P131a SiO in the high-mass protocluster NGC 2264-C: A tracer of protostellar shock history?

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Turbulence in regions of stellar cluster formation is believed to play a key role in supporting molecular clumps against fast gravitational collapse. This is particularly relevant in the context of high-mass star formation, since a first generation of low-mass stars may be needed before a massive star ($> 8\,$Msun) can form. Protostellar outflows have been proposed as a potential dominant source of turbulence in large protoclusters that could counterbalance gravity for several free-fall times.

To understand the role of outflow-driven turbulence, we used the Nobeyama 45-m telescope to map the high-mass protocluster NGC 2264-C in an excellent shock tracer: SiO(J = 2–1). Comparison of the SiO emission distribution with that of mm continuum and dense molecular gas tracers reveals three spatially and kinematically distinct SiO components: (1) A region around the central dense part of the protocluster where SiO appears relatively depleted despite it being affected by molecular outflow activity as seen in, e.g. CO lines; (2) a ring-like structure of relatively strong high-velocity ($> 10\,\mathrm{km\,s^{-1}}$) SiO emission around the central region, directly tracing current outflow activity; and (3) a peripheral, low-velocity ($\sim 3\,\mathrm{km\,s^{-1}}$) SiO emission component surrounding the high-velocity ring. We will discuss the nature of each component and the implications in the framework of high-mass cluster formation. In particular, our analysis suggests that the third component may be a record of past protostellar activity, thus supporting the idea of a previous episode of star formation.