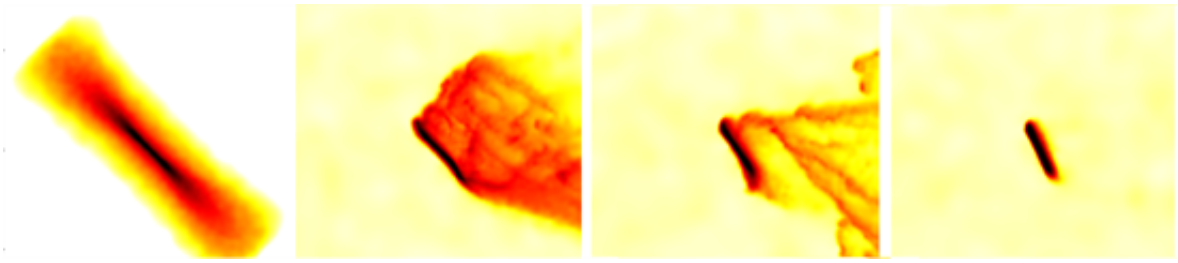
Astronomers let gaseous disks tilt and shrink in virtual wind tunnel

August 28 2017



The left-most image shows the starting point. The second picture shows the situation after 250 years, then after 500 years and eventually after 1000 years. Credit: Thomas Wijnen, Radboud University

A team of Dutch astronomers, led by Thomas Wijnen from Radboud University, has managed to tilt and shrink gaseous disks, in which planets form, in a virtual wind tunnel. The research helps in finding an explanation for the tilted planetary orbits in our own solar system, for example. Wijnen and his colleagues publish their findings in two articles in the journal *Astronomy & Astrophysics*.

A newborn star is surrounded by a disk of gas and dust out of which planets form. In addition, there is a lot of remaining gas in star forming areas, which was not used to form stars (and their disks).

Dutch astronomers presume that the gaseous disk from which our own planet system originated was tilted under the influence of its movement

through gas. To investigate this hypothesis, they placed a star with a gaseous disk in a virtual wind tunnel and tested several different conditions. A real wind tunnel was not an option, because that tunnel should be larger than a complete solar system and because the processes last for hundreds of thousands of years.

Thomas Wijnen, who will defend his PhD thesis at Radboud University on October 5, and who is now working at Leiden University, is the first author of two scientific articles. He explains: "In a video of our simulation (below) you see the disk tilting. You can also see how the outer layers of the dust disk are stripped by the flow. The disk also shrinks because it continuously sweeps up gas from the flow, but that is harder to see in the video."

The researchers are able to describe the shrinking of the discs theoretically and apply their theory by simulating discs in, among others, the Trapezium Cluster, a star-forming region in the Orion Nebula in the constellation of Orion at 'only' 1300 light years from Earth.

The Dutch simulations appear to resemble the reality well. Wijnen: "We have discovered that near collisions between two disks are less important than previously thought. Our simulations show that sweeping up gas from the environment is more important. Until now, no one had investigated the influence of the swept up gas and no one had thought that it can play such a big role."

In the future, the researchers would like to investigate the influence of a shrinking disk on the formation of planets. They suggest that due to the shrinking, planets that originate on the outside of the system can move to their star. Research on planet formation is "hot" because in early 2017 the Trappist-1 system was discovered which has seven big planets orbiting close to its star.

More information: T. P. G. Wijnen et al. Changes in orientation and shape of protoplanetary discs moving through an ambient medium, *Astronomy & Astrophysics* (2017). DOI: 10.1051/0004-6361/201730793

T. P. G. Wijnen et al. Disc truncation in embedded star clusters: Dynamical encounters versus face-on accretion, *Astronomy & Astrophysics* (2017). DOI: 10.1051/0004-6361/201731072