Date: Friday, 6 August 2021
Time: 3:00pm – 4:00pm
Speaker: Dr Susanne Horn (Applied Mathematics Research Centre, Coventry University)
Venue: Zoom

Title: Multimodal rotating magnetoconvection in liquid metals.

Abstract: The geomagnetic field is generated and sustained by rapidly rotating turbulent convection deep within Earth’s liquid metal core. This dynamo process is thought to occur in the optimal state of magnetostrophy, where Coriolis and Lorentz forces are approximately in balance. Born out of classical linear stability analysis, there is the long-held tenet that this state naturally facilitates the magnetic field generation and is governed by a single large-scale bulk mode.

A single-mode theory is, however, not likely to be geophysically realistic. In this talk, I will revisit some of the linear stability results and present complementary fully non-linear direct numerical simulations in the strongly supercritical regime. I will show that convective liquid metal flows are, in fact, characterised by pronounced multimodality with a mix of stationary, oscillatory, and wall-attached modes, which span a wide range of length scales. In particular, I will focus on the parameter space in which two types of stationary modes co-exist, a small-scale geostrophic mode and a large-scale magnetostrophic mode. This peculiar feature of rotating magnetoconvection was first discovered by Donna D. Elbert. Furthermore, I will discuss which onset characteristics, such as the flow morphology, length scales and frequencies, carry over to higher supercriticalities, as well as the relevance of these results for our understanding of planetary core convection and dynamo generation.

Bio: Susanne Horn is a Senior Lecturer in Numerical and Mathematical Fluid dynamics at Coventry University. Susanne's research interests include astrophysical and geophysical fluid dynamics, Rayleigh-Bénard convection, turbulence, rotating flows, and coherent structures.