Thermal neutron background measurements in the Gran Sasso National Laboratory

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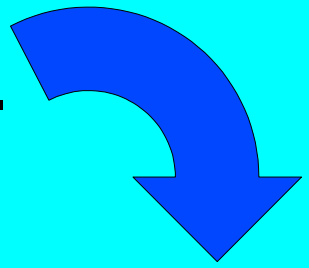
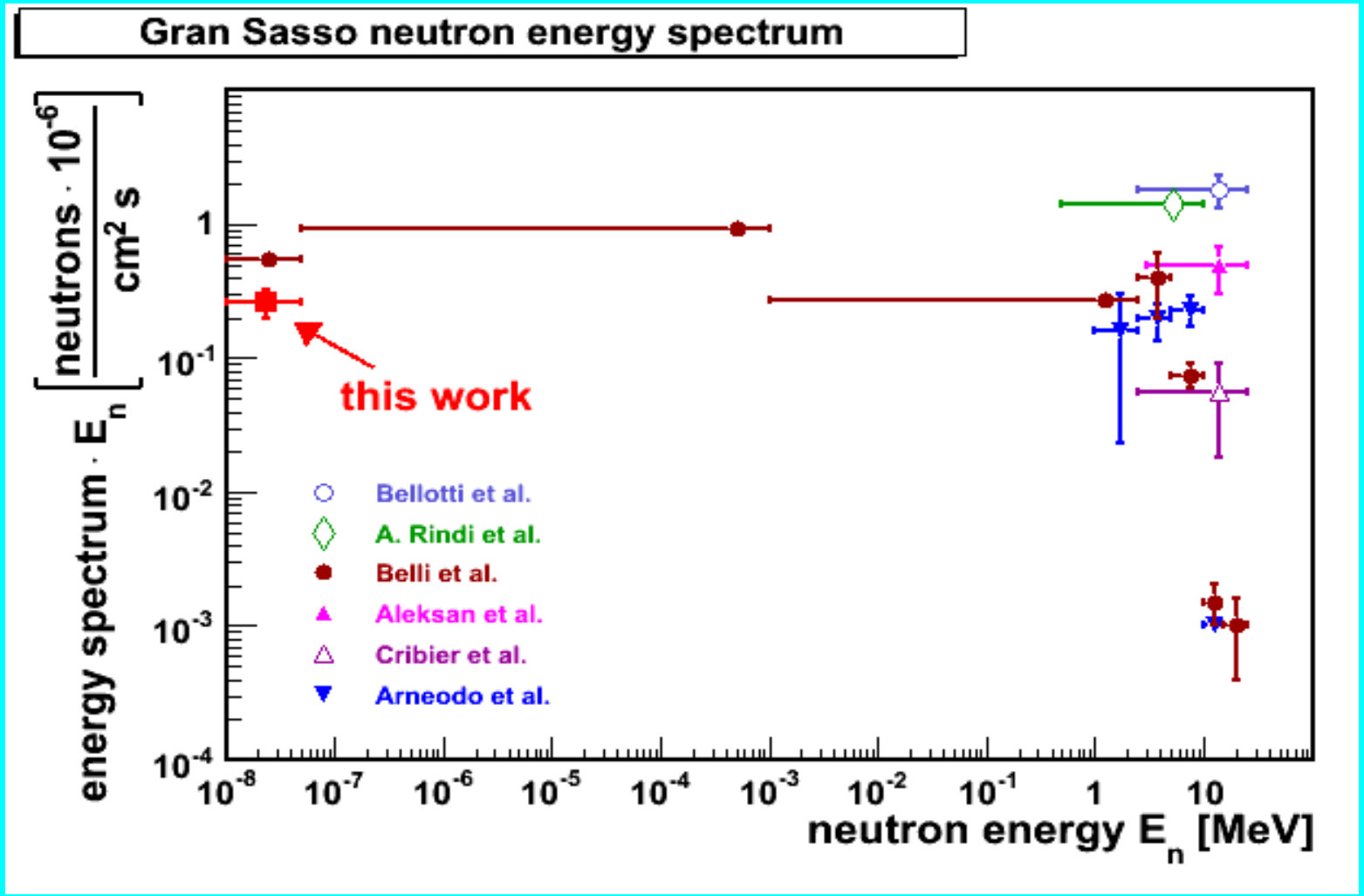
- In April of this year we have measured the neutron flux in The Gran Sasso Underground Laboratory (Italy).
- It was a test measurement of only thermal neutrons.
- Our result is...



Thermal neutrons flux

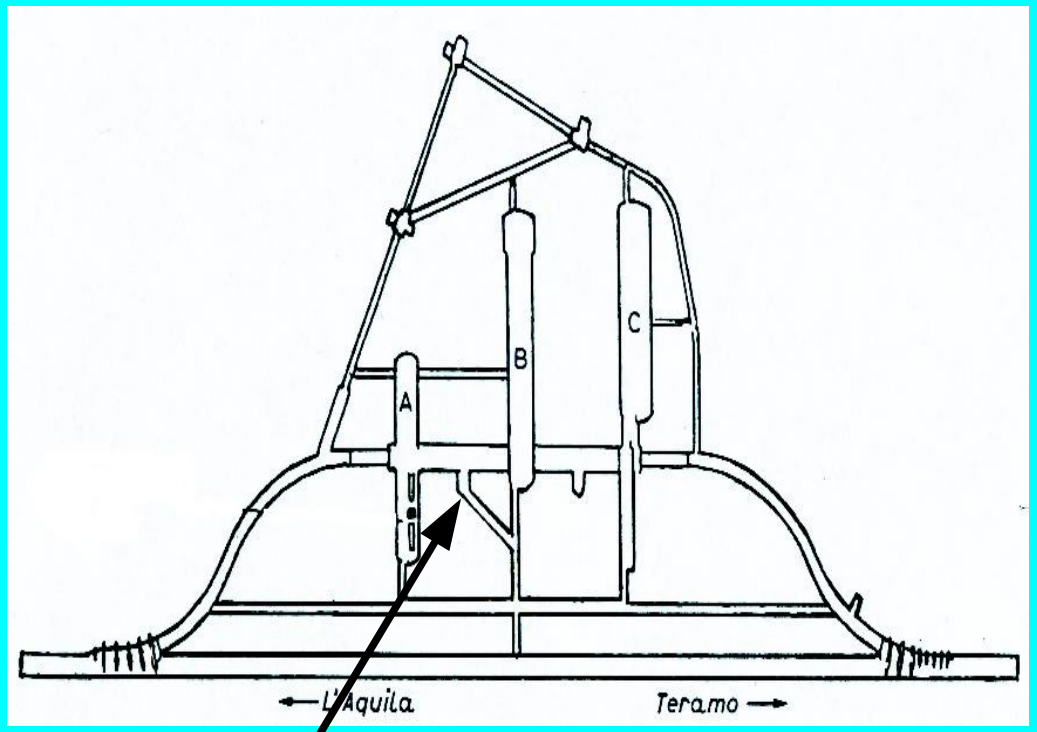
$(5.4 \pm 1.3) \times 10^{-7}\ n \cdot cm^{-2} \cdot s^{-1}$

Measurements of the Gran Sasso neutron flux



Wulandari et al. hep-ex/0312050v2

Gran Sasso National Laboratory



our experimental setup

- Near highway tunnel under Gran Sasso Mountains (Italy)
- Covered by 1400 m of rock (3600 m.w.e)
- μ flux: 10^{-6} m^{-2} h^{-1}

<u>Low background laboratory</u>
•neutrino physic
•dark mater search
•double β decay search

The counter

Gas helium-3 proportional counter
Neutrons are registered by a reaction:

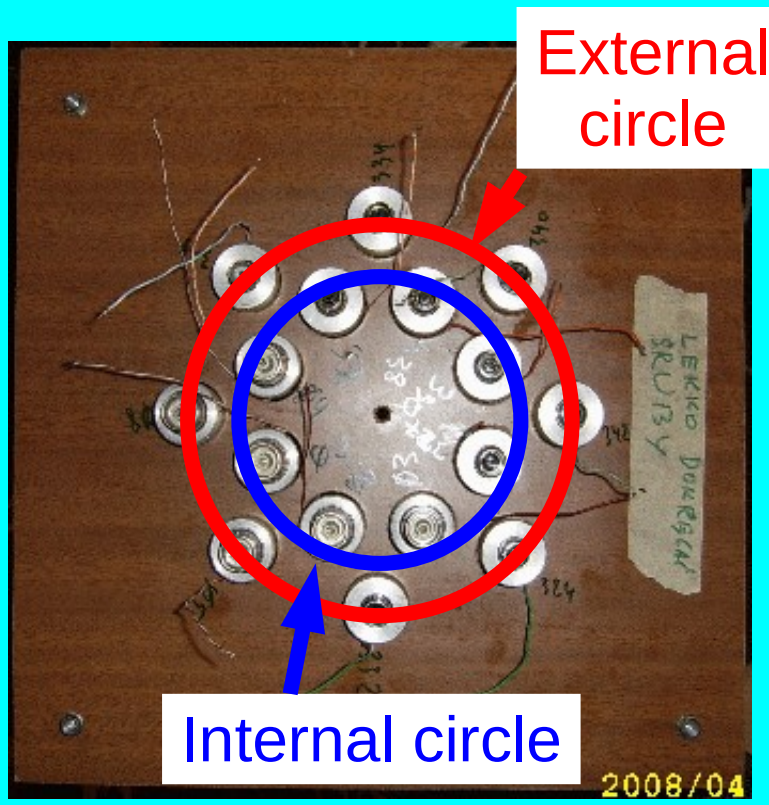
$$^{3}He + n \rightarrow {}^{3}H + p + 764\ keV$$

Mainly thermal neutrons (E~0,024eV) are registered
50 cm long, 2.5 cm in diameter
4 atm helium pressure
20 years old
Borrowed from IChTJ Żerań

detector setup -- two configurations
16 counters, 8 FADC channels

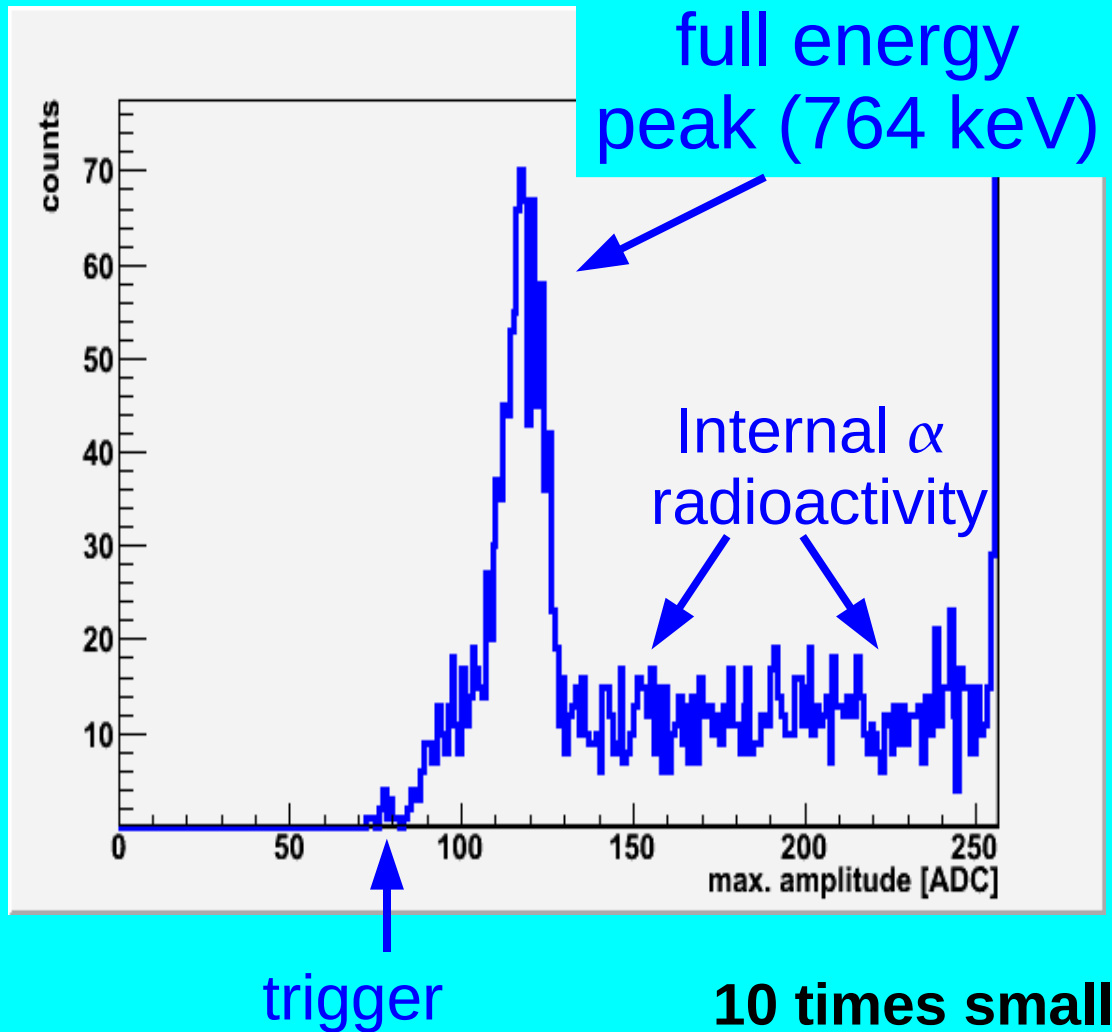
"line"
7 days

"circles"
10 days



"circles"
(top view)

Registered ^{3}He spectrum at Gran Sasso (one week, 16 counters)

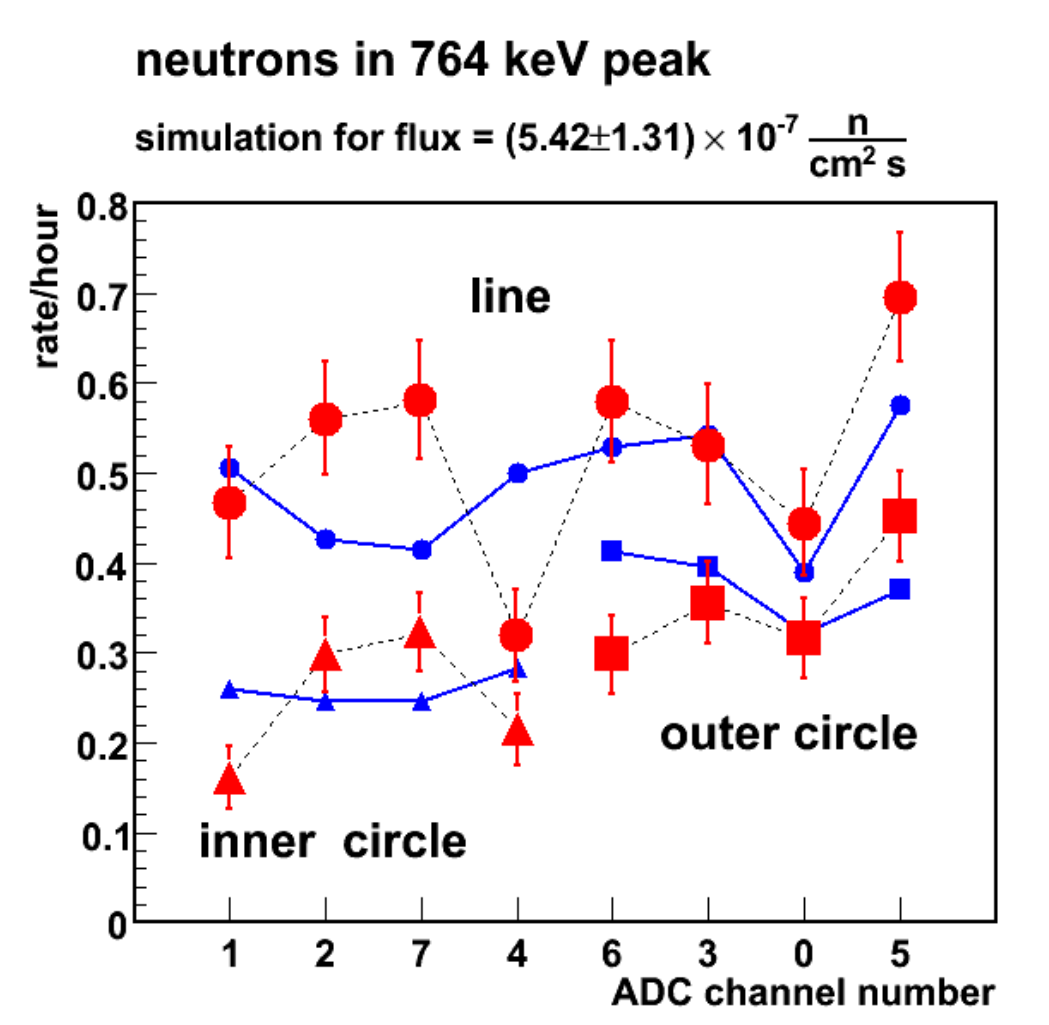


^{3}He (n,p) ^{3}H + 764 keV

Neutron peak:	
neutrons	650 week^{-1}
internal α's	160 week^{-1}

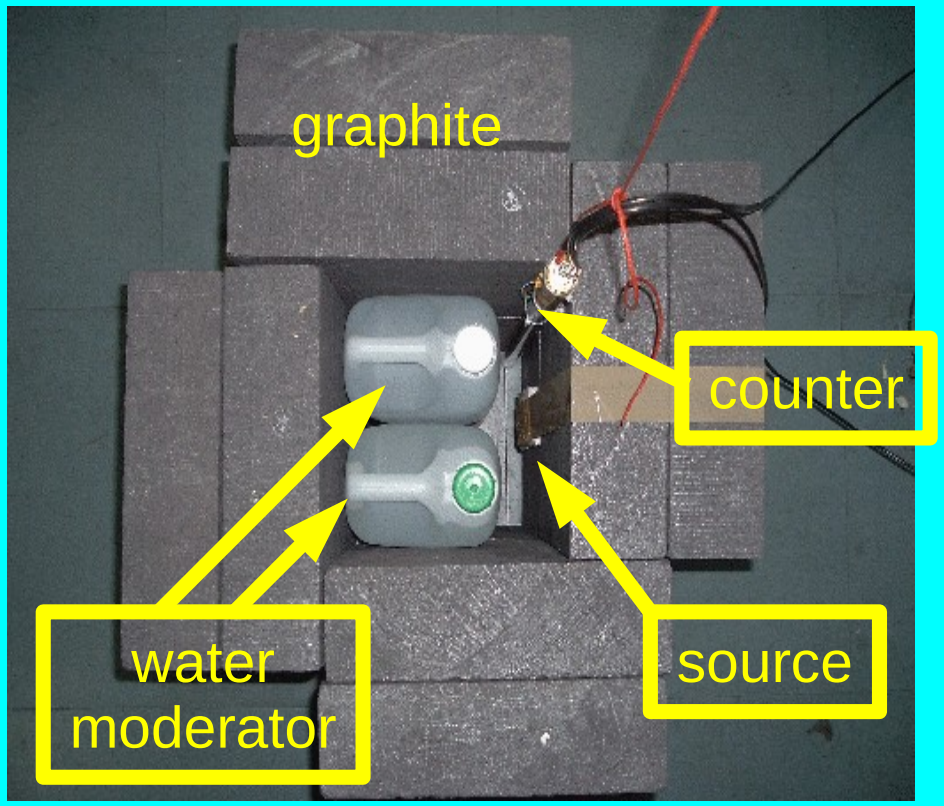
10 times smaller neutron flux can be measured

result = measurement + MC



- For flux calculation registered counting rate must be compared with simulation
- Simulations are as critical as measurements

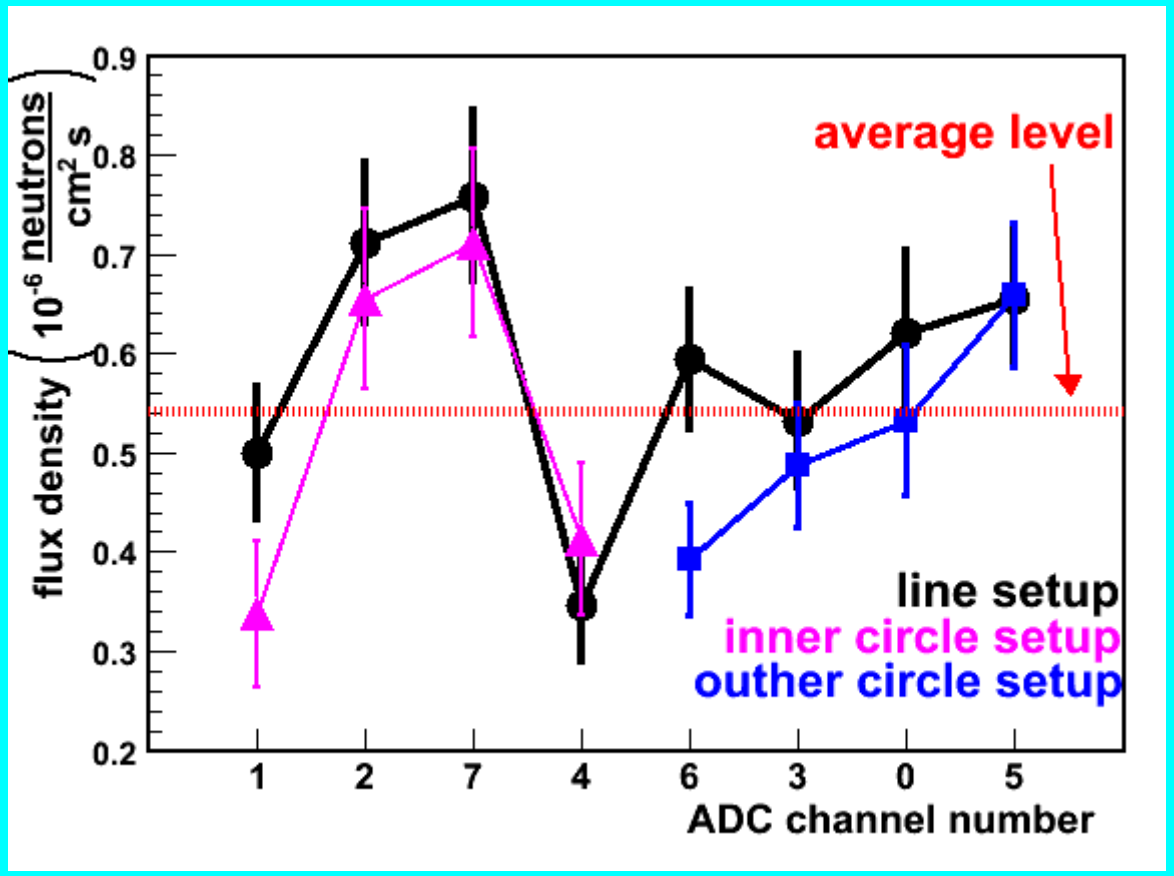
GEANT4 simulation tests



Setup for test
of counter simulation

- Graphite test chamber
- 20 cm thick walls
- Neutron Source Am+Be, 200 Hz
- Walls reflect neutrons: test setup is isolated
- **Difference between simulations and measurements ~ 1% (for new counters)**

Thermal neutron flux



Flux calculated for all counter pairs and setups separately

average: $(5.4 \pm 1.3) \times 10^{-7}\ n \cdot cm^{-2} \cdot s^{-1}$

Summary

- We measured thermal neutron flux at Gran Sasso National Laboratory (Heidelberg-Moscow room).
- Result (preliminary): $(5.4 \pm 1.3) \times 10^{-7}\ n \cdot cm^{-2} \cdot s^{-1}$ (statistical errors only)
- Grant: ILIAS-TA P2007-12-LNGS (part I): one month measurements of thermal neutron flux „ ... in order to demonstrate the sensitivity of the method and the alpha background”. (EU contract RII3-CT-2004-506222)
- We have a plan to measure neutron flux in a few energy ranges at LNGS and Boulby.