The aim of the project is to provide **a new mathematical tool allowing for semi-analytical understanding of mulit-soliton interactions, where the relativistic nature of the solitons will be fully taken into account**. Specifically,

1. I will extend the notion of *the collective coordinate method*, which currently by construction leads to *a non-relativistic effective Lagrangian*, to **relativistic collective coordinate method** (RCCM), where the Lorentz symmetry of the original field theory will be recovered at the level of the effective Lagrangian.

2. Using the RCCM I will **explain phenomena** occurring in collisions of topological solitons at the relativistic regime applying a perturbation scheme, where the relativistic corrections are systematically included.

3. Using the RCCM I will also explain the interaction of radiation, which is a pure relativistic phenomenon, with topological solitons. This will shed a new light for the old famous problem i.e., **soliton resolution conjecture**, and in consequence, may help to prove or falsify this conjecture.

Topological solitons are solutions of nonlinear field equations possessing, at first glance, two quite opposed features. On the one hand, solitons are particle-like objects, whose energy density is localized in a certain region of space. On the other, they carry a topological charge, a quantity characterising a solution globally, that depends on the field behavior at infinity. Partly owing to this juxtaposition of short-range and long-range features, the dynamics of topological solitons is extremely involved. The detailed, qualitative as well as quantitative understanding of dynamics of topological solitons, is crucial not only for a theoretical reason, providing a comprehensive insight into fundamental properties of solitonic models, but also it is vital for applicational or even practical reasons, allowing e.g., for a precise manipulation of solitons in condense matter systems.

The most popular method allowing for a semi-analytical insight into the complexity of topological soliton dynamics is to construct a **collective coordinate model** (CCM). Despite many successes, a generic, very important shortcoming of CCMs has been that they reduce a relativistic field theory to a non-relativistic mechanical system.

It is the aim of the project to provide a relativistic generalization of the usual CCMs, so that solitons are approximated by relativistic particles, and therefore, extend the applicability of the CCM for relativistic regime.