Development of a validated Monte Carlo model of the ACNS Dingo Beamline

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Background: The Australian Centre for Neutron Scattering (ACNS) Dingo beamline is the only high-flux thermal neutron source available in the region and is mainly used in neutron imaging. Previous spectroscopic measurements indicate a broad spectrum of epithermal and fast neutrons together with gamma radiation, which have not been yet directly characterised due to the high flux of the beam and have significant implications for radiobiology research. Therefore, we propose the development of an accurate, experimentally validated Monte Carlo (MC) simulation model of the beamline and hutch, from the reactor pinhole to the nozzle, including all the identified and newly developed instrumentation. The developed MC model will i.e. extend the capabilities of the beamline, and allow virtual rehearsal of planned experiments or measurements of phenomena otherwise not directly observable.

Material and Methods: Computer-Aided Design (CAD) drawings of the Dingo beamline were processed in Autodesk Inventor 2022, and then imported into Geant4 using CADMesh interface [1]. Geant4 simulation package has been developed to import the model and load or generate relevant detectors and simulation scenarios specified by the user in a macro file. Field characteristics, neutron flux and out-of-beam neutron and gamma spectra, were measured experimentally. The out-of-beam Bonner Sphere spectra were unfolded and implemented as the initial input in the simulation. The model was validated through the simulations of field characteristics at the scintillator screen stage and out-of-beam energy spectra. Produced results were compared to the existing experimental data, and the model was iteratively revised until a satisfying agreement was reached.

Preliminary results: A detailed model of the Dingo beamline has been successfully imported and passed repeated G4 (femtometer scale) geometry tests. First results show that the simulated field characteristics; and out-of-beam neutron spectra are in good agreement with the experimental data. It was also confirmed the epithermal and fast neutron components constitute a significant part of the incident beam.

[1] C. M. Poole et al., *Australas Phys Eng Sci Med*, vol. 35, no. 3, pp. 329-34, Sep 2012