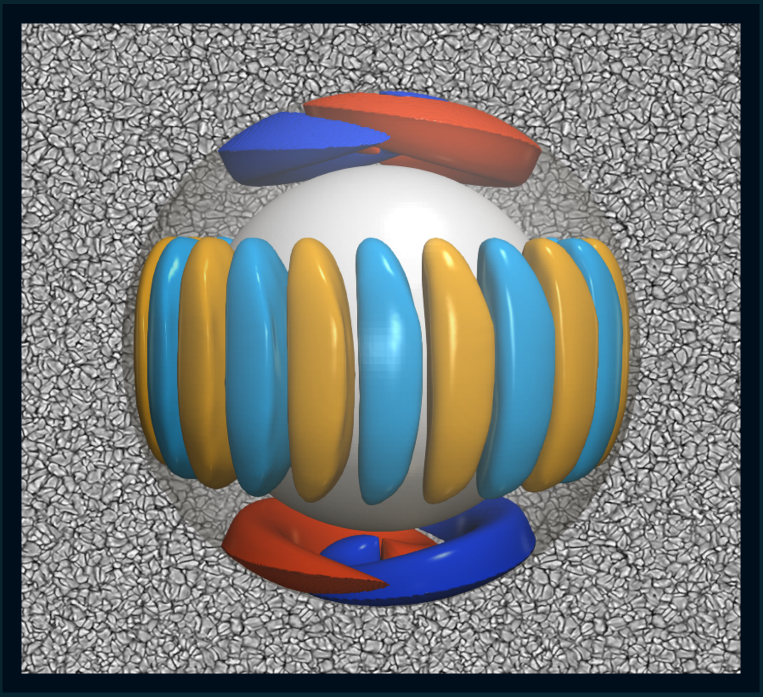
Theory of solar oscillations in the inertial frequency range



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Yuto Bekki:
Theory of solar oscillations in the inertial frequency range

The interior of the Sun can be studied with helioseismology, which analyses oscillations observed on the solar surface. Conventionally, high-frequency acoustic modes have been used. Low-frequency modes of *inertial oscillations* were predicted to exist in the Sun but had not been observed until recently. In this thesis, we report the observational detection of a number of different types of solar inertial modes.

For interpreting the observations, we have developed a linear eigenmode solver for the differentially-rotating convection zone. Our model predicts the existence of *mixed* modes between the equatorial Rossby and the columnar convective modes. It is also found that the turbulent diffusion has a substantial impact on the radial structure of the equatorial Rossby modes.

In addition to the linear analysis, we also carried out fully nonlinear numerical simulations of the Sun's convection zone to study the excitation and amplitudes of these inertial modes. The observed amplitudes of the equatorial Rossby modes can be explained by the stochastic excitation due to turbulent convection. However, we find that the large latitudinal entropy variation is required to properly reproduce the observations of the high-latitude modes, which are *baroclinically* unstable. This result is an observational evidence of the thermal wind balance in the Sun's convection zone.

The knowledge obtained in this thesis will help us to establish a method to use solar inertial modes to probe the interior of the Sun.

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