How well do you know your neutron detector?

Neutrons, together with protons and electrons, form the building block of the universe: atoms. By itself, neutrons can be used in a multitude of scientific research fields such as materials and life sciences. There are different ways to produce these *free* neutrons, but the way the upcoming European Spallation Source (ESS) research facility produces large amounts of neutrons ($\sim 10^{15}$ neutrons/second/cm^2) is by a *spallation* reaction. The spallation reaction can be understood by considering the opening shot in a game of billiard, where the cue ball breaks the rack of object balls with both speed and strength. Here, the object balls represent the neutrons. To study the samples that we are interested in, we let the free neutrons interact with it, and thereafter investigate how the neutrons have changed. But how do we actually "see" these neutrons? That's where a neutron detector comes in!

A neutron detector provides information of the neutrons indirectly, that is, by measuring the radiation created when the neutrons interact with the detector. For the BIFROST instrument at ESS, position-sensitive ^{3}He neutron detectors will be used. These detectors both count the number of neutrons that have interacted with the detector (number of events) and also give the position of where the interaction occurred in the detector. But then comes the question, to what extent can we trust the position information provided by the detector? To find out, we subjected the detector system to a *factory acceptance test* at the Laboratoire Léon Brillouin in Saclay, France using a portable neutron source. By exposing free neutrons to small defined regions of the detector and taking measurements, we are able to find out the *resolution* of these detectors, that is, how well the detector is able to differentiate between the positions of two separate neutron interactions.

In the larger picture, these resolution results will provide a benchmark for when the BIFROST instrument is installed and operational at ESS, and will serve to monitor the long-term performance of the detectors when subjected to the anticipated strongest neutron source in the world that is the ESS facility.