



Angelo Pagano
INFN –Division of Catania
Rapporteur

Panel Discussion Topic VI

Physics Cases and Instrumentation for the EURISOL-DF, next step towards Eurisol

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Two important Items (for reaction studies and link with structure effects) :

- a) **Implementation (of existing devices) or new developments : neutron detections - fully integrated with Charged particles (i.e. the same object has to measure n, CP)**
- b) **“ comparison =link ” with reactions induced by stable isotopes – beams/targets available or in progress in different EU. infrastructures : (related to Yorik B. and Marek L. Yesterday presentations)**

Idem est:

Synergic collaboration and expertise with potential laboratories with good stable beam facilities (as relevant example: the LNS –CT should be one of them. The LNS is planning to upgrade the intensity of stable (HIB) for both $\beta\beta 00$ and In-Flight (see for details:HIB2015workshop:<https://agenda.infn.it/conferenceDisplay.py?confId=10053>)

WHY

Beside the “classical ” well established physics cases for Eurisol-DF (as largely discussed on 15th -16th in Lisbon 2017), It is useful to remind us that :

Neutron detection (integrated with CP) Is a powerful method in (only few references, sorry for that) REACTION STUDIES (for both neutron and proton rich nuclei):

1- coincidences: n,gamma or (n,lp,gamma),n-cluster,spectroscopy : anomalies in statistical model predictions (Coulomb –pre-Fermi energies) (fusion reaction, fission, clusters)

M.Baldo et al., PL B 156 (1985); A. GALONSKY et al., PL B 197(1987); G. Caskey et al. PRC , R31,4 (1985); A.A. Korshennikov et al., PRL 87, 092501 (2001). C. Beck, Clusters in Nuclei, Vol. 3, ed. Springer Verlag Berlin Heidelberg (2014).

2-n,n correlation studies: relative population of excited state, size and mean-life of emitting source –spectroscopy of excited states- (Coulomb-Fermi and medium energies) (fusion reaction, transfer, break-up, sequential decay)

N. Colonna, et al., PRL ,75,3,(1995); R. Lednicky et al. PLB 373 (1996), R. Ghetti , et al. NPA, 765,(2006);

3- Deep inelastic and Projectile Fragmentation (energy sharing- time scale of nuclear reactions from preequilibrium to sequential emission) Multifragmentation and/or production of short living exotic nuclei of density far away from the saturation value (pre Fermi energy and medium energies)

E. De Filippo and A. Pagano, Eur. Phys. Jour. A 50, 32 (2014) and ref.s therein

HOW

- High efficiency neutron detection (new plastic/crystal materials of efficiency $\sim 5\%/cm^3$?) beside well none examples, DEMON, NEDA, MONSTER, etc....) **but, fully integrated with CP:** See for example: N. Zaitseva NIM A 668 (2012)
- **highly segmented (large solid angle $\square 4\pi$)** to have a full control of the cross-talk
- Mandatory: TOF, PSD (n,gamma, CP) and Digital Acquisition (increases the information you get from the experiment)

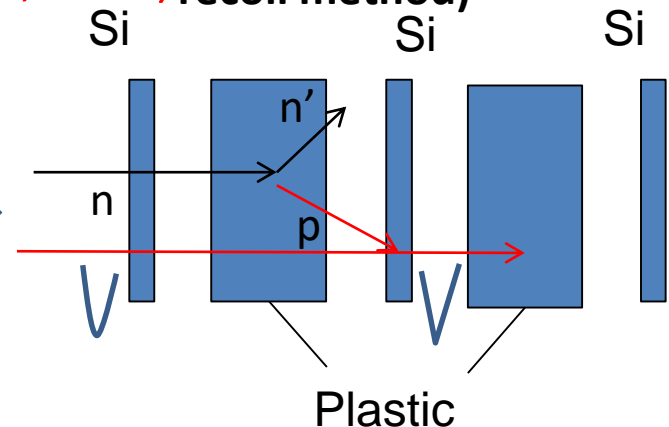
Possible configuration:

(small) Basic detection cell : Plastic (FAST-SLOW) ,...), Inorganic (SLOW)

...Phoswich detectors?? Integrating different possibilities of Fast and Slow decay component of scintillation process and assembled in a "multi-cluster" geometry (as an example, Like in cp "PARIS" detector, Farcos, ecc...)

More ambitious and complex devises???:

**STACK
Detector**



Conclusions

In this brief report I stressed the importance to detect in a systematic way neutrons as fundamental hadrons for nuclear reactions studies and its relevance for nuclear spectroscopy , by covering large physics interest from coulomb to medium energies.

Highly segmented devices (with the necessity to study new material) are unique way to master the crucial problems of Cross talk.

I also point out the necessity to integrate (in efficient way) the important expertise coming from those laboratory where important facilities for stable beams are already in operation (and/or are going to be upgraded in intensity ,such as, for example, LNS in Catania)

I am grateful to the organising committee for the hospitality and for the invitation to the workshop. In particular, I warmly thank Professor Lidia Ferreira.