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Tracing the mass loss history of WX Psc with ALMA and KVN

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Contributed talk

Abstract:
We present the combined results of ALMA and KVN (Korean VLBI Network) observations toward WX Psc (IRC+10011) which is a long-period variable OH/IR star. The SiO masers of v=1 and v=2, J=5-4, and the SiO thermal emission of v=0, J=5-4 were observed together with the H2O v2=1, 5(5,0)-6(4,3) and continuum emission at ALMA Band 6 in October 2017 (Cycle 5). This ALMA observation aims to study the development of asymmetric outward motions during the evolutionary phases from the asymptotic giant branch (AGB) stars to the planetary nebulae (PNe), which are closely related to the conspicuous phenomena of the mass loss at the late stage of AGBs. The strong SiO and H2O maser features are detected around the continuum emission peak, which imply the asymmetric morphology of the high density regions of the inner circumstellar envelope (CSE) swept by the stellar winds. The clumpy structures of the CSE of this source are also clearly shown by SiO v=0, J=5-4 thermal components, which are very similar to the detached shell found in many carbon-rich evolved stars. The size of this detached shell-like structure is about 100 mas that corresponds to the dust layer around this object. The detached shell-like structures are known to be developed either through the interaction of distinct wind phases or an episodic mass loss eruption associated with a thermal pulse, thus they give a crucial information related to the mass loss history of late AGB stars. While the spatial resolution 20 mas of this ALMA observation cannot clearly resolve the detailed characteristics of the inner part of the CSE, the KVN observations show in detail the spatial distributions of the v=1 J=1-0, J=2-1, J=3-2 SiO masers emitted from the inner regions of CSE. Therefore, the monitoring VLBI observations of KVN for this source help us to trace the mass loss history combining the ALMA results, which can connect the stellar evolution to the wind and mass loss. The bipolar outflow feature is also found from the KVN results of 22 GHz H2O maser and the direction of the outflow axis, NW-SE, seems to be strongly related to the void regions of the SiO v=0 thermal shell structure found in this ALMA observation. These results show the power of the cross-facility synergies between ALMA and KVN for the study of stellar evolution.

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