

# K40 simulations using GEANT4



ecap

ERLANGEN CENTRE  
FOR ASTROPARTICLE  
PHYSICS

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PHYSICS



# Introduction to GEANT4

Object-oriented “toolkit for the simulation of the passage of particles through matter”

Developed for simulation of LHC detectors

Simulates particle-matter interactions

Originally HE physics, but extension for low energy EM processes implemented for some years

Ideally suited to simulating detection units

## Previous Works

Daniel Göring<sup>[1]</sup> (ECAP) used GEANT4 to simulate K40 background in ANTARES already in September 2006

M Anghinolfi, H Constantini, K Fratini & M Taiuti<sup>[2]</sup> (INFN Genova) tested GEANT4 in March 2008 and compared their results to previous simulations by J Brunner

## Objectives

Simulate the Cherenkov background induced by K40 decay

Model geometry and characteristics of a multi-PMT optical module (31 3" PMTs)

Evaluate and parametrize OM response to K40 background

Find constraints to triggering for multi-PMT OM

Consistency check: compare to previous simulations with GEANT4 for ANTARES OM and to ANTARES data

## Method

Simulating one OM in a cube of water  
using actually measured quantum efficiencies

Water composition as measured at ANTARES site

Cube volume freely adjustable  
(optimal size for simulation to be determined)

Optical Module simulated as thin 3" disks without  
glass sphere

## GEANT4 Limitations

Low energy EM physics modelling accurate to within 1% down to 250 eV (recommended limit) with tables present down to 10 eV

Beta decay routine yields incorrect results for K40; correcting code sample proposed by Anghinolfi et al.

For some simulation parameters optimal values have to be empirically found to guarantee correct results without compromising execution time



## Current Status

Using Daniel Göring's code as basis

Code changes necessary for latest GEANT4 release completed

Recompilation of GEANT4 to include K40 decay correction pending

Simulation code compiling and running and adapted to multi-PMT OM geometry

PMT characteristics still to be measured

## Summary and Outlook

Using GEANT4 for K40 background simulations  
has been successfully done before

Improvements and caveats accounted for

Everything ready to start simulations

Results coming soon!



# Coffee Time!



## References

[1] Daniel Göring

“Simulations with GEANT4 of the optical background from  $^{40}\text{K}$  decays in deep sea neutrino telescopes”

September 2006, PI1 Erlangen

[2] M Anghinolfi, H Constantini, K Fratini & M Taiuti

“Simulations of the  $^{40}\text{K}$  noise in the ANTARES environment with Geant4”

March 2008, INFN Genova

Antares-phys-2008-001-K40



# Test Page

ET

AOI

NSHR

DLUXP

QWERTY

ASDFGHJ



If you can read this, you do not  
need glasses!

