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担当： 内山

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2. AN ORDERED MAGNETIC FIELD IN THE PROTOPLANETARY DISK OF AB AUR REVEALED BY MID-INFRARED POLARIMETRY
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On dust-gas gravitational instabilities in protoplanetary discs

Henrik N. Latter* & Roxana Rosca

- Protoplanetary disc内でのdust成長：cm barriers 問題
  - Collective instabilitiesの働きでクリアできる可能性
  - Classical gravitational instability
  - Streaming instability
  - **Secular gravitational instability (SGI): aerodynamical friction between particles and gas**
    - single-fluid SGI はいかなる条件下でも起きる
      - single-fluid SGI: assume that the angular momentum bestowed onto, or removed from, the gas disk is negligible
    - On sufficiently long scales, both sides of this momentum transaction must be included
      - two-fluid modelでの近似になるが、SGIに発生条件が生じる
      - 本論文ではその詳細を解析的に調査

- strongly-coupled (左) and weakly-coupled (右) particlesで条件を探査
  - 中間くらいのスケールで不安定

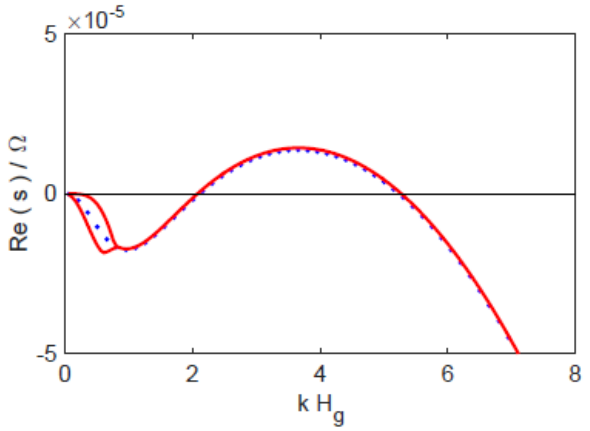


Figure 4. Growth rate of the SGI as a function of k for tightly coupled particles. Parameters are: $Q_g = 3$, $\epsilon = 100$, $\delta = 0.01$, and $\alpha = 10^{-5}$. The solid red line is the full solution to the dispersion relation, and the blue dots correspond to the asymptotic growth rate (52).

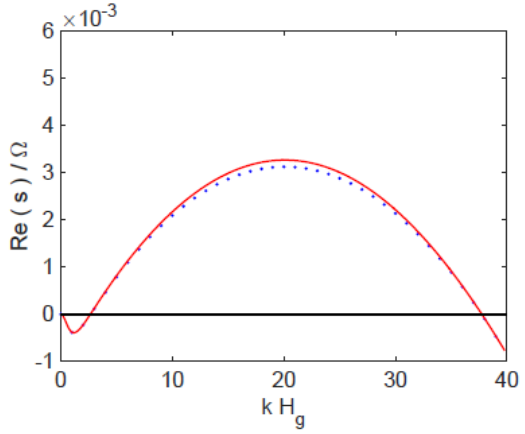


Figure 3. Growth rate of the SGI as a function of radial wavenumber k for weakly coupled particles. Parameters are $Q_g = 5$, $\epsilon = 0.1$, $\delta = 0.01$, and $\eta = 10^{-4}$. Here $H_g = c_g/\Omega$ is the gas vertical scale height. The solid red line is the full solution to the dispersion relation and the blue dotted solution is the asymptotic growth rate from (46)

- Razor-thin disc modelを仮定すると、mm-dastで<30AUでは効かない
- Well-coppled dustでも効かない

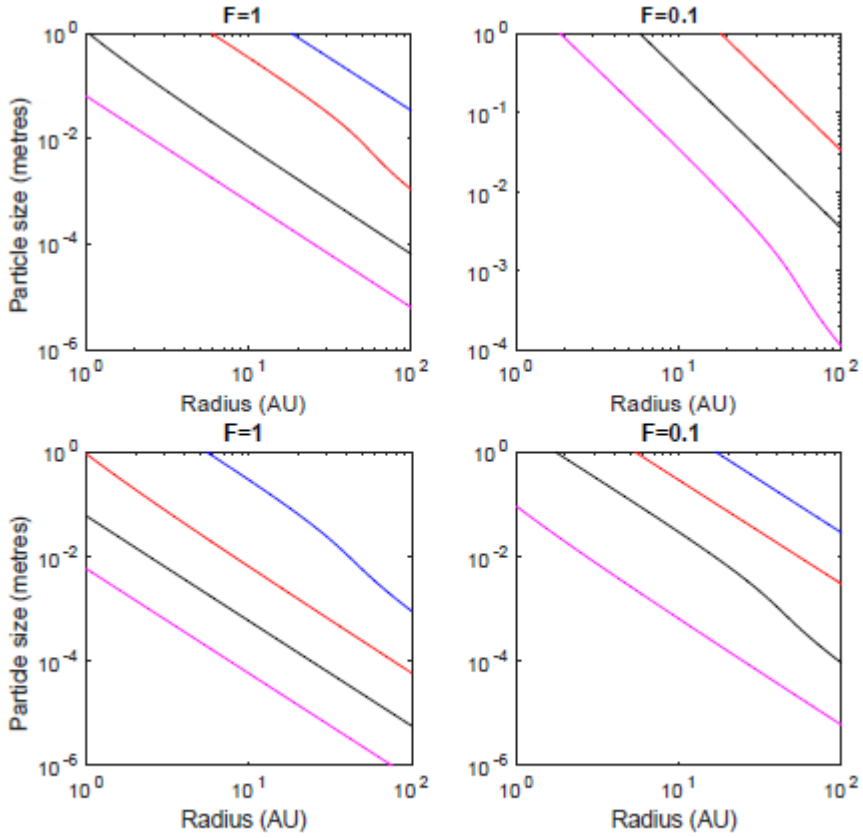


Figure 5. Stability curves in a plane of disk radius and particle size. The pink, black, red, and blue curves correspond to $\alpha_g = 10^{-7}, 10^{-6}, 10^{-5}, 10^{-4}$. The regions above the respective curves are unstable. Two disk models are employed, a more massive disk with $F = 1$ (left panels) and a less massive disk with $F = 0.1$ (right panels). The upper row corresponds to a dust-to-gas mass ratio of $\delta = 0.01$, while the lower row to $\delta = 0.1$.

AN ORDERED MAGNETIC FIELD IN THE PROTOPLANETARY DISK OF AB AUR REVEALED BY MID-INFRARED POLARIMETRY

Dan Li[1], Eric Pantin[1,2], Charles M. Telesco[1], Han Zhang[1], Christopher M. Wright[3], Peter J. Barnes[1,4], Chris Packham[5,6], and Naibí Mariñas[1]

- 10.3 umでのAB Aurのダスト偏光の観測
  - CanariCam at the 10.4-m Gran Telescopio Canarias
- <80 AUで~0.44%, より外側で~1.4%の変更を検出
- 偏光パターン、強度、PAでmodel fitting
  - 内側はdichroic emission of elongated particles aligned in a disk B-field
  - 外側は散乱偏光
  - B-field: a poloidal shape tilted from the rotational axis of the disk

Table 1
Model parameters

Parameter	Value	Unit
T_*	10,000	K
R_*	2.5	$R_\odot$
Inclination	27	Degree
$r_{\rm in}$	0.5	AU
$r_{\rm out}$	400	AU
q	1.2	...
r_0	100	AU
h_0	8.5	AU
γ	1.125	...
$M_{\rm dust}$	1.2e-4	$M_\odot$
$a_{\rm min}$	0.01	μm
$a_{\rm max}$	1.0	μm

Note. — Emission of the star is assumed to be blackbody.

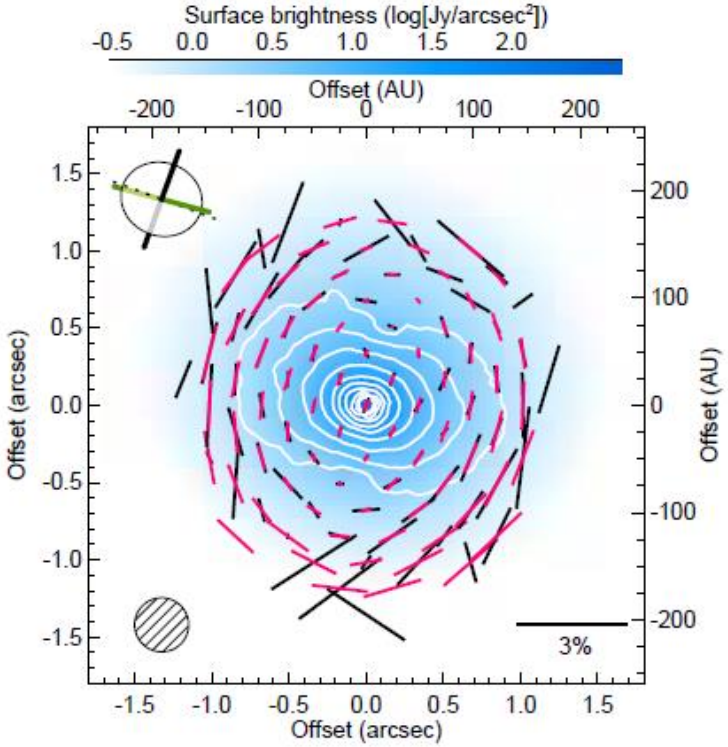


Figure 3. The best-fit model (red vectors) superimposed on the observation (black vectors). Displayed in the background is the surface brightness of the model disk, superimposed by model polarized intensity contours. In this model, the disk is threaded by a tilted poloidal B-field, the projected orientation of which is shown in the upper-left sketch (green line). See the electronic edition of the Journal for a color version of this figure.

- Disk of AB Aur: optically thick at 10.3 μm
  - Disk 表面に磁場：magneto-rotational instability が起きる場所に磁場がある

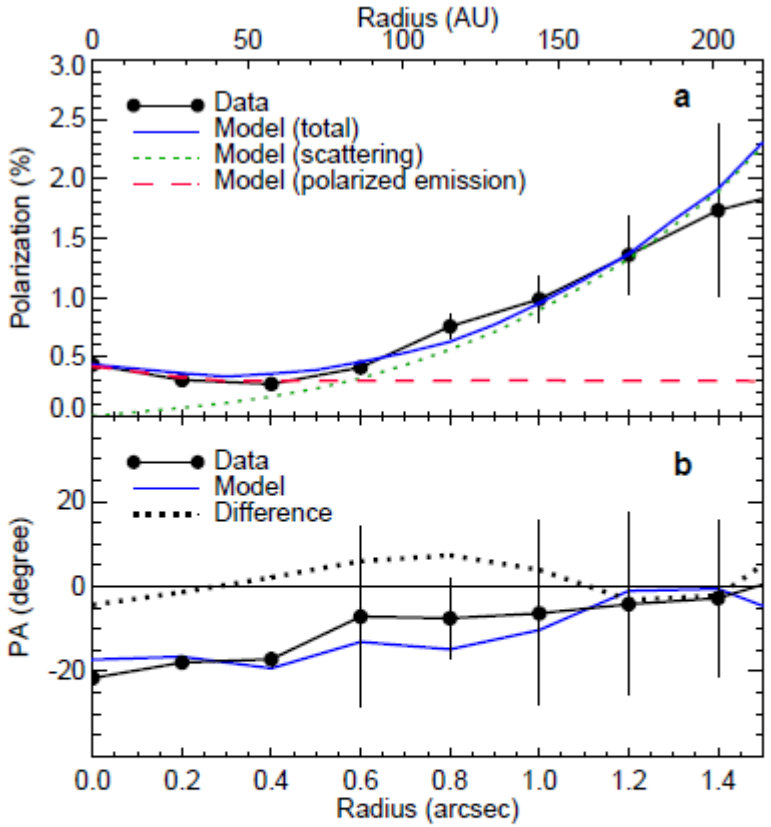
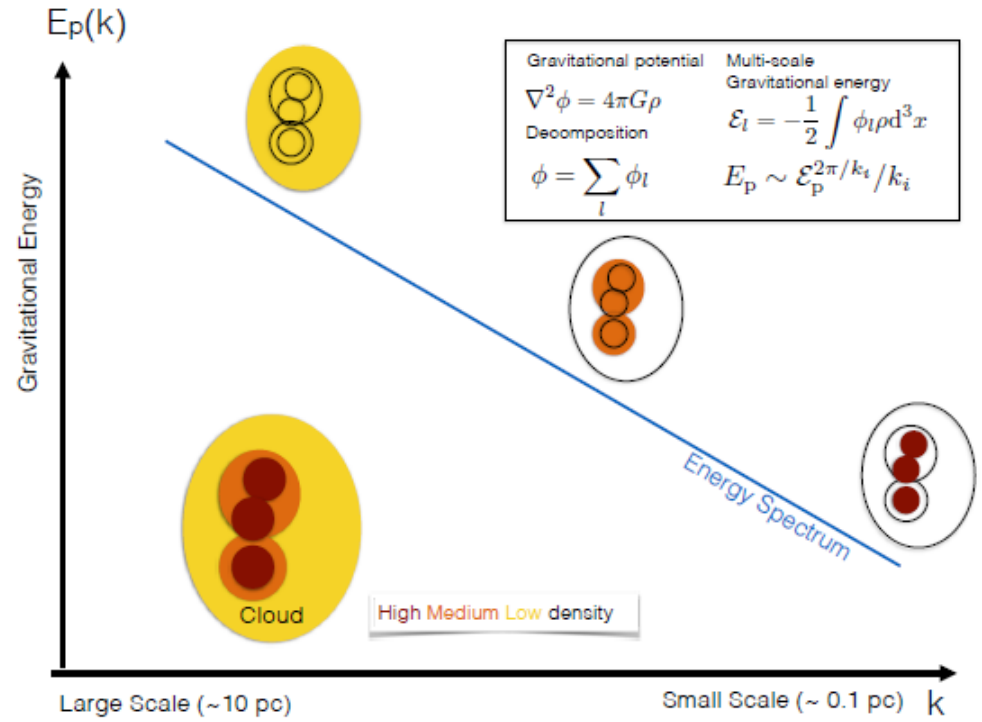


Figure 4. Illustration of the goodness of fit. Azimuthally averaged degree of polarization (a) and polarization P.A. (b) of the model (blue lines) and the observation (black lines with 1-σ error bars) are compared at a range of deprojected distances from the star. In the outer disk ($r > 0\farcs5$), most polarization is contributed by scattering (green dotted line). Toward the inner disk ($r < 0\farcs5$), scattered polarization becomes negligible and polarized emission (red dashed line) from aligned dust grains dominates. See the electronic edition of the Journal for a color version of this figure.

Probing the multi-scale interplay between gravity and turbulence – Power-law like gravitational energy spectra of the Orion Complex

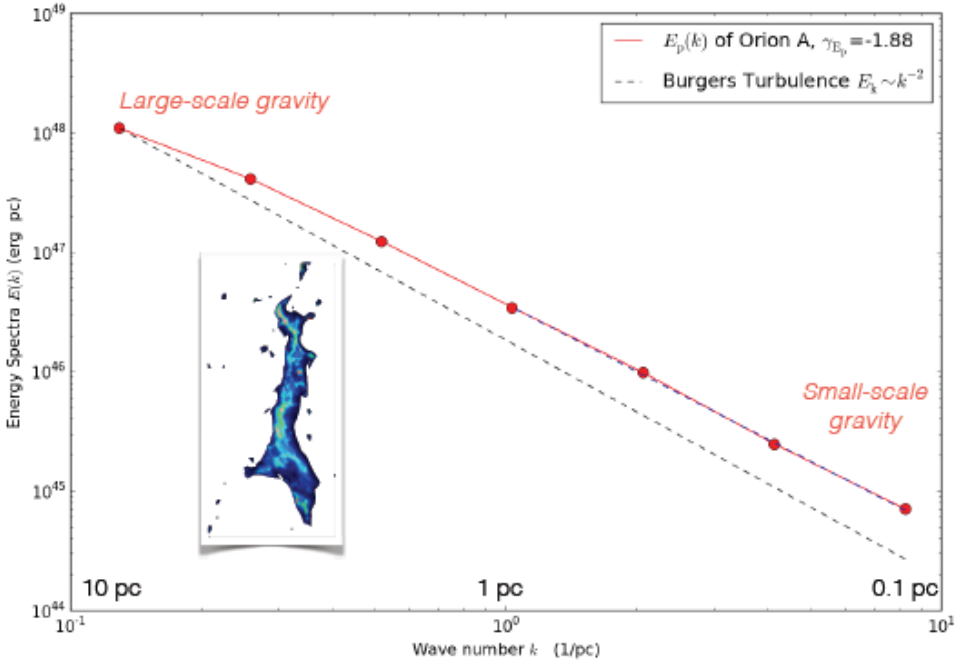
Guang-Xing Li[1⋆] , Andreas Burkert[1,2]

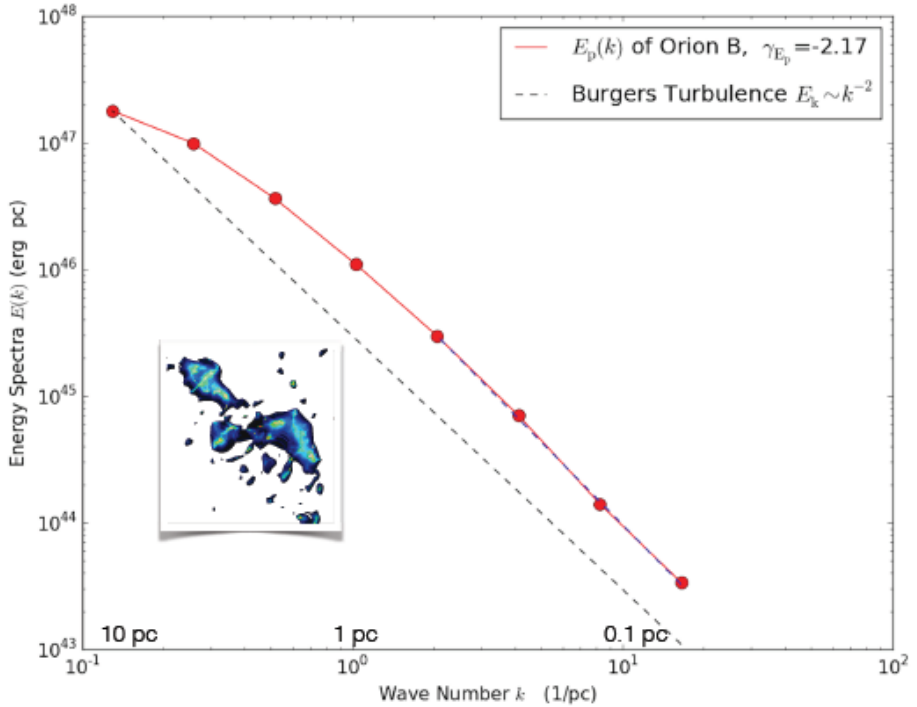
- 先行研究でgravitational energy spectrumという概念を提唱した
  - To quantify the importance of gravity on multiple physical scales
- 実際にOrion A & Bでwavelet-based decomposition techniqueでこれを算出した
  - The map traces column densities
    1*10^21 cm^-2 < N < 2*10^23 cm^-2
  - resolve down to ~36”
    (correspond to 0.07 pc)
  - From a few pc down to ~0.1 pc scale



- ~k^{-2} 程度
  - compressible turbulenceと同程度の依存性
  - 重力と乱流の広い空間スケールでの相互作用の可能性を示唆

  - Orion Aでは乱流より緩やかな依存性
    - Sub-pc スケールでは重力が乱流に勝っている状態にあると考えられる

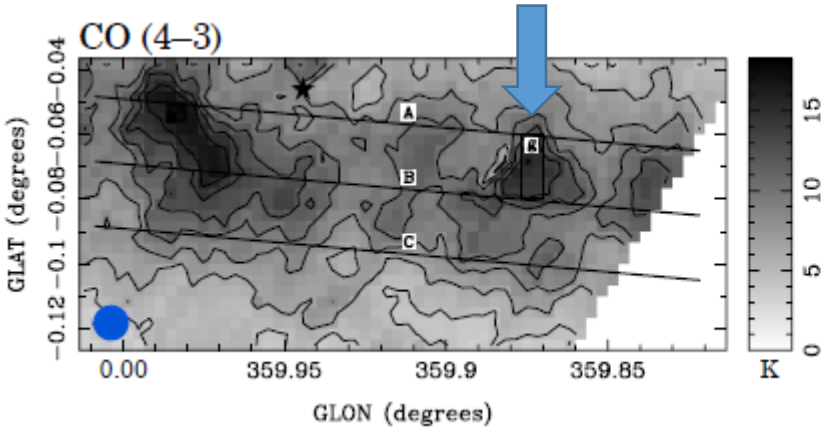


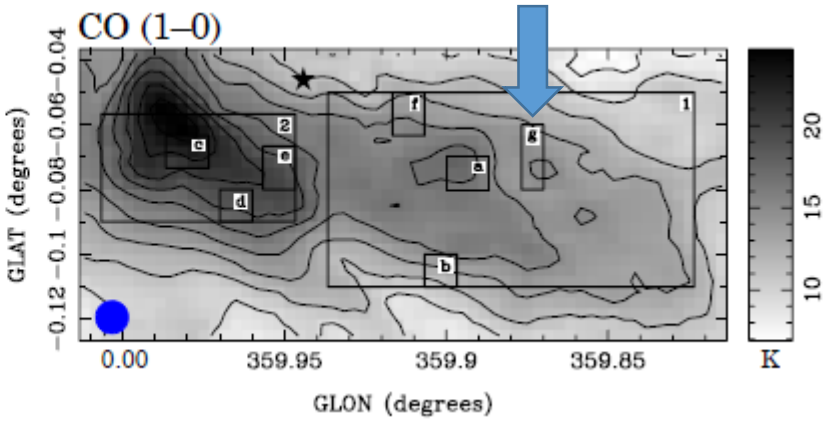


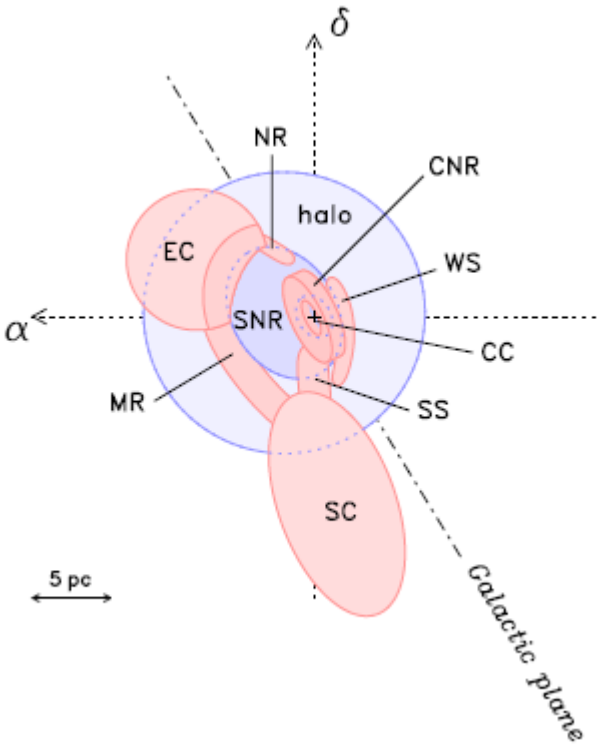
The Chemistry and Kinematics of Two Molecular Clouds near Sagittarius A*

John A. P. Lopez[1,2⋆], Maria R. Cunningham[1], Paul A. Jones[1], Jonathan P. Marshall[1,3], Leonardo Bronfman[4], Nadia Lo[4], Andrew J. Walsh[5]

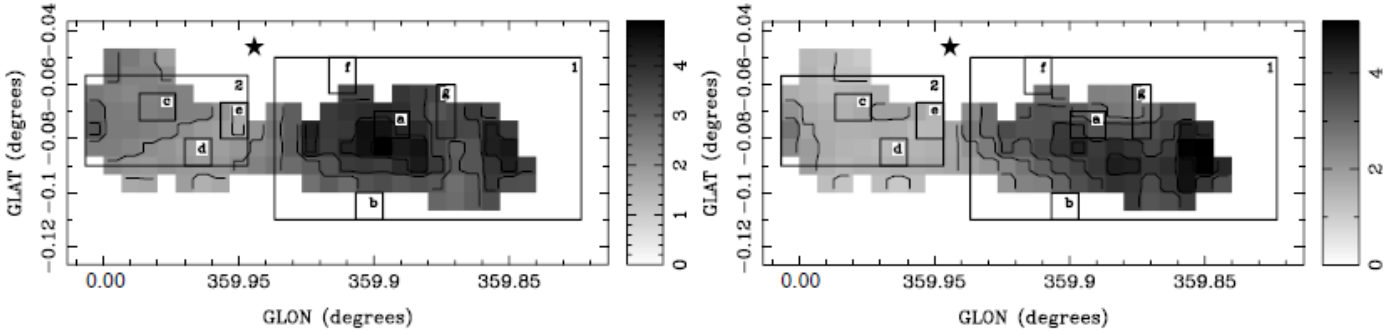
- CMZのEC(50km/s cloud)とSC(20km/s cloud)とMRのガスを0.65, 3, 7mm で観測
- 20km/s cloudの西端に冷たくてややthickな領域



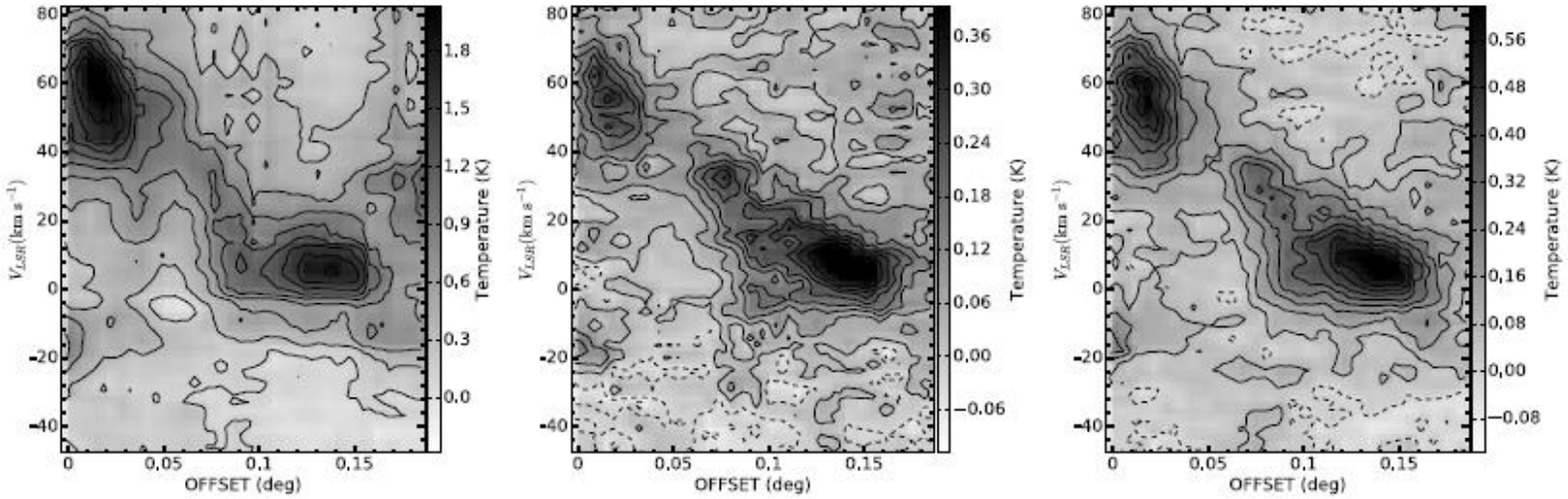




- 20 km/s cloudの方が冷たく shock & high density tracerで明るい



(a) 7-mm SiO 1–0 / 7-mm ^{13}CS 1–0　(b) 7-mm HNCO 2(0,2)–1(0,1) / 7-mm ^{13}CS 1–0



(a) 7-mm CS 1–0 - slice A　(b) 7-mm HNCO - slice A　(c) 7-mm SiO - slice A

- 各分子ガスのPV diagram の構造に差はない
  - Well-mixed gas
- 速度構造を見るとMRは20 km/s cloudと繋がっているようだ
  - 50 km/s cloudまで構造は伸びているかも？

G345.45+1.50: An expanding ring-like structure with massive star formation ⋆,⋆⋆

Cristian López-Calderón[1, 2, 3], Leonardo Bronfman[1], Lars-Åke Nyman[2, 4], Guido Garay[1], Itziar de Gregorio-Monsalvo[2, 4, 5], and Per Bergman[6]

- 大質量星形成環境と考えられるG345.45+1.50のring-like structureを13CO(3-2)で観測
  - この領域は銀河面から離れているため視線方向でコンタミが起きにくい
  - 17’*20’の領域を0.2pcの分解能で観測
  - 感度は0.1 km/sの分解能で~1K
- リング状の構造をclumpに分解
  - ガス温度~30K

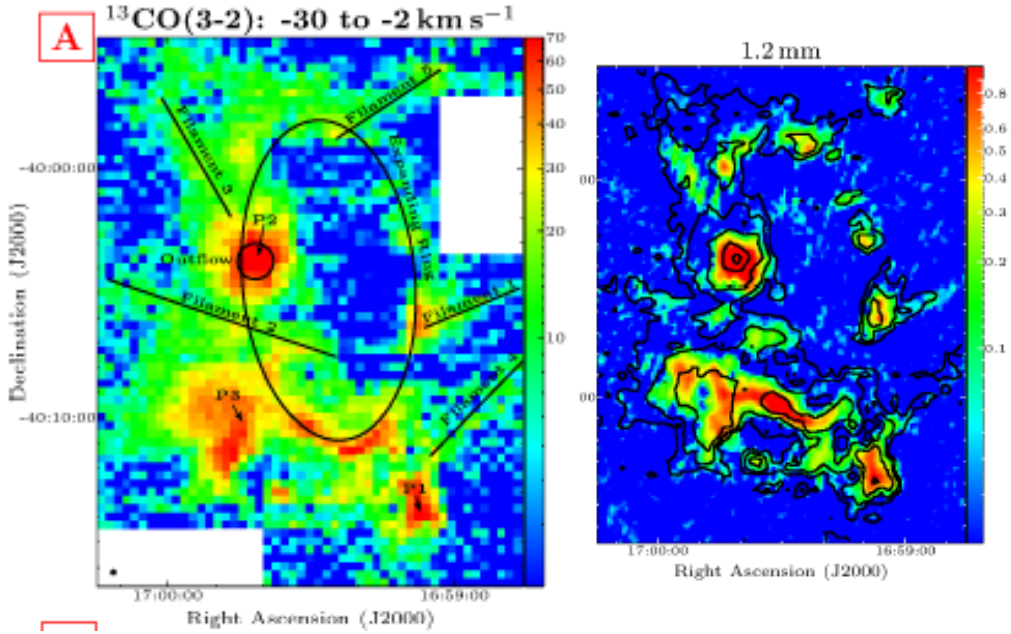


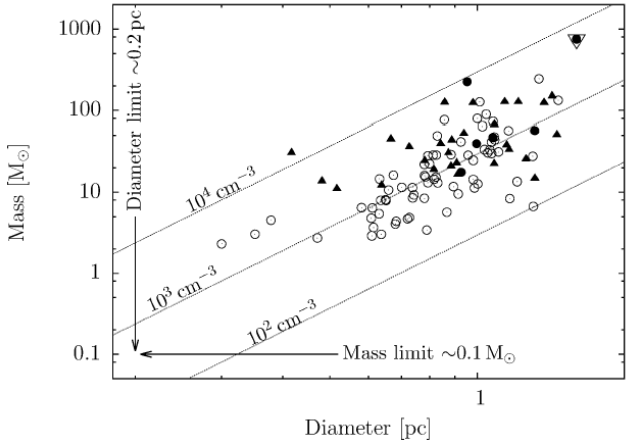
Table 2. Summary of the physical properties of the 104 identified ^{13}CO clumps.

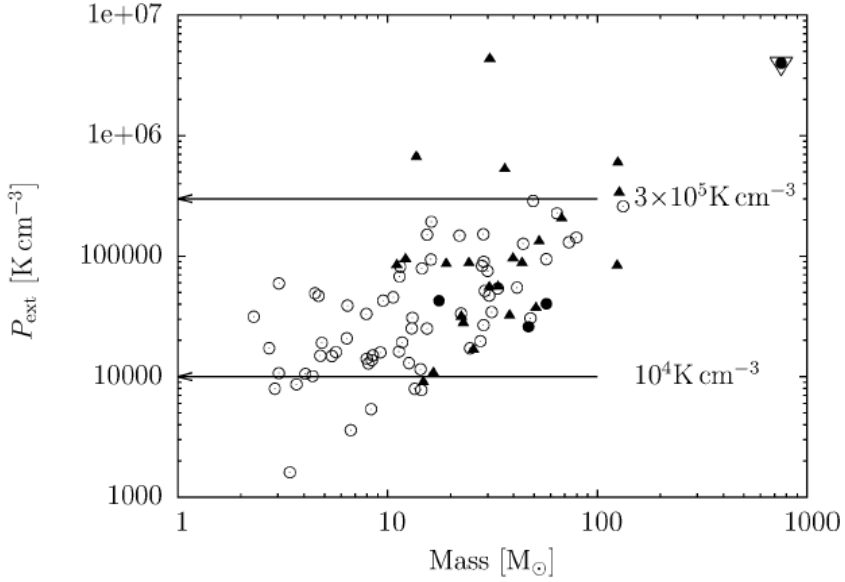
Parameter	Range	Average	Median
Diameter [pc]	0.3-1.6	0.9	0.9
[1]Mass [$M_\odot$]	2.3-7.5×10^2	44	23
[2]Density [cm^{-3}]	10^2-10^4	2×10^3	10^3
[2]Column density [cm^{-2}]	3×10^{20}-2×10^{22}	3×10^{21}	2×10^{21}
Line velocity width [km s^{-1}]	0.7-2.0	1.1	1.0

[1] The total mass of the clumps is 4.5×10^3 $M_\odot$.

[2] Densities and column densities are estimated assuming a mean molecular weight of μ=2.29.

- 18%のclumpでIR放射があり星形成を示唆
- 13clumpsがcollapsingで残りは外圧と平衡状態





- リング構造のPV fittingから膨張速度は~1km/s
  - Expansion timescale: ~3*10^6 yr
  - 中心にあるIR対応天体の無い超新星爆発をした電波源が起源か？

Parameter	Value
Spatial center	16:59:26 −40:04:30 (J2000)
LSR velocity center	−12.4 km s^{-1}
Radius	3.4 pc
Expansion velocity	1.0 km s^{-1}
α	57 deg
β	−175 deg
Mass	6.9×10^3 M$_\odot$
Energy	7×10^{46} erg
Expansion time	3×10^6 yr