

Tytuł projektu

Badanie zdarzeń akrecyjnych i wpływów w obszarach formowania masywnych gwiazd za pomocą maserów

Project title

Using Maser Variability to Probe the Episodic Accretion and Outflow Events in High-Mass Star Forming Regions

Dyscyplina /Area of science

Astronomia

PROJECT DESCRIPTION

Project goals

- To assess if maser bursts are signatures of non-continuous accretion processes and outflows in the early phases of high-mass star evolution
- To constrain the current scenarios of high-mass star formation
- To improve the models of maser radiation in astrophysical environments

Outline

Mechanisms of formation of high-mass stars are one of the main unsolved problems of modern astrophysics. Whether high-mass stars form as the result of slow, equilibrium collapse of clumps over several free-fall times or if they collapse quickly on the order of a free-fall time, possibly mediated by large scale accretion along filaments or disc, remains an open question. Recent numerical radiation hydrodynamics simulations suggest that present-day forming high-mass stars experience variable accretion and this process is accompanied by luminous outbursts induced by the episodic accretion of gaseous clumps falling from the circumstellar disk onto the protostar. There is a growing evidence that astrophysical masers provide a reliable approach to study accretion bursts and non-continuous outflows because they are very sensitive to its environment. Indeed, recently observed accretion events confirmed that a change in physical conditions can selectively favour or unfavour the pumping/sink mechanism of different maser transitions. During these events, several maser transitions flare to enhanced fluxes, also at rarely seen transitions for which the emission disappears within timescales of weeks. Understanding the origin and evolution of these phenomena are essential to constrain the current scenarios of high-mass star formation as well as the maser models. The maser group is focusing on using a suite of radio telescopes, including the 32m dish and European VLBI Network to monitor several transitions of main maser species. The immediate aims are to understand the importance of flare events observed at maser lines as signposts of non-continuous accretion processes at early stages of high-mass star formation. The datasets are available from a monitoring program since 2009 for a large sample of high-mass star forming regions. Furthermore, new multi-frequency observations started in middle 2018. Work plan includes: searching for extraordinarily bursts in maser lines and follow up observations with interferometers, survey of new maser transitions which probably

characterize sudden accretion events, studying of long-term changes in maser morphologies.

Work plan

1. Searching for unusual variations in the flux density of maser lines towards a large sample of high-mass star formation regions
2. Follow up observations of extraordinarily bursts with radio interferometers
3. Studying of long-term changes in maser structures
4. Explaining the plausible causes of maser bursts

Literature

Carratti o Garratti, A. et al., 2017, Nat. Phys., 13, 276

Moscadelli, L., et al., 2017, A&A, 600, L8

Szymczak, M., et al., 2018, A&A, 617, A80

Szymczak, M., et al., 2018, MNRAS, 474, 219

Required initial knowledge and skills of the PhD candidate

- ➔ Knowledge about basic techniques of radio observations
- ➔ Understanding of microwave spectroscopy
- ➔ Eager to learn
- ➔ Eager to work hard

Zgłaszający projekt/ Author of the project

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Proponowani promotorzy i mentorzy/prospective supervisors

1) promotor główny/ main supervisor

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2) promotor pomocniczy / co-supervisor