Configuration studies for a cubic-kilometre deep-sea neutrino telescope - KM3NeT – with NESSY, a fast and flexible approach

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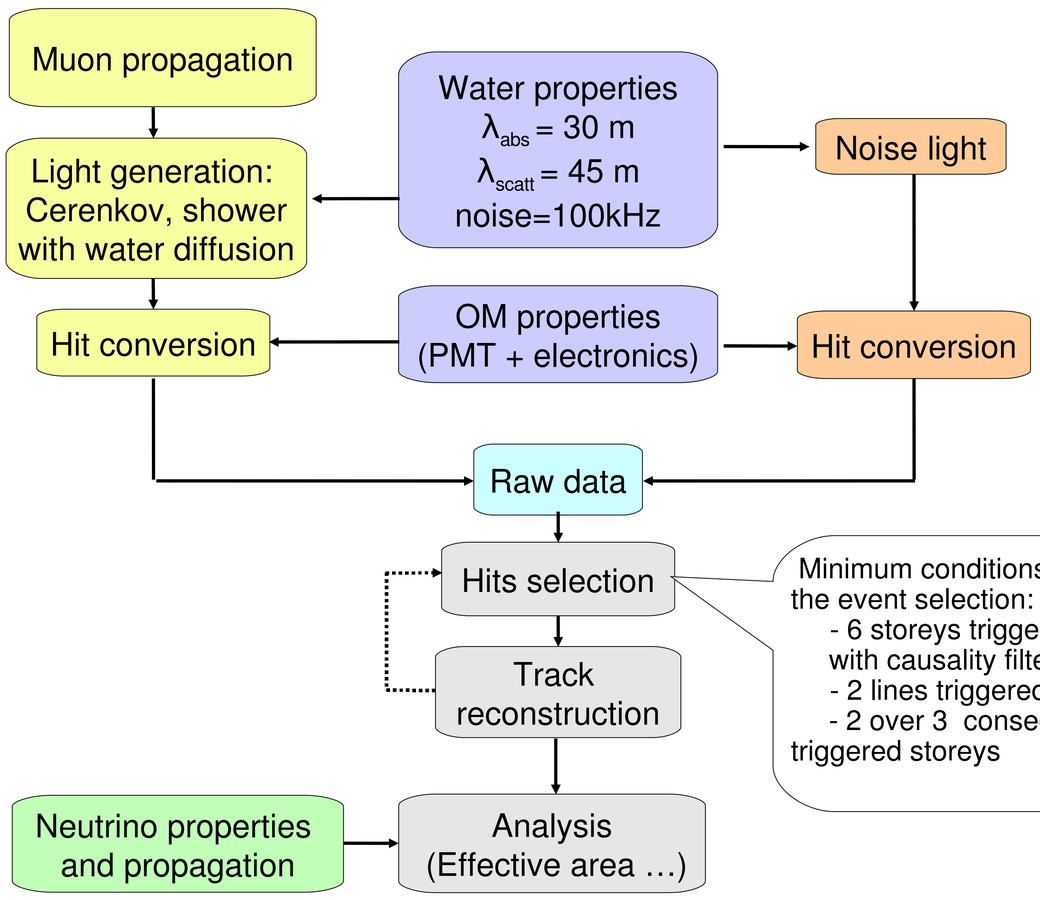
NESSY: a full simulation and analysis chain

Developed with the *Mathematica* software

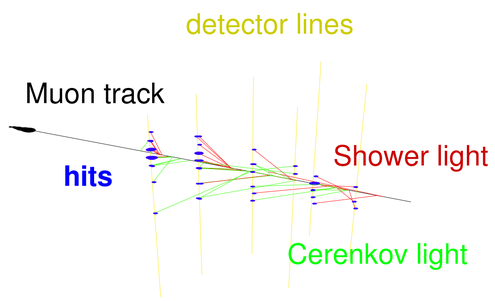
Detailed semi-analytic simulation (fast and flexible)



• The muon propagation and interaction formulae are the same as used in GEANT 4

• The light scattering is simulated with an analytic model of diffusion in the sea (single scatter)

• The reconstruction algorithm is based on an iterative method followed by a maximum likelihood fit

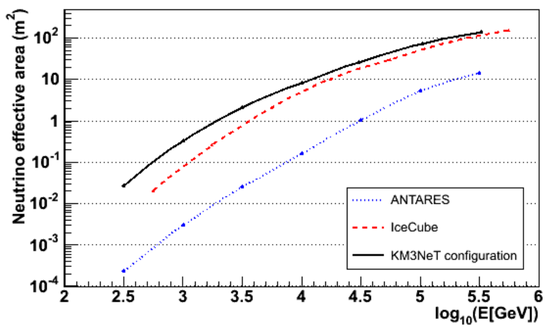


Comparison with other experiments

Optimal geometry for water light absorption of 30 m is:

127 lines spaced by 100 m with 25 storeys every 15 m with

6 × 10'' PMTs in each storey.

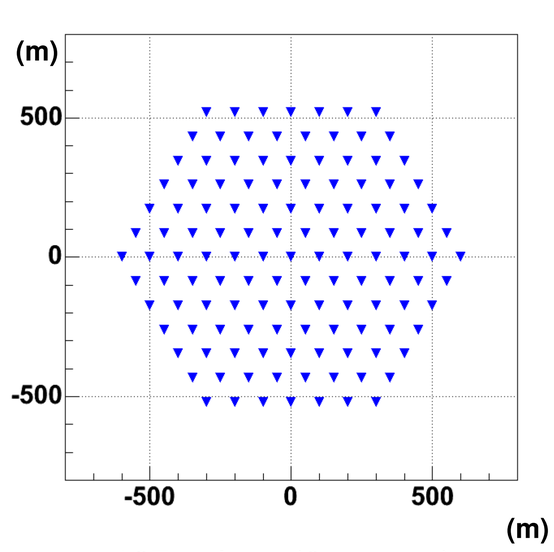


Mean angular resolution ~0.2°

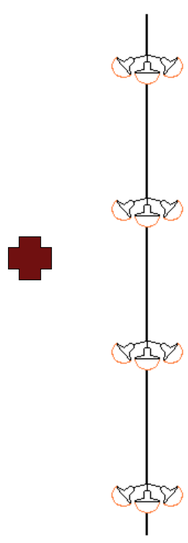
This configuration is slightly better than IceCube up to 10 TeV.

*This study = **first step to optimize a cubic-kilometre deep sea detector**. Other parameters have to be taken into account: environmental properties, energy reconstruction...*

A homogeneous and compact geometry



127 strings (6 crowns)



25 storeys

Optical module (OM)
With 10'' PMTs

(J. Carr et al, this conference)

Geometry optimization

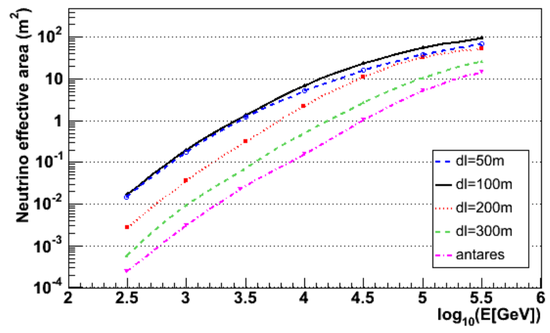
Optimization for up-going muon neutrinos between 1 and 100 TeV

When the distance between lines increases:

• competition between:
- Reconstruction efficiency ↘
- Instrumented volume ↗

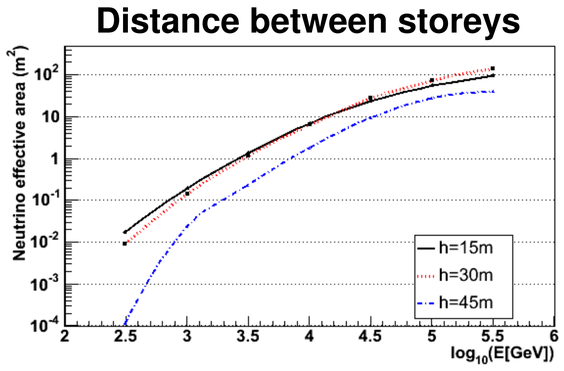
• angular resolution: 0.06° ↗ 0.4°

Distance between lines



⇒ optimal distance between lines = 100 m

Distance between storeys



• From 15 to 30 m, the reconstruction efficiency:
- ↘ at low energy
- ↗ at high energy

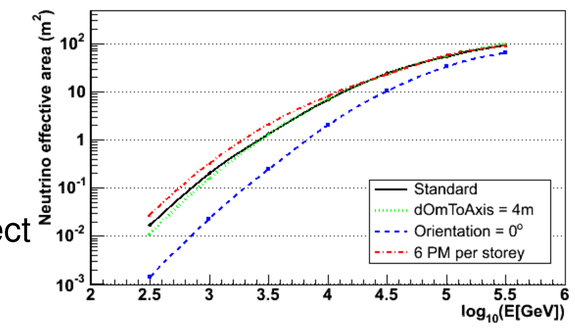
• The trigger definition limits the distance between storeys.

⇒ optimal distance between storeys = 15 m

From 45° to vertical PMTs orientation, the efficiency decreases.

Doubling the PMT detection surface has only significant effect at low energy.

PMTs configuration in the storey



⇒ optimal: 6 PMTs with 45° inclination

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30th International Cosmic Ray Conference
2007 – Merida – Yucatan - Mexico