Late-type galaxies are places of significant star formation. The overall morphology is dominated by the spiral arms, between which “empty” interarm regions can be found. With the increase in sensitivity and resolution of the radio observations, recently, in some of such galaxies the so-called “magnetic arms” have been detected in the interarm regions. In such magnetic arms the lines of the magnetic field become more ordered and form a spiral structure resembling the one of the star forming spiral arms.

The physical models do not predict the existence of such magnetic arms in the interarm regions of a galaxy. Several mechanisms were proposed to explain the magnetic arms. In Weżgowiec et al. (2016) it was presented that the strongly polarized radio emission, coming from cosmic rays moving in an organized magnetic field, as well as a slight increase in the temperature of the hot gas in the areas of the magnetic arms may be caused by the magnetic reconnection processes. During these processes, some of the energy of the magnetic field would be then transformed into the thermal energy of the surrounding gas. At the same time, by acting more efficiently on the turbulent component of the magnetic fields the reconnection processes would make the remaining field organized better, i.e. the magnetic field lines will become better aligned in the same direction. If this occurred in larger areas of the interarm regions it could contribute to the formation of the magnetic arms.

In the proposed project we plan to study more disk spiral galaxies that reveal the existence of magnetic arms in the interarm regions. An analysis similar to that presented in Weżgowiec et al. (2016) should tell us whether the studied galaxy NGC6946 presents an exceptional case or it is possible to trace gas heating by the magnetic reconnection in the interarm regions of spiral galaxies.

We plan to analyze both radio and X-ray data for selected spiral galaxies. Because the discussed phenomena seem to be difficult to observe, we will study galaxies that are angularly extended, which will allow to analyze the regions of their disks in detail. Although this limits our study to only 4 objects, significant amount of the archival radio and X-ray data for these well-known galaxies should allow a detailed analysis of the discussed phenomenon.

For all galaxies maps of the radio total and polarized emission, as well as the X-ray images of the hot diffuse gas will be created. These maps will be used to select regions of spiral arm and interarm regions, for which parameters of the magnetic field and the hot gas will be obtained. Then, the strengths and energies of the magnetic fields will be derived, as well as the temperatures, densities and thermal energies of the hot gas. The results will be compared to see if for the interarm regions possible increases in the temperature of the hot gas correspond to weaker yet more ordered magnetic fields, as it was observed in NGC6946.

The proposed project is the first attempt to observationally detect the processes of reconnection of the magnetic fields in a sample of objects by combining the results of the analysis of both radio and X-ray data. If we obtain similar results to that suggested by Weżgowiec et al. (2016), it would confirm the significance of the reconnection of the magnetic fields for the evolution of the spiral galaxies. Furthermore, it will allow to provide better constraints for the theoretical models of the reconnection of the local and thus the evolution of the global magnetic fields.