

Gravity drives the evolution of infrared dark hubs: JVLA observations of SDC13

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It is now widely considered that interstellar filaments are an important intermediate stage in the star formation process. The vast majority of cores (the direct progenitors of stars) sit on top of the densest filaments. Yet a number of questions remain regarding the physics that govern their formation and evolution. Studies of infrared dark clouds (IRDCs) help shed light on this, as they are thought to contain the pristine fingerprints of the initial conditions of star formation. We present a study of the SDC13 IRDC hub filament system. SDC13 contains 1000 M_{sun} of material, resides 3.6kpc away in the galactic plane, and has a remarkable morphology containing 4 parsec-long filaments that spatially converge on a central hub region. Overall, SDC13 is an ideal target to study how filaments form, fragment and dynamically interact with each other. In combining NH_3 emission data from the JVLA interferometer and the GBT single-dish telescope, we studied the evolution of SDC13 down to 0.07pc spatial scales. We propose a scenario for the evolution of the SDC13 hub in which the filaments first form as post-shock structures in a supersonic turbulent flow. As a result of the turbulent energy dissipation in the shock, the dense gas within the filaments is predominantly sub-sonic. Then gravity takes over and starts shaping the evolution of the hub, fragmenting filaments and pulling the gas towards the centre of the gravitational well. By doing so, gravitational energy is converted into kinetic energy in local cores (where we see the gas velocity dispersion increase towards 73% of starless cores) and global hub centre potential well minima. This generates more massive cores at the hub centre as a result of larger acceleration gradients due to the hub morphology itself.

Filaments