The Design of Neutron Imaging Instrument combined with PGAA set up at Maamora Triga Reactor

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ABSTRACT
A new neutron imaging instrument will be built to support the area of neutron imaging research (neutron radiography and tomography) at Maamora Triga Research Reactor (CNESTEN Research Centre, Rabat). This neutron imaging set up will be combined with prompt gamma with the prompt gamma-ray activation. The whole system will be mounted on the tangential channel. Both techniques are complementary and their combination provides full picture about sample by obtaining the material’s composition and the spatial distribution of the material in the sample set up. In this configuration the convergent part consist on the association of material with capability to reduce rapid neutrons and gamma (Borate, Iron, Borate polyethylene and lead), and a primary shutter.

The installation of these parts is in process. The second part is housed in the Triga Reactor hall, and including: The drum exchanger Collimator, Flight tube and Beam deflector. As defined in our previous works basing on Grant4 simulations, fast neutron (5cm sapphire) and gamma (5cm bismuth) filters will be inserted in the convergent part. The LCD drum exchanger is housing 4 pinhole collimator with apertures of 1cm, 2cm, and 2.5cm and will reduce the beam size to 8 cm x 8 cm, 12 cm x 12 cm and 20 cm x 20 cm at the detector position respectively. The whole instrument will operated in three different positions, one for high resolution and the other for high flux.

INTRODUCTION
Recent developments towards an imaging set-up at the PGAA instrument are done (PGAI) at Maier-Leibniz Zentrum (MLZ) and NIPS-NORMA at Budapest-Nuclear Centre. These instruments are designed with regard to the different possible beam options. In our case the combination was chosen to explore the same beam tube (tangential beam) and both set up can be used separately as well as in combination (Fig 1). This project is supported by IAEA under MOR1010.

EXPERIMENTAL SET UP
Since the Ni and PGAA instrument used the same beam line they has a common component primary:

- Primary collimator housing 5 cm Sapphire (1 m low carbon steel + 45 PE+B4C rings with length of 45cm) inserted in the tangential channel

The configurations the Neutron Imaging on ON and OFF modes are presented schematically in Fig. 4.

SHIELDING ASPECT
Several commercial High-density concrete commercially available under the name Hormirad mixed with different ratio of the boron (15%, 5%, and 1.99%). Hormirad are investigated to define the Optimal material. The Grant4 Simulation results shows that the shielding material should have 50% of Iron.

As the optimal shielding composition is corresponding to material with 50% of iron we will use a mixture of 50% Cement + 50% boron steel as shielding material

CONCLUSIONS
As presented above the final version of the combined imaging set-up with the PGAA instrument is well defined. These instruments are designed with regard to the different possible beam options.

Both facilities will be build in two phases:

- Phase I: consist in the installation of the primary collimator (including the filters) and the primary shutter (December 2017).
- Phase II: the installation of the rest of facilities components (L/D exchanger, fast shutter, flight tube, beam delimiter, beam stop, neutron guide, system detector...). In this phase, we project also to build shielding around the facilities (December 2018).

REFERENCES


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