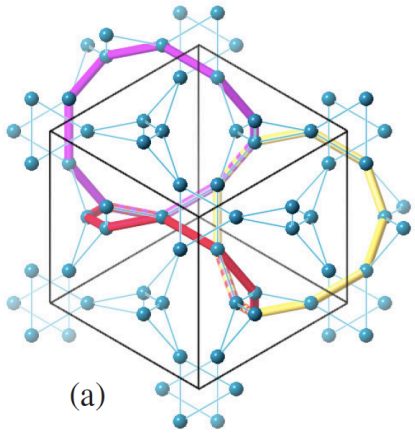
Hidden and conspicuous magnetic order in hyper-kagome magnets

O.Petrenko@warwick.ac.uk

The main goal of the project is to experimentally study highly unusual magnetic properties of several gadolinium-containing garnets, primarily $Gd_3Ga_5O_{12}$ (GGG), $Gd_3Al_5O_{12}$ and $Gd_3Te_2Li_3O_{12}$. Although the compounds have been known for decades, it has only recently been realized that the particular way in which the Gd ions form a crystal structure, described as a hyper-kagome lattice, is crucial in order to understand their magnetic behaviour. The structure consists of corner-sharing triangles with the Gd ions forming 10-site loops, shown in colour on the left. In GGG, the loops are responsible for a hidden order in a spin-liquid phase in zero field, as identified by the powder neutron diffraction analysis [1]. They are also responsible for the appearance of the flat modes in the excitation spectrum in higher magnetic fields [2].


(a)

This project will address all important and yet completely open questions: What it the *nature of field-induced ordering* in the garnets? What *interactions* are responsible for the selection of a particular magnetic state among many other possibilities? Can the signatures of the *multi-spin correlations* be found in other compounds?

We will use neutron scattering as a main tool in our investigations, in particular on single crystal garnet samples.

[1] J.A.M. Paddison, H. Jacobsen, O.A. Petrenko, M.T. Fernandez-Diaz, P.P. Deen and A.L. Goodwin, Science **350**, 179 (2015).

[2] N. d'Ambrumenil, O.A. Petrenko, H. Mutka and P.P. Deen, Phys. Rev. Letters **114**, 227203 (2015).