Visualization and Analysis of Synthetic Observations of Star Forming Regions

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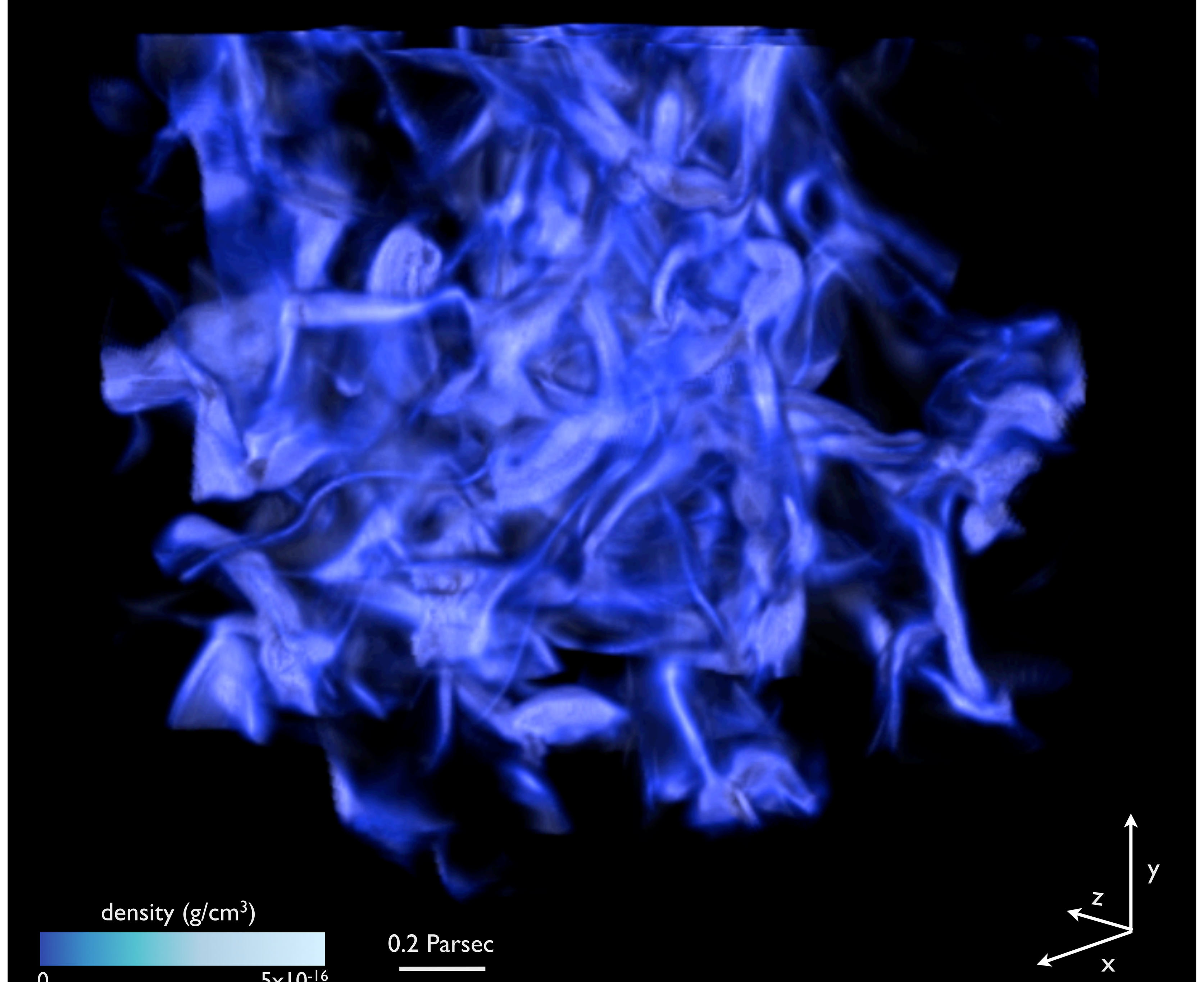
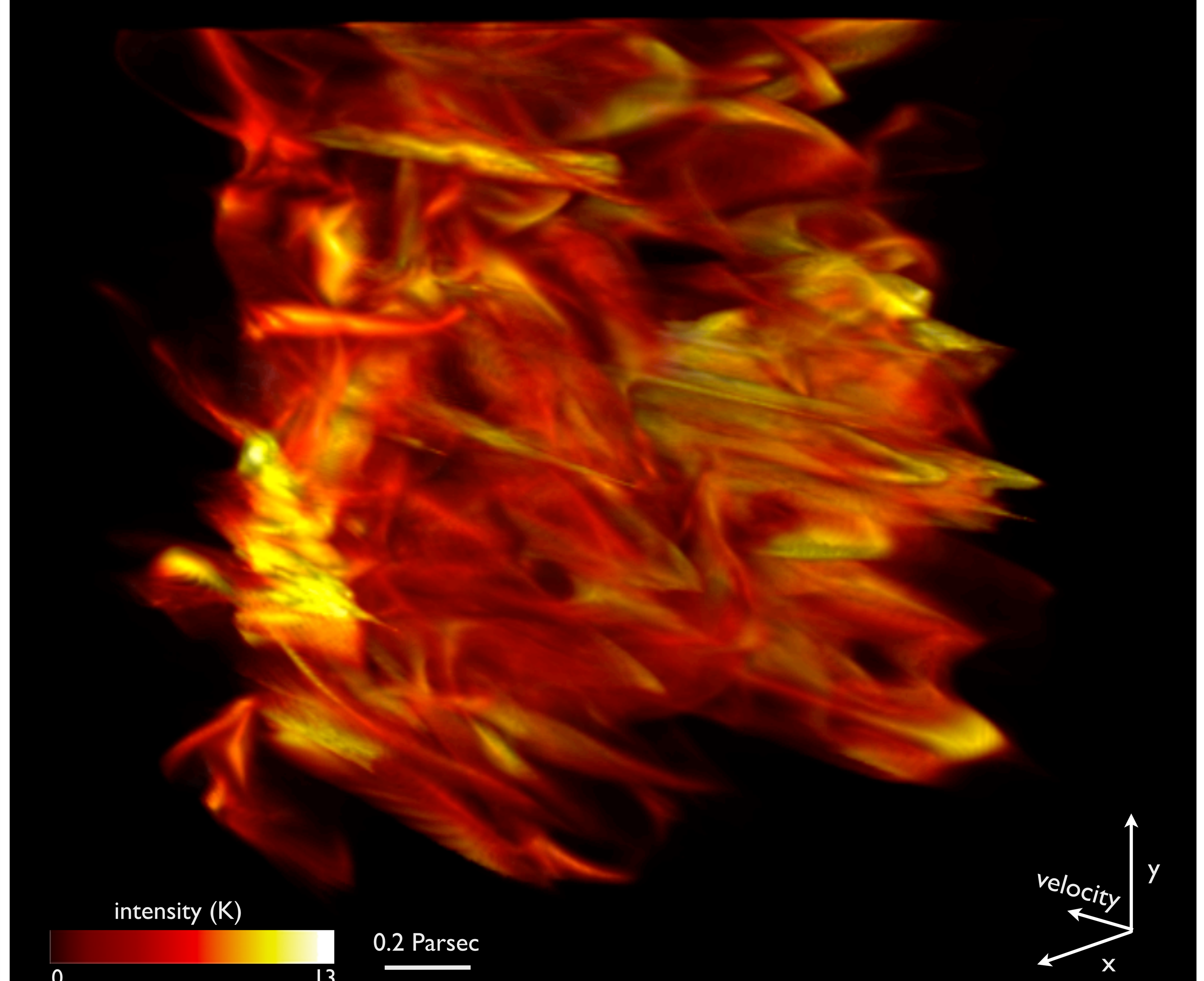
Simulation



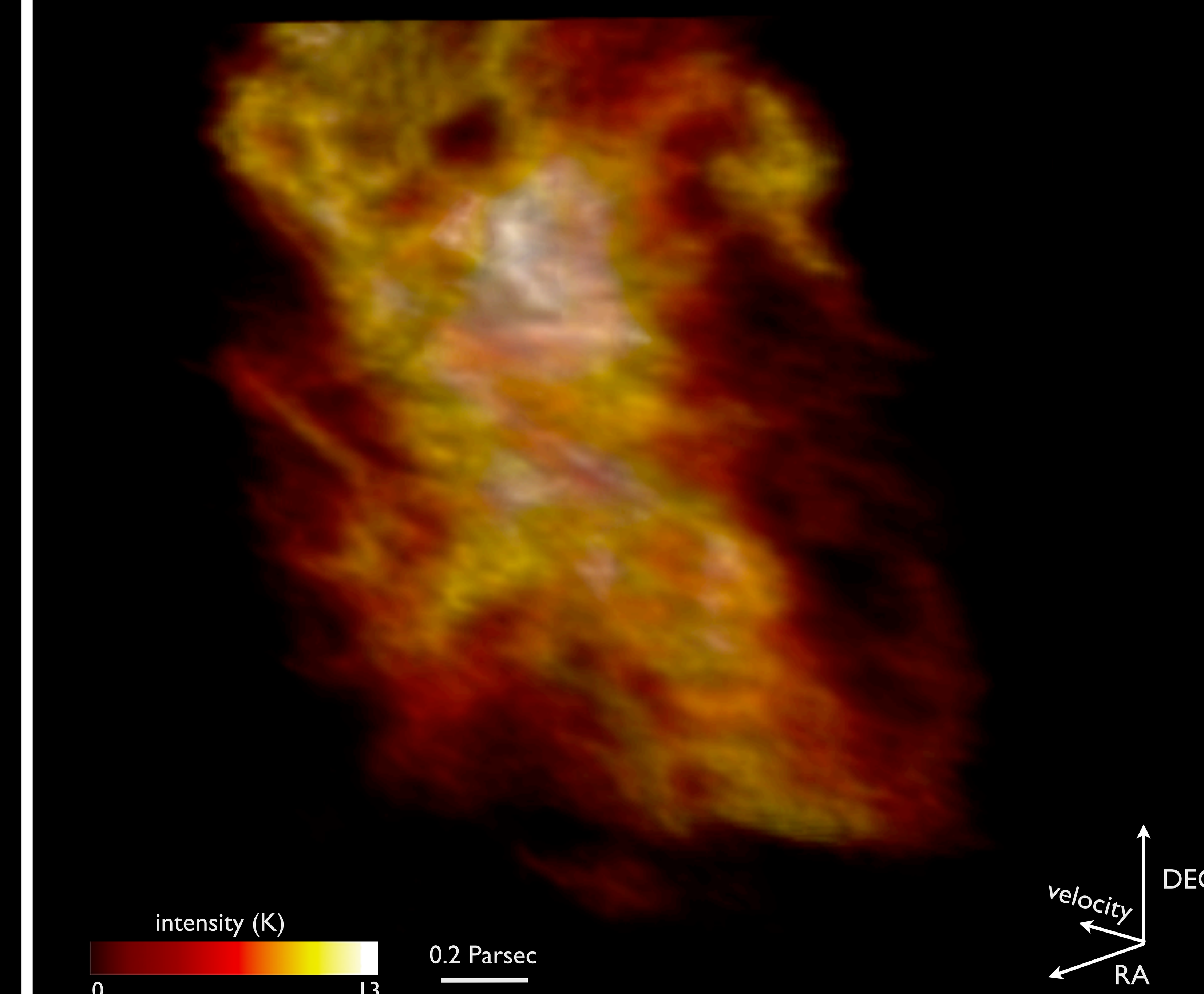
Above: A simulated star forming region after evolving for ~20,000 years. The color maps to the gas density. This data set was produced with the ORION adaptive mesh refinement (AMR) three-dimensional gravito-radiation-hydrodyanics code (Offner, et al., 2008). Since it is impossible to measure the 3D position and 3D velocity vector for real star forming regions, simulations like these are vital.

Synthetic Observation



Above: Synthetic single-dish ^{13}CO(3-2) observations of the simulated (*left*) star forming region using the radiative transfer code RADMC. High velocity gas is visible as peaks extruding along the velocity axis. These peaks correspond to kinematic features embedded in the simulation (*left*) such as outflowing gas and turbulence. The velocity ranges from -1 to 5 km/s.

Real Observation

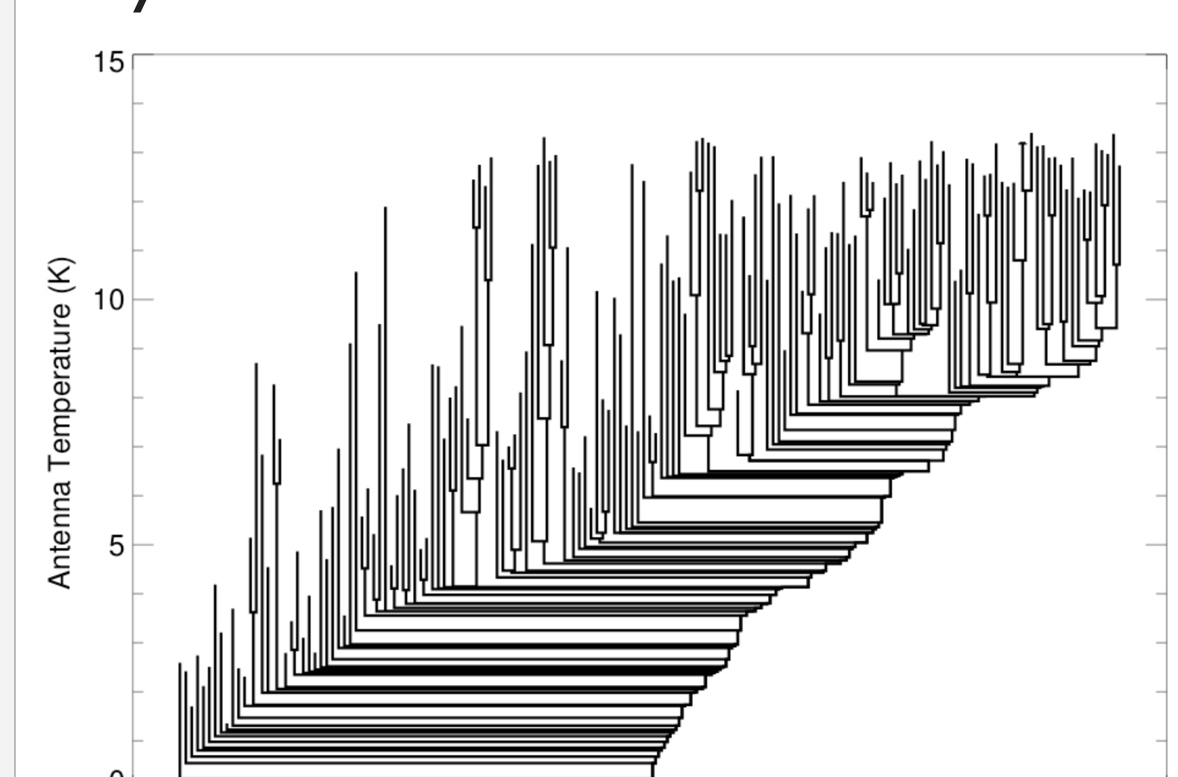


Above: 3D representation of the NGC 1333 star forming region, a young active region which is ~300 parsecs away, as seen in ^{13}CO(1-0). The data were gathered using the FCRAO radio telescope. The velocity ranges from 4 to 10 km/s. Like the synthetic observation (*left*), peaks of high velocity gas are visible. This region has a number of embedded outflows and expanding shells.

Summary

We present multidimensional visualizations used for the exploration, analysis, and comparison of simulated synthetic observations and real astronomical observational data cubes. By comparing synthetic observations of simulated star forming regions to real observational radio data cubes utilizing 2D and 3D visualization techniques we are able to more effectively and efficiently compare these types of data, in particular their hierarchical structure and kinematic features such as outflows or expanding shells. For our synthetic data we use simulations performed with the ORION adaptive mesh refinement (AMR) three-dimensional gravito-radiation-hydrodyanics code which follow the collapse and evolution of protostars down to AU size scales. The synthetic observations are produced using RADMC, a molecular line radiative transfer code. Through comparisons of 2D dendrogram representations of the star forming region's hierarchical structure, 2D column maps, and 3D data visualizations we are able to gain a better understanding of the physical structures and kinematic features, and enhance the interpretation of astronomical data cubes.

Synthetic Observation



Left: A dendrogram representation of the synthetic observation (*middle image above*) showing the data's hierarchical structure. Diagrams like this allow us to both better understand the hierarchical nested structure of star forming regions as well as provide a simple way to compare synthetic observations and real observations. The "leaves" on the tree represent the brightest, most compact sources of emission.

For more information, movies, and live demos, make sure to find me!

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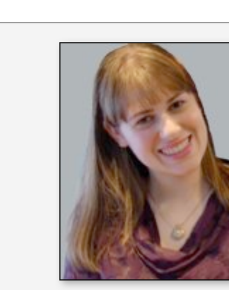

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