The Star Formation Newsletter #336 (24-30)

2021/03/05

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今回紹介しない論文のAbstractは省略

High-Resolution Mid-Infrared Spectroscopy of GV Tau N: Surface Accretion and Detection of Ammonia in a Young Protoplanetary Disk

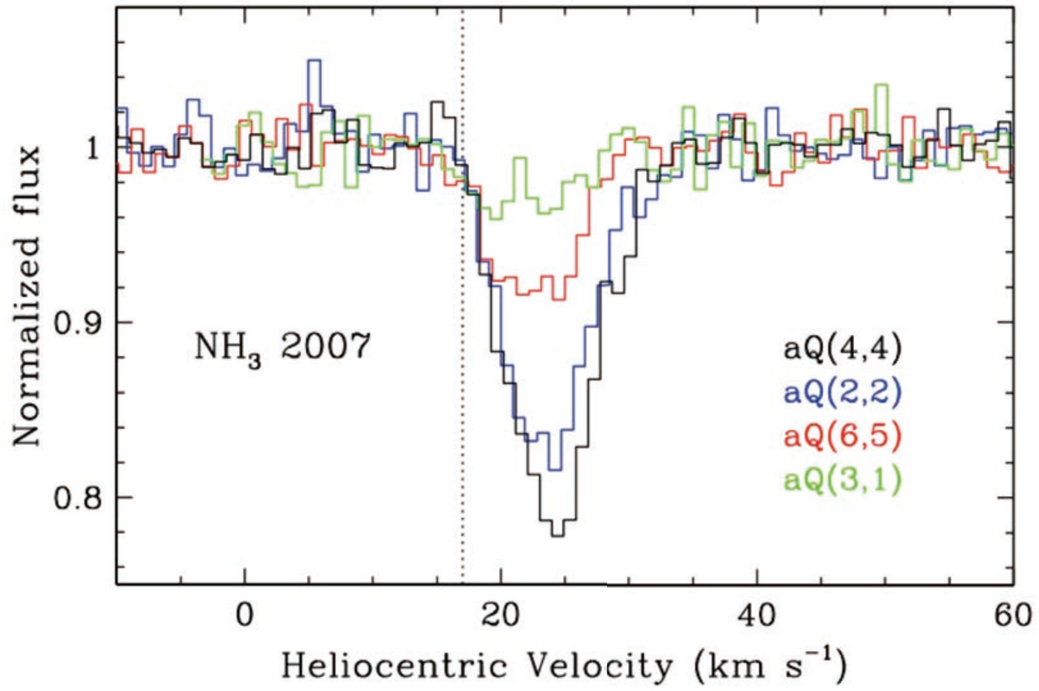
Joan R. Najita, John S. Carr, Sean D. Brittain, John H. Lacy, Matthew J. Richter, Greg W. Doppmann Physical processes that redistribute or remove angular momentum from protoplanetary disks can drive mass accretion onto the star and affect the outcome of planet formation. Despite ubiquitous evidence that protoplanetary disks are engaged in accretion, the process(es) responsible remain unclear. Here we present evidence for redshifted molecular absorption in the spectrum of a Class I source that indicates rapid inflow at the disk surface. High resolution mid-infrared spectroscopy of GV Tau N reveals a rich absorption spectrum of individual lines of C2H2, HCN, NH3, and water. From the properties of the molecular absorption, we can infer that it carries a significant accretion rate (1e-8 to 1e-7 Msun/yr), comparable to the stellar accretion rates of active T Tauri stars. Thus we may be observing disk accretion in action. The results may provide observational evidence for supersonic "surface accretion flows," which have been found in MHD simulations of magnetized disks. The observed spectra also represent the first detection of ammonia in the planet formation region of a protoplanetary disk. With ammonia only comparable in abundance to HCN, it cannot be a major missing reservoir of nitrogen. If, as expected, the dominant nitrogen reservoir in inner disks is instead N2, its high volatility would make it difficult to incorporate into forming planets, which may help to explain the low nitrogen content of the bulk Earth.

概要

- 分子の吸収線から表面降着流を示唆
  - 結構降着率が高い
- NH3を"惑星形成領域"で初検出
  - Nのメジャー分子にはならない

TEXES(the Texas Echelon-cross-Echelle spectrograph)によるGV Tau Nの観測 (2006, 2007)

- GV Tau N
  - evolved Class I (Hogerheijde et al. 1998)
  - 1.2'' 離れたところに GV Tau S
- TEXES
  - 中間赤外線 (> 200 K)
  - slit width 0.54''
  - R ~ 100,000
  - NH3, HCN, C2H2, H2O, H2を検出



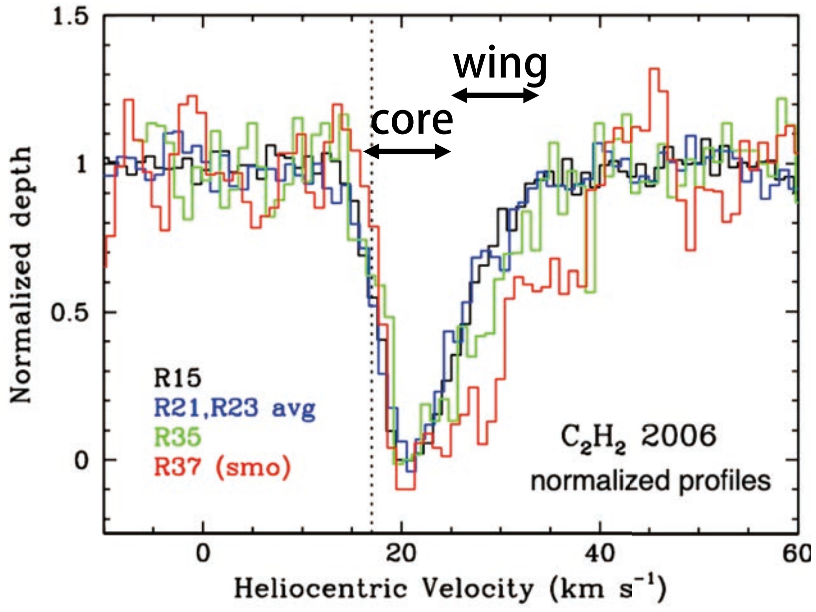
円盤内側で初のアンモニアの検出

- umbrella mode
- [NH3/HCN] ~ 0.5
  - 他のT tauri disks(Mandel+12, Pontoppidani+19): 上限が~0.1
- NH3は地球の窒素のmain missing reservoir にはならない

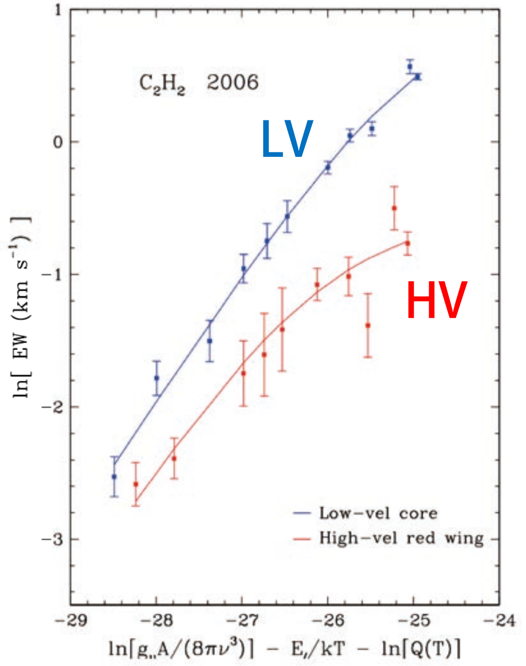
表面降着流?

- ２成分の吸収線：redshift した core(LV) と wing(HV)
- core とwingの速度成分を再現するようなパラメーターを探す
  - T ~ 450 K
  - HVの方がカーブが強い：HV成分はLV成分に比べて光学的に厚いところからの寄与
- a few au からの放射が、円盤表層で吸収されているのでは
  - ほぼedge-on
  - HV: dM/dt ~ 1e-7 Msun/yr , LV: ~ 7e-9 Msun/yr
  - 非理想MHDシミュレーションから示唆
    - super sonic
  - edge-onはレア：こういう天体の割合が鍵となるかも

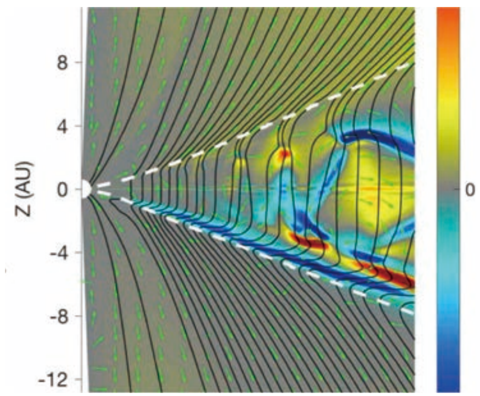
C2H2の吸収線

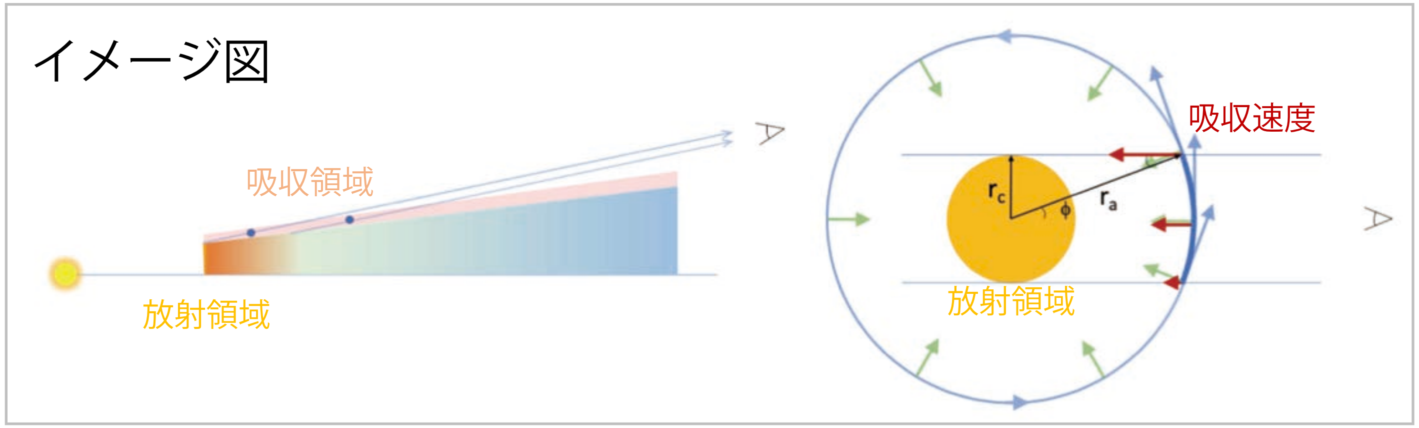


Curves of growth for C2H2



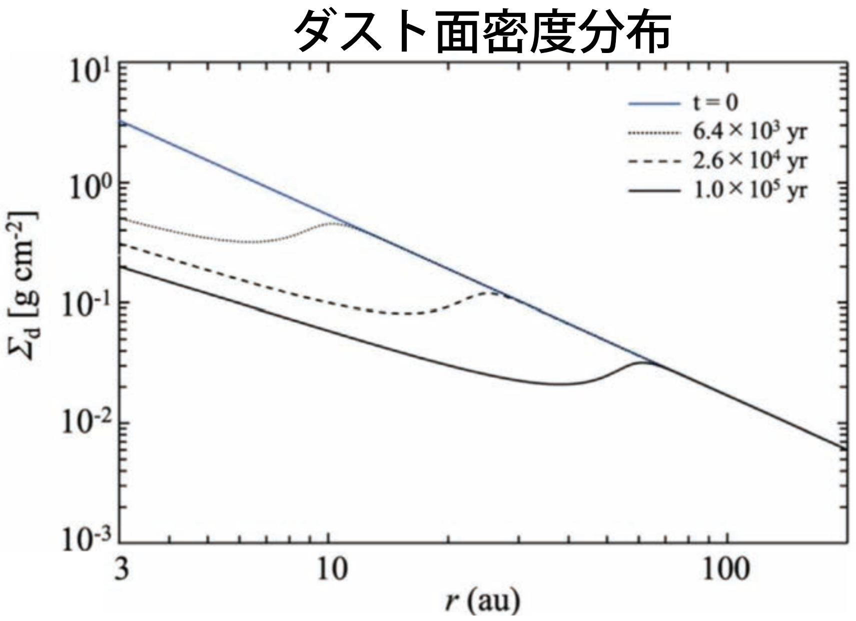
Bai (2017)
radial mass flux

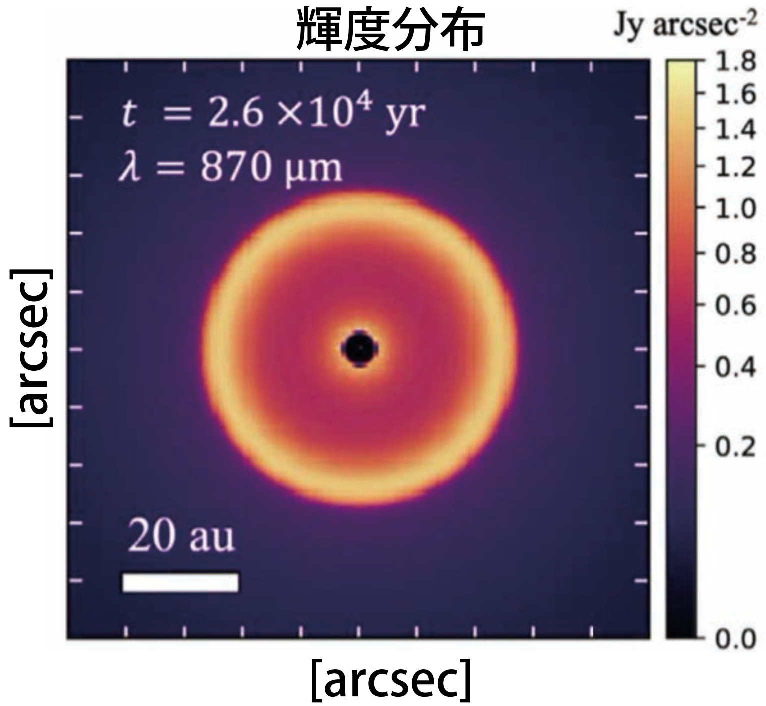




28 Ring formation by coagulation of dust aggregates in early phase of disk evolution around a protostar

Satoshi Ohashi, Hiroshi Kobayashi, Riouhei Nakatani, Satoshi Okuzumi, Hidekazu Tanaka, Koji Murakawa, Yichen Zhang, Hauyu Baobab Liu, Nami Sakai Ring structures are observed by (sub-)millimeter dust continuum emission in various circumstellar disks from early stages of Class 0 and I to late stage of Class II young stellar objects (YSOs). In this paper, we study one of the possible scenarios of such ring formation in early stage, which is coagulation of dust aggregates. The dust grains grow in an inside-out manner because the growth timescale is roughly proportional to the orbital period. The boundary of the dust evolution can be regarded as the growth front, where the growth time is comparable to the disk age. With radiative transfer calculations based on the dust coagulation model, we find that the growth front can be observed as a ring structure because dust surface density is sharply changed at this position. Furthermore, we confirm that the observed ring positions in the YSOs with an age of $\lesssim 1$ Myr are consistent with the growth front. The growth front could be important to create the ring structure in particular for early stage of the disk evolution such as Class 0 and I sources.





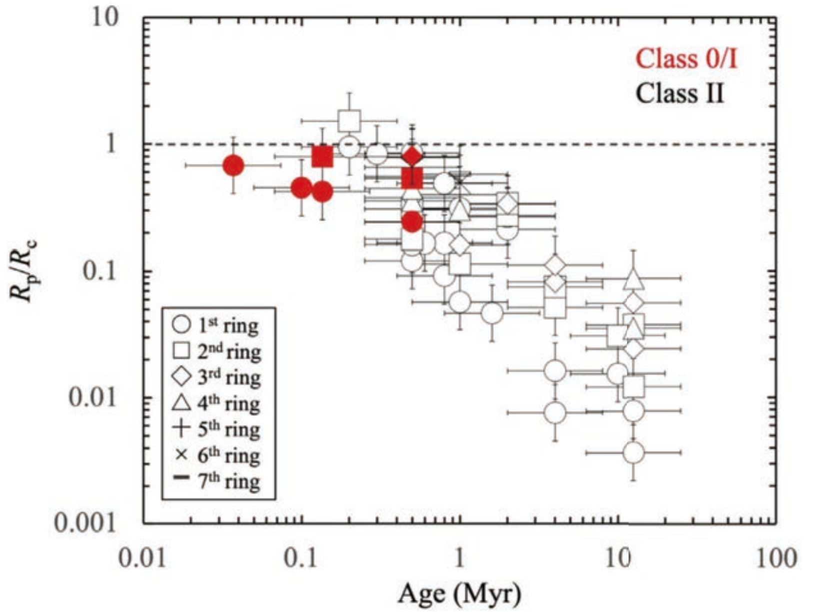


Figure 9. The ratio of the ring positions (R_p) to the growth front (R_c) is shown against the stellar age. A ratio of unity indicates that the position of the ring corresponds to the growth front, which is found at the stellar age of $\lesssim$1 Myr. The symbols and colors represent the same as in Figure 8.

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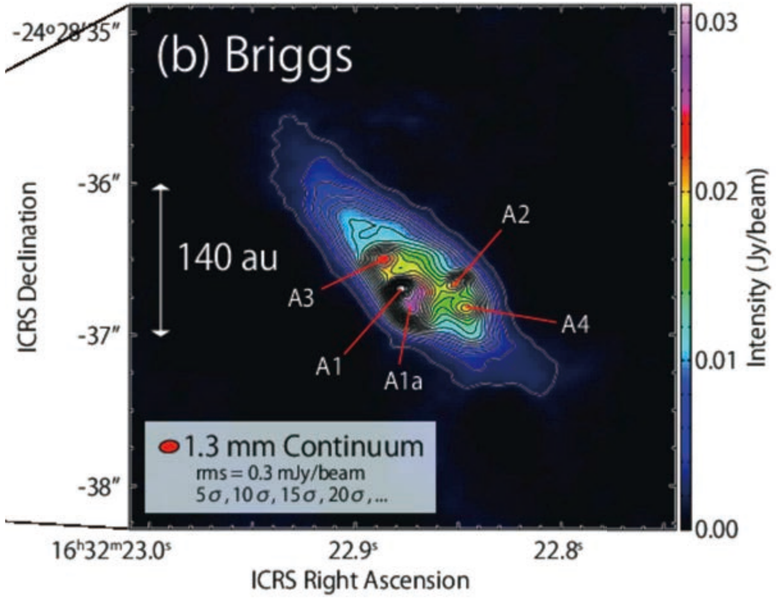
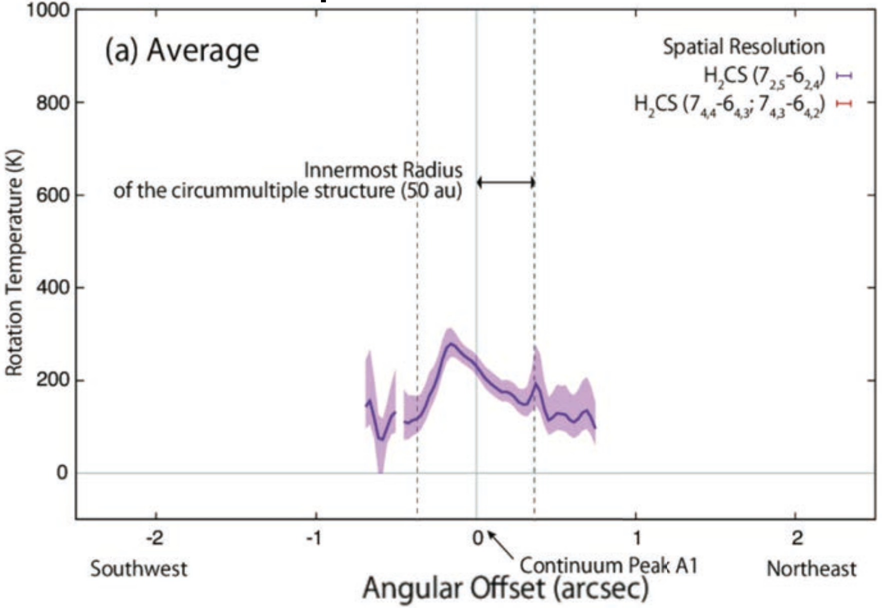
Substructures in the Disk-Forming Region of the Class 0 Low-Mass Protostellar Source IRAS 16293-2422 Source A on a 10 au Scale

Yoko Oya, Satoshi Yamamoto We have observed the Class 0 protostellar source IRAS 16293-2422 A in the C17O and H2CS lines as well as the 1.3 mm dust continuum with the Atacama Large Millimeter/submillimeter Array at an angular resolution of 0."1 (14 au). The continuum emission of the binary component, Source A, reveals the substructure consisting of 5 intensity peaks within 100 au from the protostar. The C17O emission mainly traces the circummultiple structure on a 300 au scale centered at the intensity centroid of the continuum, while it is very weak within the radius of 50 au from the centroid. The H2CS emission, in contrast, traces the rotating disk structure around one of the continuum peaks (A1). Thus, it seems that the rotation centroid of the circummultiple structure is slightly different from that of the disk around A1. We derive the rotation temperature by using the multiple lines of H2CS. As approaching to the protostar A1, the rotation temperature steeply rises up to 300 K or higher at the radius of 50 au from the protostar. It is likely due to a local accretion shock and/or the preferential protostellar heating of the transition zone from the circummultiple structure to the disk around A1. This position corresponds to the place where the organic molecular lines are reported to be enhanced. Since the rise of the rotation temperature of H2CS most likely represents the rise of the gas and dust temperatures, it would be related to the chemical characteristics of this prototypical hot corino.

1.3mm Continuum



Rotation Temperature Profile around A1



Accretion shock による局所加熱