DESCRIPTION FOR THE GENERAL PUBLIC

High-mass star formation is still a clue for modern astrophysics. Such stars end up their lives spectacularly, as supernovae or black holes. However, the formation processes are still not fully understood despite more efficient research instruments. *How to build a massive star before it becomes unstable? Are they form in a similar way to lower mass stars like our Sun via accretion and outflows or via merging of lower mass stars?* It is challenging to observe high-mass star-forming regions. These stars evolve rapidly, are formed in a dense environment, and are located at large distances from us in the Galaxy (ca. 3-5 kpc).

In this project, we plan to observe maser emission that occurs naturally in the vicinity of high-mass stars, in clouds of gas with sizes of a few astronomical units. Maser emission is based on the amplification of microwaves. Microwaves, contrary to light, can escape from dense gas and dust clouds and reach radio telescopes on Earth. Especially, the cm wavelengths from the methanol and water molecules as well as OH radical are used in studies of the close environment of massive protostars. In recent years, it has been discovered that the 4.5 cm methanol maser line underwent outburst events. The 32 m radio telescope of the Institute of Astronomy of Nicolaus Copernicus University in Torun is one of the leading instruments in such discoveries. We scan the Galactic plane and search for radio waves from the methanol molecules from high-mass star-forming regions during hundreds of observing hours per year. Some targets are stable over the years, some show flares, while a few show unexpected, periodic variations of emission. *How is it connected with scenarios going on around high-mass protostars? Is this a sign of changing accretion rate?*
We will search for outbursts and super-outbursts of the methanol maser lines that indicate accretion events using the Torun dish and radio telescopes in Irbene, Latvia. Using the radio interferometers, like the European VLBI Network (www.evlbi.org), we will directly image masing cloudlets at the milliarcsecond scale. In that way, we will resolve the smallest regions of the neutral gas that can be reached nowadays around borning high-mass stars. We will derive displacements of maser cloudlets and estimate their motions at the level of a few km/s, and we will see directly how the material is “dancing” around a star or stars and identify outflows, infalls, rotating disks or expanding bubbles. Infra-red observations are necessary compounds to describe the accretion event. International initiative Maser Monitoring Organization M2O is a great support to obtain data of an outbursting object at the wide electromagnetic wavelength range.