Abstract General public In English

Star forming regions are important objects to study in the universe because they can help to answer many fundamental questions in astrophysics. These regions can tell us about the fundamental mechanisms that create stars as well as those that create planets. Star forming regions are also environments which are rich in chemicals. These chemicals are essential for stars to be created and they are incorporated into the planets and comets that are created in Solar Systems. It is in fact possible that the key chemical ingredients to start the formation of life were brought to the Earth from comets. Many of these chemicals were formed during the early stages of the Sun's formation. Therefore, understanding star forming regions is significant for astrophysics, astrochemistry and astrobiology.

From previous studies of star formation, we know that stars are born within dense clouds of gas and dust. When these clouds are of sufficient mass, they collapse, and the centre begins to heat up. At this stage, the central source is called a protostar. These regions of star formation are rich in chemicals which form in the gas and on icy dust grains in the protostar's surrounding environment. As the protostar evolves, it heats up the surrounding gas and dust. This causes chemicals that were formed on the icy dust grains to sublimate, i.e. turn from a solid to gas. When the light from the protostar shins through this material, it can be absorbed and remitted by the chemicals. This leads to a unique pattern called a spectrum. Each chemical has its own unique spectrum. We can compare ones created in laboratories on Earth with those we detect from space, to identify chemicals in star forming regions. This spectrum depends on the physical conditions, such as temperature and density in the cloud. Analysing the spectra from the environments around protostars can tell us about the physical conditions when stars form.

This research proposal focusing on understanding low-mass star formation. Low-mass stars are those with masses up to 2 times larger than the mass of the Sun. By observing many different low-mass protostars, it has been determined that there are 6 clear stages of formation. These range from cold dense clouds, through warm, chemically rich hot-cores, to the formation of planets. However, there are a lot of unanswered questions as to how exactly these stars form and how the evolution of the protostar changes within each stage. This is a challenge because the environments where stars form are physically and chemically complex. This research project will search for the first indicators of evolutionary stages within the hot-core stage of low-mass star formation. It will focus on forming low-mass stars that have close companions, i.e. where many forming stars are in close proximity as they are forming. In these regions, if more than one hot-core is present, then differences between these hot-cores can be explored to determine if the protostars are at different stages of evolution. To determine if differences are due to evolution and not other factors can be a challenge. By focusing on companion forming stars, that are forming in the same birth cloud, differences due to a different birth environment can be excluded. To determine the differences due to evolution, other physical factors have to be excluded. This project will search for evolutionary differences by studying three different tracers of evolution: chemistry, outflows and filamentary structures. These three tracers have never been combined before to create a three-tier test of evolution. By comparing the evolutionary stage of each protostar with each of these tracers, a significant new understanding of star formation and the evolution of low-mass forming stars will be achieved.