The star formation efficiency in interacting galaxies

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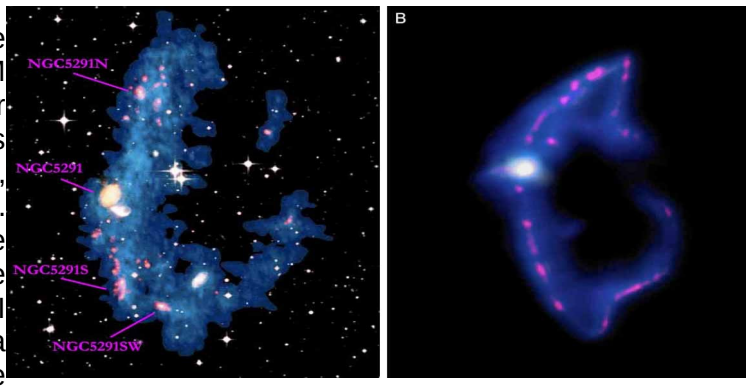
Interacting galaxies represent ideal laboratories to study the interstellar medium (ISM). There are two classes of interactions : (i) gravitational interactions between two galaxies and (ii) hydrodynamical interactions. The latter kind of interaction occurs within the hot atmosphere of galaxy clusters within which a galaxy moves at a high speed : the ISM of the galaxy is stripped by the ram pressure exerted by the hot cluster atmosphere. In both kinds of interactions a significant amount of the galaxy's ISM is expelled from the galactic disk, losing its strong gravitational confinement. According to the external and internal conditions during its expulsion the gas might stay confined, disperse, or collapse. Extraplanar star formation might then continue, stop, or increase for a short time. In addition, the ISM in the disk of interacting galaxies is often compressed by the tidal field or ram pressure. The compression can alter the phase of the ISM (atomic/molecular) and its ability to form stars.



In the past, we have studied the star formation efficiency of the ISM in compressed and extraplanar regions of six Virgo cluster galaxies (NGC 4522, NGC 4330, NGC 4438, NGC 4388, NGC 4501, NGC 4654). To determine the star formation rate UV and IR images are required, the gas properties are derived from HI and CO imaging. We found a different equilibrium between the molecular and atomic gas in compressed regions with an unusually high atomic fraction. The extraplanar gas is also dominated by the atomic gas phase in all galaxies. The star formation efficiency is always very low in the extraplanar ISM.

Within the present project we want to compare the reaction of the ISM to ram pressure stripping to the reaction of the ISM to a tidal interaction with another galaxy. To this aim, GALEX UV, Spitzer IR, VLA HI, and ALMA CO observations with kpc resolutions are available for several interacting pairs of galaxies. The student will interpret these multi-wavelength data and compare the results to analytical and dynamical simulations. We will begin with NGC 5291, for which VLT MUSE data is also available. The system is composed of an early-type galaxy, NGC 5291, and a highly disturbed companion galaxy. The HI is distributed in a huge asymmetrical ring-like structure connected to NGC 5291, consisting of a series of sub-condensations which correspond to intergalactic starforming (HII) regions. We will study the molecular fraction and the star formation efficiency of the gas in the tidal ring and compare it to what we have found in ram-pressure stripped galaxies. The results will give insight into (i) how the ISM reacts to different kinds of perturbations and (ii) how its ability to form stars changes according to the interaction parameters. This will lead to a better understanding of the complex physics of star formation. Such local nearby laboratories are useful to investigate processes that might be important at high redshift when gas reservoirs were much more important and subject to environmental processes.

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