Non equilibrium dynamics of the electroweak phase transition in a non minimal composite Higgs model

PhD student: Andrea Guiggiani
Supervisors: Stefania De Curtis, Giuliano Panico

Cosmology is a very active research field in theoretical physics. This area clearly provides a playground where physics beyond the Standard Model (BSM) can be probed. The exploration of the early stages of the cosmological history of our universe can lead to a deeper comprehension of the dynamics that takes place at high energy scales, allowing us to advance towards the understanding of how nature works at its fundamental level.

One of the most compelling aspect of this field is that many theories predict the presence of new physics already at the TeV scale, where many puzzles such as dark matter and baryogenesis could find an explanation. Moreover, the observation of gravitational waves, which could have been generated during the early stages of the universe, have opened new possibilities of testing new physics.

In the recent years a new interest in first-order phase transitions in the early universe has been developed since they could be source of gravitational signals. The peculiar aspect of a first-order phase transition is that the false and true vacuum are separated by an energy barrier and thus the transition must occur via quantum tunneling. During the phase transition bubbles of true vacuum are nucleated and eventually collide and coalesce producing gravitational waves which are potentially detectable at future interferometers. Such mechanism can also provide a possible explanation to baryogenesis through electroweak (EW) baryogenesis where the baryon asymmetry is generated during the EW phase transition.

The aim of my PhD project is the study of BSM theories, with particular attention to their cosmological consequences and the analysis of new possible high temperature phase transitions, whose consequences could be tested in the next future.