Description for the general public

Strongly coupled quantum fluids are realized in nature in various ways. They can be found in form of compact neutron stars in our universe or in form of tiny droplets of Quark-Gluon Plasma, a phase of melted nuclear matter created here on earth only for fractions of a second in high-energy colliders like the LHC. For the blink of a moment the early universe was filled with this Quark-Gluon Plasma at a temperature almost a million times larger than the temperature in the centre of our sun. Other experimentally studied examples, many orders of magnitude colder, are atomic Fermi and Bose gases. These systems can become superfluid or form a Bose-Einstein condensate at extremely small temperatures close to absolute zero. State-of-the-art technologies used in sensors, storage media or computer RAM are based on features of strongly coupled quantum systems. Another example, high-temperature superconductors, might be used in strong magnetic field applications in the near future.

Strongly coupled quantum systems share interesting features despite the apparent differences in seize, temperature, density or field strengths. Both, Quark-Gluon Plasma and ultracold Fermi gases, which are magnetically tuned into a Feshbach resonant regime, were found to constitute nearly perfect fluids, i.e. showing almost no resistance in their flow behavior. The goal of the project ”Properties of strongly coupled quantum fluids” is to shed light onto this similarity. Various transport coefficients in both systems will be studied by analyzing available experimental data with dynamical simulations while analytic insight will be gained from kinetic theory calculations. Particular focus will be put on a consistent treatment of fluid dynamical fluctuations. This is important for a conclusive understanding of the thermodynamic properties of strongly coupled quantum fluids, their phase structure and their transport properties.