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Large scale analysis of the von Kármán Sodium experiment using Proper Orthogonal Decomposition

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Dynamo instability, i.e the amplification of a residual magnetic field by a fluid flow, is generally assumed to be the mechanism behind the emergence of large scale magnetic fields in the universe. In 2006, the von Kármán Sodium (VKS) experiment was able for the first time to produce a dynamo through a highly turbulent flow of liquid sodium driven by two counter-rotating impellers in a cylindrical cavity. A key ingredient for success was the use of appropriate boundary conditions.

We performed a study of this successful setup in the case of a symmetric forcing where the impellers counter-rotate at same frequency and therefore the velocity is on average an axisymmetric quadrupole. To this end, simulations were carried in both the growth and saturated dynamo regimes by SFEMaNS which we will analyze by means of Proper Orthogonal Decomposition (POD) applied to the velocity and magnetic fields. This analysis will show that most of the energy can be captured by a small number of POD modes.

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