

VIPERS and beyond: evolution of galaxies inside the large scale structure through cosmic ages

How galaxies were formed? A simple question, but no simple answer. Even if modern galaxy surveys push our understanding of galaxy physics and evolution further and further, we have no final answer.

In the present-day Universe large galaxies are often divided into two basic types. Elliptical galaxies look on the pictures like roundish clouds with no interesting substructure; usually they are filled with old stars and contain no material to form new stellar populations. The other type – spiral galaxies – are those which we most often admire in the pictures made e.g. by the Hubble Space Telescope. They have very complex structure, with spiral arms, bulges, lanes of dust and clouds of gas, dotted by areas where new stars are still being born. These two types are not all yet – the real zoo of galaxies is much more rich. There is a large and mysterious population of lenticular galaxies – “red and dead”, with no new stars forming any more but disk-shaped, often with central bulge, however, with no spiral arms. We have a variety of irregular galaxies, dwarf galaxies and many others.

What led to the formation of so different types of galaxies? Some theories say that fate of galaxies was determined when it was born by the properties of the dark matter halo in which it was formed. Other approach attributes a crucial role to interactions with other galaxies. Astronomers agree now that the reality is most like more complex and both these factors played a role in formation and evolution of galaxies. Different combinations of different processes ultimately led to the formation of today’s variety of galaxies.

In our project we plan to make use of the unique 3D map of the Universe as it was when it was a half its present age, 8 bln years ago, which we created in the framework of the project VIPERS – VIMOS Public Extragalactic Redshift Survey, which was a Large program of the European Southern Observatory.

This map provides us not only the positions of galaxies in the space but also a possibility to investigate their physical properties – masses, shapes, stellar populations - by different means, even if it is obviously much more difficult than in the case of galaxies from our cosmic neighborhood. In our project we will weight and measure these galaxies, compare their properties, classify them, look how they are located in the cosmic web – a sponge-like structure woven of galaxies and dark matter. And we will compare them with galaxies we find in the local Universe, as well as with more distant objects. This will allow us to draw evolutionary paths of different types of today’s galaxies and to understand processes behind them.

Shall we catch spiral galaxies turning elliptical – red handed (or at least red)? Shall we see lenticular galaxies just turning red? Huge and unprecedented data of the VIPERS project gives us real chances for such discoveries!