Star Formation News Letter No. 318, #7-16：工藤哲洋

7 Time variability in the bipolar scattered light nebula of L1527 IRS: A possible warped inner disk

Brian T. Cook[1], John J. Tobin[2], Michael F. Skrutskie[3] and Matthew J. Nelson[3]

8 ALMA reveals the magnetic field evolution in the high-mass star forming complex G9.62+0.19

D. Dall'Olio[1], W.H.T. Vlemmings[1], M.V. Persson[1], F.O. Alves[2], H. Beuther[3], J.M. Girart[4,5], G. Surcis[6], J.M. Torrelles[4,5], and H.J. Van Langevelde[7,8]

9 Interaction between Northern Coal Sack in the Cyg OB 7 cloud complex and the multiple super nova remnants including HB 21

Kazuhito Dobashi[1], Tomomi Shimoikura[1], Nobuhiro Endo[1], Chisato Takagi[1], Fumitaka Nakamura[2,3], Yoshito Shimajiri[4] and Jean-Philippe Bernard[5]

10 Cloud-cloud collision in the DR 21 cloud as a trigger of massive star formation

Kazuhito Dobashi[1], Tomomi Shimoikura[1], Shou Katakura[1], Fumitaka Nakamura[2,3] and Yoshito Shimajiri[4]

11 Discovery of CCS Velocity-Coherent Substructures in the Taurus Molecular Cloud 1

Kazuhito Dobashi[1], Tomomi Shimoikura[1,2], Tetsu Ochiai[1], Fumitaka Nakamura[3,4], Seiji Kameno[5], Izumi Mizuno[6,7,8] and Kotomi Taniguchi[4,6,9,10]

12 Revealing the Star-Disk-Jet Connection in GM Aur using Multiwavelength Variability

C. C. Espaillat[1], E. Macías[1], J. Hernández[2] and C. Robinson[1]

13 Analysis and test of the central-blue-spot infall hallmark

R. Estalella[1], G. Anglada[2], A. K. Díaz-Rodríguez[2] and J. M. Mayen-Gijon[2]

14 High gas/dust size ratio indicating efficient radial drift in the mm-faint CX Tau disk

S. Facchini[1], E. F. van Dishoeck[2,3], C. F. Manara[1], M. Tazzari[4], L. Maud[1,3], P. Cazzoletti[2], G. Rosotti[3], N. van der Marel[5], P. Pinilla[6] and C. J. Clarke[4]

15 Runaways and shells around the CMa OB1 association

B. Fernandes[1], T. Montmerle[2], T. Santos-Silva[1] and J. Gregorio-Hetem[1]

16 The Astrochemical Impact of Cosmic Rays in Protoclusters I: Molecular Cloud Chemistry

Brandt A. L. Gaches[1], Stella S. R. Offner[2] and Thomas G. Bisbas[3,4]

ALMA reveals the magnetic field evolution in the high-mass star forming complex G9.62+0.19

D. Dall'Olio[1], W.H.T. Vlemmings[1], M.V. Persson[1], F.O. Alves[2], H. Beuther[3], J.M. Girart[4,5], G. Surcis[6], J.M. Torrelles[4,5], and H.J. Van Langevelde[7,8]

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http://arxiv.org/pdf/1905.00415

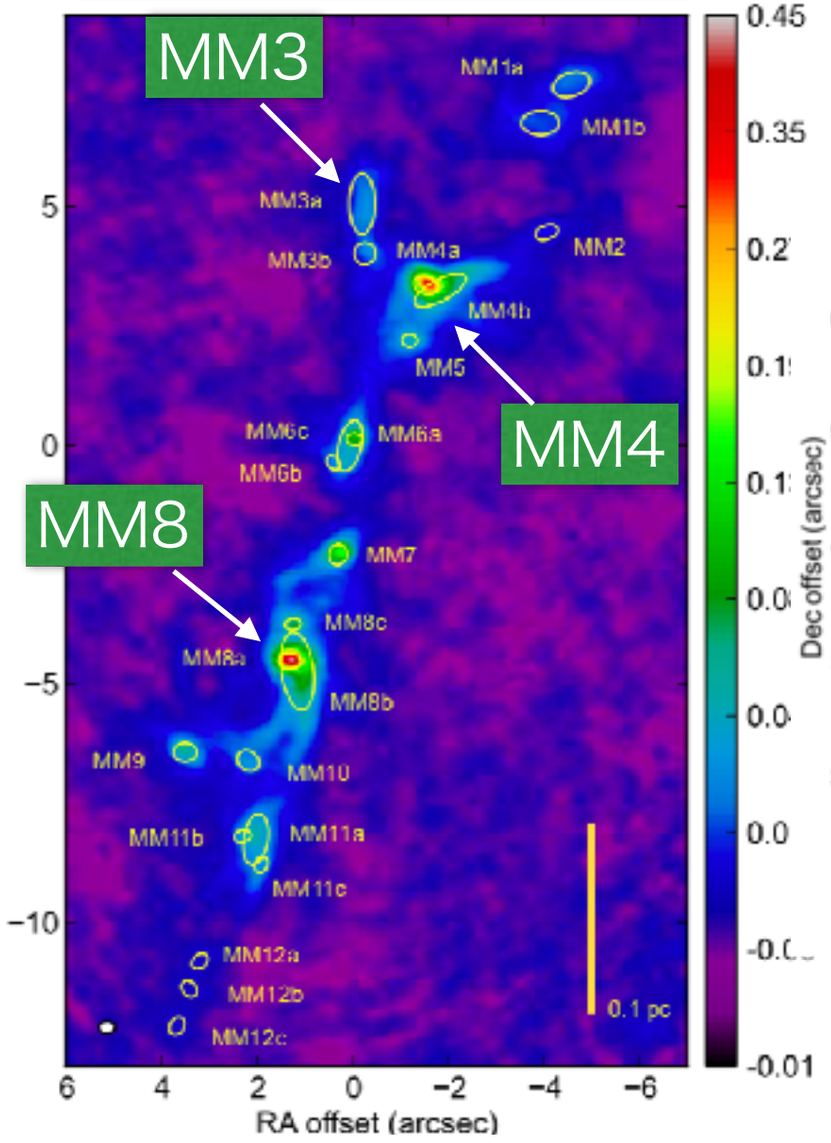
- フィラメント内にある大質量の原始星コア（距離~5.2 kpc）について，ダスト放射の偏光をALMAを使って特定し，磁場の方向（と強さ）を見積もった.

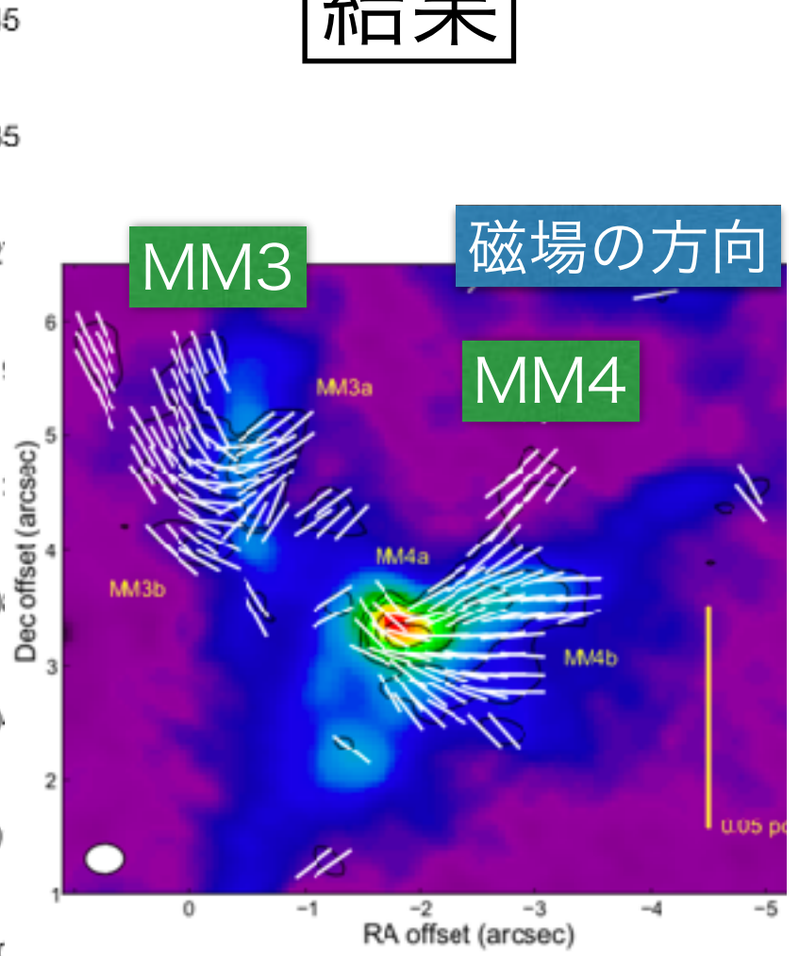
- 進化の進んでいないコアの方が，進化の進んだコアよりも，磁場が強かった.

- 平均的な磁場の強さは11mGで，乱流のエネルギーよりも大きい．他の観測から見積もられる磁場の強さや方向と一致していた.

結果

フィラメントの全体像





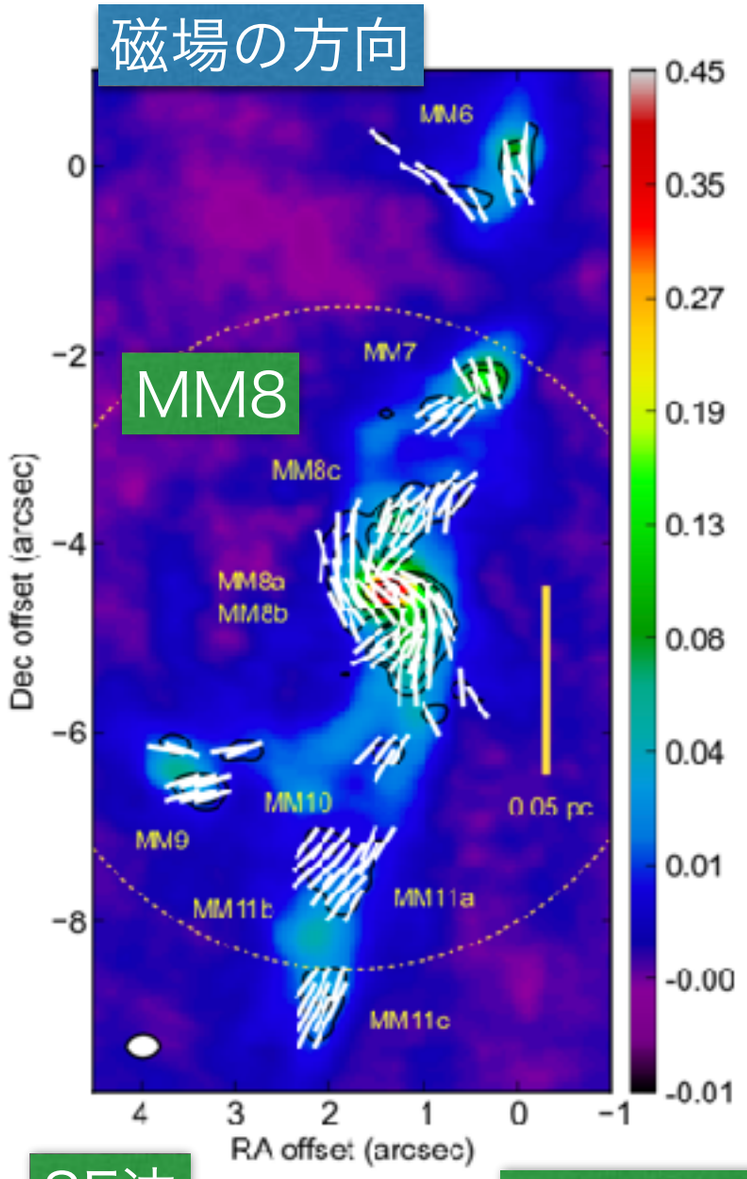


Table 2. Polarised intensities and magnetic field parameters.

DCF法　SF法　mass-to-flux ratio

Core	I_{peak} (mJy beam^{-1})	$I_{pol}{}^{a}$ (mJy beam^{-1})	$\sigma_\psi{}^{b}$ (°)	$\sigma_v{}^{c}$ (km s^{-1})	$B_\perp^{DCF}$ (mG)	b (°)	$B_\perp^{SF}$ (mG)	B_t/B_0	質量	λ
MM3	27.6	2.79±0.07	41.8 ± 0.1	2.00 ± 0.01	0.33 ±0.02	11.9 ± 0.2	3.30 ±0.07	0.2	21	8
MM4	321.6	1.80±0.06	28.0 ± 0.4	2.00 ± 0.01	1.57 ±0.02	9.4 ± 0.3	13.18 ±0.42	0.1	43	6
MM7	168.9	0.66±0.08	—	—	—	—	—	—		
MM8a	366.7	1.74±0.08	30.5 ± 3.8	2.35 ± 0.01	1.64 ±0.02	8.6 ± 0.4	17.10 ±0.75	0.1	38	21
MM8c	44.6	1.25±0.08	—	—	—	—	—	—	（太陽質量）	
MM9	63.4	0.91±0.07	—	—	—	—	—	—		
MM11a	42.8	0.54±0.10	—	—	—	—	—	—		

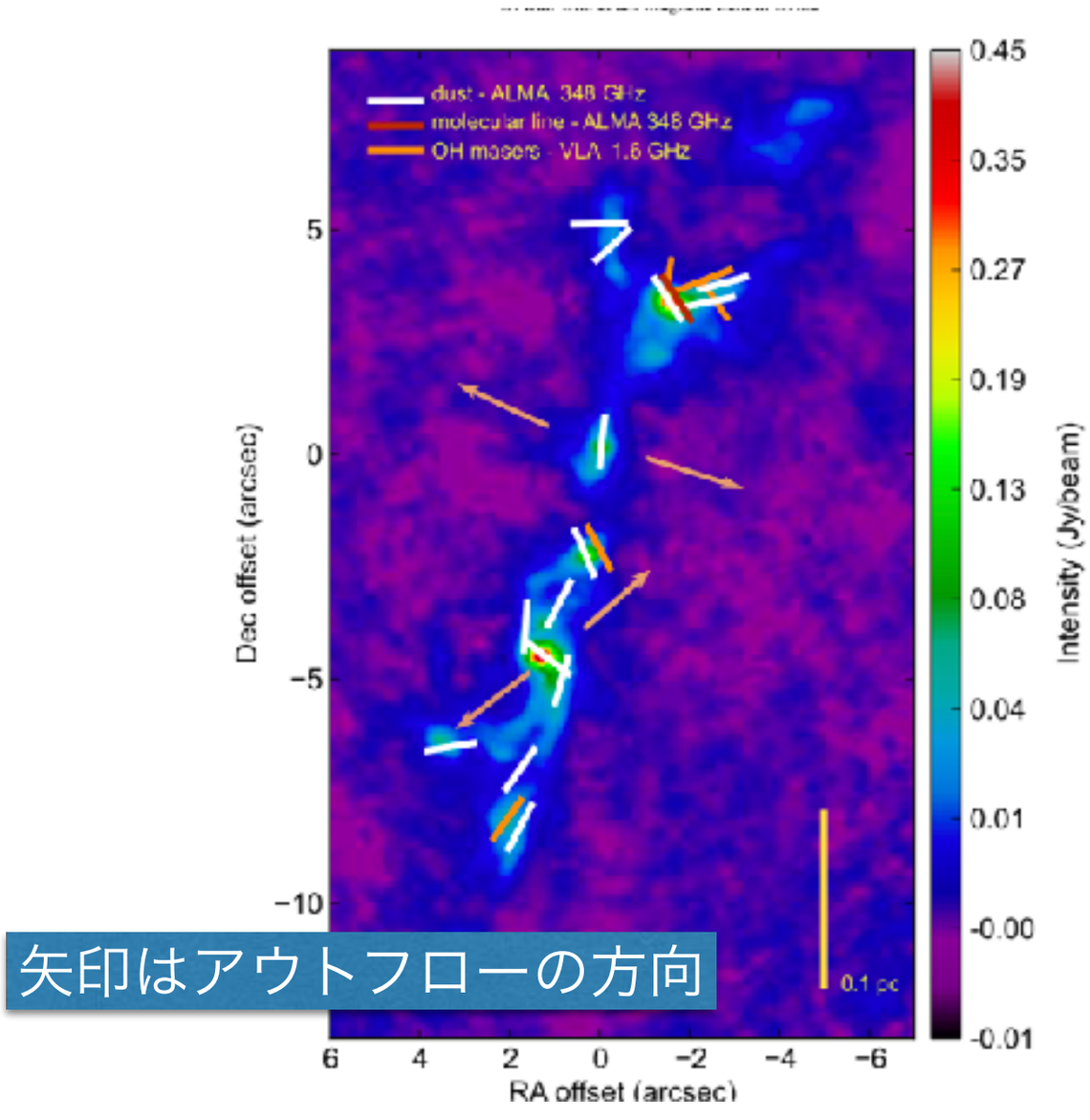
大スケールとランダムの比

Notes. [a] I_{pol} are taken at the peak of the polarised intensity. In case of MM3 and MM4 the peak is located in M
[b] All the values of σ_ψ are obtained using the classical variance, calculated around the circular mean (Jammalamad
et al. 2013), over regions covering MM3, MM4, and MM8. [c] All the values of σ_v are obtained by Liu et al. 2017, Table 3, using methanol
emissions.

議論

(1) MM8の方がMM4よりも進化の段階で若い状態にあり，MM8の方がMM4よりも磁場が強い.

(2) 他の観測から予想される，磁場の方向や強さとほぼ一致している.



矢印はアウトフローの方向

白線：今回のダスト放射の観測

赤線：今回の観測で受かった分子輝線の偏光から求めたもの.

橙線：OHメーザーの観測から

OHメーザーのZeeman effect

→ ～5mG

11

Discovery of CCS Velocity-Coherent Substructures in the Taurus Molecular Cloud 1

Kazuhito Dobashi[1], Tomomi Shimoikura[1,2], Tetsu Ochiai[1], Fumitaka Nakamura[3,4], Seiji Kameno[5], Izumi Mizuno[6,7,8] and Kotomi Taniguchi[4,6,9,10]

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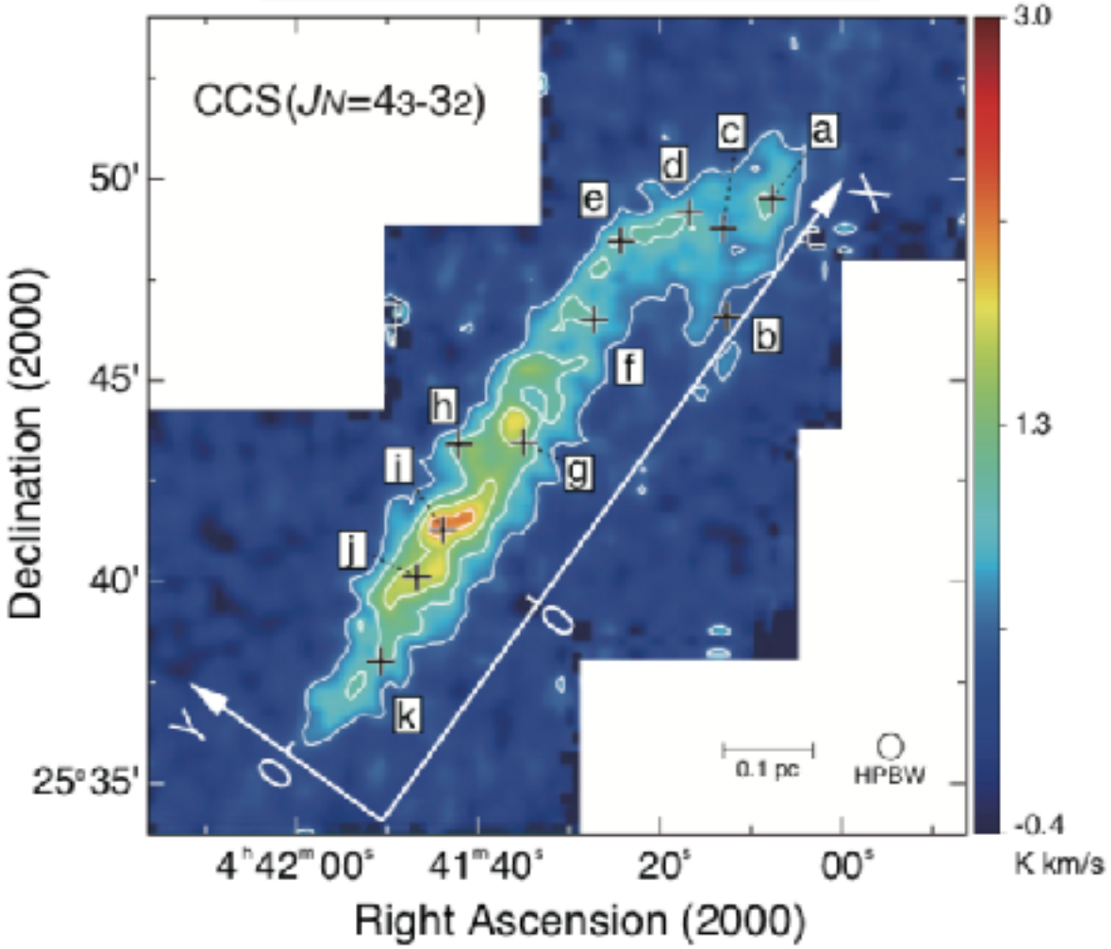
http://arxiv.org/pdf/1905.12773

- Starless な　Taurus Molecular Cloud 1 (TMC-1)を，野辺山45mを使ってCCSで観測した.

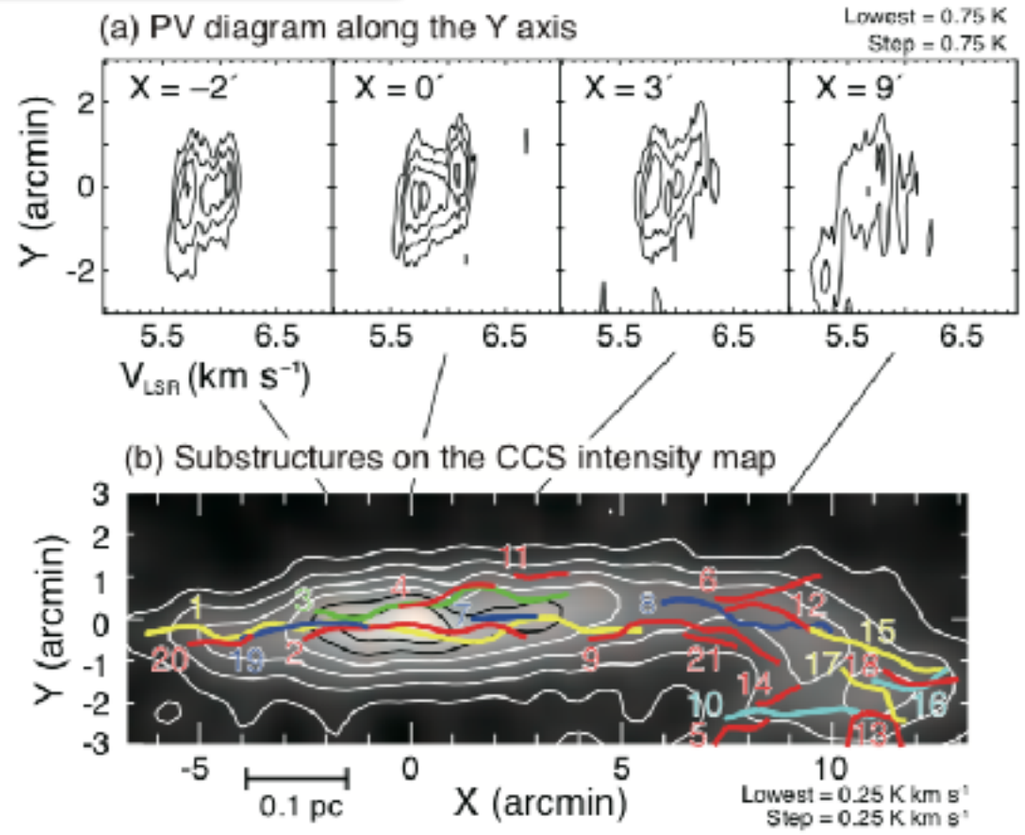
- TMC-1は，フィラメント構造をしていて，フィラメントの直径は ~0.1pcで，長さが ~0.5pc.

- TMC-1を速度構造に分解することで，フィラメントの中に，さらに21個の構造を発見した．それらの質量は，重力収縮の臨界質量程度であった.

フィラメントの全体像



Y軸方向のPV図



X軸方向のPV図

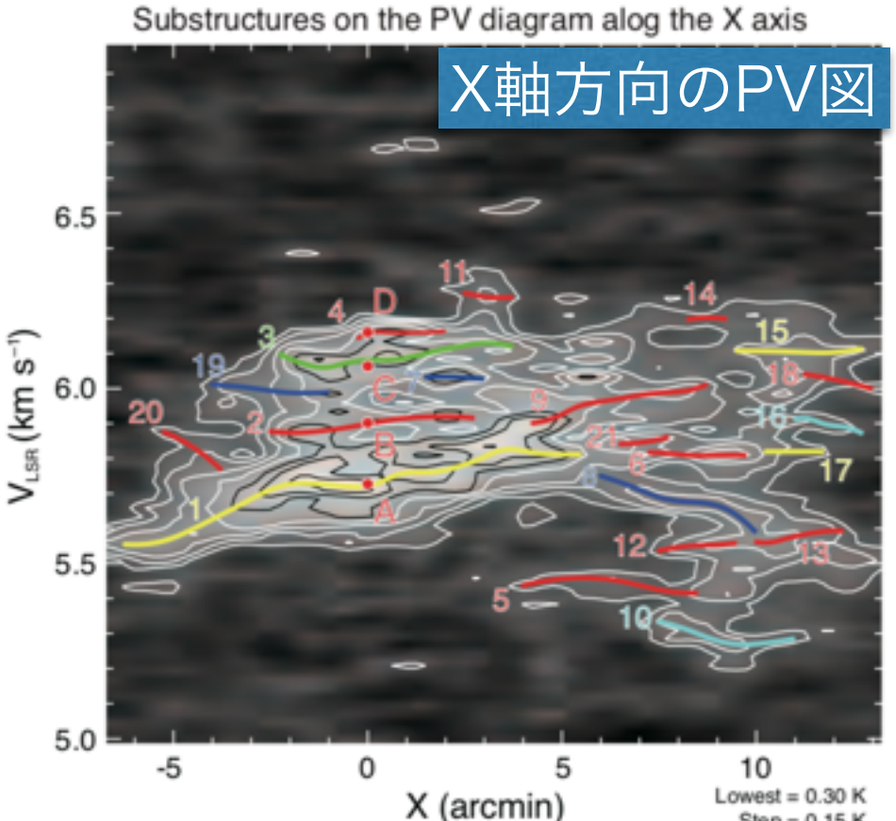


Table 1. Parameters of the velocity-coherent components

No.	Peak Position					Length	Width	Aspect	Flux	Mass	Line density
	R.A.(J2000)	Dec.(J2000)	$T_{\rm mb,max}$ (K)	$V_{\rm LSR}$ (km s^{-1})	N(CCS) (10^{12} cm^{-2})	(pc)	(pc)	Ratio	(K kms^{-1} arcmin^2)	($M_\odot$)	($M_\odot$ pc^{-1})
1	$4^{\rm h}41^{\rm m}43.0^{\rm s}$	25°41′ 9″	3.37	5.72	9.65	0.498	0.088	5.655	1.84	11.08	22.25
2	$4^{\rm h}41^{\rm m}44.9^{\rm s}$	25°40′32″	2.96	5.89	8.47	0.220	0.073	3.034	0.71	3.57	16.18
3	$4^{\rm h}41^{\rm m}46.1^{\rm s}$	25°41′ 2″	3.13	6.07	8.97	0.257	0.075	3.448	0.79	3.96	15.41
4	$4^{\rm h}41^{\rm m}44.8^{\rm s}$	25°41′26″	2.68	6.16	7.66	0.096	0.076	1.259	0.33	1.60	16.63
5	$4^{\rm h}41^{\rm m}15.4^{\rm s}$	25°45′56″	1.55	5.42	4.44	0.207	0.058	3.584	0.28	2.14	10.30
6	$4^{\rm h}41^{\rm m}23.9^{\rm s}$	25°48′51″	1.63	5.81	4.68	0.105	0.117	0.904	0.27	2.34	22.24
7	$4^{\rm h}41^{\rm m}38.7^{\rm s}$	25°42′55″	2.62	6.03	7.49	0.061	0.067	0.915	0.23	1.20	19.64
8	$4^{\rm h}41^{\rm m}26.7^{\rm s}$	25°47′ 8″	1.97	5.71	5.64	0.176	0.101	1.737	0.41	3.43	19.50
9	$4^{\rm h}41^{\rm m}30.4^{\rm s}$	25°44′40″	2.99	5.91	8.56	0.199	0.092	2.160	0.55	4.05	20.34
10	$4^{\rm h}41^{\rm m}15.0^{\rm s}$	25°46′29″	2.05	5.32	5.86	0.146	0.071	2.046	0.26	2.27	15.57
11	$4^{\rm h}41^{\rm m}39.1^{\rm s}$	25°44′31″	1.09	6.26	3.13	0.052	0.110	0.468	0.10	0.52	10.13
12	$4^{\rm h}41^{\rm m}22.8^{\rm s}$	25°48′21″	1.53	5.55	4.37	0.089	0.102	0.874	0.18	1.54	17.27
13	$4^{\rm h}41^{\rm m}\ 7.9^{\rm s}$	25°48′43″	1.30	5.57	3.73	0.170	0.135	1.254	0.23	2.07	12.21
14	$4^{\rm h}41^{\rm m}14.5^{\rm s}$	25°47′56″	0.71	6.20	2.03	0.045	0.155	0.290	0.07	0.55	12.27
15	$4^{\rm h}41^{\rm m}12.0^{\rm s}$	25°49′60″	1.38	6.11	3.94	0.140	0.095	1.483	0.27	2.52	17.95
16	$4^{\rm h}41^{\rm m}\ 9.3^{\rm s}$	25°49′34″	1.30	5.92	3.71	0.079	0.061	1.296	0.11	1.03	13.01
17	$4^{\rm h}41^{\rm m}12.8^{\rm s}$	25°48′54″	1.01	5.82	2.89	0.088	0.141	0.625	0.11	0.96	10.94
18	$4^{\rm h}41^{\rm m}\ 8.0^{\rm s}$	25°49′58″	1.43	6.03	4.09	0.075	0.079	0.955	0.13	1.32	17.53
19	$4^{\rm h}41^{\rm m}48.4^{\rm s}$	25°39′52″	2.66	5.99	7.60	0.125	0.064	1.940	0.32	1.91	15.36
20	$4^{\rm h}41^{\rm m}51.8^{\rm s}$	25°37′57″	1.76	5.77	5.05	0.065	0.079	0.825	0.13	1.05	16.13
21	$4^{\rm h}41^{\rm m}26.1^{\rm s}$	25°46′26″	1.56	5.84	4.48	0.053	0.120	0.436	0.16	1.40	26.66

臨界線密度　～17M太陽/pc

12 **Revealing the Star-Disk-Jet Connection in GM Aur using Multiwavelength Variability**

C. C. Espaillat[1], E. Macías[1], J. Hernández[2] and C. Robinson[1]

Accepted by ApJL

https://arxiv.org/pdf/1905.12789

- TTS（GM Aur：transitional disk あり）の同時観測．X線，紫外線，可視光，赤外線，cm電波の観測．

- 質量降着率の増大したとき，中間赤外と3cmの電波の増大が見られた．中間赤外は円盤内側の質量増大に起因．

- 3cm電波の増大の時に，X線は一定だったので，3cm電波はジェット起源だろう．

赤外

Spitzer Observations of GM Aur

Epoch	Date (UT)	Start Time (UT)	End Time (UT)	AOR ID	[3.6] (mag)	[4.5] (mag)
4	2016-01-05	20:12:34	23:07:45	58455040	8.11±0.01	7.99±0.01
5	2016-01-09	13:35:20	16:31:35	58454784	8.03±0.01	7.90±0.01
6	2018-01-04	05:22:25	08:17:04	64918272	8.05±0.01	7.95±0.01
7	2018-01-11	04:47:01	07:42:56	64918528	7.88±0.01	7.77±0.01
8	2018-01-19	03:42:21	06:39:31	64918784	8.11±0.01	8.00±0.01

Note. — Here we adopt the epoch labels used in RE19 and Espaillat et al. (2019) which analyzed eight epochs of GM Aur.

電波

Table 2
VLA Observations of GM Aur

Epoch	Date (UT)	Start Time (UT)	End Time (UT)	F_{3cm} [a] (μJy)	rms (μJy beam^{-1})	Ph. Cal. F_{3cm} (mJy)
6	2018-01-04	06:04:42	09:16:05	80.6 ± 3.7	2.6	450 ± 4
7	2018-01-11	04:57:02	08:08:26	95.2 ± 5.4	3.3	477 ± 5
8	2018-01-19	04:09:59	07:21:23	92.7 ± 4.4	3.2	469 ± 6

[a] The error listed here does not include the expected 5% absolute flux uncertainty of the VLA at 3 cm, but it is included in Figure 2.

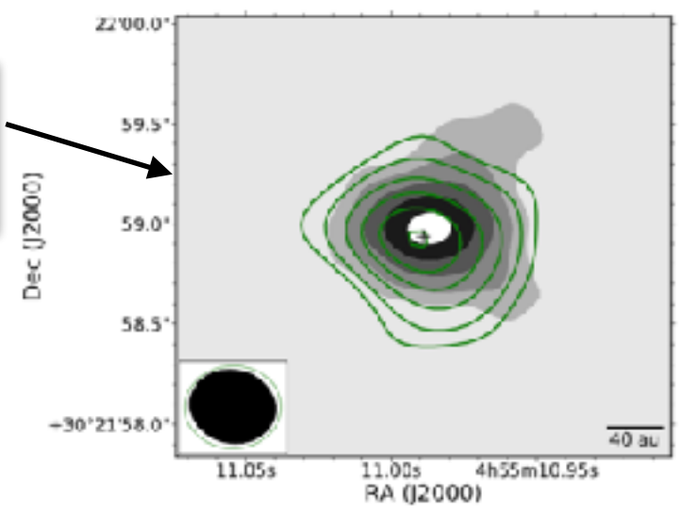
可視光とX線

Table 3
HST, *Swift*, and *Chandra* Observations of GM Aur and Stellar Properties

Epoch	Telescope/ Instrument	Identification No.	Date (UT)	Start Time (UT)	End Time (UT)	$\dot{M}$ ($10^{-8} M_\odot$ yr^{-1})	L_X (10^{30}ergs^{-1})
4	*HST*/STIS	14048	2016-01-05	20:38:03	23:00:42	$1.021^{+0.009}_{-0.009}$	–
4	*Swift*/XRT	00034249002	2016-01-05	20:43:02	22:58:00	–	$3.4^{+0.9}_{-0.6}$
4	*Swift*/XRT	00034249003	2016-01-06	00:00:00	14:42:00	–	$3.4^{+0.9}_{-0.6}$
5	*Swift*/XRT	00034249004	2016-01-09	09:13:26	16:13:53	–	$17.1^{+1.2}_{-0.9}$
5	*HST*/STIS	14048	2016-01-09	13:40:55	16:02:33	$0.768^{+0.008}_{-0.008}$	–
6	*Chandra*/ACIS	20614	2018-01-04	05:49:29	09:38:50	–	$4.4^{+0.4}_{-0.5}$
6	*HST*/STIS	15165	2018-01-04	06:10:54	08:34:18	$0.564^{+0.007}_{-0.007}$	–
7	*Chandra*/ACIS	20615	2018-01-11	04:45:07	08:32:11	–	$4.1^{+0.4}_{-0.6}$
7	*HST*/STIS	15165	2018-01-11	05:03:19	07:26:40	$1.961^{+0.012}_{-0.012}$	–
8	*Chandra*/ACIS	20616	2018-01-19	03:18:12	07:03:10	–	$4.7^{+0.5}_{-0.6}$
8	*HST*/STIS	15165	2018-01-19	03:43:47	06:07:09	$0.979^{+0.009}_{-0.009}$	–

Note. — $\dot{M}$ is from RE19 and L_X is from Espaillat et al. (2019). Identification numbers for *HST* and *Chandra*/*Swift* correspond to the Proposal ID and Observation ID, respectively.

grayscale：2015年
等高線：　2018年



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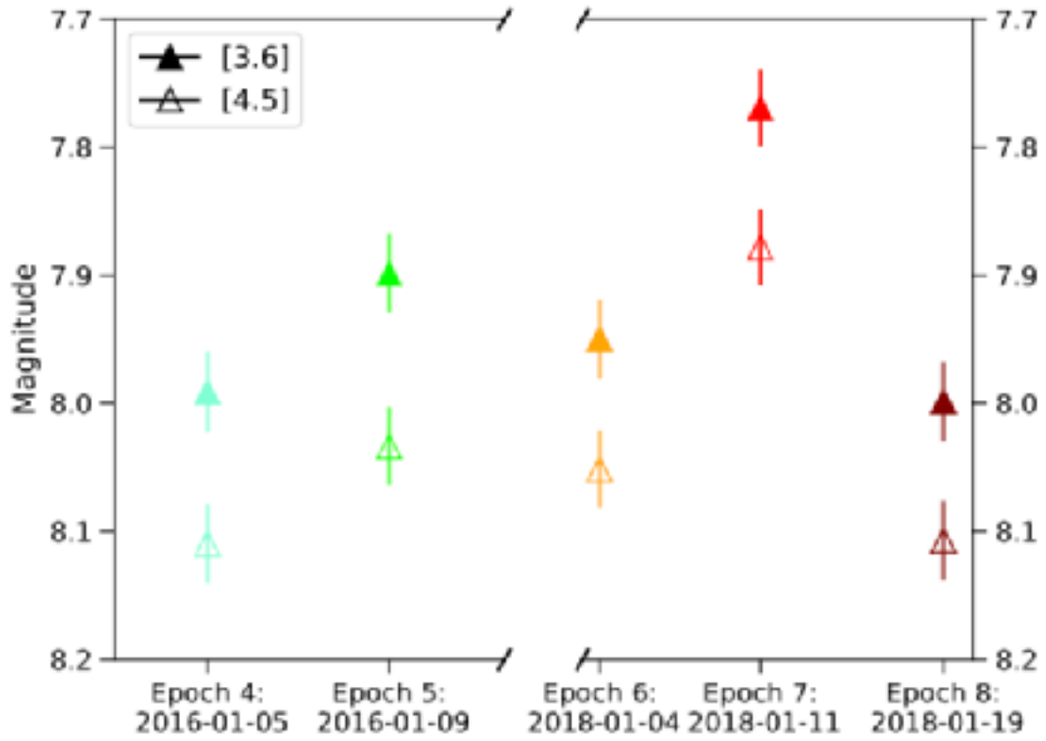
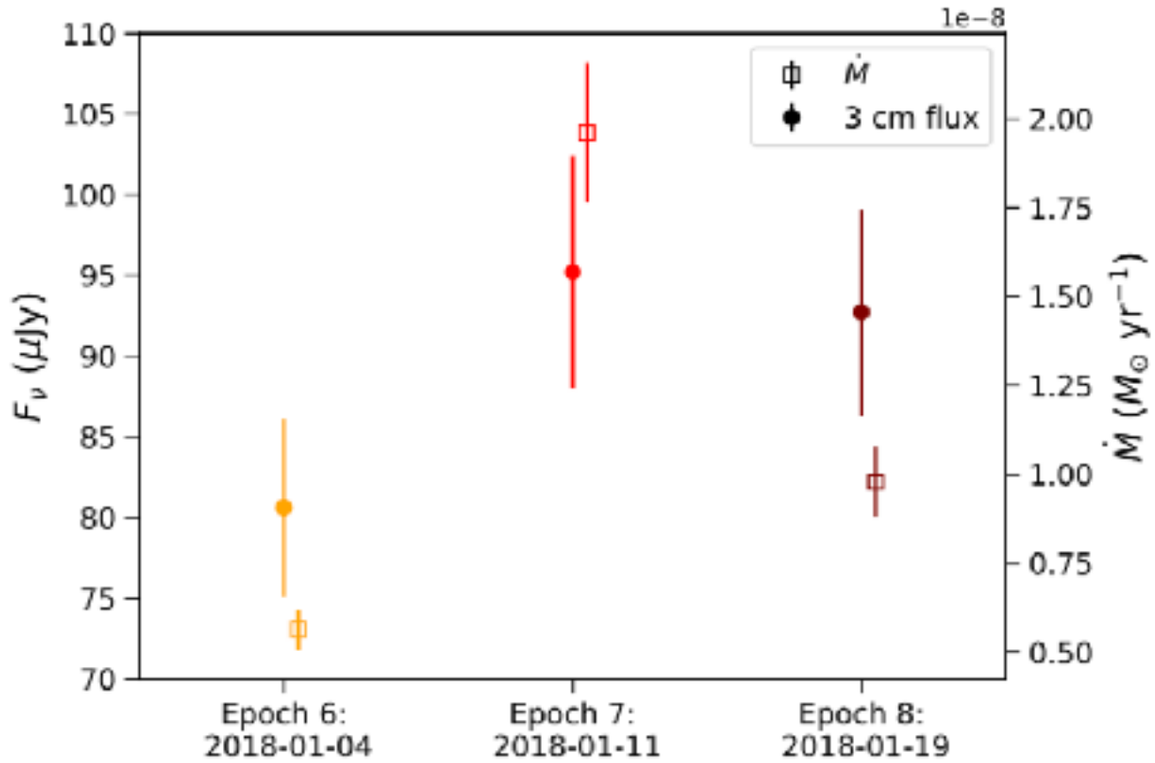


Figure 1. *Spitzer* IRAC [3.6] and [4.5] mean magnitudes of GM Aur taken in E4 to E8. There is a significant increase of emission in both *Spitzer* bands in E7.

電波



質量降着率は可視光の観測から？

6，7，8のエポックで，質量降着率が増大したとき，
中間赤外と3cmの電波の増大が見られた.
（ただし，X線は一定．）