

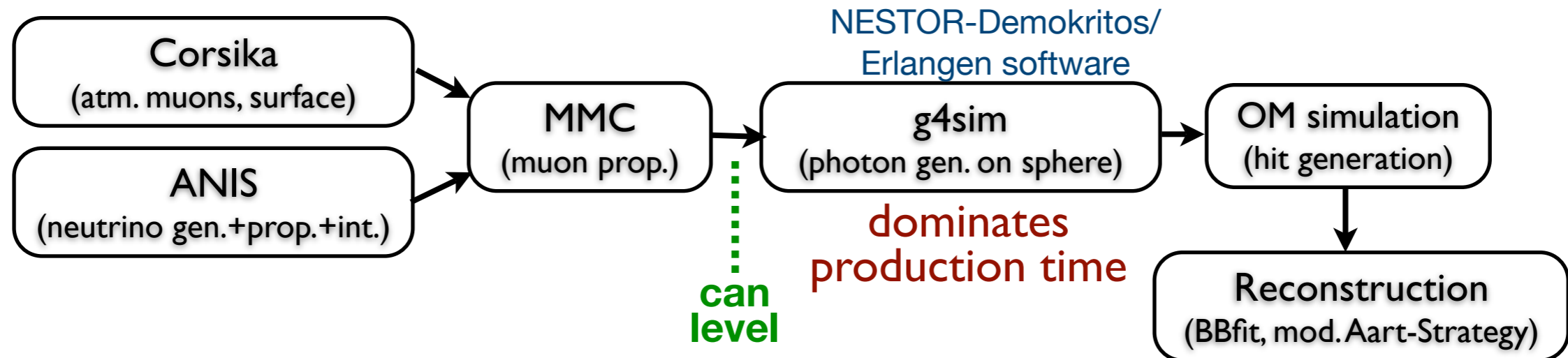
# Simulation status with the KM3Tray and ANTARES code

ecap

ERLANGEN CENTRE  
FOR ASTROPARTICLE  
PHYSICS

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# Simulation chain with KM3Tray



- Atmospheric muons: both single (bundels) and coincident (from two showers)
- Programs down to can level same as used in IceCube
- g4sim: photon propagation to spheres around OMs (current options):
  - full GEANT4 simulation (optional without scattering) **very slow**
  - look-up table for showers along muon track with  $E > E_{\text{thresh}}$  (typ.  $E_{\text{thresh}} = 1 \text{ GeV}$ ) **fast**
  - full GEANT4 simulation for direct muon light + showers with  $E < E_{\text{thresh}}$  **slow**
  - Alternative:** simple geometric light propagation for  $E < E_{\text{thresh}}$  **fast (too simple?)**
  - planned to generate look-up tables for muon track
- OM simulation: separated from photon propagation (fast testing of OM parameters)
- Reconstruction: BBfit and modified AartStrategy implemented **but not tested yet!**

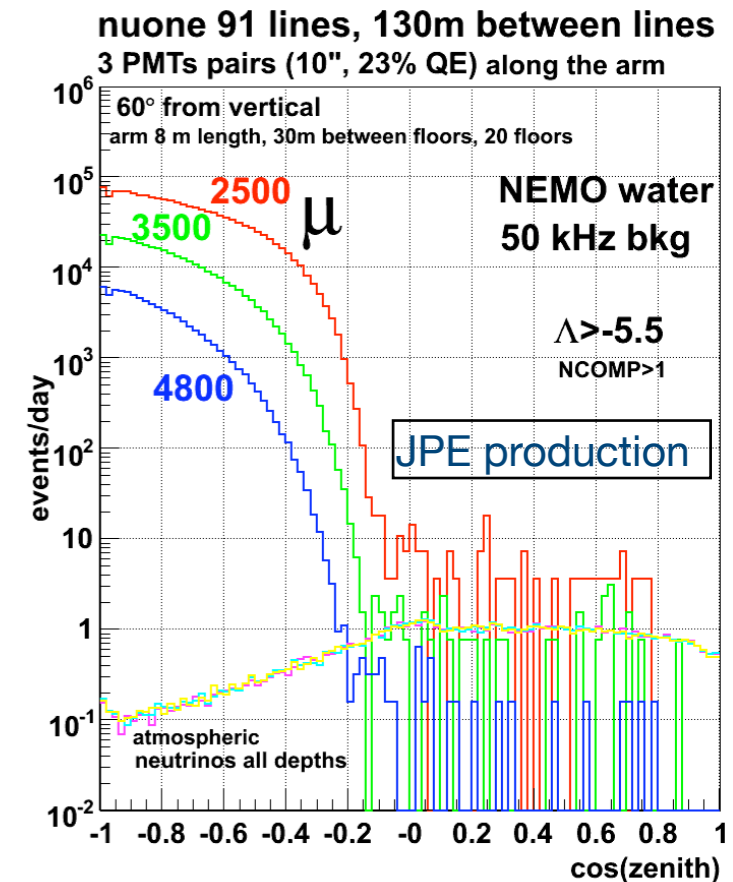
# Benchmarking

## Cluster resources:

- Erlangen: 300 cores (Dual+Quad core) (shared with two other groups)
- Lyon: 200 - 300 cores (KM3Tray tested to work)
- Athens: ~100 cores (delayed because of problems with KM3Tray implementation)

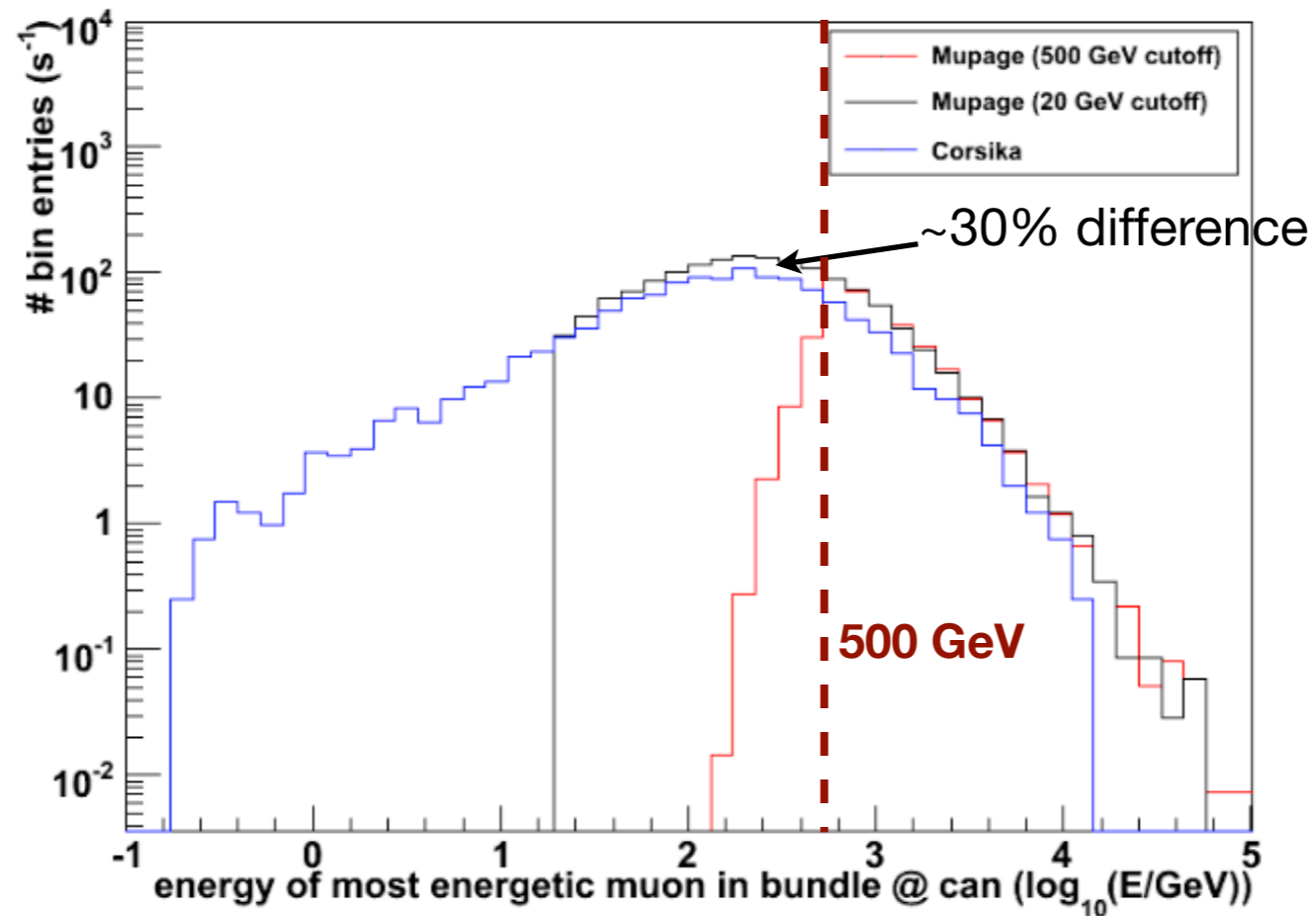
## Corsika production (most critical CPU wise):

- primary  $E$ : 600 -  $10^{11}$  GeV (Hörandel, unweighted)
- livetime = 32 h (extrapolated)
- depth 3500 m



Simulation	CPU time	Cluster time	Comments
shower look-up + GEANT4 direct light	5600 days	14 days (400 cores)	
shower look-up + geom. muon light	1400 days	3.5 days (400 cores)	estimated
ANTARES chain (JPE Mupage production)		~1 day	muon bundel energy thresh. 500 GeV

# Corsika - Mupage comparison



- Muon-bundle energy threshold @ 500 GeV only usable after tight cuts  
→ Erlangen production will start with full energy range

# Current status

## Production status:

- test production of 1000 Corsika files (4 s livetime each) (strings with Antares-storeys, depth 3500 m)
- all files have been processed with g4sim
- files will be copied to Lyon after reconstruction has been applied

## Production plans:

- MC production for full detector/depth set (3x3) will take about 1-1.5 months with 400 cores (g4sim has to be run only once for Antares-like and multi-PMT string options)

## Documentation about KM3Tray chain available at (still under construction):

[http://wiki.km3net.physik.uni-erlangen.de/index.php/Main\\_Page](http://wiki.km3net.physik.uni-erlangen.de/index.php/Main_Page)

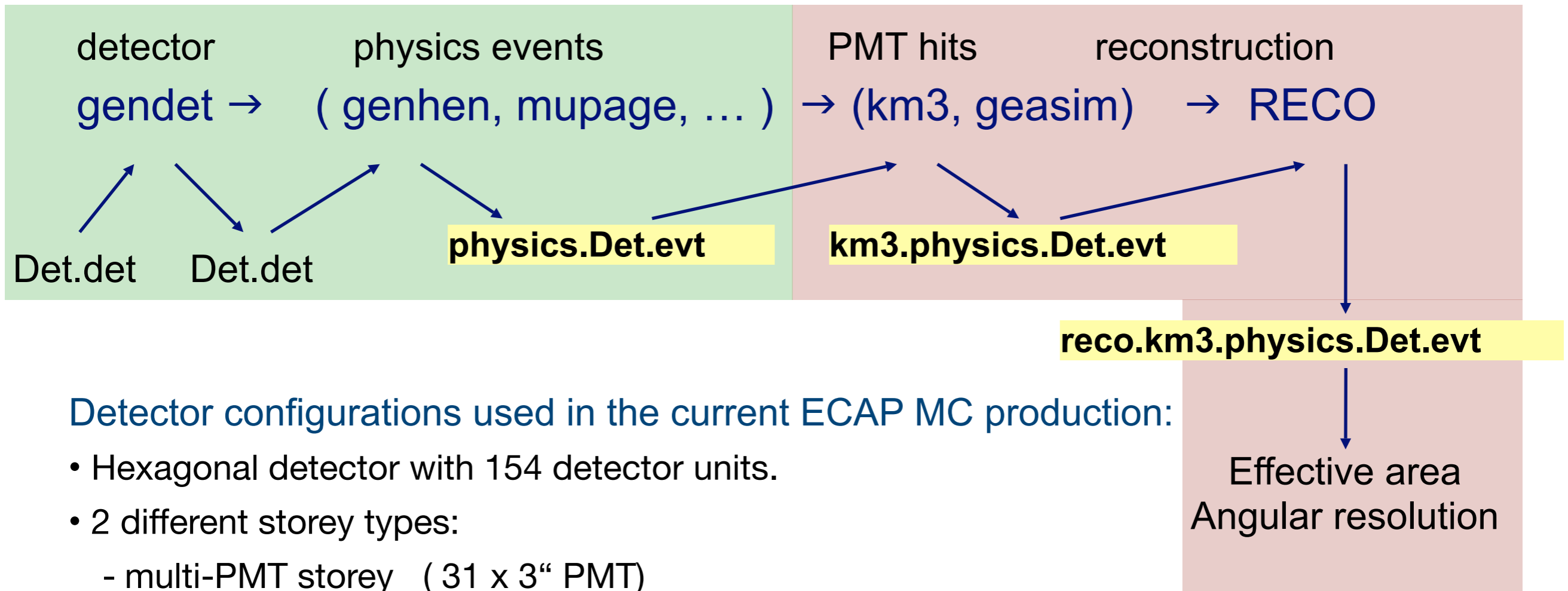
## Contains also information of interest to other groups:

- detector layout descriptions + configuration files in all formats (.det, .i3, .xml)
- water property code
- OM simulation code
- related documentations

# Simulation chain with ANTARES software

(R. Shadnize)

Done To be done



Detector configurations used in the current ECAP MC production:

- Hexagonal detector with 154 detector units.
- 2 different storey types:
  - multi-PMT storey (31 x 3" PMT)
  - Antares-like storey
- Simulations for 3 diff. depth: 2475, 3500, 4800 m
- Details: [wiki.km3net.physik.uni-erlangen.de](http://wiki.km3net.physik.uni-erlangen.de)

# Production of neutrino events

- 200 files for each detector configuration ×3 depths: 1200 neutrino data files
- Production parameters:
  - $-1 < \cos \Theta_\nu < 1$ .
  - $10^2 < E_\nu < 10^7$  GeV (  $< 10^6$  GeV in CPPM production)
- File names:
  - genhen.cable\_hexagon\_154\_20\_30\_pm1\_2475\_0001.evt
  - genhen.cable\_hexagon\_154\_20\_30\_pm1\_3500\_0001.evt
  - genhen.cable\_hexagon\_154\_20\_30\_pm1\_4800\_0001.evt
  - genhen.cable\_hexagon\_154\_20\_30\_antares\_2475\_0001.evt
  - ...
- $\sim 2 \times 10^6$  neutrino events in each configuration (  $\sim 2$  GB )
- Data in Lyon:
  - /sps/km3net/users/shanidze/public/MCdata/production1/neutrinos4pi/ANTARESDepth/OM31
  - currently only “space” 39 files from genhen.cable\_hexagon\_154\_20\_30\_pm1\_2475m\_0001.evt
  - Disk quota?



# MC production: mupage

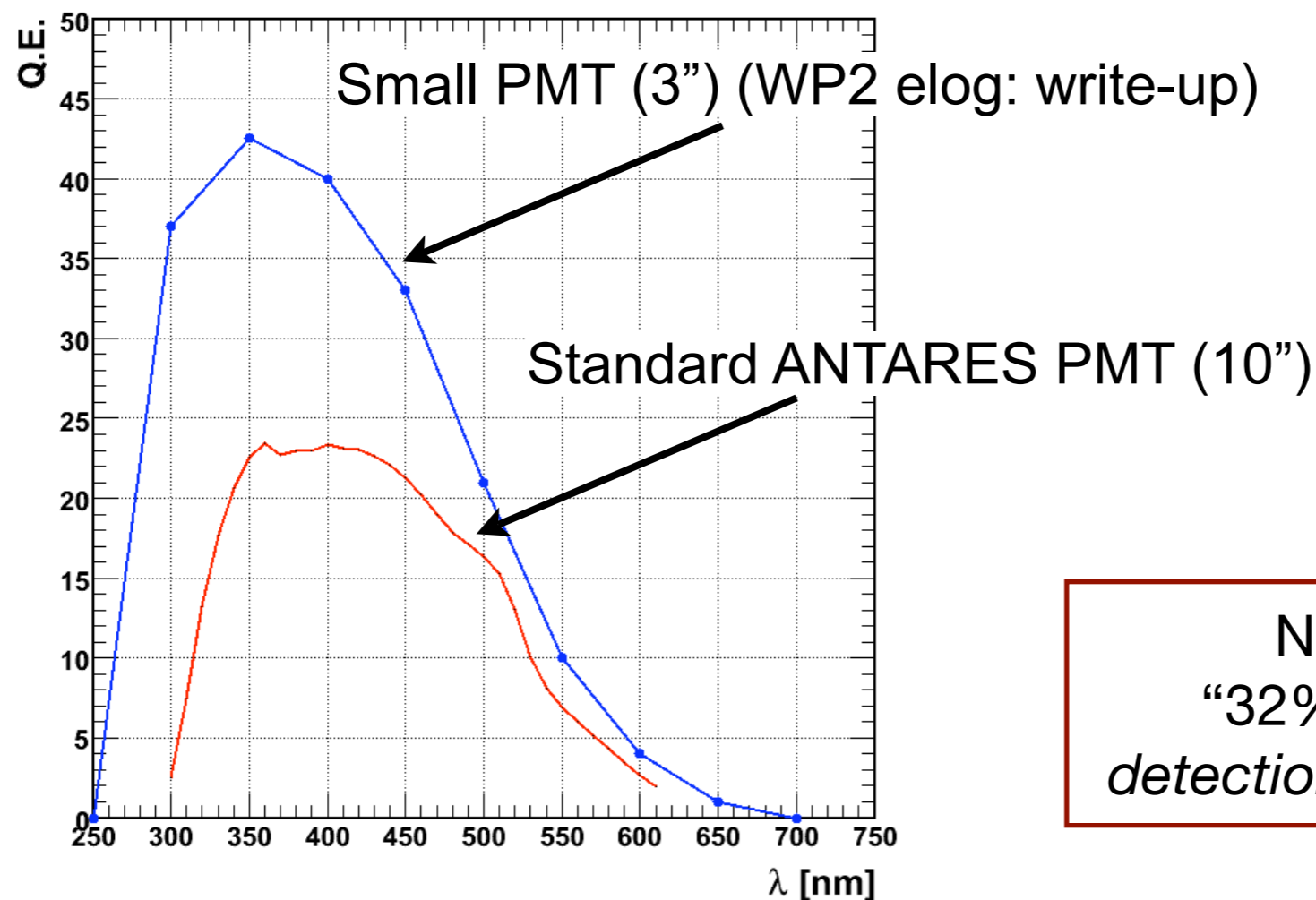
- Production of the atmospheric muon background:
- Latest version of Mupage: v3.2
- Statistics for  $\sim 1$  day (lifetime) depends on input parameters:  
minimal total energy of muons in bundle:  $E_\mu > 50$  GeV (500 GeV in CPPM)
- Current data:  
400 data file each with  $10^5$   $\mu$ -bundles/events ( $4 \times 10^7$   $\mu$ -bundles) for 3 depths
- File location: currently only ECAP (disk space problems in Lyon)
- Lifetime for  $4 \times 10^7$   $\mu$ -bundles:
  - 2475 m: 5398.4 sec (0.062 d) 7.4 kHz
  - 3500 m: 29297.7 sec (0.34 d) 1.4 kHz
  - 4800 m: 168486 sec (1.95 d) 0.24 kHz



# Preparation for KM3 production

Test and production (if necessary) of new input tables (files) for:

- environmental parameters
- PMT characteristics (QE, Angular acceptance)



Need QE curve for  
"32%QE" 10" PMT from  
*detection-unit-writeup-V3.4.pdf*

# Time schedule

First results from the current ECAP MC production is expected for the KM3NeT meeting in Athens

At least on more MC production will be necessary before TDR,  
(for large detector with at least 1 km<sup>3</sup>)