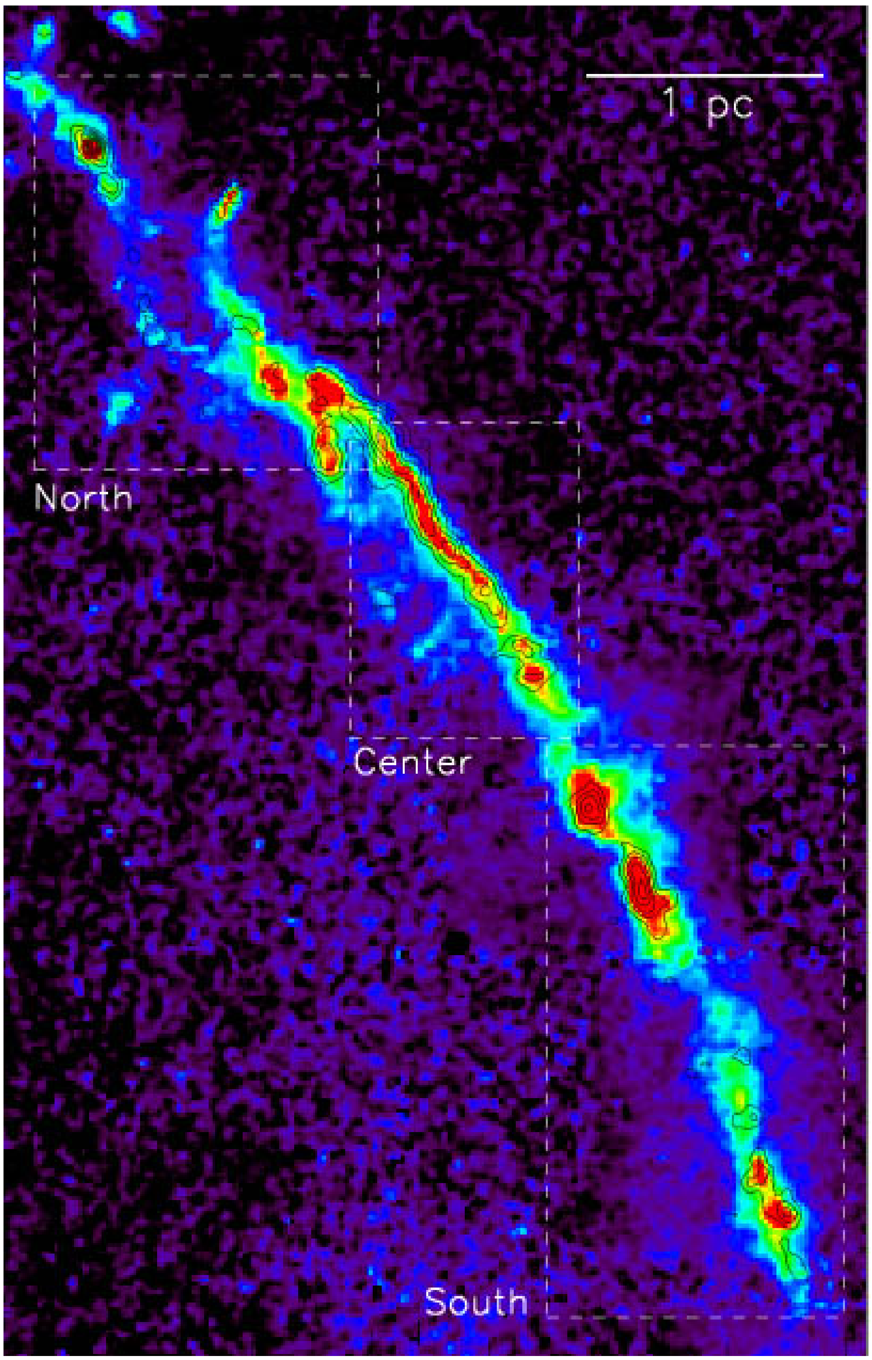
Star-forming filaments

May 22 2017



A false-color image map of the gas density in the Musca star-forming filament (the highest densities are shown in red). New theoretical work on the structure of these long filaments proposes several kinds of star-forming zones along the length and successfully reproduces many of the features seen in filaments like this one in Musca. Credit: Kainulainen, 2016

Interstellar molecular clouds are often seen to be elongated and "filamentary" in shape, and come in a wide range of sizes. In molecular clouds, where stars form, the filamentary structure is thought to play an important role in star formation as the matter collapses to form protostars. Filamentary clouds are detected because the dust they contain obscures the optical light of background stars while emitting at infrared and submillimeter wavelengths.

Observations of some filaments indicate that they are themselves composed of bundles of closely spaced fibers with distinct physical properties. Computer simulations are able to reproduce some of these filamentary structures, and astronomers generally agree that turbulence in the gas combined with gravitational collapse can lead to filaments and protostars within them, but the exact ways in which filaments form, make stars, and finally dissipate are not understood. The number of new stars that develop, for example, varies widely between filaments for reasons that are not known.

The usual model for a star forming filament is a cylinder whose density increases towards the axis according to a specific profile, but which otherwise is uniform along its length. CfA astronomer Phil Myers has developed a variant of this model in which the filament has a star-forming zone along its length where the density and diameter are higher, with three generic profiles to describe their shapes. Besides being a more realistic description of a filament's structure, the different density profiles develop different strength gravitational "wells" naturally leading to different numbers of stars forming within them.

Myers compares the star formation properties of these three kinds of zones with the properties of observed star formation filaments, with excellent results. The filament in the molecular cloud in Musca has relatively little star formation, and can be reasonably well explained with one of the three profiles indicative of an early stage of evolution. A small cluster of young stars in the Corona Australis constellation fits a second model that has evolved for longer, while Ophiuchus hosts a filament that may be near the end of its star forming lifetime and resembles the third type. The three profiles so far seem able to account for the full range of conditions. The new results are an important step in bringing more sophistication and realism to the theory of star forming filaments. Future work will probe the specific processes that fragment the various star-forming zones into their stars.

More information: Philip C. Myers. Star-forming Filament Models, *The Astrophysical Journal* (2017). DOI: 10.3847/1538-4357/aa5fa8

Provided by Harvard-Smithsonian Center for Astrophysics

Citation: Star-forming filaments (2017, May 22) retrieved 30 April 2024 from https://phys.org/news/2017-05-star-forming-filaments.html