XIV Serbian Conference on Spectral Line Shapes in Astrophysics
Bajina Bašta, Serbia, June 19 - 23, 2023
Book of Abstracts, Eds. Luka Č. Popović, Nataša Bon, Edi Bon and Sylvie Sahal-Bréchot

3D STRUCTURE OF EXPANDING H II REGIONS

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Expanding H II and wind-blown bubbles are one of the main sources of the energy input in the interstellar medium along with supernova explosions. Depending on the energy, these expanding structures provide positive or negative feedback that controls the star formation process in surrounding molecular clouds. Observational verification of the feedback between expanding bubbles and the neutral surrounding material is relevant for the theory of star formation, since the sites of star formation - molecular filaments - are formed at the intersection of expanding shells around H II regions or wind-blown bubbles. We present a survey of H II regions and wind-blown bubbles on the northern sky with different structure and driven by stars of the whole range of O and B types.

The main aim of our study is to understand the relationship between the expanding bubbles and the morphology of surrounding molecular clouds, and reconstruct the 3D structure of the bubbles and surrounding neutral material. The study will be done using optical imaging with the Zeiss-1000 telescope and BTA-6m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences (SAO RAS) and archival data in the infrared (IR). The IR data allow us to study the spatial distribution of neutral material around H II regions.

In this presentation, we discuss three star-forming complexes: S235 and S255-S257, where H II regions are excited by late O and early B-type stars. These H II regions demonstrate different types of morphology: from a 3D bubble surrounded by neutral material to blister-type. We determine their

electron densities, column density the the neutral hydrogen on the front and back walls and the depth along the line of sight. Combining the optical data with the far-IR [C II] and [O I] emission lines from the SOFIA flying telescope, we complement the 3D structure by the neutral gas kinematics. We show that the bubble-like structures appear substantially non-uniform and clumpy while they look like regular structures on the plane of the sky.