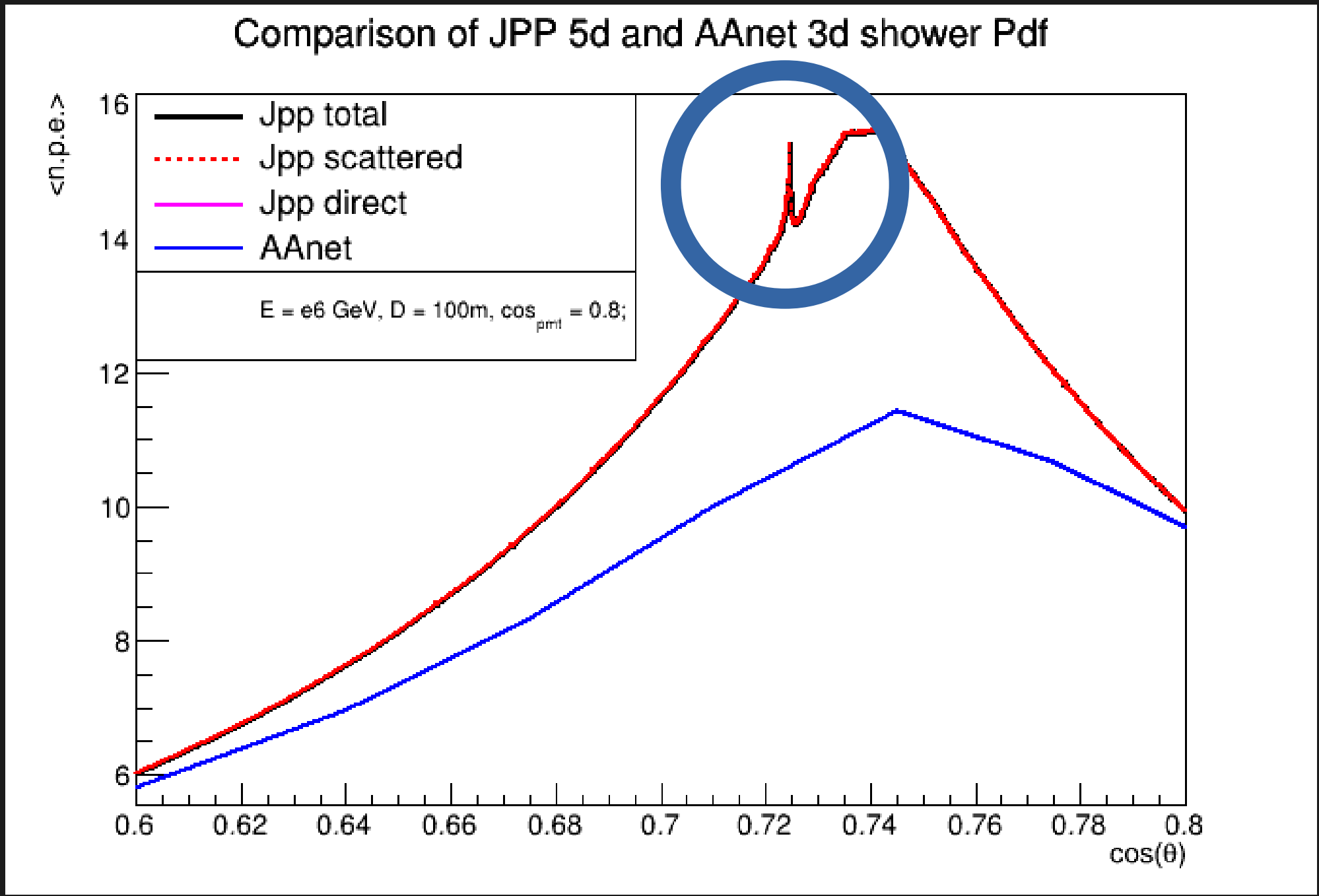
PMT position
2 PMT directions
Reception angle
Arrival time


1d #theta = #pi/2, evt 4864
LL
phi [deg]

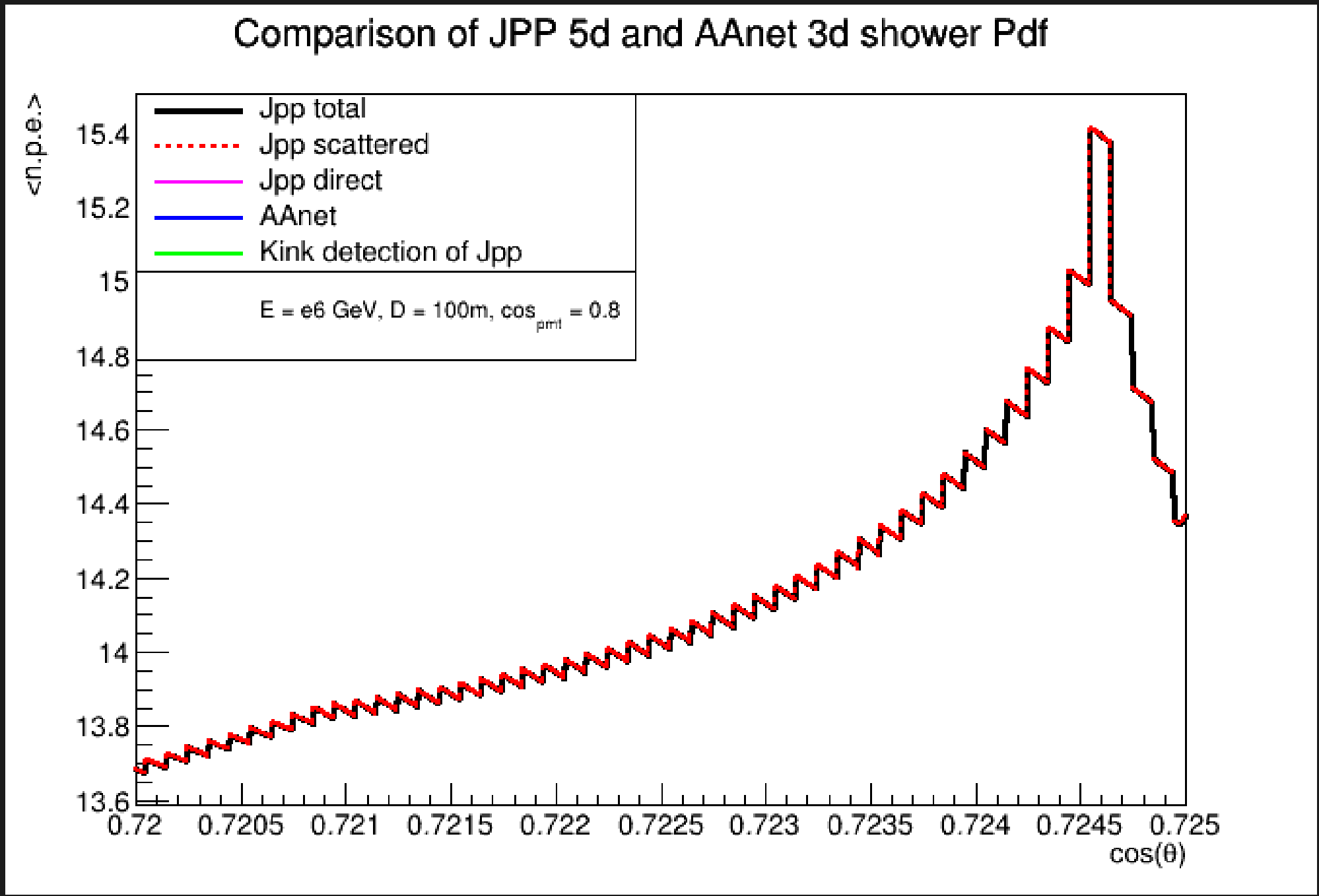

1x1 deg zoom, evt 4837
+2.528e3
theta [deg]
phi [deg]


+9.1639e1
1x1 deg zoom, evt 4837
+3.99793e3
theta [deg]
phi [deg]
−2.7794e1


+3.1492e1
1x1 deg zoom, evt 4941
+3.724
theta [deg]
phi [deg]
−1.329



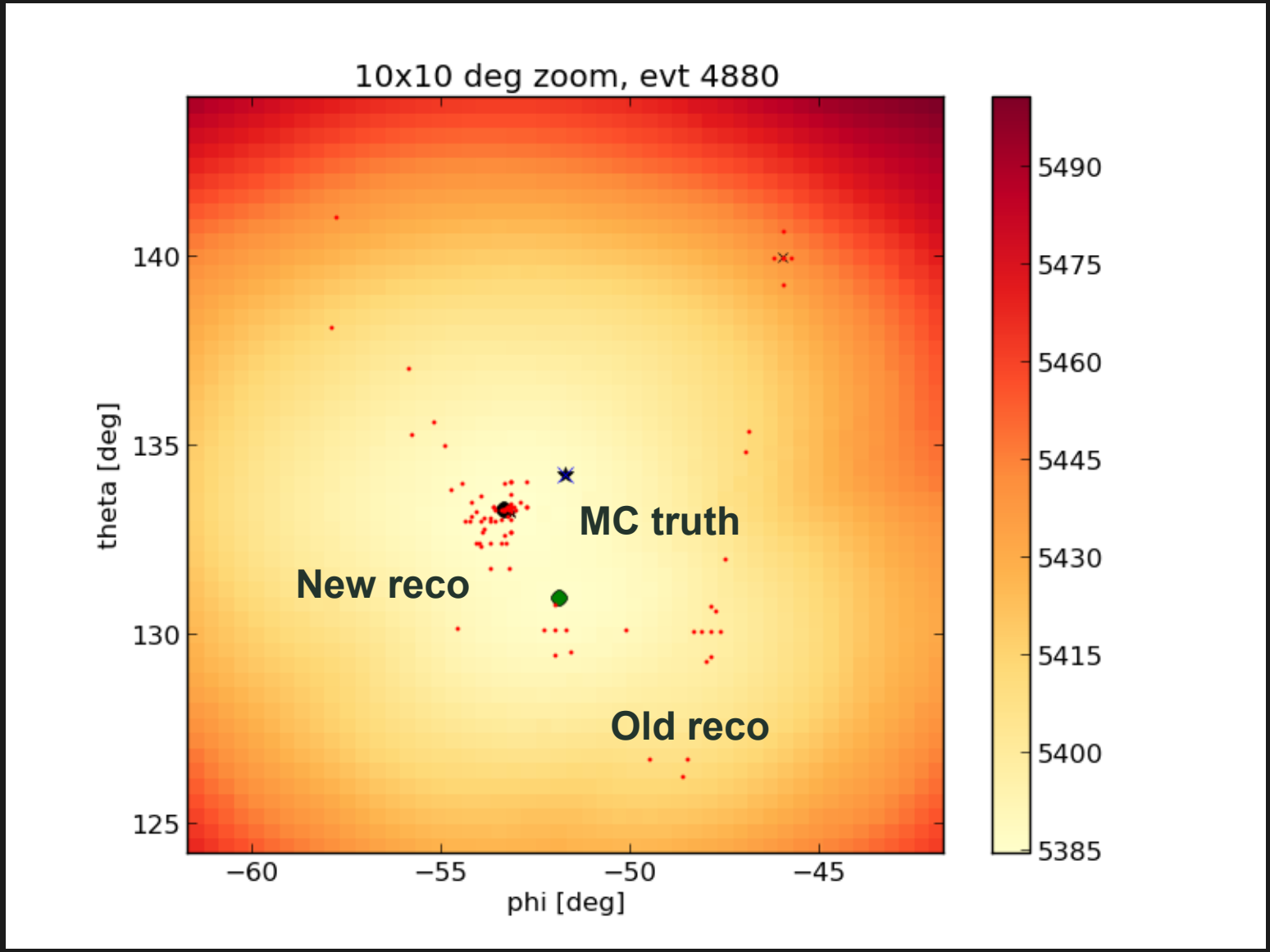
I found bugs in Jpp PDFs.



I found bugs in Jpp PDFs.

Bugs have now been fixed!

Thank you Maarten



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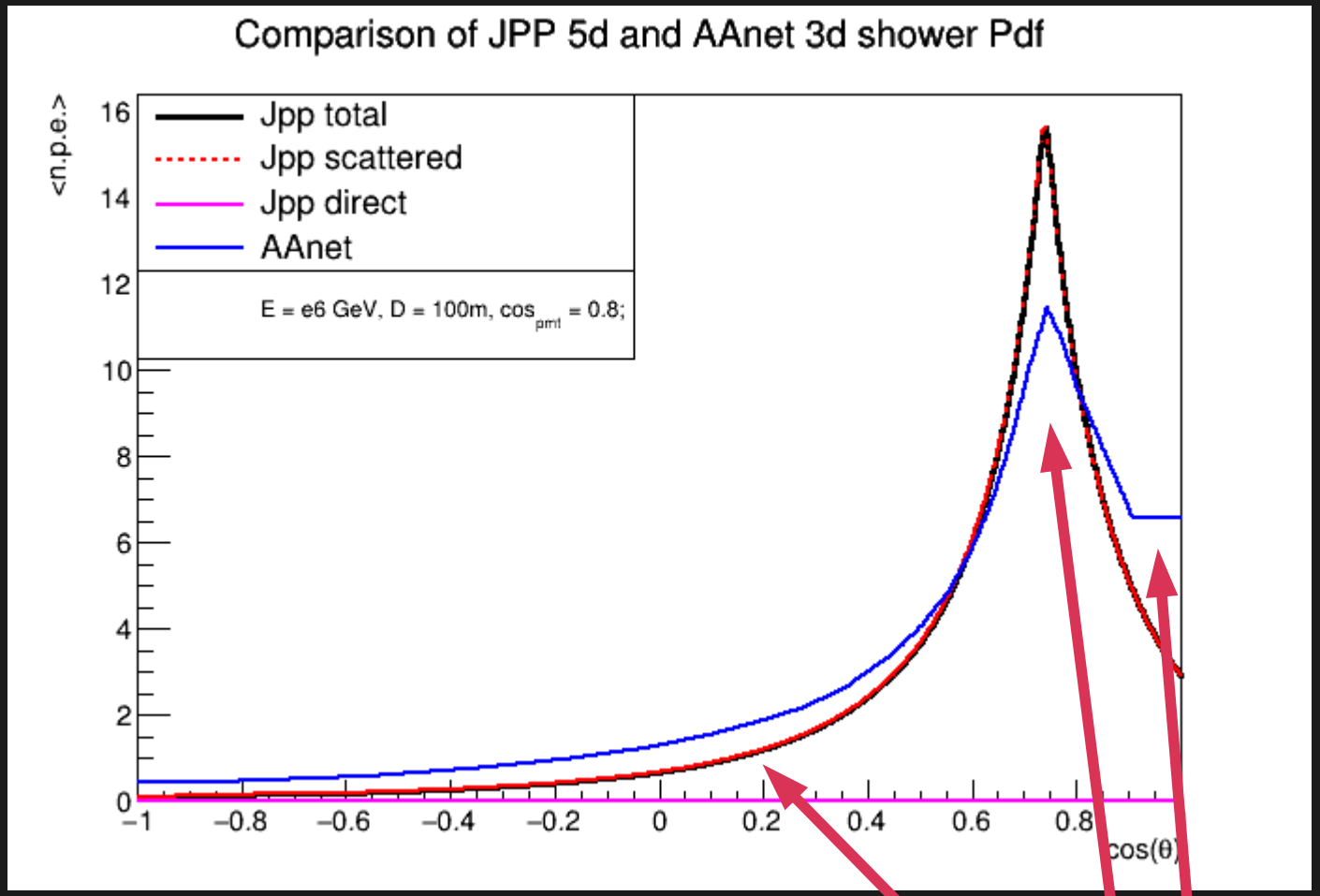
Thank you Maarten

- Working towards a better ARCA res
- **What I find exciting about my work**
- How to convey excitement to others

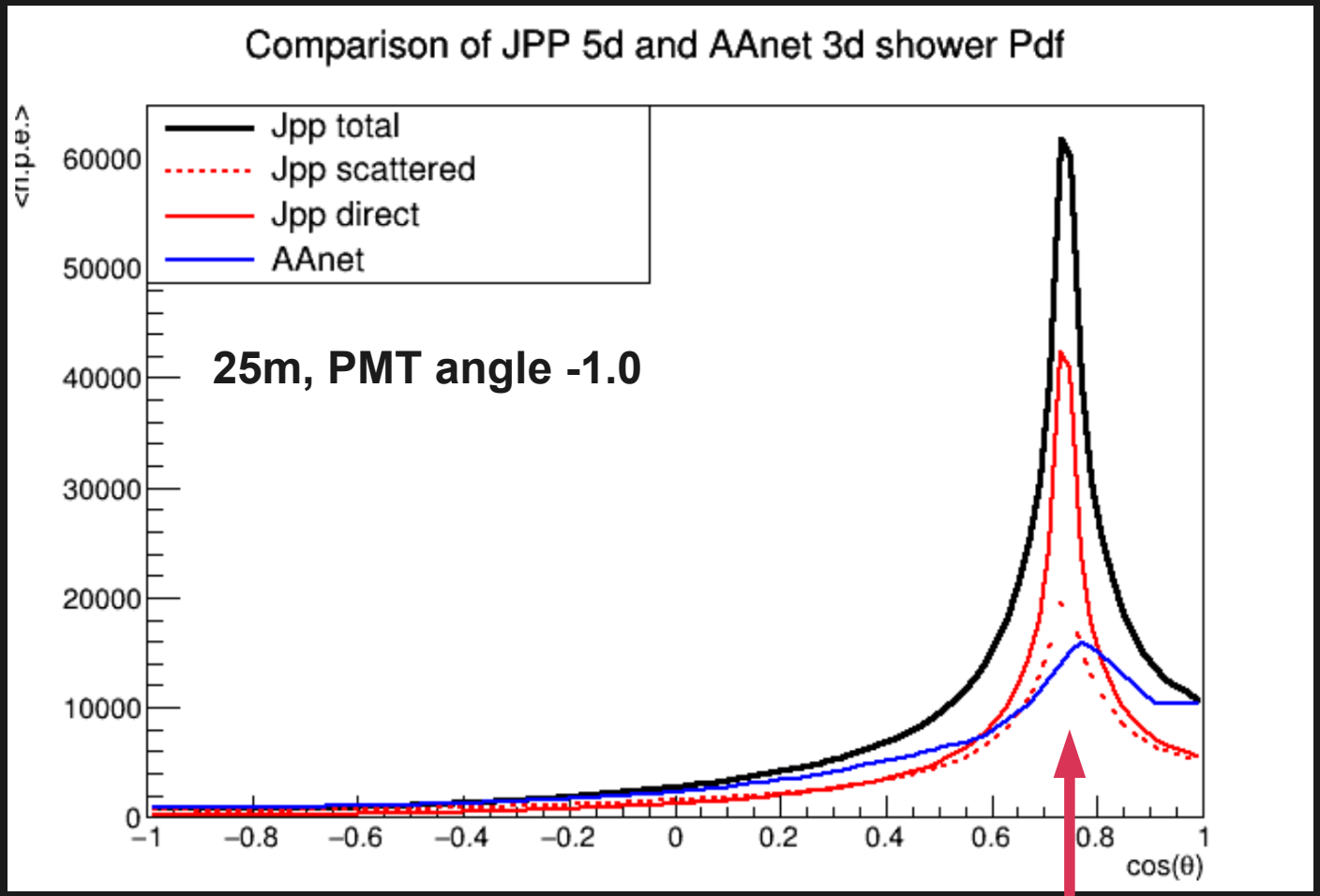
- **Why are Jpp and AAnet PDFs different?**



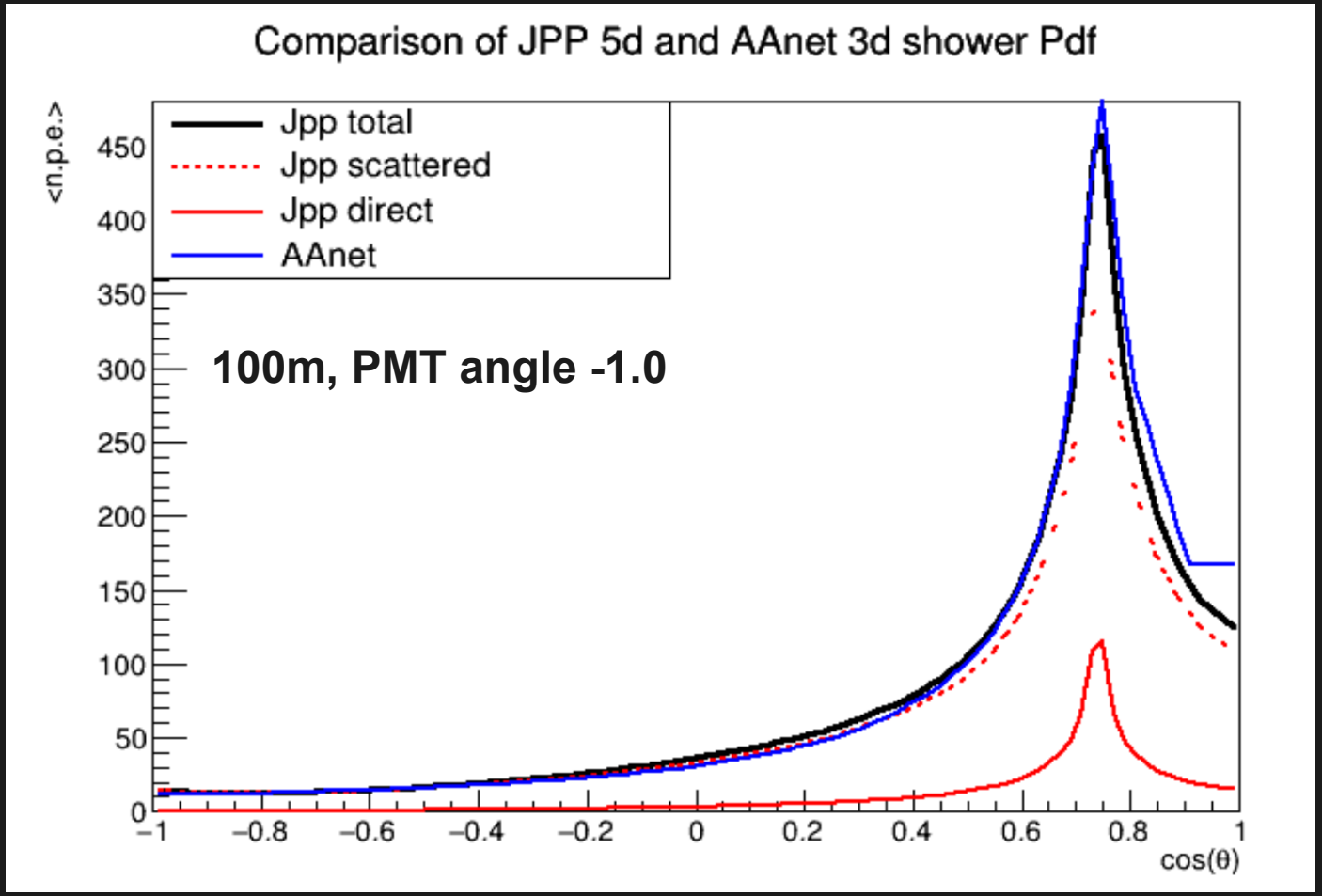
disagreement

Jpp PDF: based on theoretical approximations
AAnet PDF: MC interpolation

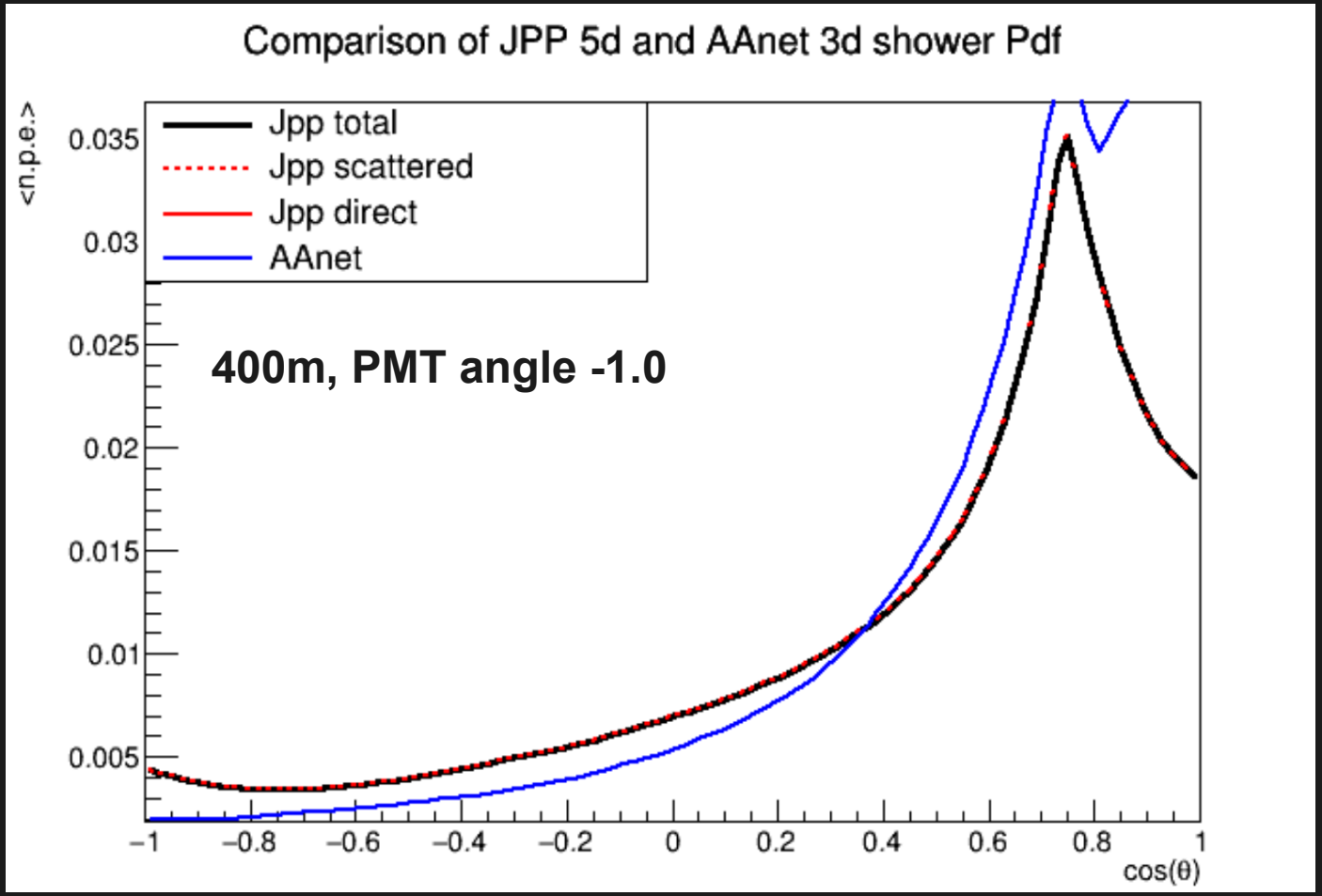
- Why are Jpp and AAnet PDFs different?
- N-scattered light? Other approximations?



When close, a lot of direct light

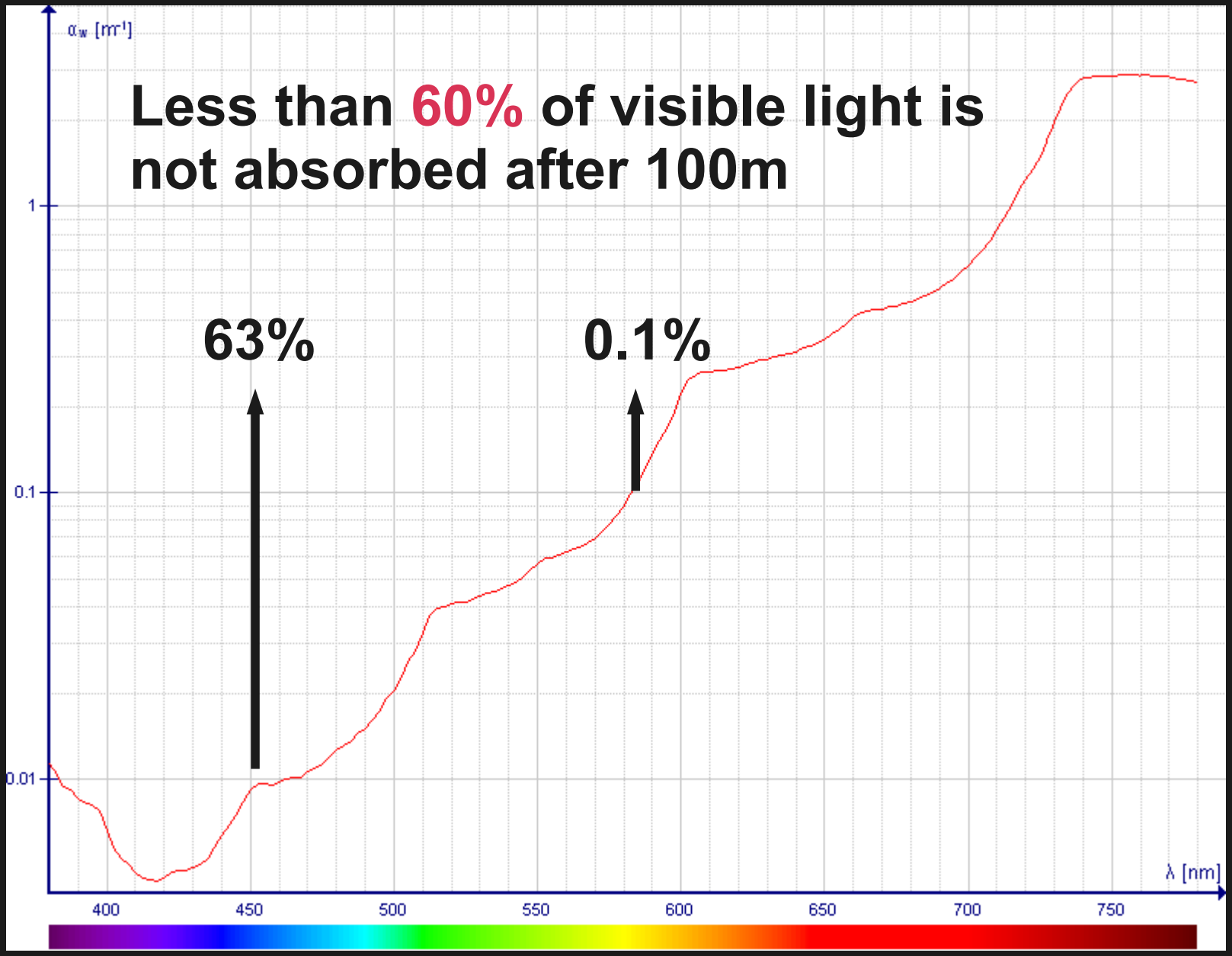


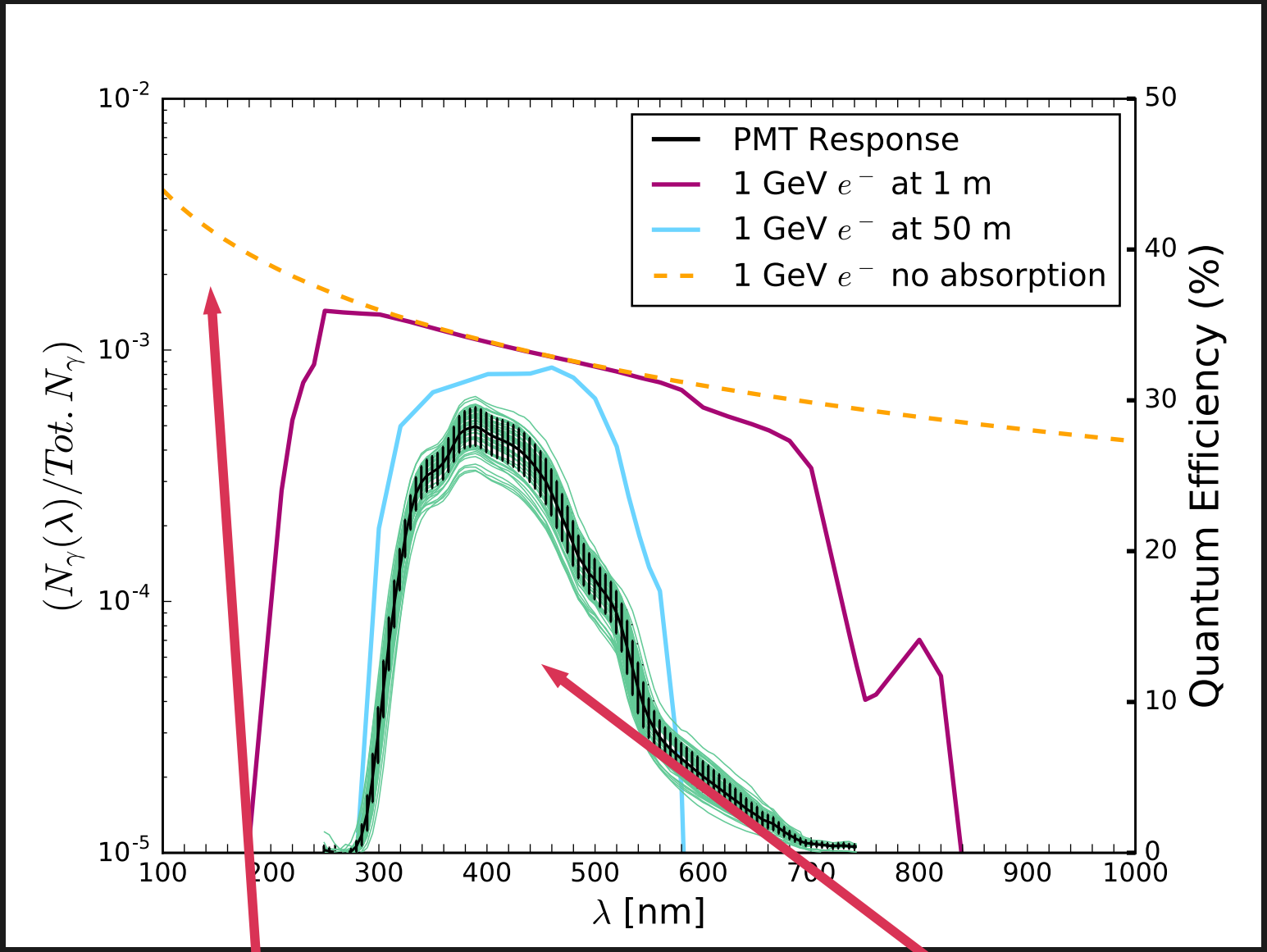
When far away, mostly 1-scattered light



When very far away, only 1-scattered light?

- Why are Jpp and AAnet PDFs different?
- N-scattered light? There are other approximations we could try.
- Re-emission?


Less than 60% of visible light is not absorbed after 100m
63%
0.1%
αw [m-1]
1
0.1
0.01
λ [nm]
400
450
500
550
600
650
700
750



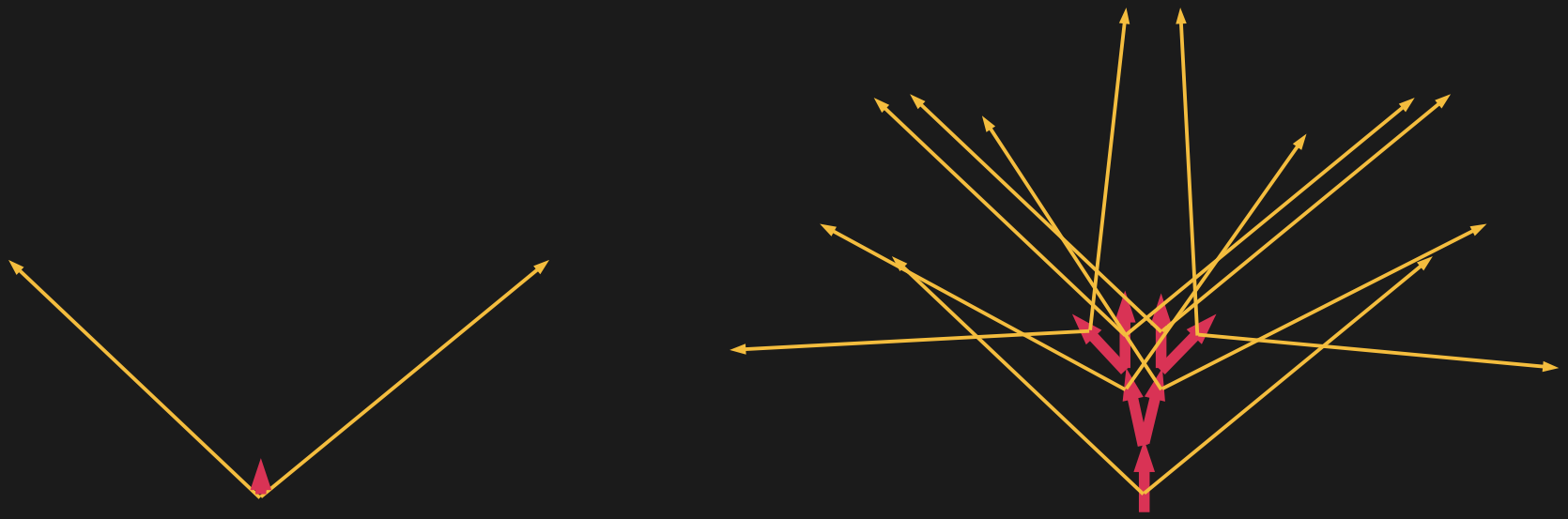
All these hard photons are absorbed.

Re-emission in visible?

- Why are Jpp and AAnet PDFs different?
- N-scattered light? There are other approximations we could try.
- Re-emission?
- **Spread of particle shower**

Particle shower

Cherenkov photons



At low energies, showers are small

Not so much at high energies

How does the longitudinal and radial spread affect the light profile?


distant snicker

- Working towards a better ARCA res
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Exhibit A:

The type of slides we show each other during collaboration meetings in KM3NeT

Updates from the Calibration Group

TDR Positioning

next sea ops (ARCA/ORCA): 3 autonomous beacons per site

Calibration Unit

Laser Beacon

Detector time calibration

in dark room

in sea

Time-lines

High Energy MC production for ORCA7DU

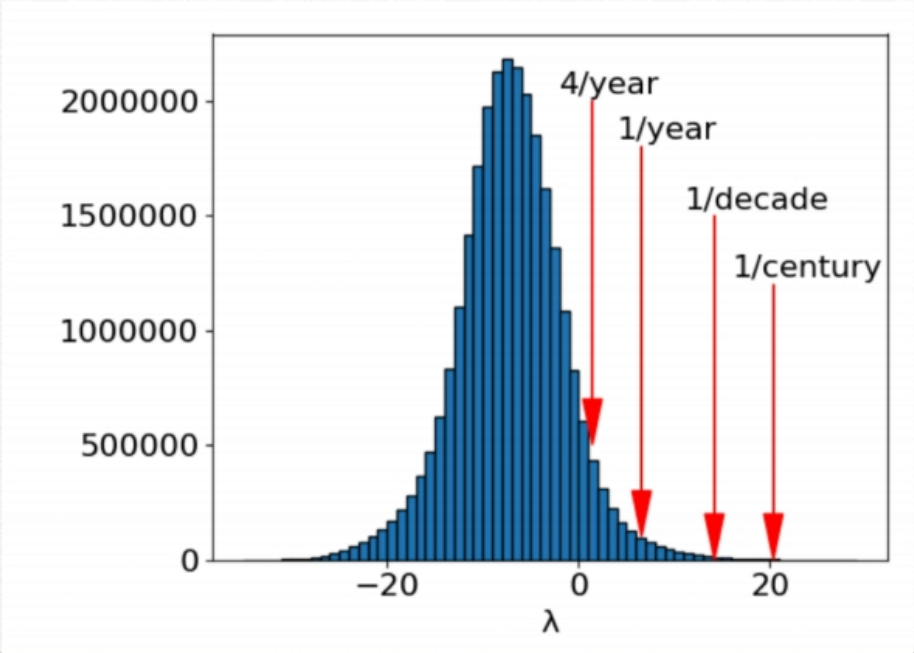
Antares/KM3NeT collaboration meeting
Tbilisi, 26/02/2019

APC group: Luigi, Gwenhaël, Marta & Nhan

AMON real-time analysis

- ANTARES is sending the neutrino stream (cosθ>0 & Λ>-5.2) in real-time to AMON
- Analysis ANTARES/FERMI-LAT correlation is running in real-time since 18/01/2019 in the AMON server.
- Any alert above the 4/yr threshold will trigger a GCN notice. (using archive data, only one event passes the threshold)
- ANTARES AMON subgroup to follow the alert in coordination with AMON team. Distribution of the alert pending the approval of the ANTARES subgroup

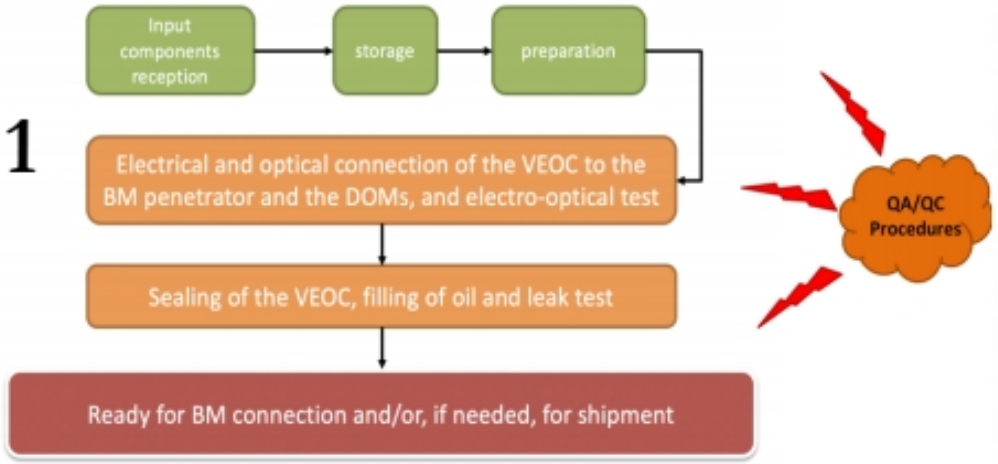
To test the system, we are running with a low threshold: no GCN notice but private mail to check the procedure

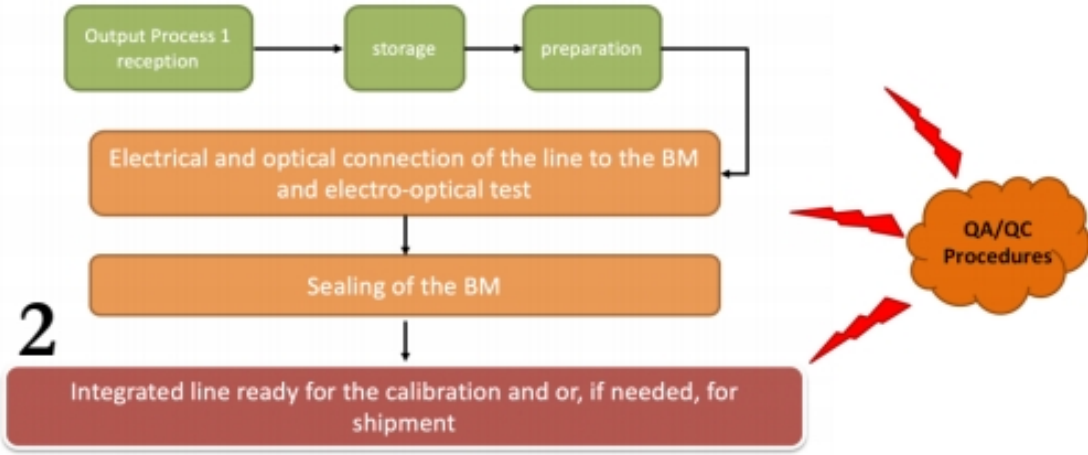


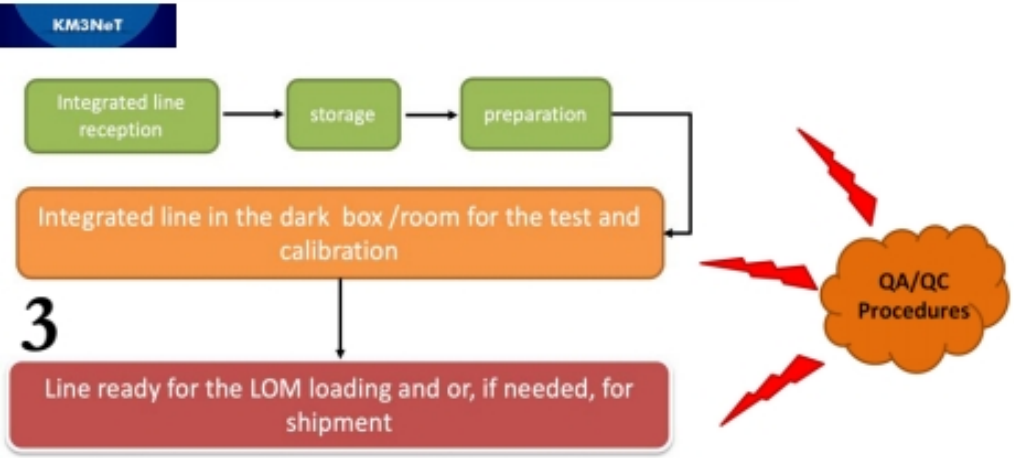
Date	λ	FAR (/yr)
19/01/2019	4.36	7.79
24/01/2019	-11.02	56.97
25/01/2019	-6.86	33.68
26/01/2019	-10.45	54.24
04/02/2019	-11.93	60.67
05/02/2019	-13.39	65.22
06/02/2019	-16.62	70.83
09/02/2019	-6.52	31.73
19/02/2019	-8.38	42.80
20/02/2019	-10.70	55.48

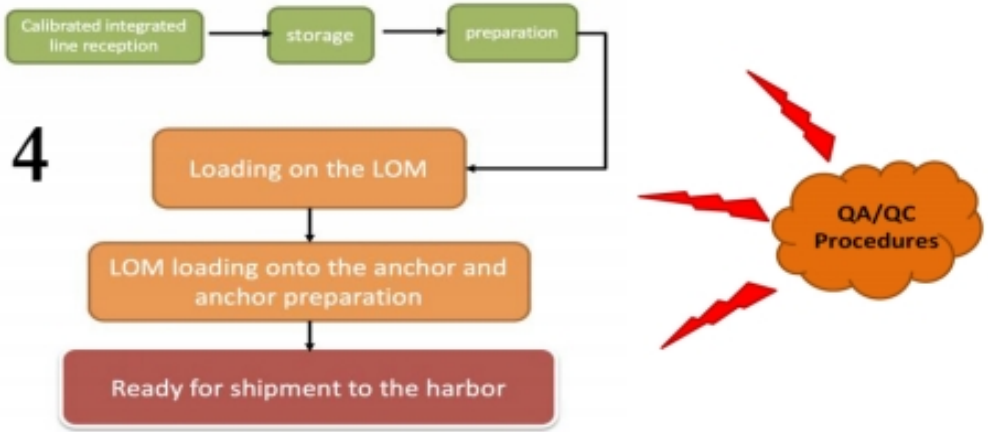
No coincidence passes the FAR threshold

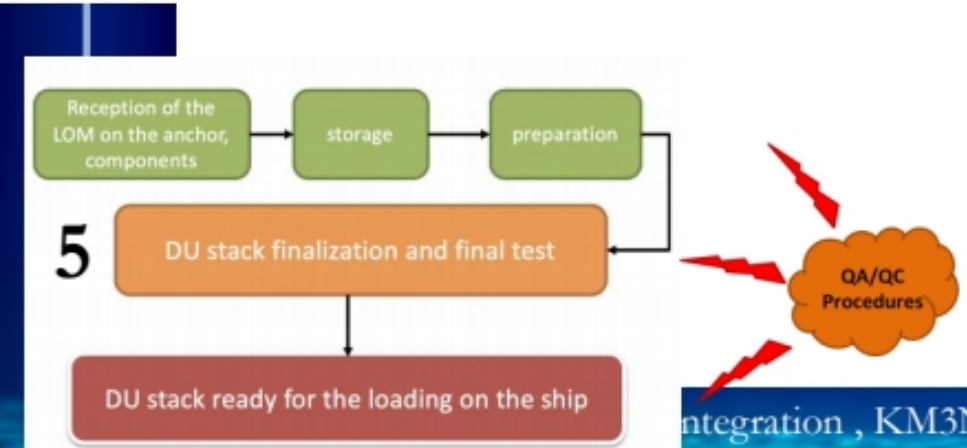
DU integration overview: processes in main steps











When the step foresees a test, if the results are negative, the following step can't be started and the operator have to comply with the QA/QC rules.

Erlangen QE&DE measurement details.

- Details: GoogleDrive -> KM3NeT_PMT_2013_002-Evaluation Report Hamamatsu_R12199.pdf
- QE measurement is affected by the reflection air/glass (4%) + absorption in the glass (0.7%).
- Beam configuration for QE measurement.
  Round spot of 8-10 mm diameter at PMT center
- Beam configuration for the QE scan.
  - 1 mm diameter optical fiber with ~3 mm black tube at the output to make the beam more collimated.
  - At PMT center, where the distance between optical fiber and PMT was < 1 mm, the diameter of light spot was 1 mm.
  - It should increase to the edge, due to spherical shape of PMT. Distance from fiber to photocathode at the edge is ~25 mm. Quick estimation: ~5 mm diameter.
  - Two simulations tried:
    - 1 nm beam 18.99932% DE
    - 5 mm beam 19.00459% DE
- QE is measured with high intensity laser, measuring current. It contains afterpulses, delayed pulses etc.
- DE is measured with single photon mode. Current is integrated in the window: integration 35-40 ns with the mean peak of the signals lying in the middle of the time window.
  - Hits outside [-20ns,20ns] window are mostly delayed hits/fast afterpulses. From JTTS:
    - Out of 17.5 ns: Delayed pulses: 0.0255111
    - Out of 20 ns: Delayed pulses: 0.0213511
  - This hits should be added back to DE!
- CE is measured for 7 PMTs only and it is 0.88+-0.03.
  - Not compatible with Hamamatsu 0.96 (since our DE does not containe delayed + afterpulses.

Astronomy Telegram : 17-01-2018 announcements

- **11184 FACT : Exceptional Flare of Mrk 421 at TeV energies**
  Since December 2017, Mrk 421 has been showing already some activity at TeV energies, as reported in the ATels #11077 and #11086 by the FACT and HAWC collaborations. The source was observed by FACT for a total of 5.5 hours between 1:15 UTC and 7:05 UTC (MJD 58135). At the beginning of the observation, the source showed a flux of about 6-7 times that of the Crab Nebula (CU) at TeV energies, then increasing to more than 9 CU. Over the whole observation, the flux was varying between 3 and 10 CU with a decrease towards the end of the night and an average flux of roughly 6 CU.
- **11186 MAXI/GSC : detection of a rapid X-ray brightening from Mrk 421**
- **11194 HAWC : observation of Mrk421 reaching peak TeV flux in month-long enhanced activity**
  (6 equivalent CU) between 2018-01-17 06:39 and 09:47 UTC. This is about 10 times the all-time averaged flux measured by HAWC and the highest one since the beginning of this enhanced period. Enhanced emission has also been reported by FACT (ATel #11086 and #11184), and MAXI/GSC (ATel #11186).
- **11195 Swift/BAT : finds hard X-Ray flaring activity correlated with an ongoing TeV flare of Mrk421**
- **11199 TACTIC : detection of a strong TeV flare from Mrk 421**
  Multi-wavelength observations of this enhanced activity of the source have also been reported by FACT (ATels : #11184), HAWC (ATel : #11194), MAXI/GSC (ATel : #11186) & Swift/BAT (ATel : #11195). An exceptional flare was reported by FACT at TeV energies between 1:15 UTC and 7:05 UTC on Jan 17 (MJD 58135) with a maximum of >10 CU and a decrease towards the end of the night.
  The ongoing flaring activity of Mrk421 at TeV energies was already reported since December 2017 by the FACT and HAWC collaboration (ATels #11077 and #11086).

Why?

- “I need to know what to say”
  - Use notes in your PowerPoint-like program
  - Do a dry run

- “I need to know what to say”
- “Slides are used as work logs”

  There are other ways of logging work:
  - Elog
  - Wiki
  - Uploading .ppt with notes
  - Uploading .pdf with notes
  - Backup slides

- “I need to know what to say”
- “Slides are used as work logs”
- “It takes effort to make nice slides”

The KM3NeT template will help with that

The KM3NeT template

- Slide types
- Predetermined fonts
- Predetermined colors
- Bank of logos
- Bank of images

Search for neutrino counterparts of the HAWC point-source sky map

Giovanna Ferrara ***INFN-LNS***
Luigi Fusco ***APC***

Search for

Neutrino counterparts of HAWC point-sources

Margaret Davis Michael Smith

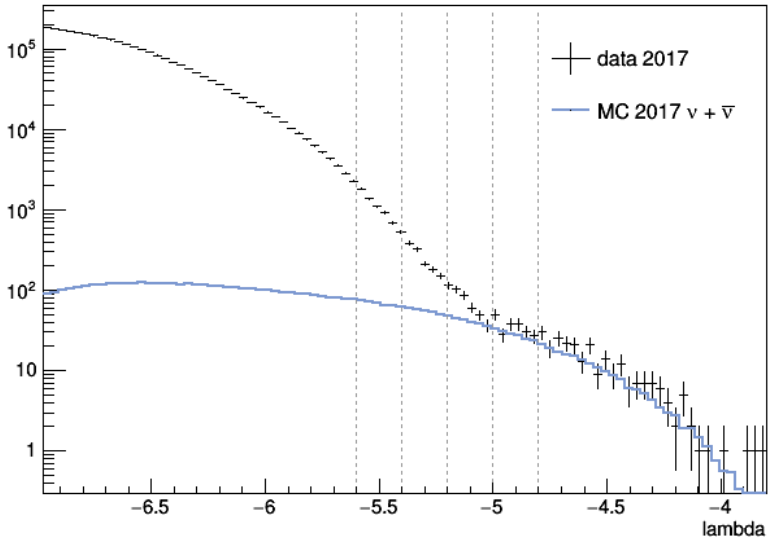
PMT efficiency calibration update

- PMT efficiency calibration update
- K40 simulations comparison
- K40 simulation updates

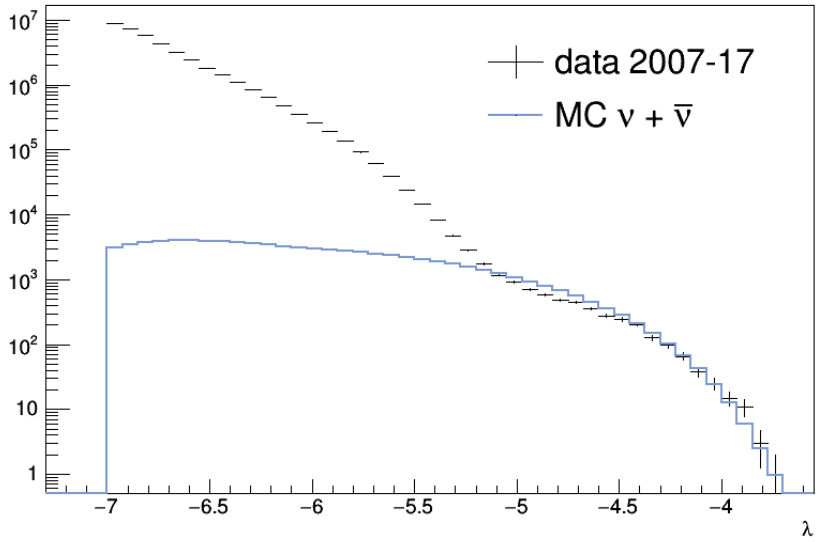
Data/MC comparison

Variables: *tcosth* > 0 (upgoing), $\lambda >$-5.6 -5.4 -5.2 -5.0 -4.8 (AAFit) or $\chi^2 <$0.9 0.8 0.7 0.6 (BBFit)
estimate of angular error $\beta < 1^\circ$ (AAFit)

With previous best cut 6466 tracks (2007-16), 5862 tracks (2007-15), 678 tracks (2017). Still processing mupage ntuples



2017 only



2007-17

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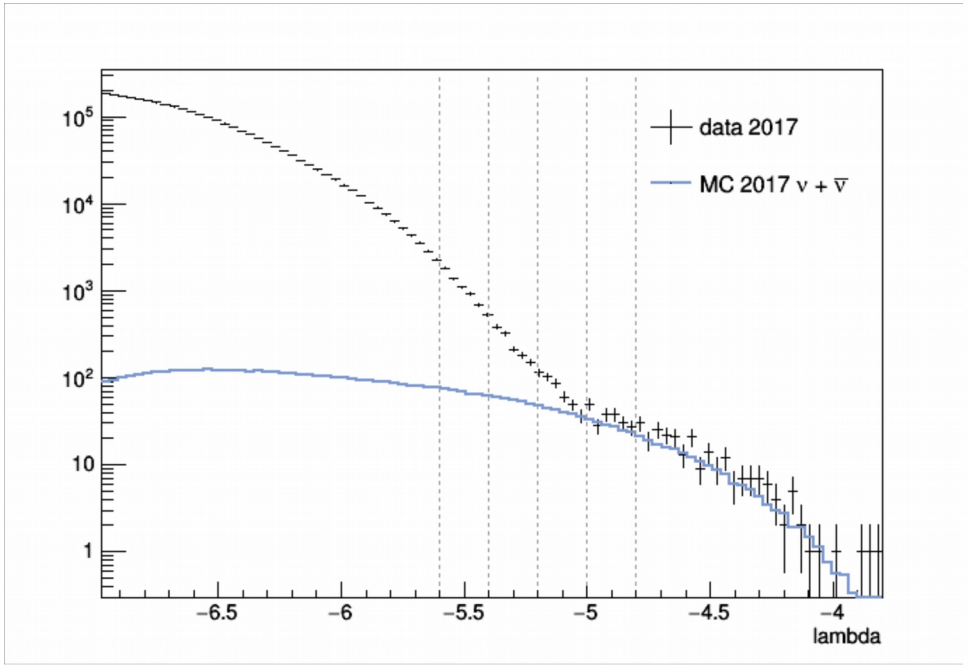

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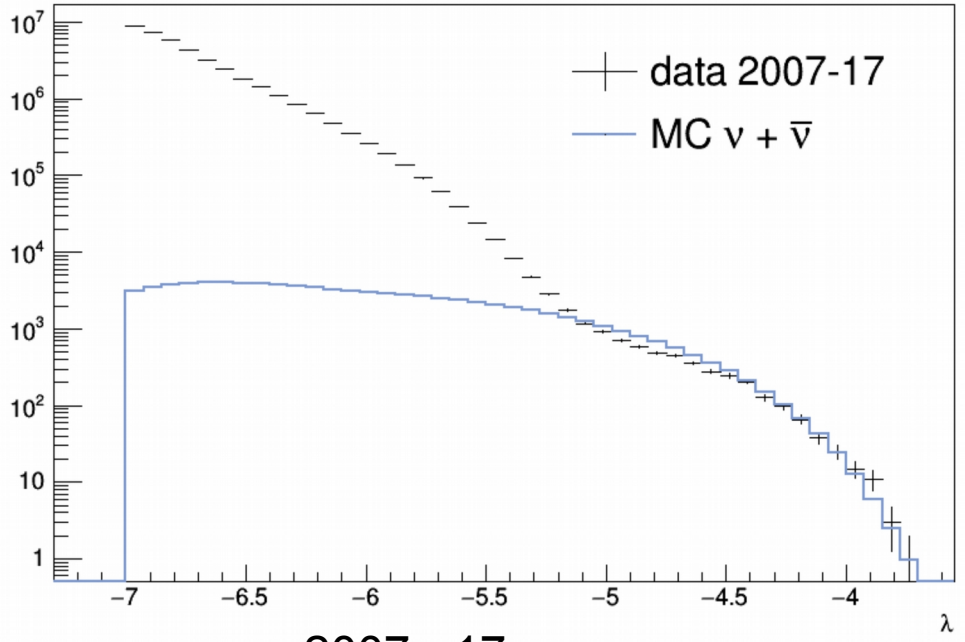

2007 - 17

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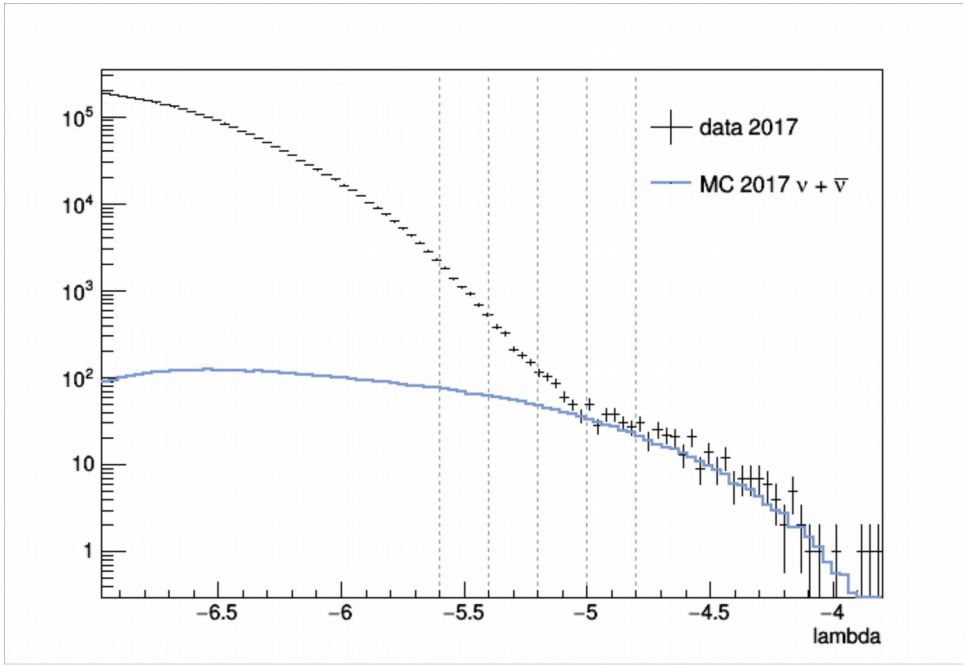

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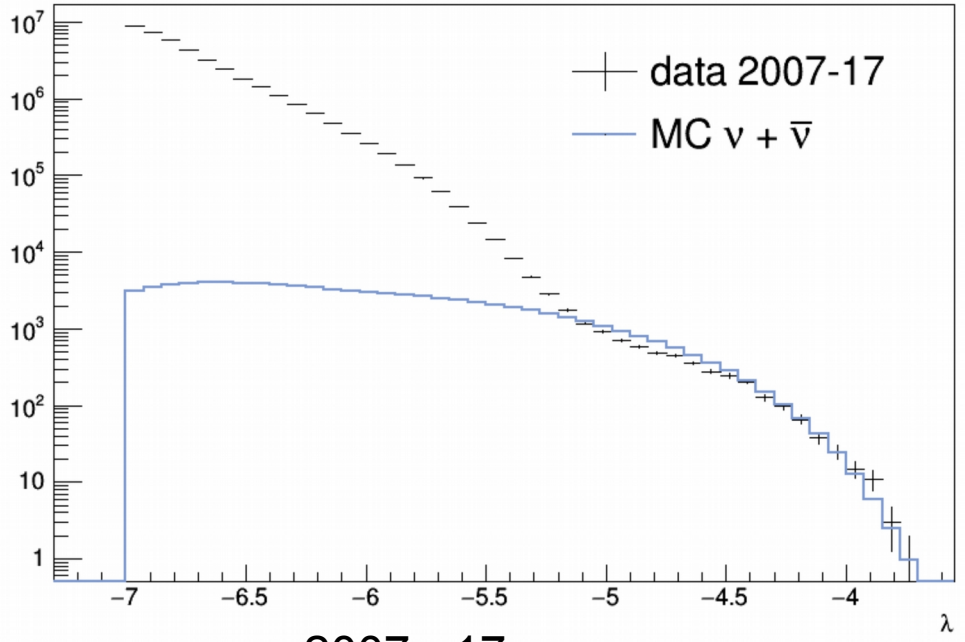

2007 - 17

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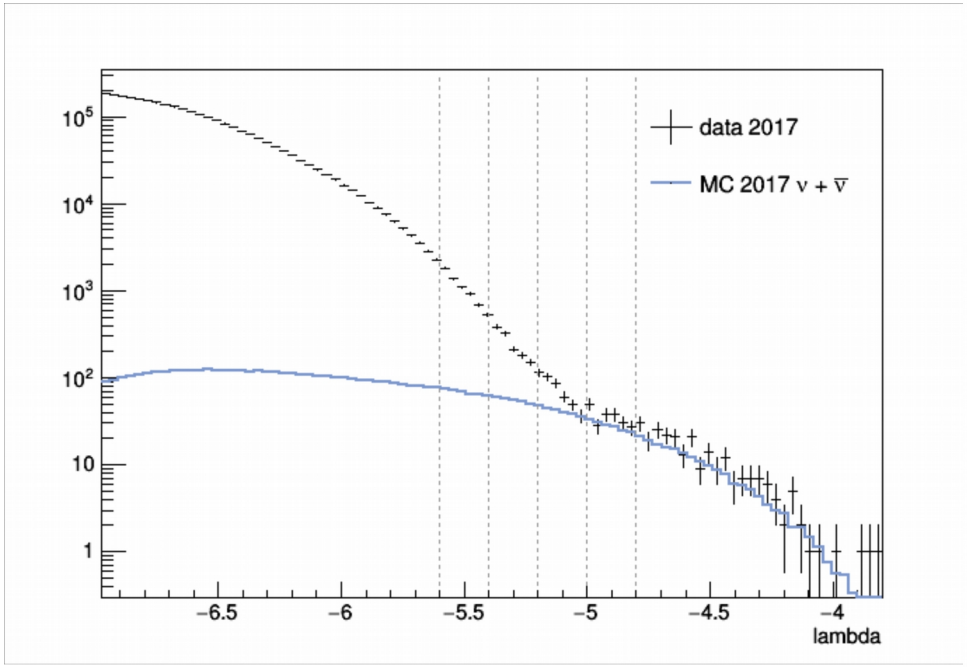

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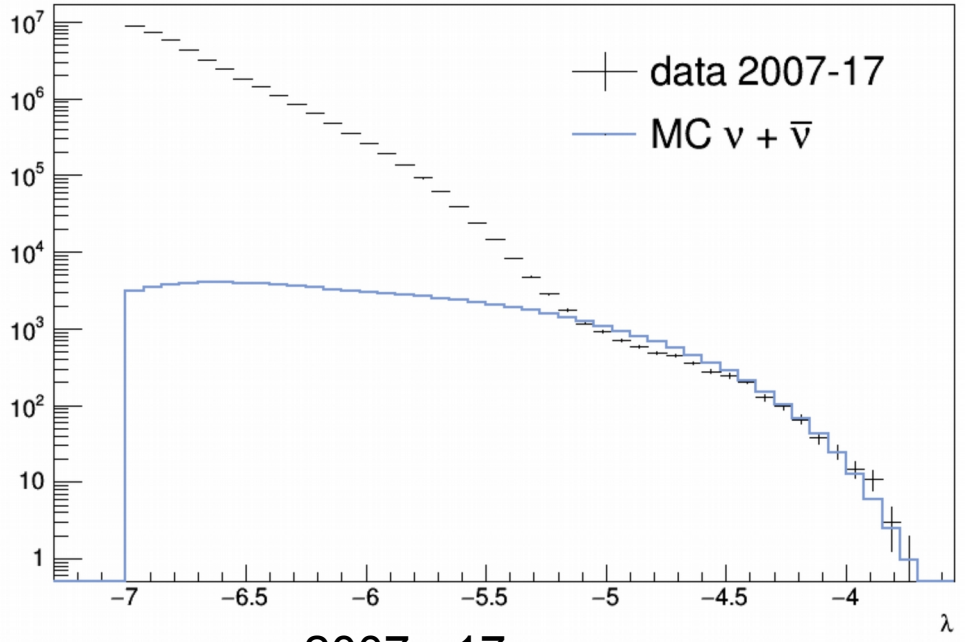

2007 - 17

Data/MC comparison

Looking at upgoing neutrinos from GC

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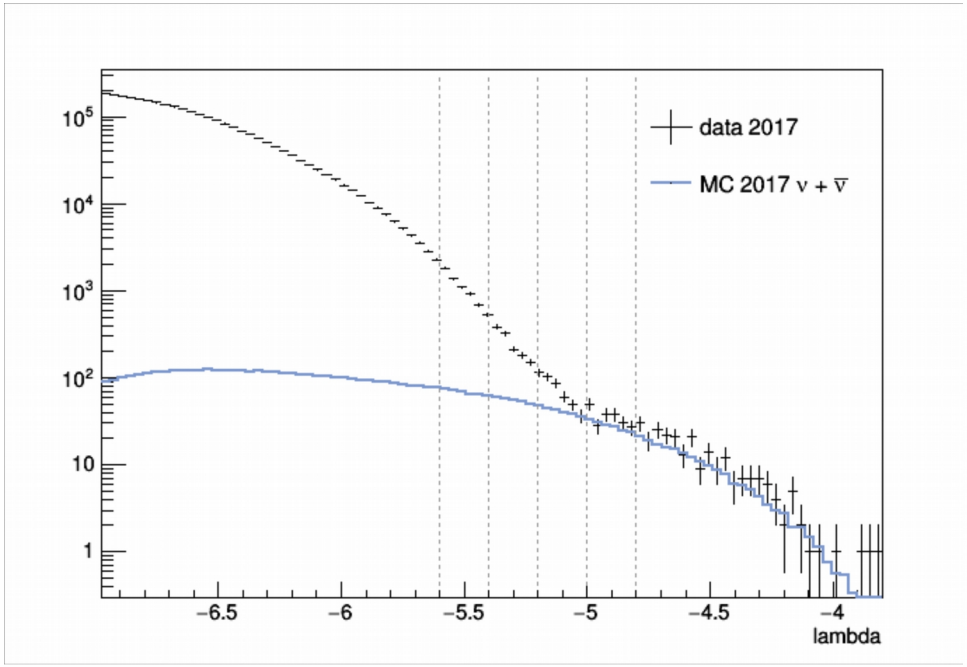
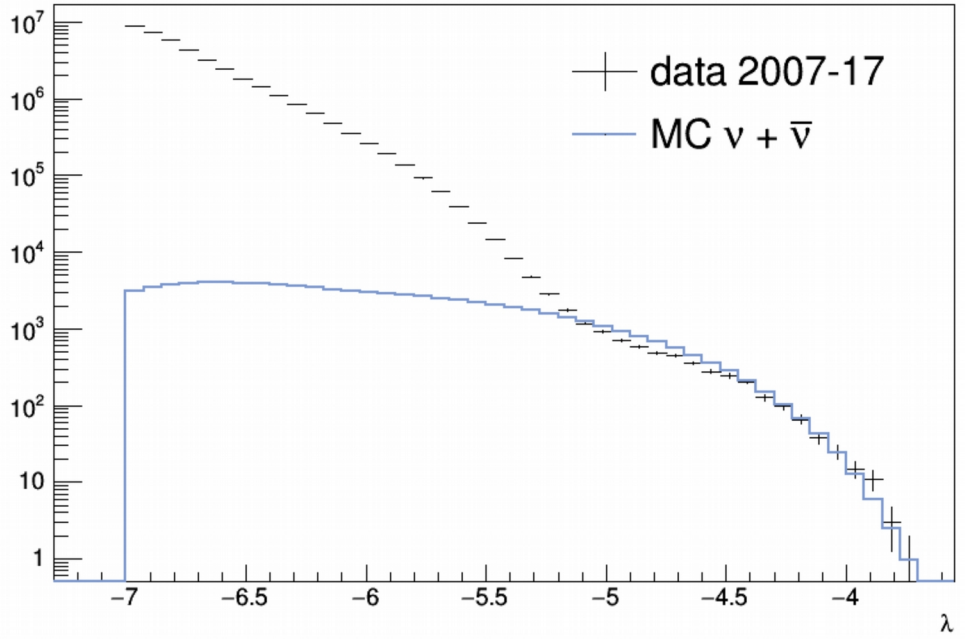




Data/MC comparison

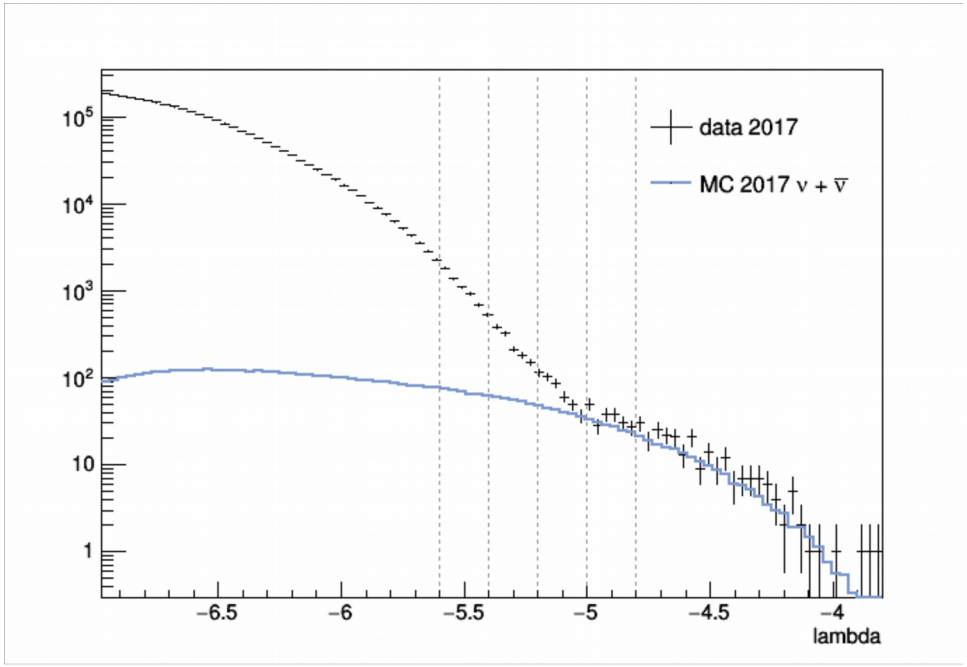
Looking at upgoing neutrinos from GC

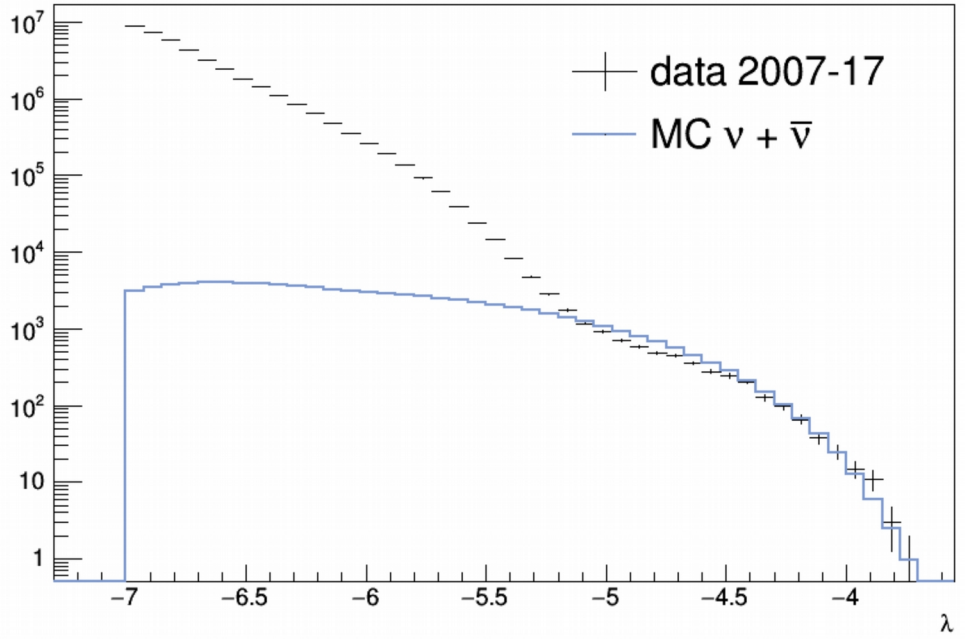
2007 - 17: 7.2k tracks

2017: 0.7k tracks

Muons not included in MC

Is there an excess?





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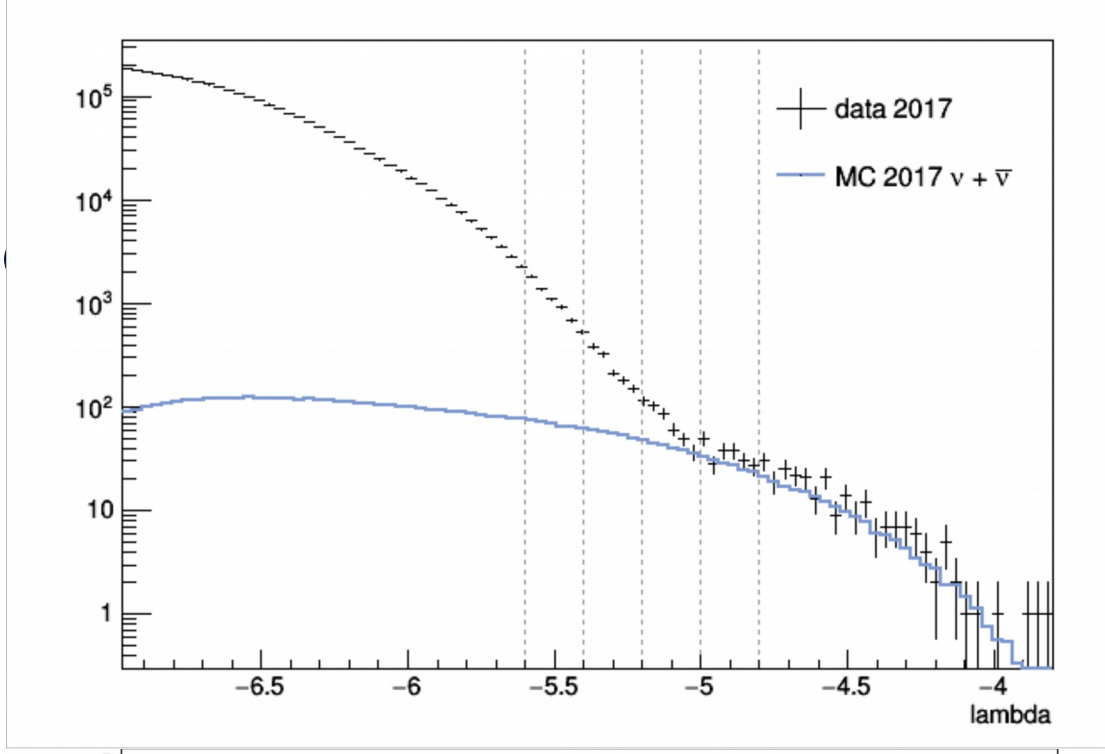

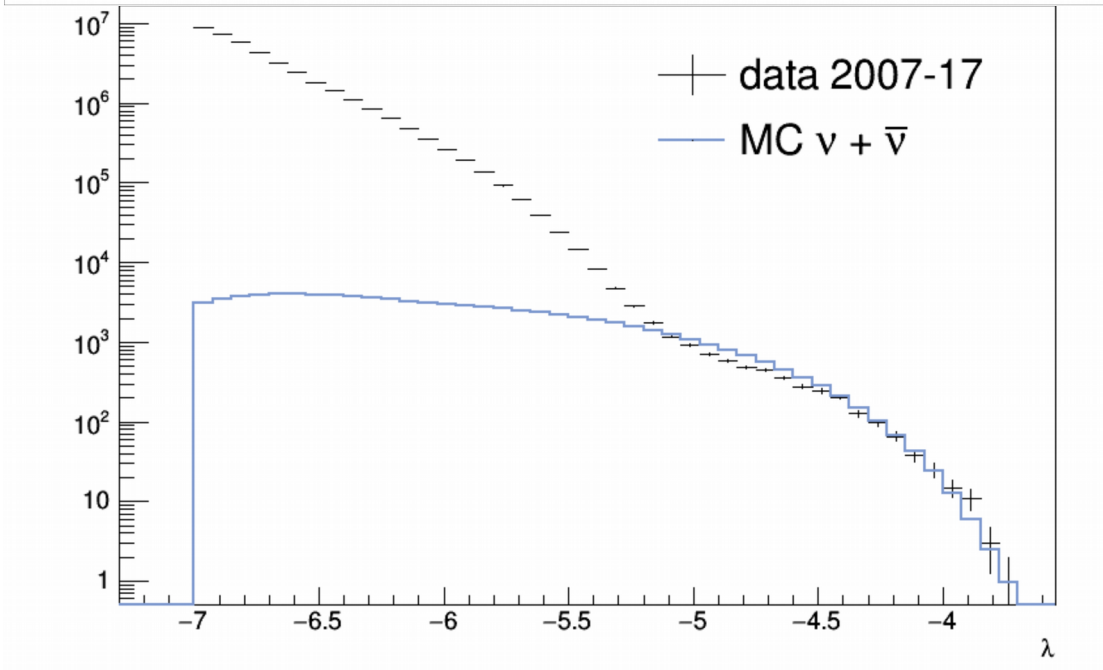

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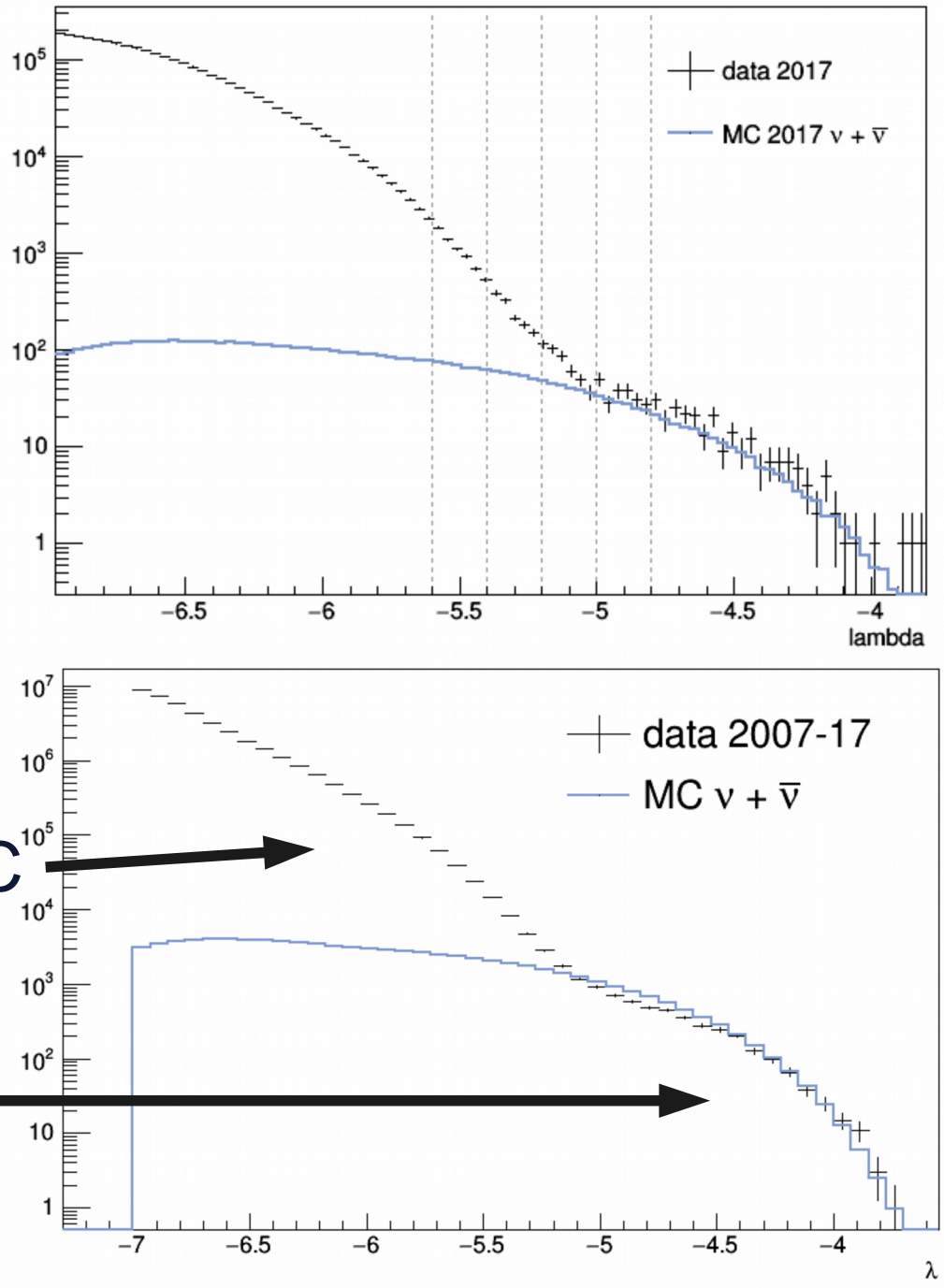

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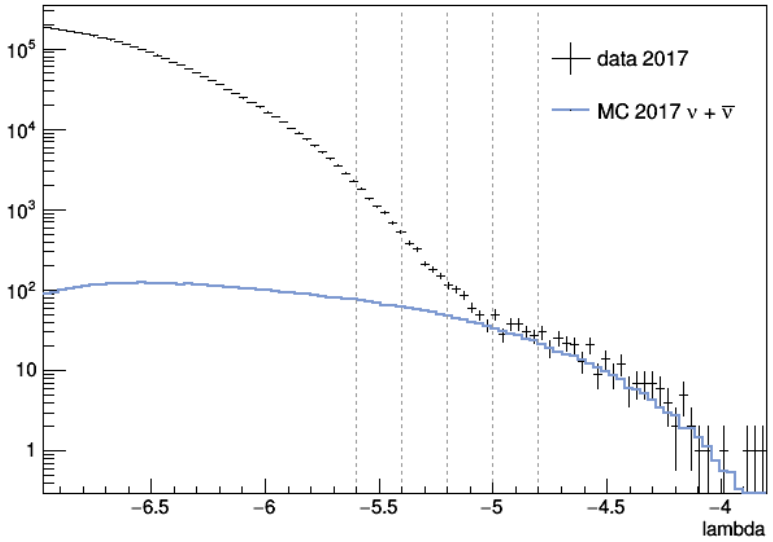
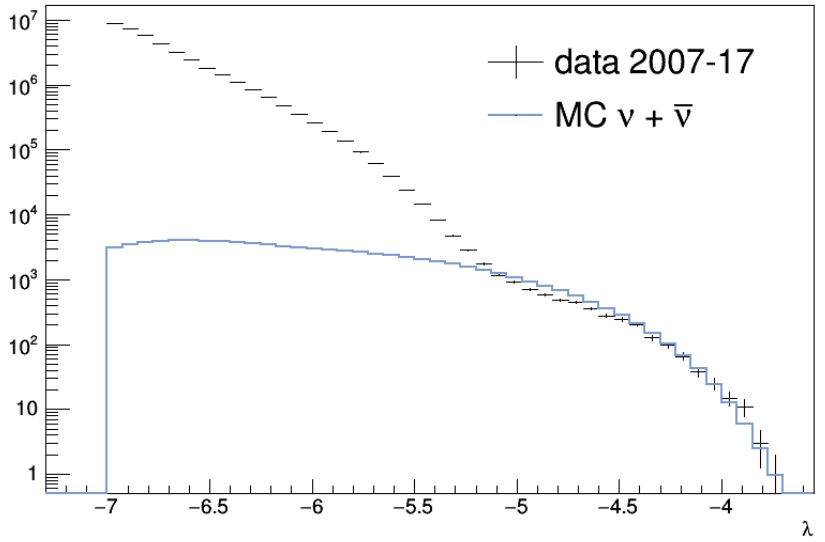
estimate of angular error $\beta < 1^\circ$ (AAFit)

With previous best cut 6466 tracks (2007-16), 5862 tracks (2007-15), 678 tracks (2017). Still processing mupage ntuples



2017 only



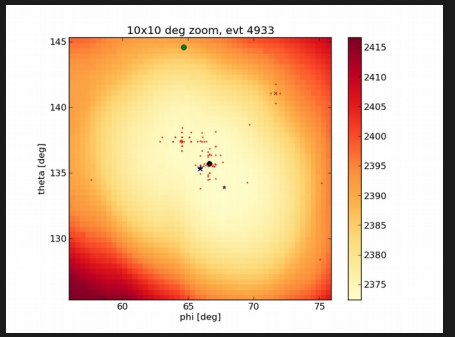
2007-17

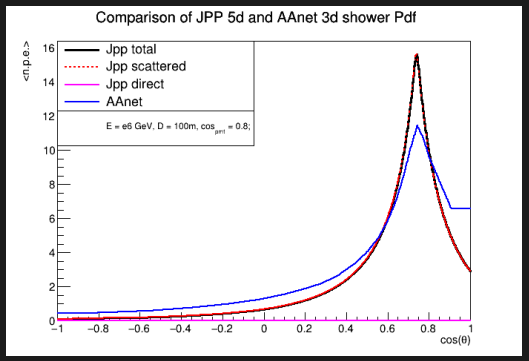
“Looks good enough to be used out of the box,

is simple enough that it will rarely need cleaning up.”

~ me

I am working towards improving the reconstruction of showers in ARCA





Light in our detector is interesting and important to think about

The KM3NeT template is in the works for streamlining quality presentations

KM3NeT