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Numerical simulations of photoevaporating protoplanetary disks irradiated by a nearby massive star

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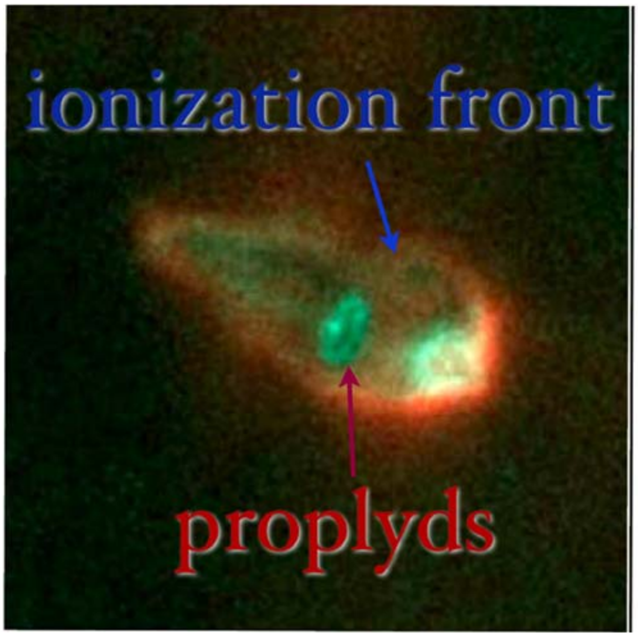

It is important to consider how the gas in protoplanetary disks disperses because it has great influence on the formation of gas giant planets and planetesimals.

Photoevaporation, a process by which the gas thermally escapes from the disks due to the heating by UV irradiation, is an important mechanism for the gas dispersal in the outer region which contains most of the disk mass.
In particular, protoplanetary disks in star clusters, called proplyds, are dominantly influenced by UV irradiation from a nearby massive star.
Actually, it is observationally known that the proplyds in the Trapezium cluster are illuminated by the nearby massive star, theta^1 Ori C, and surrounded by tear-drop-shaped ionization fronts which are thought to originate from the photoevaporating flow from the disks.
Since stars are generally born in star clusters, it is important to study how the gas in proplyds disperse.

In this work, we calculated the surface density evolution of the disks with considering photoevaporation due to the nearby massive star and gas accretion toward the central star.
As a result, photoevaporation efficiently disperses the gas in the outer region of the disk, and the radius of the edge of the disk shrinks to become several times 10 AU in ~10^5 yr.
This is consistent with the disk radii of the proplyds observed in the Trapezium cluster.
The photoevaporation rate is ~10^7 M_sun/yr in this calculation.

Next, we performed hydrodynamical simulations of the photoevaporating flow from the disks, and obtained the radii of the ionization fronts around the proplyds by calculating the flux of the ionizing photons from the nearby massive star.
And we analyzed how the size of the ionization front depends on the distance from the massive star and the photoevaporation rate from the disk.
As a result of our calculations, the observed correlation between the ionization front radii and the distances from the massive star is well reproduced by our model when we adopt the photoevaporation rate of 10^7 M_sun/yr which we obtained in the above-mentioned calculations of

the evolution of the disk surface density.
These two results suggest that the photoevaporation and accretion model explains the gas dispersal of the proplyds.

We would like to discuss the various influences of the rapid dispersal of the gas in the proplyds in the talk.

Keywords: protoplanetary disk, dispersal of gas, photoevaporation, numerical simulation