The aim of the project is to identify **the correct solitonic effective field theory (EFT) of the fundamental theory of strong interaction, Quantum Chromodynamics (QCD)** and provied a **unified description of baryonic (nuclear) matter at all scales**. This includes computation of:

1. properties of atomic nuclei: binding energies and excitations bands of light and heavy nuclei;
2. nuclear matter phases and corresponding equation(s) of state and thermodynamic properties (e.g., compression modulus);
3. properties of neutron stars and their dynamics during a merging to a black hole (related properties of gravitational waves).

Although all phenomena of nuclear physics should, in principle, be describable by the fundamental theory of strong interactions, **Quantum Chromodynamics** (QCD), this is practically unfeasible owing to the complexity of nuclear systems (nuclei and nuclear matter). Instead, phenomenological models, usually based on nonrelativistic quantum mechanics, are employed for the modelling of nuclear properties, where the interactions introduced in these models are typically fitted to experimental data rather than derived from a more fundamental theory. It is the main aim of this project to bridge the gap between fundamental theory and nuclear phenomena by developing a QCD-based EFT regarding the relevant physical fields (mesons and baryons) and applying it to a reliable and quantitatively precise calculation of nuclear properties **at all scales**.

The Skyrme model (SkM) is an example of an EFT with the additional fascinating property that, while mesons are introduced as the fundamental degrees of freedom (DoF), baryons, nuclei and nuclear matter emerge as collective nonlinear excitations (**topological solitons**) of said fundamental DoF.

Identification of an EFT which covers baryonic phenomena on all scales is important not only from theoretical point of view (showing a possible road to the original quantum theory) or as a tool allowing for an explanation of the existing experimental data (e.g., excitation bands of nuclei, the maximal mass of neutron stars) but can be essential for identification of new phenomena e.g., possibly observed in neutron stars mergers (properties of ultra-dense nuclear matter or searching for imprints of generalized theories of gravity).

Such an EFT will be obtained by a combination of two existing Skyrme type models, the standard, so-called minimal Skyrme model (mSkM) and the BPS Skyrme model (BPS SkM), into a generalized Skyrme model (gSkM).