WP6: Optimal design of neutron detectors and gamma-ray detectors

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Proposed tasks within the WP

Task1: Implementation of the different detector units in G4. Implementation of the neutron detector array geometries (NEDA, MONSTER). Combination with gamma detector arrays (EXOGAM2, AGATA, etc.). Combination with geometries of medium resolution gamma detectors based on new scintillator materials.
Deliverable: *flexible simulation code after 12 months*

Task2: Development and further development of existing event generators. Development of analysis packages for the evaluation of the MC results.
Deliverable: *event generator(s) code, analysis code, after 16 months*

Proposed tasks of the WP (II)

Task3: Validation of the response of the prototypes of the detectors. Study and evaluation of the different geometry configurations. Optimization of the full setups. Study or optimization of the cross talk between different detectors. Study of the effect of different neutron databases on the detectors efficiency.
Deliverable: *report, after 24 months*

Task4: Publication of the results
Deliverable: *article(s), after 36 months*

Work performed until now (presentations on Friday)

M. N. Erduran, " A simple event generator for testing neutron detectorarrays. The fusion-evaporation case"

D. Jordan, "An event generator for beta decay studies"

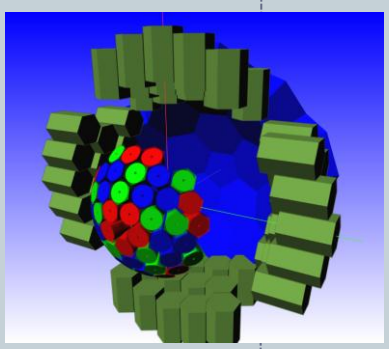
J. J. Valiente or T. Hüyük, "NEDA simulations with the AGATA code ....."

T. Martinez, "Thermal neutron simulations ....."

V. Modamio, "Simulation aspects of NEDA mechanics …."

Work of the NEDA group

- Use of GEANT4 simulation tool – Include the geometry and the physics for each detector (gamma, charged particle, neutron)
- Create (still ongoing) an event generator for fusion-evaporation reactions with the energy and angular distributions for neutrons for the various channels of interest (2n, alpha n, pn, …).
- Couple AGATA + NEDA + …



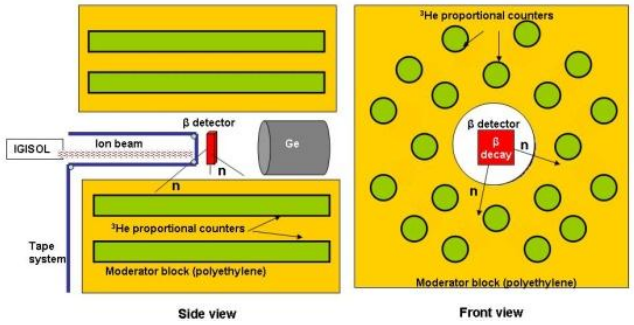
NW+NEDA+AGATA

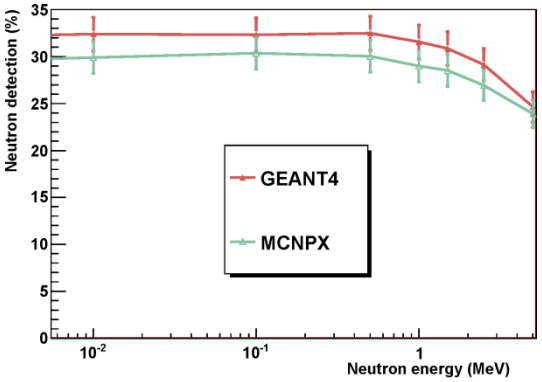
- Study of key reactions to populate neutron deficient nuclei
  - $^{58}Ni+^{56}Fe \rightarrow ^{114}Xe^*$
- Fusion evaporation code PACE_NA97 with TCs Koning has been used to start testing the angular distributions of n with data already existing.

CIEMAT work

- Beta delayed neutron emission probabilities P_n have been investigated at JYFL and FRS-GSI with the BEta deLayEd Neutron (BELEN) detector, within the collaboration UPC-IFIC-JYFL-CIEMAT-GSI-LNL-U.Surrey-U.Santiago-U.Edimburgh-E.Liverpool

- CIEMAT is taking part in the analysis of the first batch of data JYFL 2009-2010.
- Well known neutron emitters ^{88}Br, ^{94,95}Rb and ^{138}I have been measured to experimentally determine the detection efficiency of the counter
- The detecction efficiency has been determined by MC simulation with GEANT4 and MCNPX. It is already known that MCNP and GEANT4 produces different results when neutron transport is dealt with.
- Our work could help to understand possible sources of discrepancies. Bugs in routine calls have been identified in GEANT4.





IFIC work

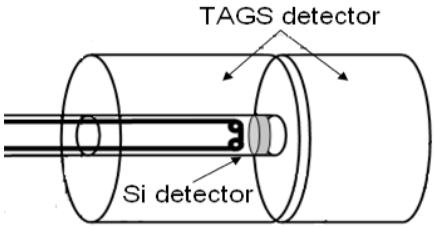
• Further development of an event generator for designing, optimization and performance characterization of beta decay experimental set-ups

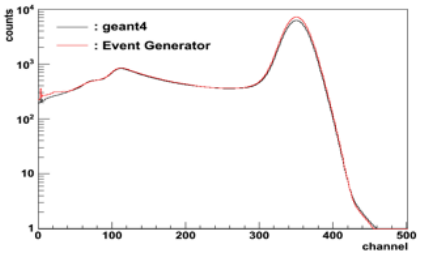
• It includes as secondary process beta delayed neutron emission

• For the decay of the nucleus, an statistical model based on nuclear level densities and gamma-strengths has been used (high excitation E)

• At low energies, the known level scheme has been used for the generation of the electromagnetic cascade

• The event generator has been integrated in Geant4 and tested with different experimental set-ups.





How do we proceed within WP6: questions to be answered at the end of the meeting

Update of the work performed until now
What is needed for the next year ? Who will do it ?, how ?, when ?
Reordering/ redefinition of some priorities ?
Should we continue in the way we are working ?

Development of common tools (physics list, event generators, analysis tools, definition of parameters of interest of the simulations, light production, databases testing)

Division of the work and coordination
Code development, optimization of the work already done, use of existing codes ?
Collaboration further definition and publication policy

Goals and needs

More precise division of the work and coordination

Development of common tools (physics list, event generators, analysis tools, definition of parameters of interest of the simulations, light production, databases testing)

Further development of codes, or optimization of existing codes (explore AGATA and other available codes)

Characterization of new materials

THANK YOU