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

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Abstract: We present new interferometer data of Ammonia molecular line emission towards SDC13, a unique interstellar filamentary cloud of molecular gas. For the first time, we observe gas velocity width peaks towards starless cores, opposite to the previously observed troughs in the "transition to coherence". Also considering gravitational acceleration, altogether, these results hint at the importance of gravity in the evolution of infrared dark hub filament systems.

1. Introduction

Interstellar filaments represent a key stage in star formation. As they become gravitationally unstable, the densest filaments fragment into cores [1], the direct progenitors of stars. The link between filament, core and star formation is one of the main issues of modern astronomy. Reservoirs of cold molecular gas called Infrared Dark Clouds (IRDCs) shed light on this as they contain the mostly pristine initial fingerprints of star formation.

SDC13 is a hub IRDC system of 4 parsec-long filaments located 3.6kpc away, containing 1000M$_\odot$ of material (Figure 1) [2] [3]. We present new interferometer data of SDC13 down to spatial scales of ~0.07pc, capable of probing the missing link between filament, core and star formation [4].

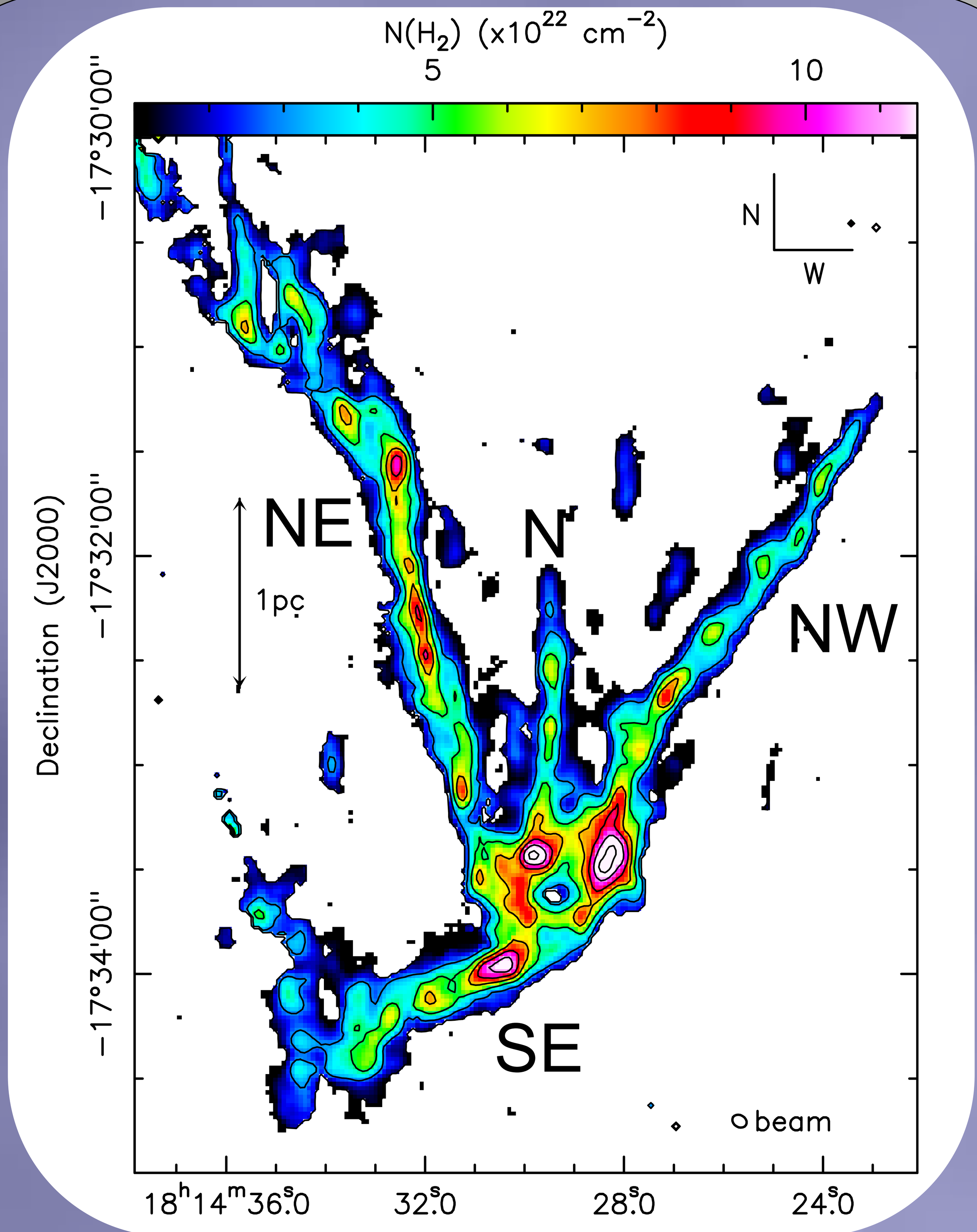
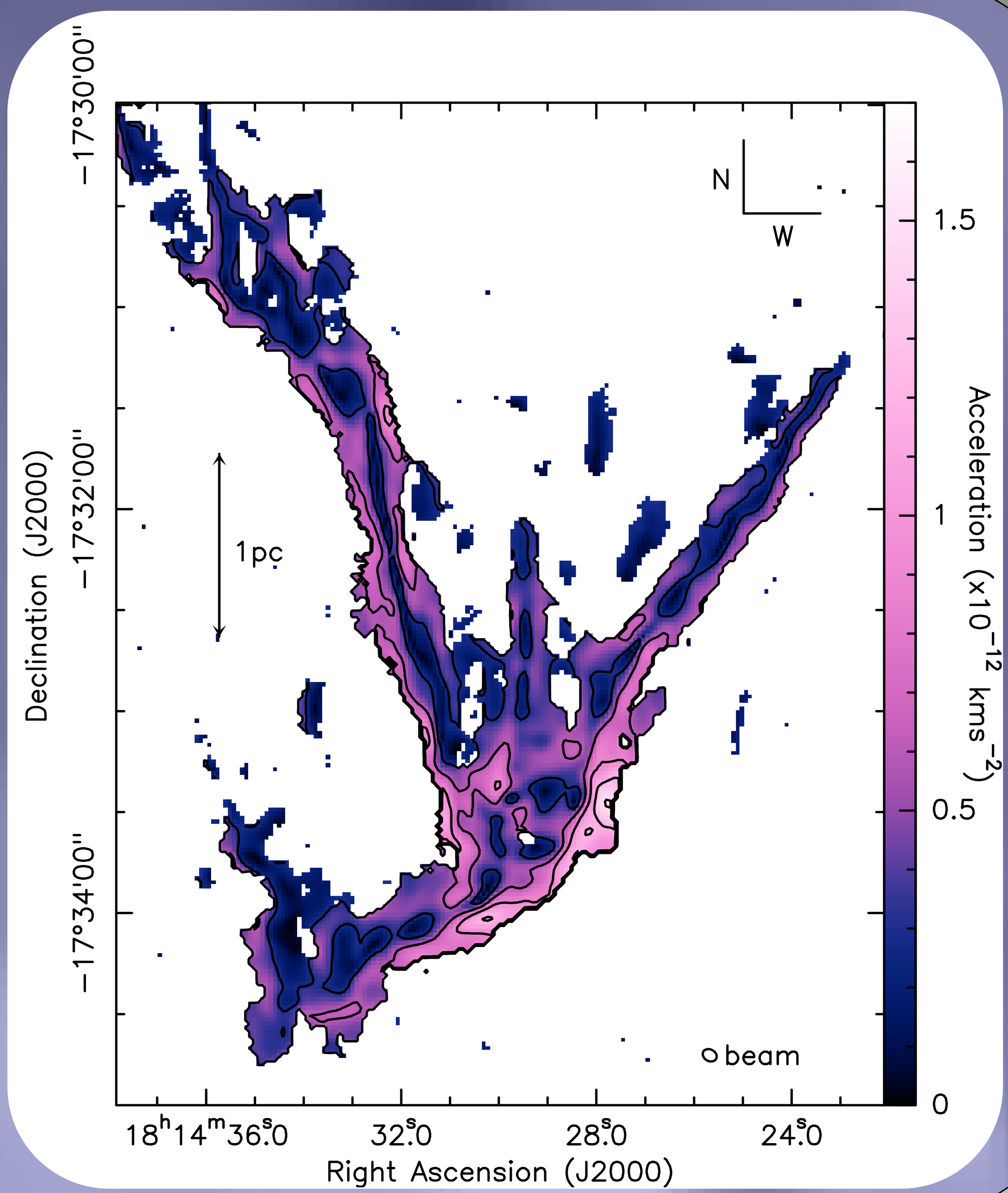


Figure 1. H_2 Column density across the 5'x5' extent of SDC13. Filament names are labelled.

Figure 2. The acceleration due to gravity at each pixel, where the mass of each pixel was calculated from the H2 column density of Figure 1.



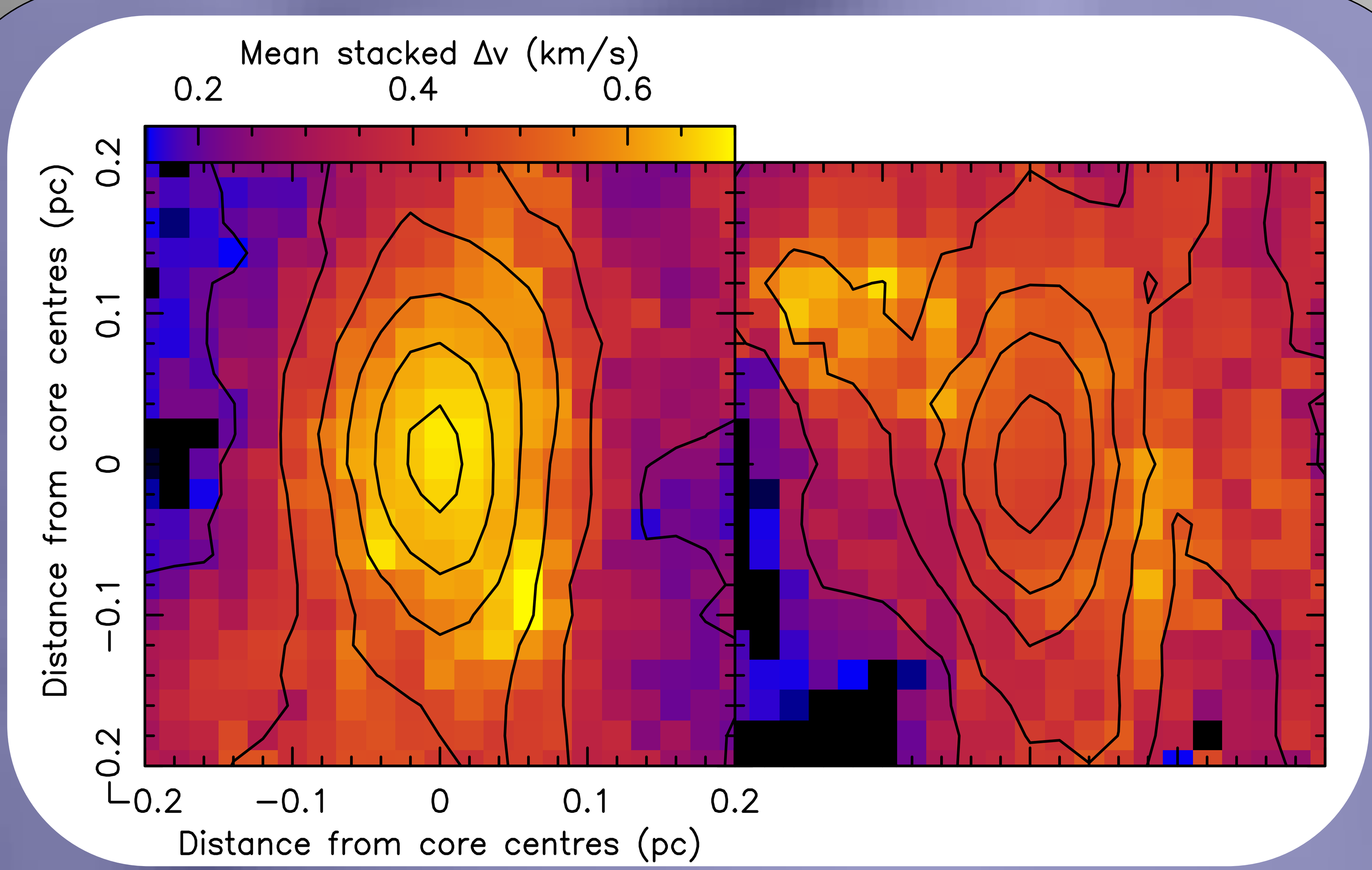


Figure 3. Stacked visual representation of the average velocity width at starless core positions <u>with</u> peaks (left) and <u>without</u> peaks (right). Overplotted mean stacked column density contours.

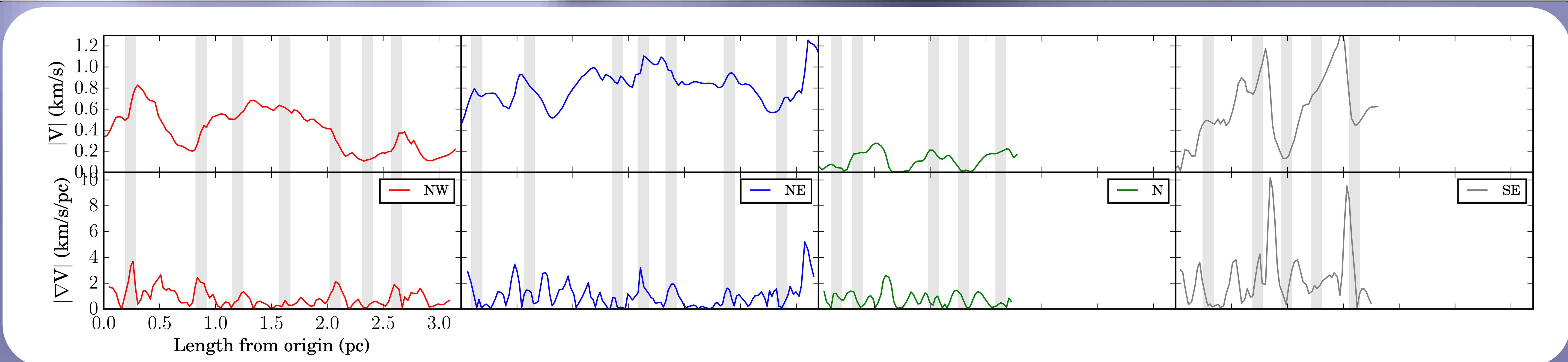


Figure 4. Profiles along the spine lengths of filaments: NW (red), NE (blue), N (green) and SE (grey). The top panel shows the H_2 column density, the middle shows the absolute line-of-sight velocity, while the bottom shows the absolute velocity gradient. Vertical shaded regions represent core positions.

2. Results

Our main results are:

- Regular ~0.33pc core spacing
- Velocity width peaks at 61% of starless cores
- Starless core GPE to KE conversion efficiency ε~20%
- Velocity gradient peaks at ~50% of cores, as expected for accreting cores
- Strongest acceleration gradient towards position of largest core at the hub centre

References [1] André et al. 2010, AAP, 518, L102. [2] Peretto & Fuller 2009, AAP, 505, 405. [3] Peretto et al. 2014, A&A, 561, A83. [4] Williams et al. 2017, in preparation. Background: SDC13 Spitzer 8μm map [3].

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