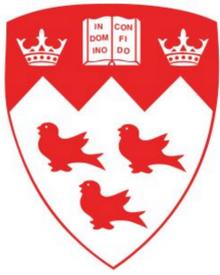




Neutron Spectral Measurements around a Scanning Proton Beam



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INNOVATION / IMPACT

- We describe measurements of neutron spectra around a scanning proton beam.
- Measurements were made using the Nested Neutron Spectrometer (Detec Inc., Gatineau, QC) operated in pulsed and current mode (Dubeau et al., 2012; Maglieri et al., 2015).
- Spectra measured as a function of location in the treatment room and for various proton beam energies.

FACILITY / BEAM

- Skandion proton therapy clinic in Uppsala, Sweden.
- Clinical proton beam in a treatment room with a gantry and a dedicated nozzle.
- Compact IBA Proteus Plus cyclotron.
- Maximum proton energy of 230 MeV
- Neutron measurements with and without water phantom in the beam.

MATERIALS AND METHODS

- Extended energy range NNS (Figure 1), on couch at 1 m from isocentre.
- Range of proton energies (Bragg peak depths) with & without water phantom (37 cm x 37 cm)
- Field size of 20 x 20 cm² at isocentre
- Figure 2 shows a photo of setup

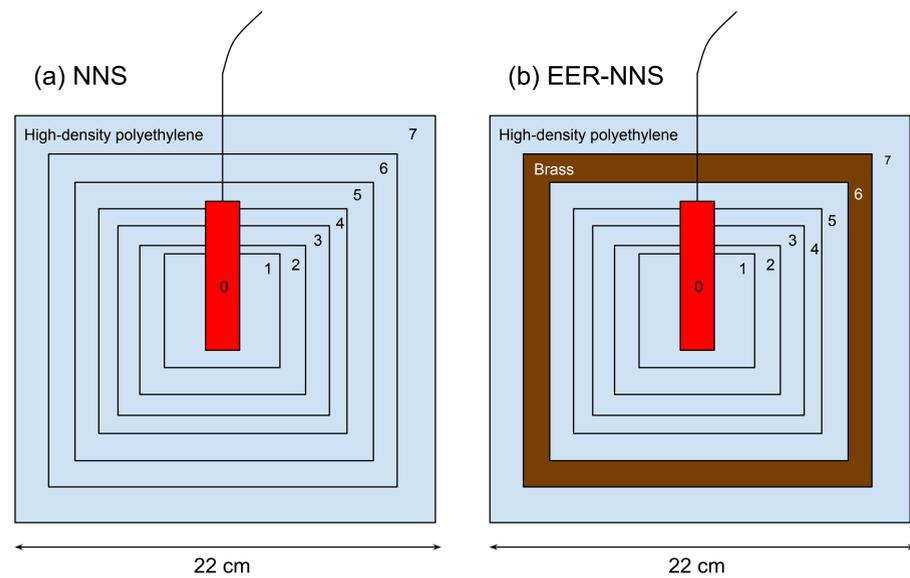


Figure 1: The NNS comprises a central He-3 detector (active neutron detection) with seven high density polyethylene shells that may be arranged around the detector. (a) The standard NNS, (b) the extended energy range (EER) NNS with moderator 6 replaced by a brass shell.

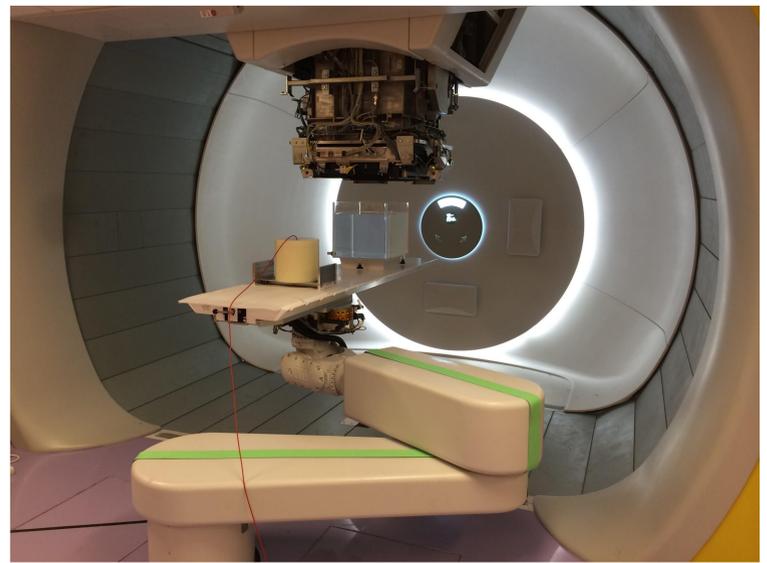


Figure 2: The NNS on the couch of the proton therapy beam with the water phantom in place.

RESULTS

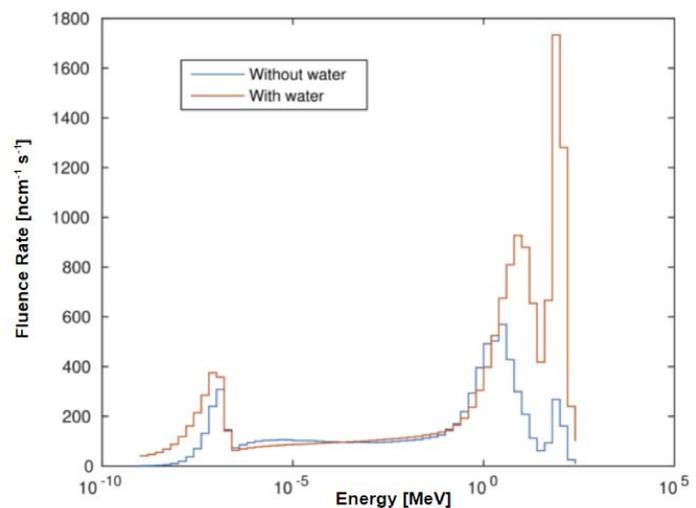


Figure 3: Preliminary unfolded neutron spectra measured at 1 m along the couch for the 200 MeV proton beam with and without water phantom.

CONCLUSIONS

- We have measured neutron spectra around a scanning proton therapy beam, with and without a water phantom, using an extended energy range Nested Neutron Spectrometer.
- Preliminary results provide neutron spectra with the expected direct, evaporation, and thermal peaks and demonstrate the effect of placing a water phantom (representing a patient) in the proton beam.

REFERENCES

Dubeau, J., et al. "A neutron spectrometer using nested moderators." *Radiation protection dosimetry* 150.2 (2012): 217-222.

Maglieri, R., Lica, A., Evans, M., Seuntjens, J., & Kildea, J. (2015). Measuring neutron spectra in radiotherapy using the nested neutron spectrometer. *Medical Physics*, 42(11), 6162-6169.

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