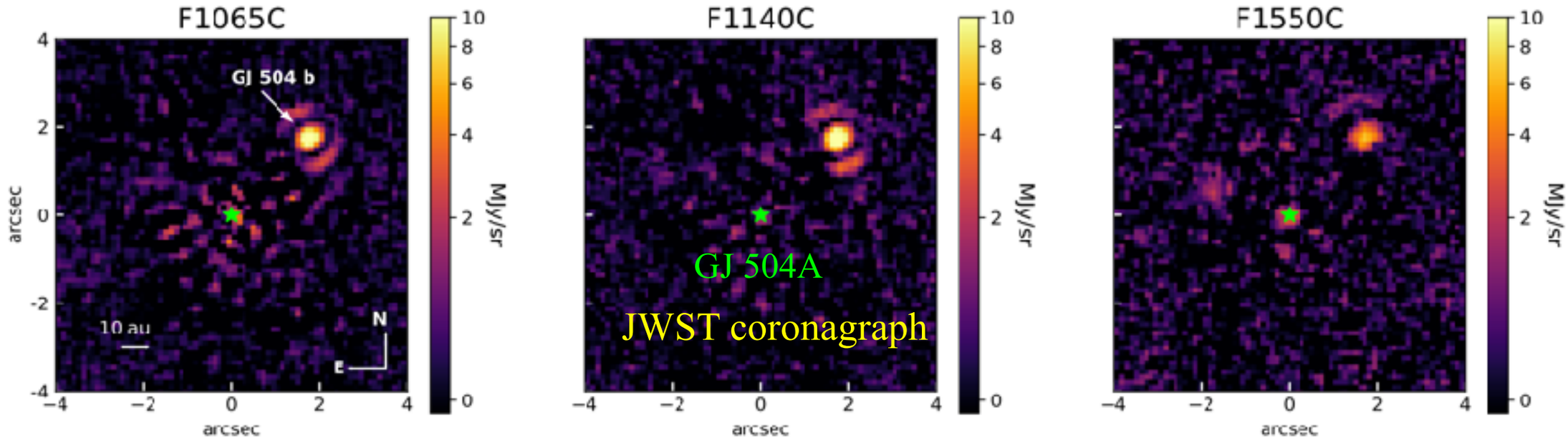
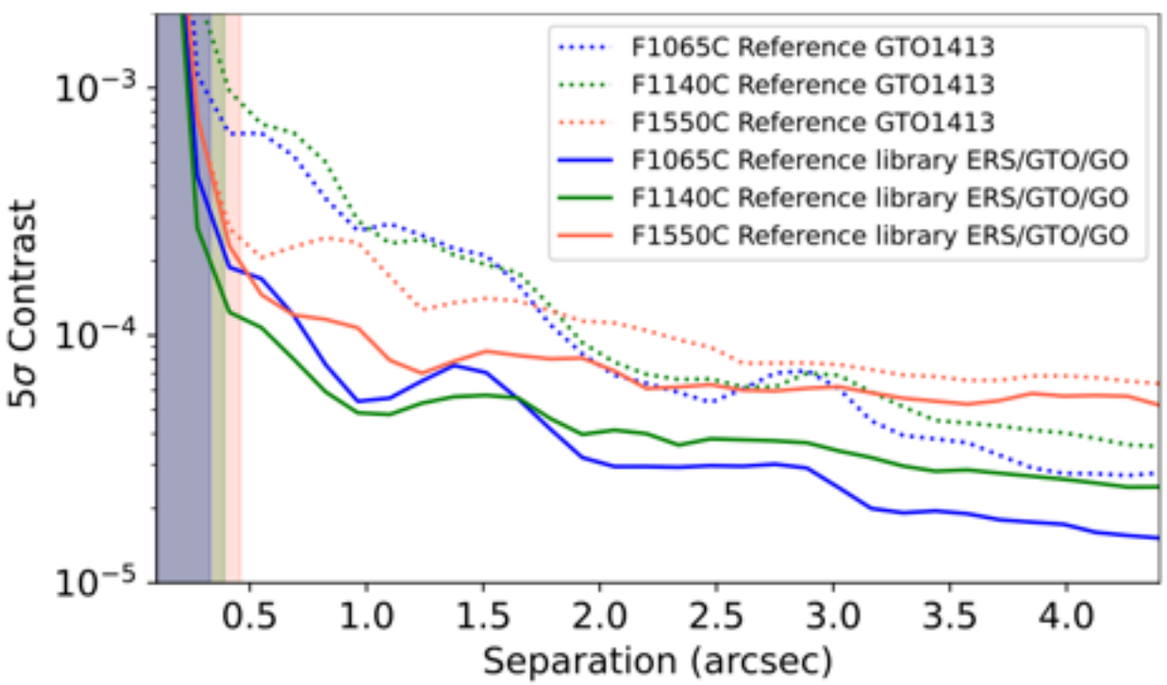
星形成ゼミ　2024.12.27—2025.1.2　花輪 知幸 2025年1月24日

- **Detection of H_2O and CO_2 in the Atmosphere of the Hot Super-Neptune WASP-166b with JWST, A.W. Mayo et al. ApJ? arXiv:2501.00609**
- **JWST-ALMA Study of a Hub-Filament System in the Nascent Phase, N.K. Bhadari et al. A&A Letters arXiv:2501.00506**
- **A Novel Survey for Young Substellar Objects with the W-band Filter. VII. Water-Bearing Objects in the Core of the Rho Ophiuchi Cloud Complex, T. Sharma et al. ApJ arXiv:2501.00433**
- **First unambiguous detection of ammonia in the atmosphere of a planetary mass companion with JWST/MIRI coronagraphs, M. Malin et al. A&A arXiv:2501.00104**
- Novel SiC UV Instrumentation Development with Potential Applications for the Habitable Worlds Observatory, P. Saxena et al. JATIS arXiv:2412.21034
- Submillimeter-wave spectroscopy of the CH_3O radical, J.-T. Spaniol The Journal of Physical Chemistry A, arXiv:2412.20990
- The RISTRETTO simulator: Exoplanet reflected spectra, M. Bugatti et al. SPIE 13096 arXiv:2412.20879
- Rotational excitation cross sections for chloronium based on a new 5D interaction potential with molecular hydrogen, S. Demes et al. Physical Chemistry A arXiv:2412.20808
- **Uncovering the hidden physical structures and protostellar activities in the Low-Metallicity S284-RE region: results from ALMA and JWST, A.R. Jadhav et al. ApJ arXiv:2412.20364**
- Timescales of Solar System Formation Based on Al-Ti Isotope Correlation by Supernova Ejecta, T. Iizuka et al. ?? arXiv:2412.20022
- **Pattern Finding in mm-Wave Spectra of Massive Young Stellar Objects, Y. Angarita A&A arXiv:2412.19934**
- **Magnetic fields on different spatial scales of the L328 cloud, S. Gupta et al. MNRaS. arXiv:2412.19701**

First unambiguous detection of ammonia in the atmosphere of a planetary mass companion with JWST/MIRI coronagraphs, M. Malin et al. A&A arXiv:2501.00104

GJ 504A 年齢不定 160^{+360}_{-60} Myr (Kuzuhara+13), 1.5 Gyr (Fuhrmann & Chini 15), D'Orazi+1.74 Gyr, [M/H] ≈ + 0.6 GJ 504b, ≈ + 0.1 to 0.3 GJ 504A



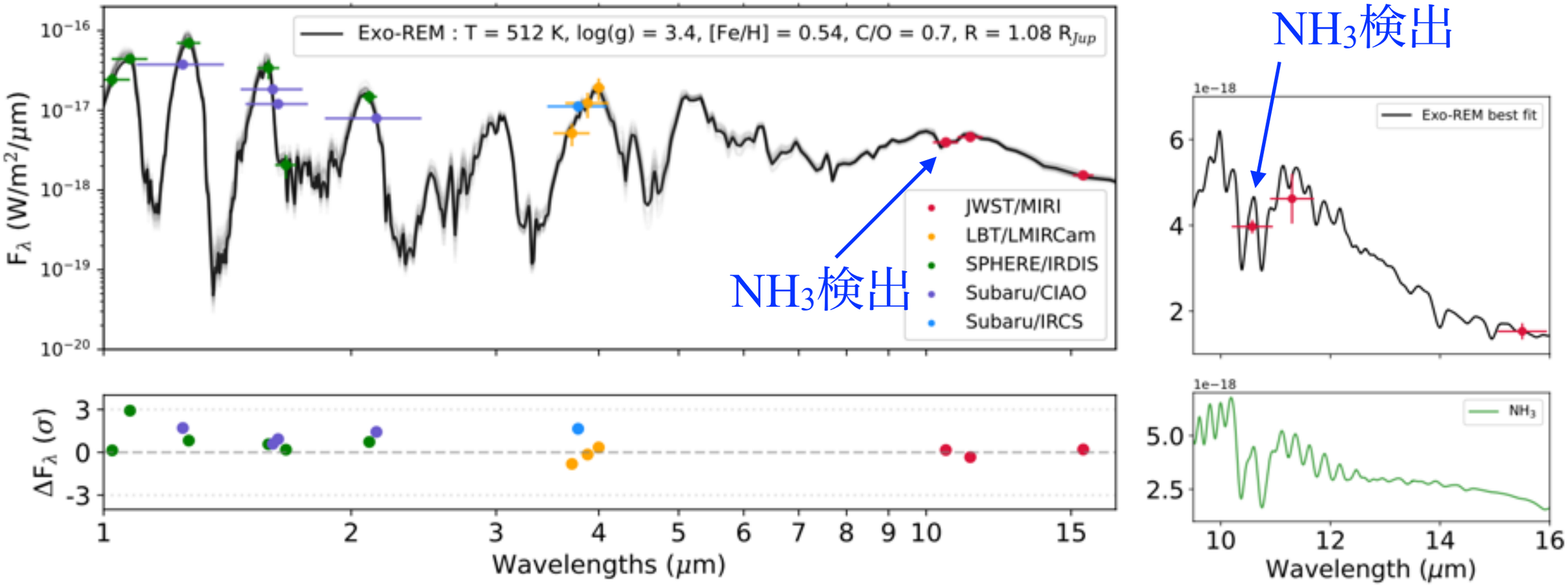


JWST

Parameters	NIR only	NIR and MIR
T_{eff} (K)	509^{+13}_{-20}	512^{+10}_{-10}
logg	$3.42^{+0.41}_{-0.27}$	$3.45^{+0.35}_{-0.25}$
Metallicity	$0.52^{+0.11}_{-0.12}$	$0.54^{+0.09}_{-0.11}$
C/O	$0.70^{+0.06}_{-0.07}$	$0.70^{+0.06}_{-0.07}$
Radius (R_{Jup})	$1.13^{+0.16}_{-0.14}$	$1.08^{+0.04}_{-0.03}$
Luminosity log($L/L_\odot$)	$-6.09^{+0.07}_{-0.07}$	$-6.12^{+0.02}_{-0.02}$
Mass (M_{Jup})	$1.3^{+1.8}_{-0.5}$	$1.0^{+1.8}_{-0.3}$

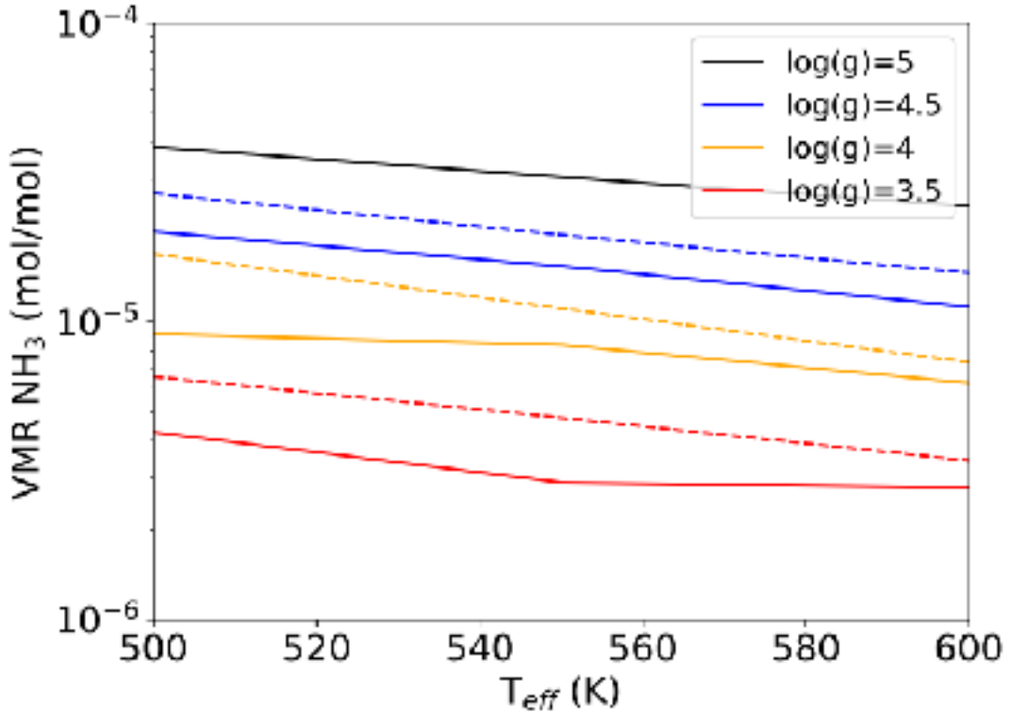
誤差が改善

T type



volume mixing ratio (VMR)
体積(分子数)でのabundance

(本文では値を書き間違い)



半径と光度はよく決まったが、
質量の不定性は残っている。

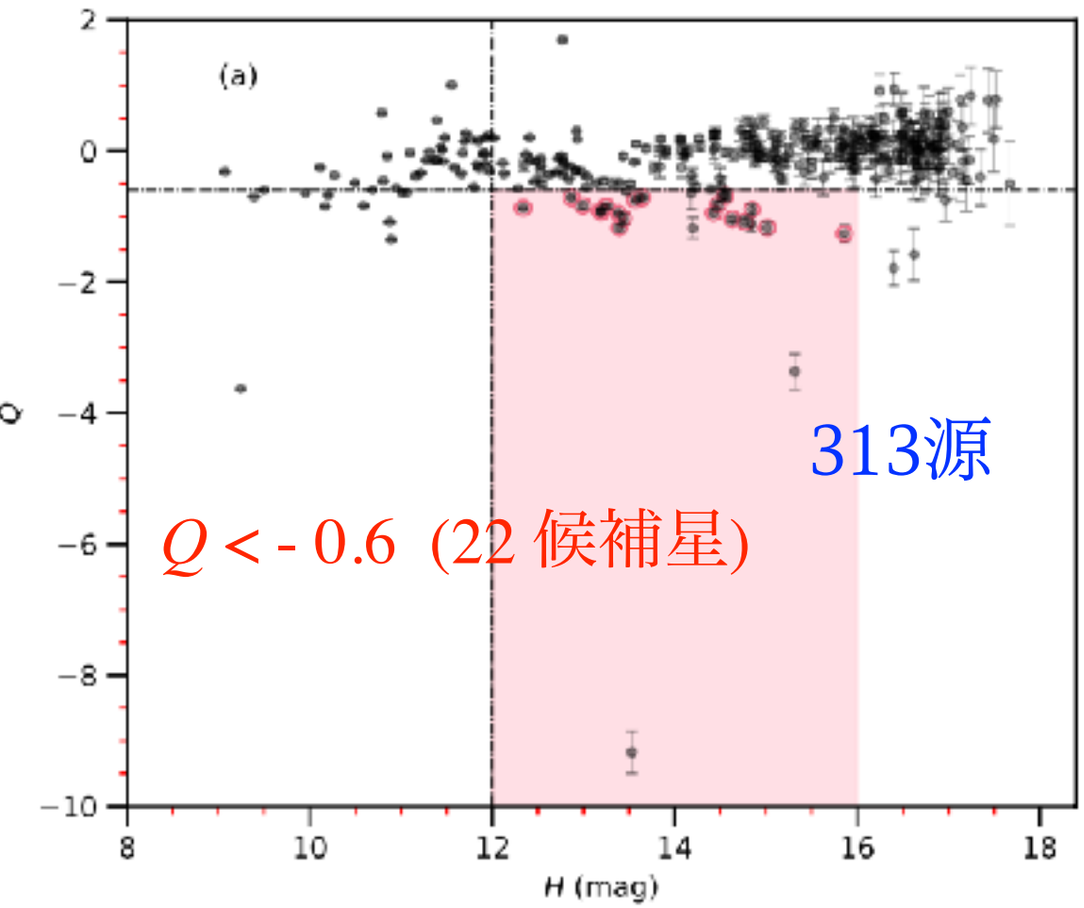
A Novel Survey for Young Substellar Objects with the W-band Filter. VII. Water-Bearing Objects in the Core of the Rho Ophiuchi Cloud Complex, T. Sharma et al. ApJ arXiv:2501.00433

J (1.25 μm), *H* (1.65 μm), *W* (1.45 μm) = 水の吸収帯 Aller & Liu (2020)

褐色矮星探し

$$Q = J - W + e(H - W),$$

$$e = (A_J - A_W)/(A_W - A_H). = 1.85$$



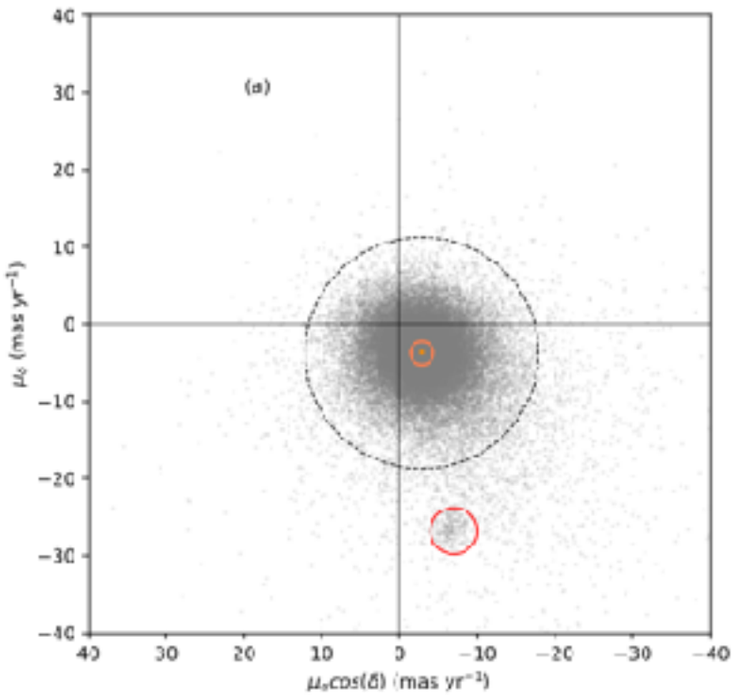
CFHT 3.6 m

J, *H* 80 sec, *W* 520 s

Serpens South, Serpens Core, Perseus, σ Orionis で実施済み

過去のサーベイデータから固有運動，SED を確認（1つ巨星）

8星は赤外線スペクトルも取得 $\lambda/\Delta\lambda = 700$



アクリーションの兆候 (Pa β, Br γ) や赤外超過のないものも見つかる。20候補星は M6 から L4.

Detection of H_2O and CO_2 in the Atmosphere of the Hot Super-Neptune WASP-166b with JWST, A.W. Mayo et al. ApJ? arXiv:2501.00609

これまでに観測された hot Neptune 大気

HAT-P-11b (NH_3, H_2O, CH_4, CO_2), WASP-107b (NH_3, CH_4, SO_2, CO, CO_2, H_2O, cloud deck), LTT 9779b (featureless, cloud deck)

WASP-166 F型星, $1.19 \pm 0.06\ M_\odot$, $1.22\ R_\odot$, 6050 K, $J \sim 8.35$ mag

WASP-166b: $P = 5.44$ d, $R_p = 6.9 \pm 0.3\ R_\oplus$, $M_p = 32.1 \pm 1.6\ M_\oplus$

地上(光学)観測で Na, H_2O (tentative) 検出, 母星の自転は $\lambda = -15.52^{+2.85}_{-2.76}$ degrees

Grism 中解像度 Single object slitless spectroscopy

NIRSpec G395 M with NIRISS SOSS での近赤外での初透過光観測

$R = \lambda/\Delta\lambda \sim 1000$ 解析手法についても詳しく記載（全体で42頁）

JWST Pipeline Stage 1: Detector-level processing
Eureka! Stage 2: Spectroscopic processing
Eureka! Stage 3: Spectral extraction
Eureka! Stage 4: Spectroscopic light curves
Eureka! Stage 5: Light curve fitting
Eureka! Stage 6: Transmission spectrum

Median Absolute Deviation ~ 200 ppm

基本的に forward modeling
各種の惑星大気モデル

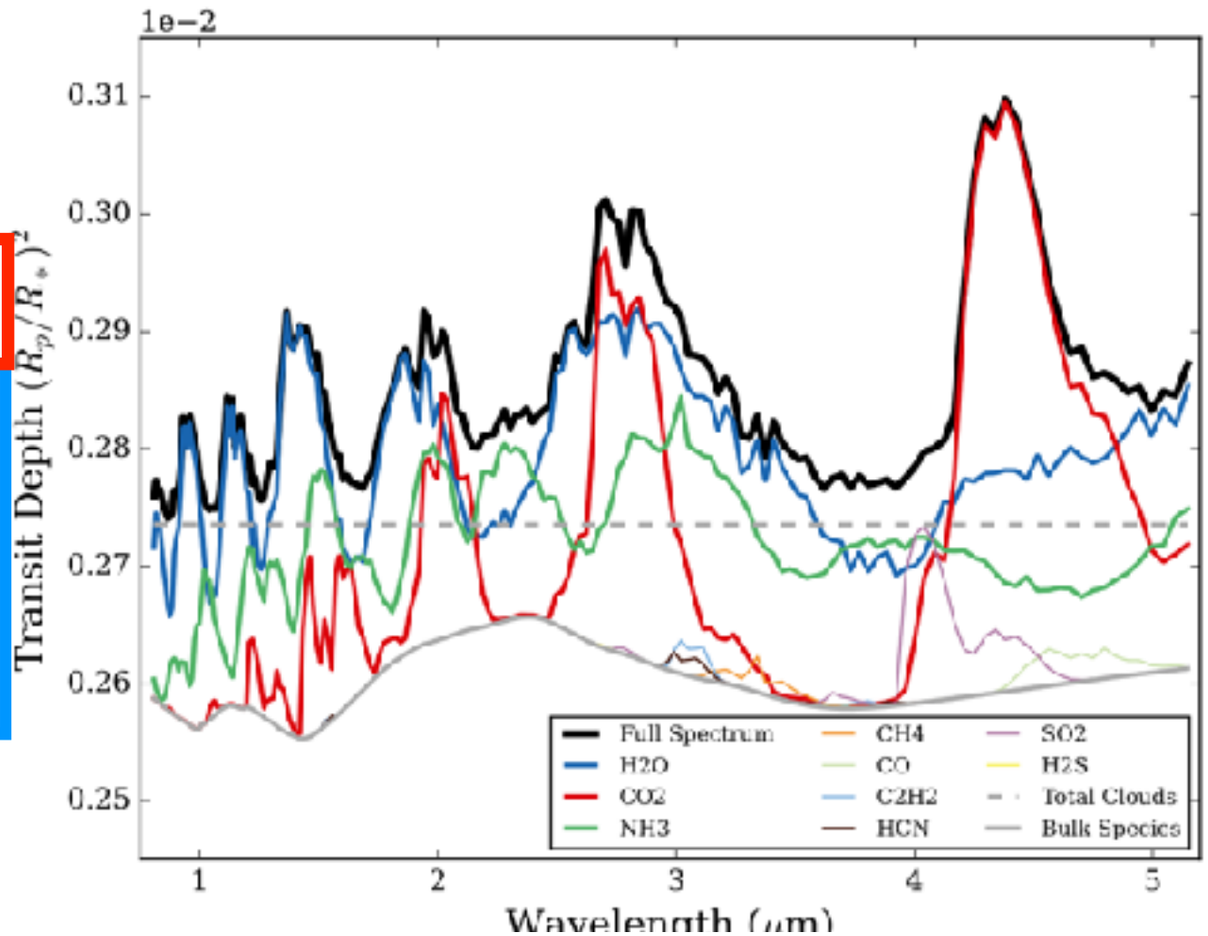
SOSS でも同様の解析

Table 5. Free Parameter Posteriors from POSEIDON Reference Retrieval

Parameter	POSEIDON Symbol	Units	Value
Planet reference radius[a]	R_p_ref	R_J	$0.60^{+0.01}_{-0.01}$
Planet mass	M_p	M_J	$0.101^{+0.005}_{-0.005}$
Planet isothermal temperature	T	K	772^{+166}
X_{H2O}[b]	log_H2O	-	$-1.30^{+0.21}_{-0.23}$
X_{CO2}	log_CO2	-	$-2.23^{+0.31}_{-0.37}$
X_{CH4}	log_CH4	-	$-7.93^{+1.34}_{-1.37}$
X_{CO}	log_CO	-	$-6.36^{+2.35}_{-2.40}$
X_{C2H2}	log_C2H2	-	$-7.81^{+1.53}_{-1.44}$
X_{HCN}	log_HCN	-	$-7.72^{+1.59}_{-1.52}$
X_{NH3}	log_NH3	-	$-4.00^{+0.33}_{-0.79}$
X_{SO2}	log_SO2	-	$-5.69^{+1.37}_{-2.77}$
X_{H2S}	log_H2S	-	$-7.27^{+1.96}_{-1.82}$
$\log_{10}(P_{cloud})$	log_P_clouds	$\log_{10}$(bar)	$-2.31^{+0.67}_{-0.74}$
Instrumental offset	δ_{rel}	ppm	$14.4^{+10.7}_{-8.9}$

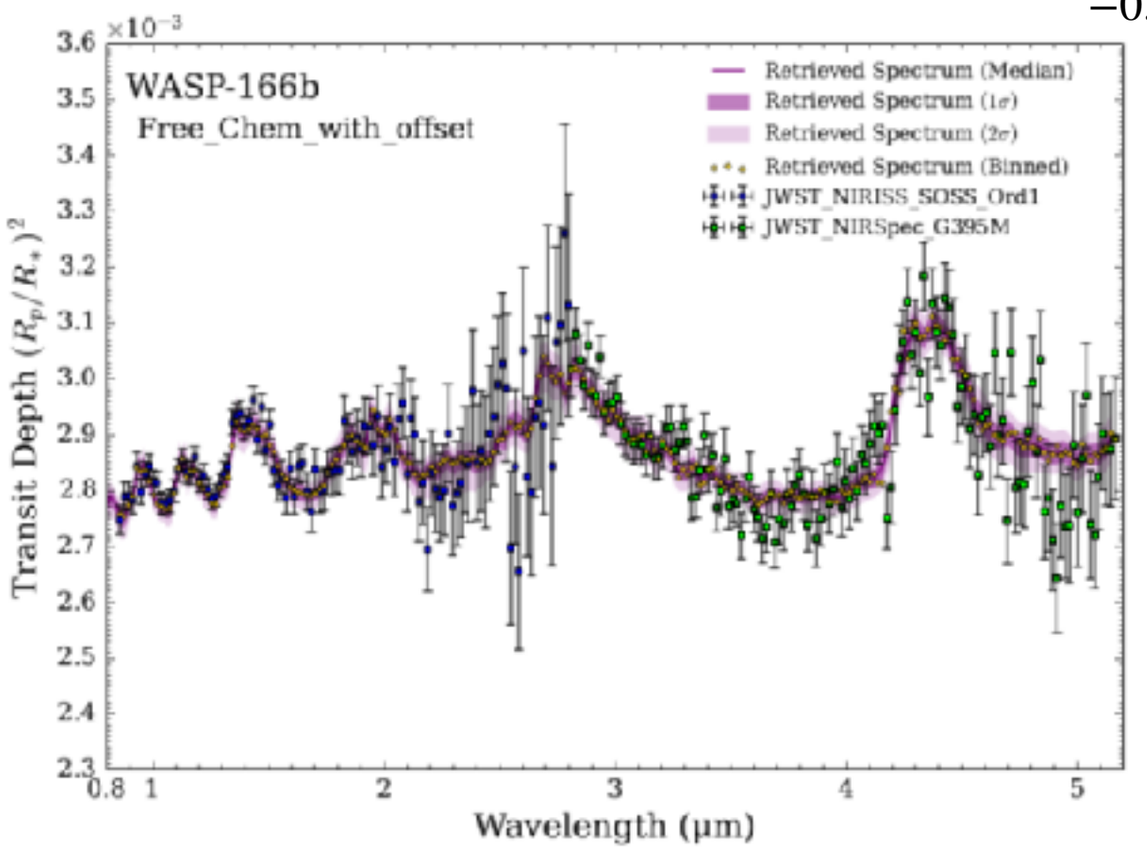
検出

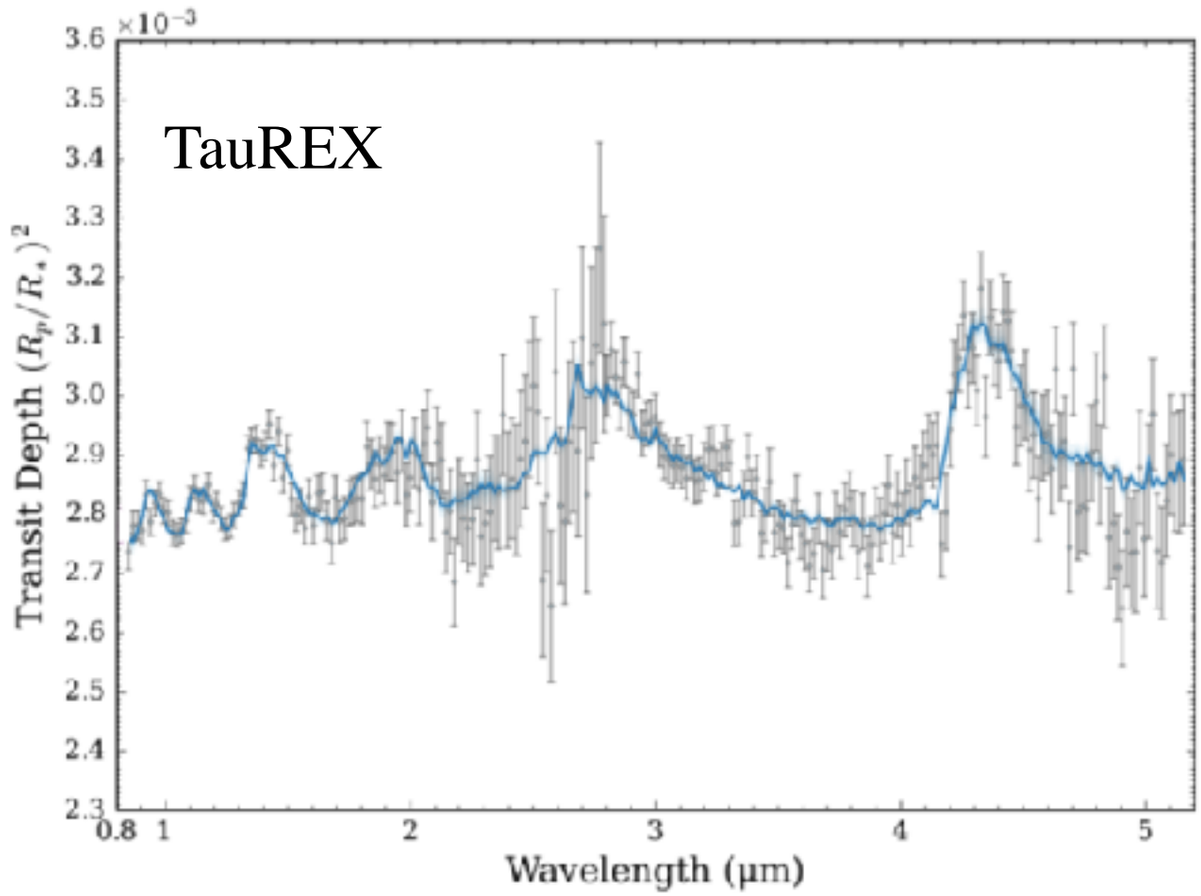
非検出



H_2O, CO_2, CH_4, CO, C_2H_2, NH_3, SO_2, H_2S

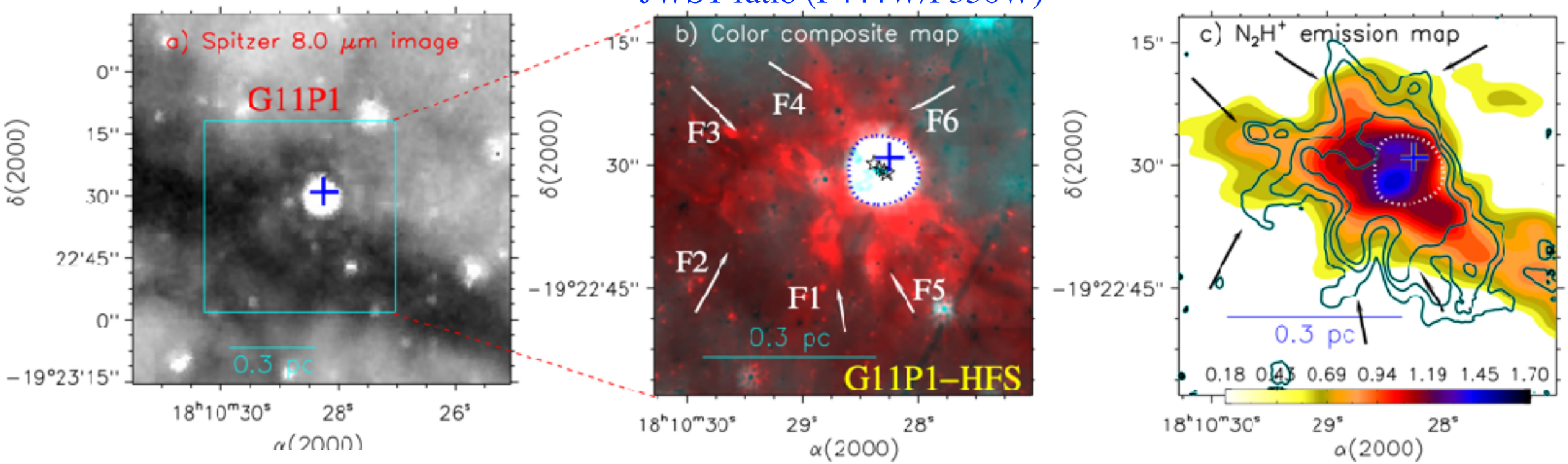
$$C/O = 0.282^{+0.078}_{-0.053}$$

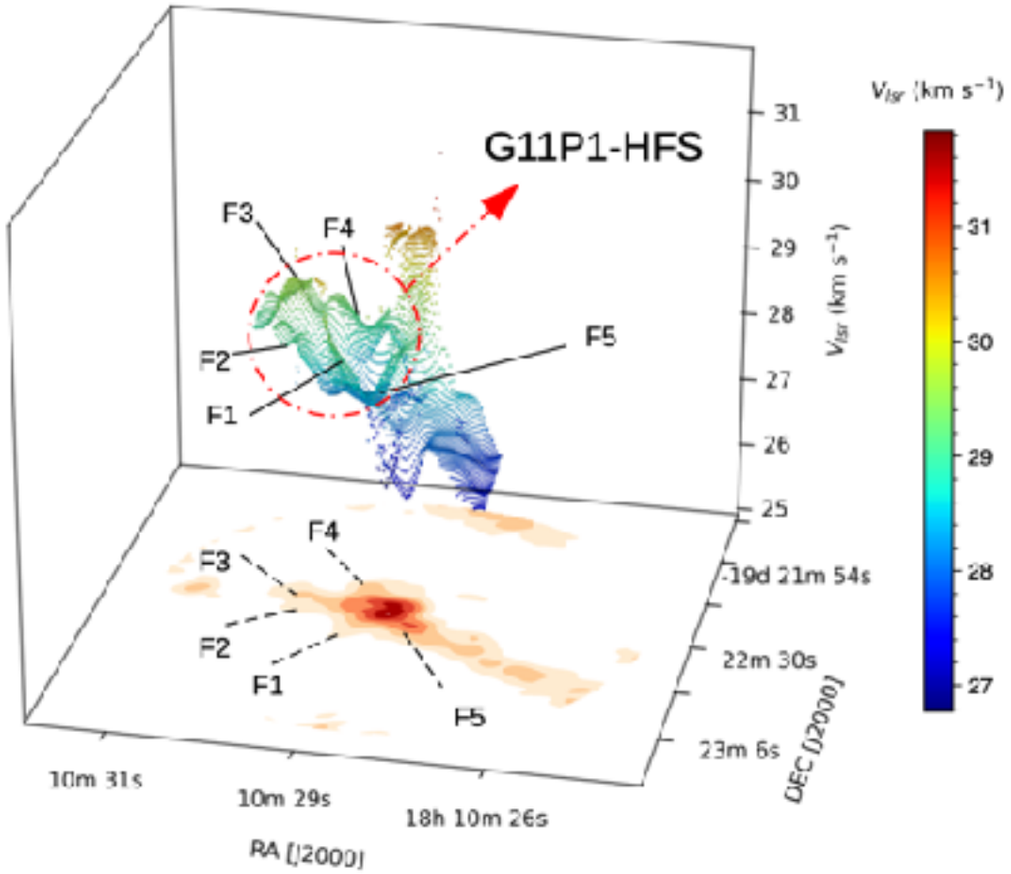


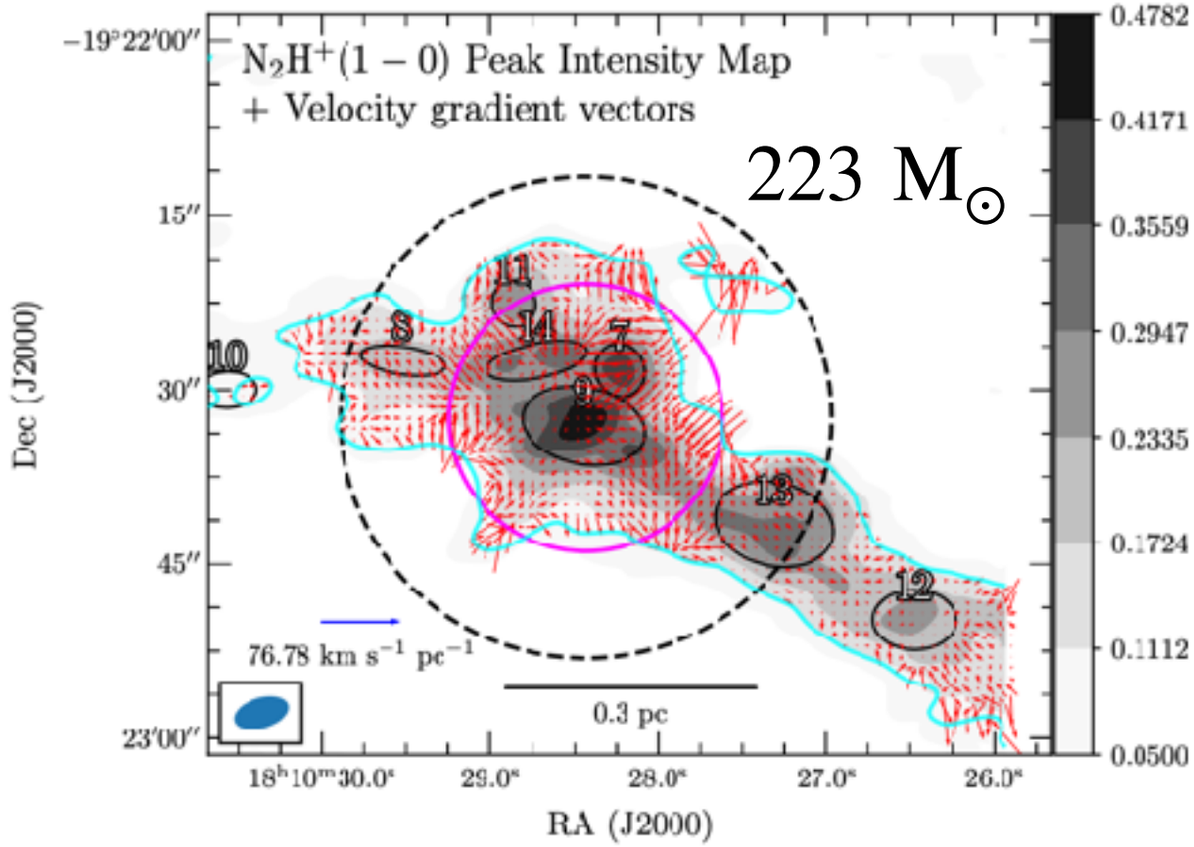


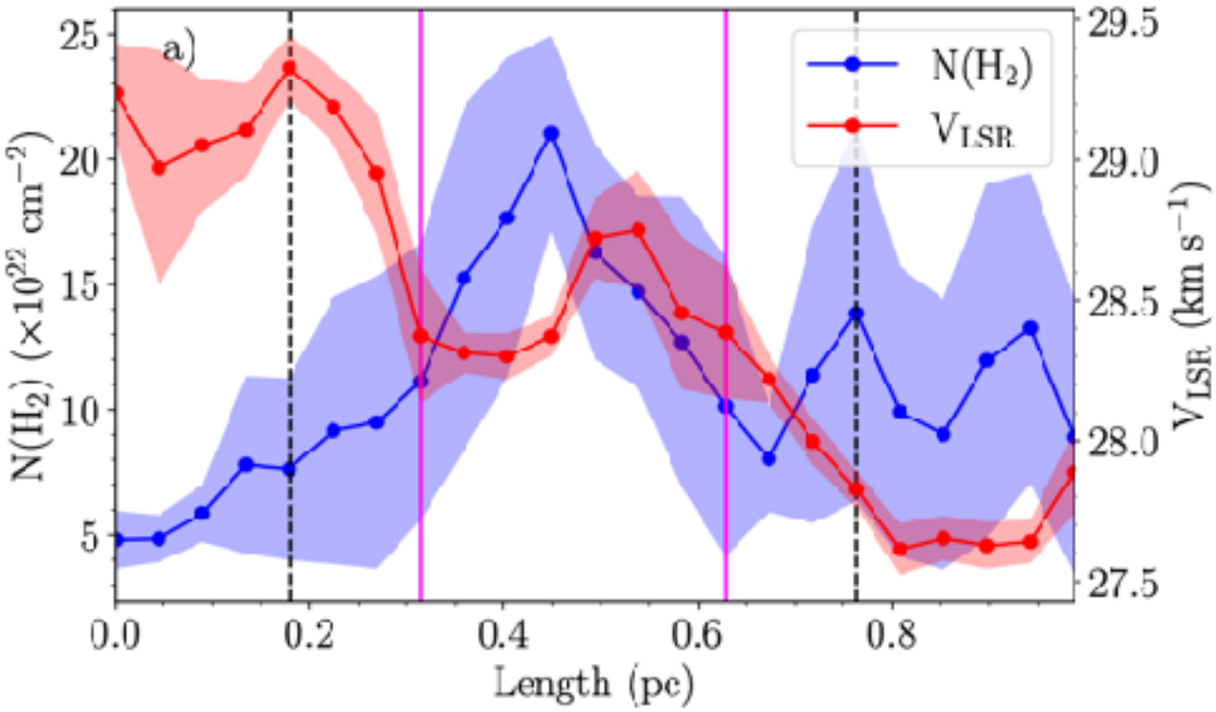
JWST-ALMA Study of a Hub-Filament System in the Nascent Phase, N.K. Bhadari et al. A&A Letters arXiv:2501.00506

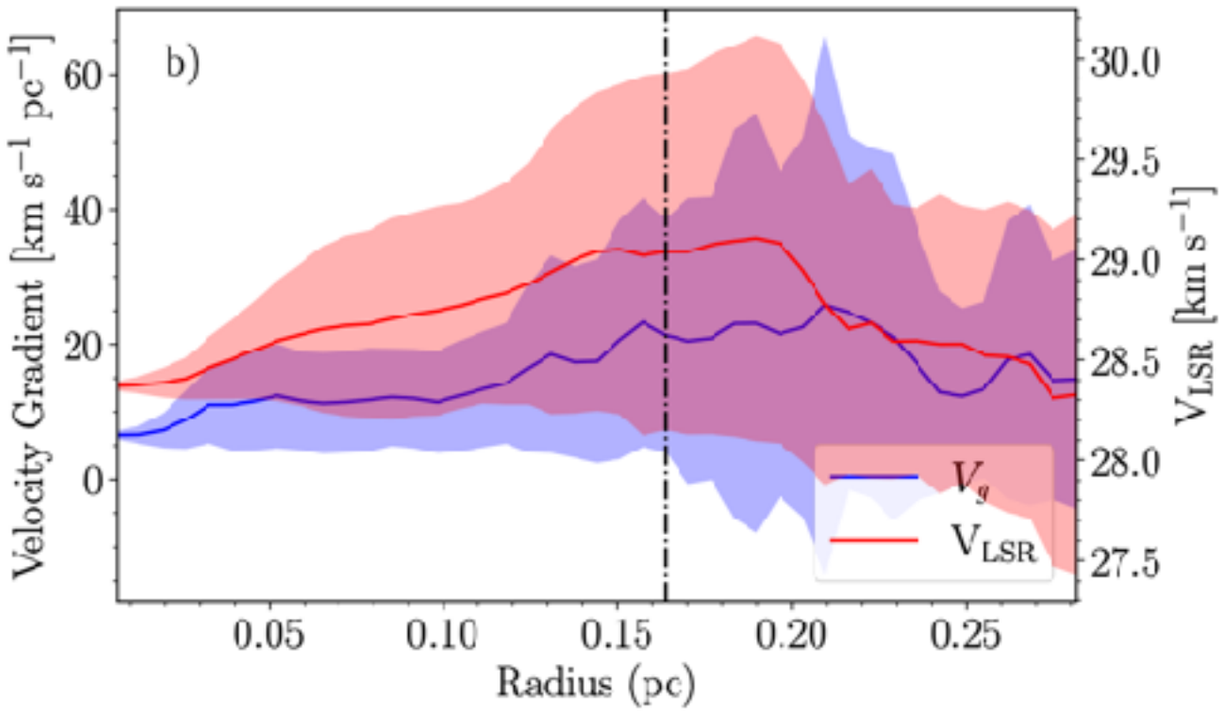
JWST ratio (F444W/F356W)











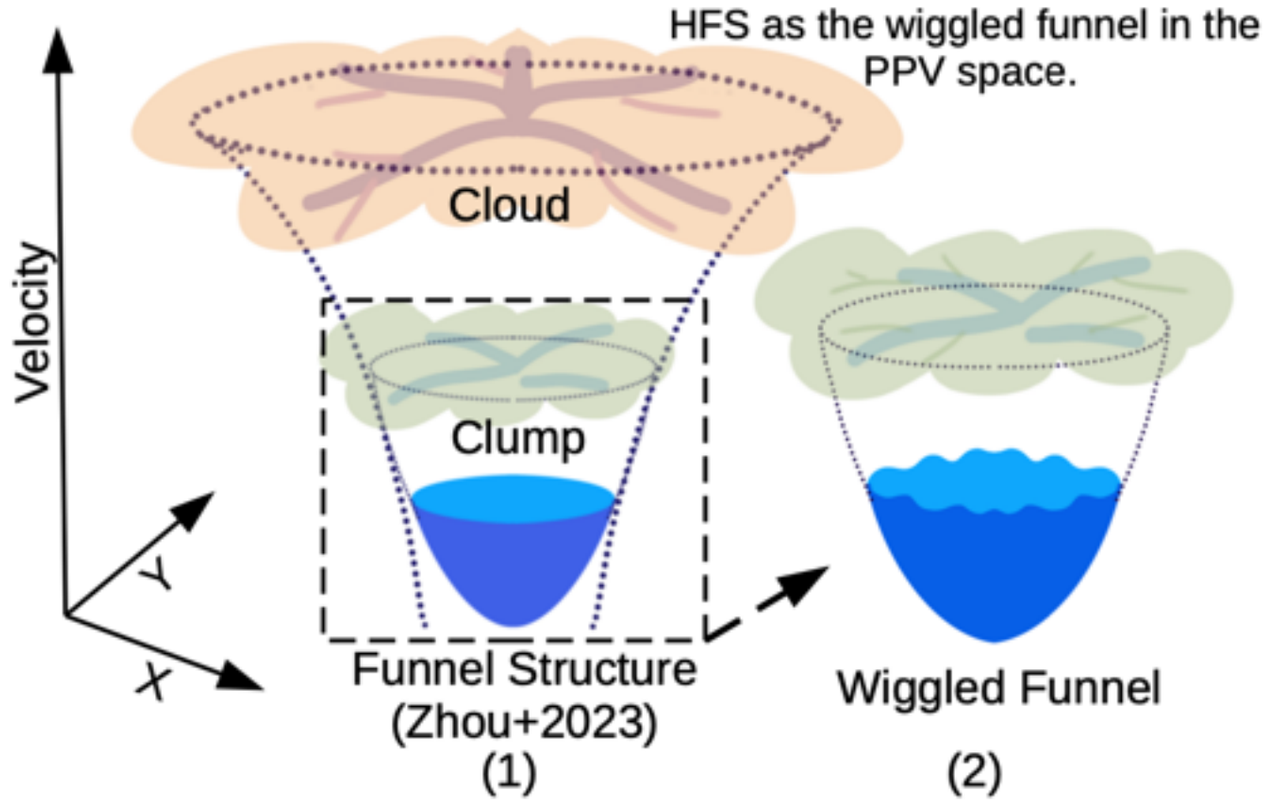


Fig. 5: Schematic diagram of hierarchical HFSs in *PPV* space as a funnel structure: (1) discussed by Zhou et al. (2023), (2) wiggled funnel, revealing the role of sub-filaments.

重力は $N(H_2)$から求めた

重力によりフィラメントに沿って落下している。

Pattern Finding in mm-Wave Spectra of Massive Young Stellar Objects, Y. Angarita A&A arXiv:2412.19934

下処理

LSR を揃える

H_2CO強度で規格化

Principal component analysis

(PCA)

Locally linear embedding

(LLE)

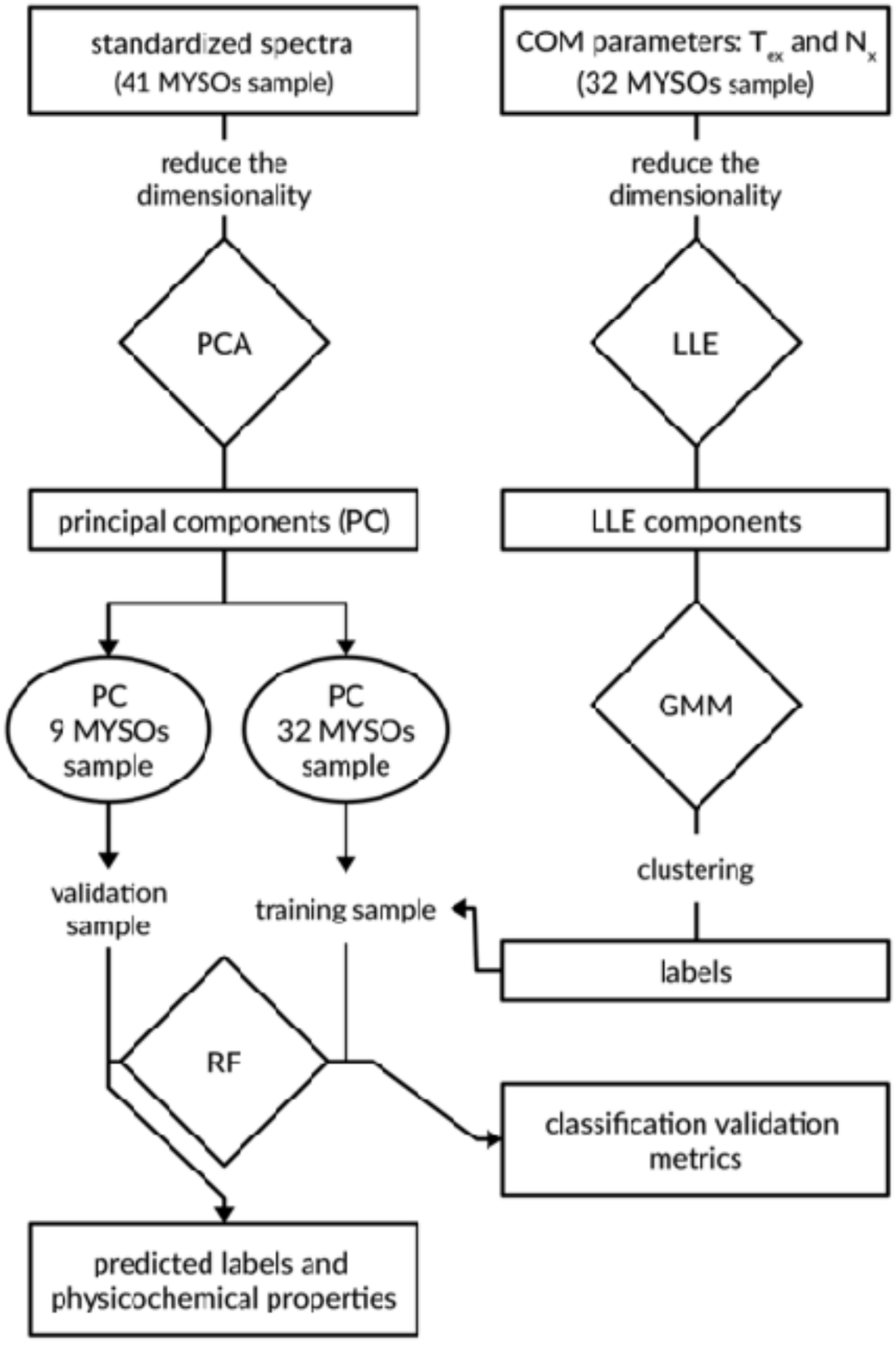
Gaussian mixture models

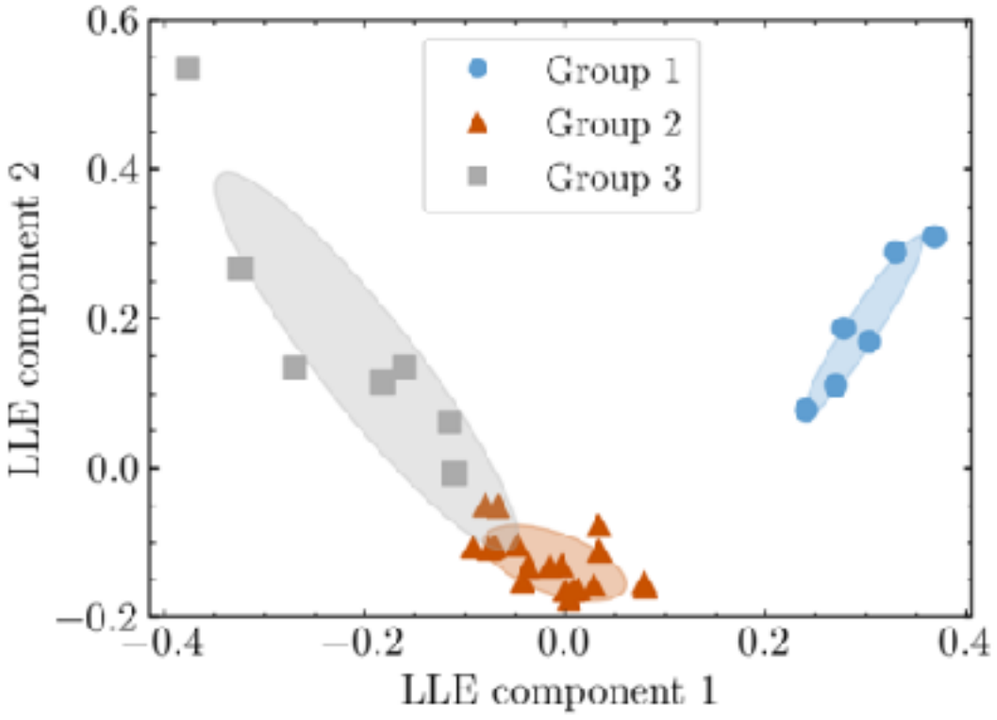
(GMM)

T_{ex}, N などを陽に使わない

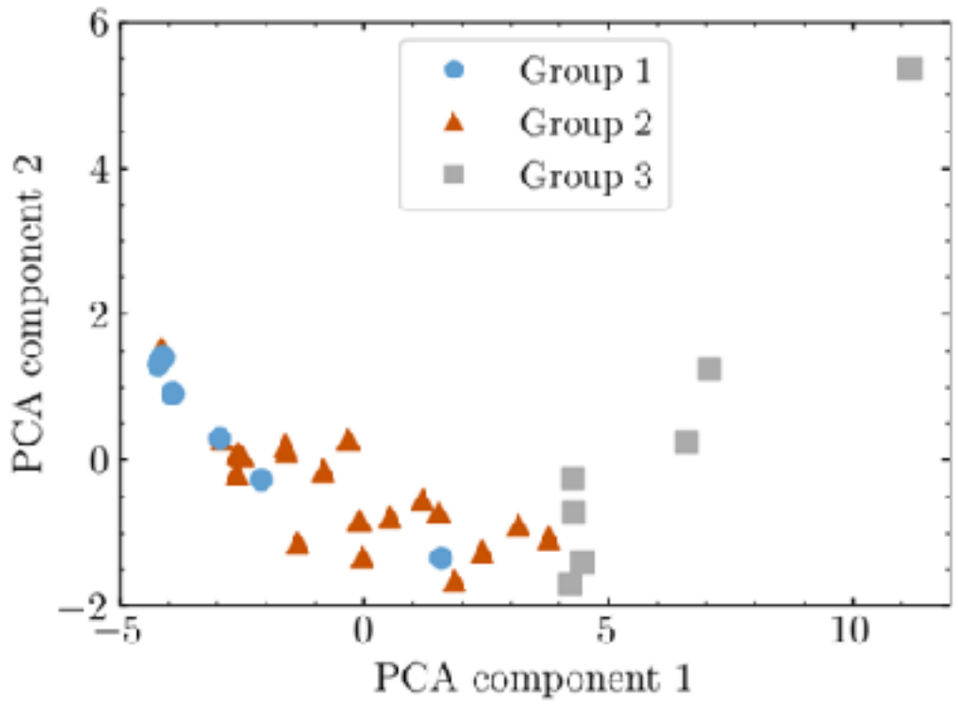
（客観かつ定量的な解析）

機械学習





Group 1 sources (cold, COM-poor)



Group 2 (warm, medium-COM-abundance)

Group 3 (warm-to-hot, COM-rich)

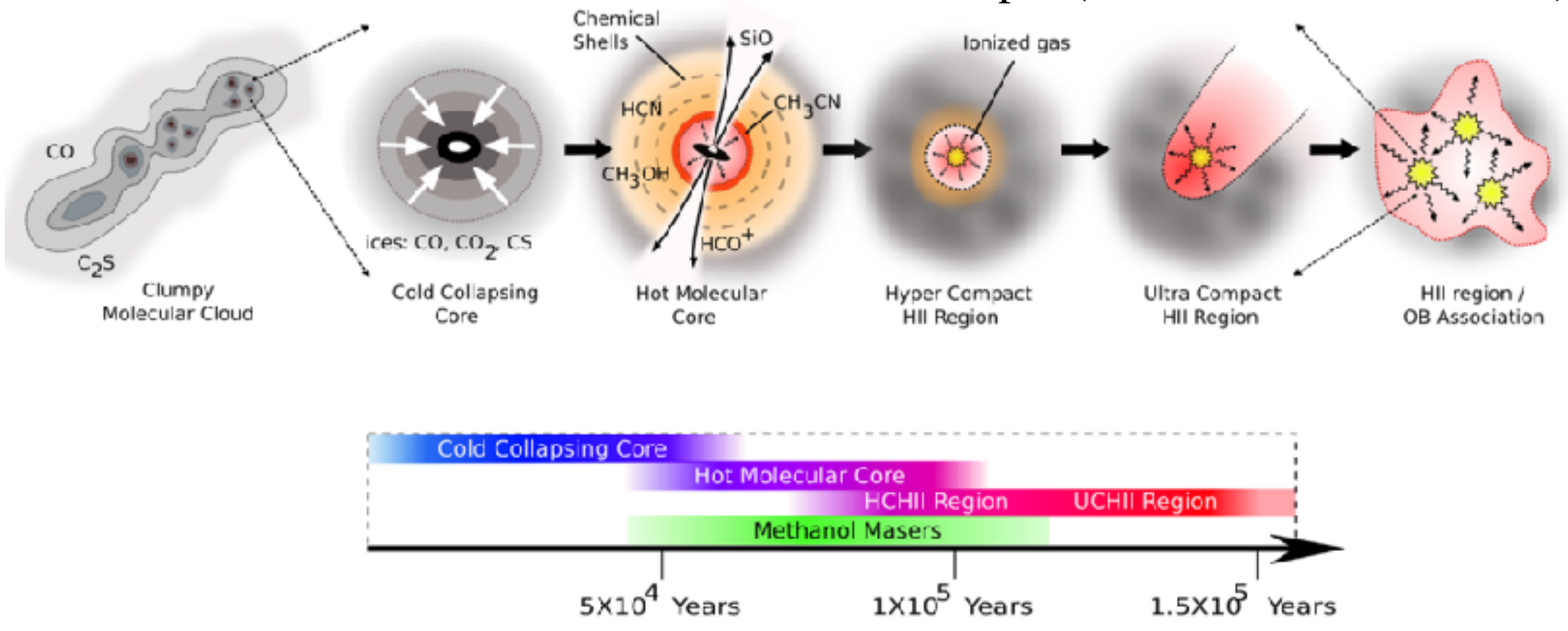


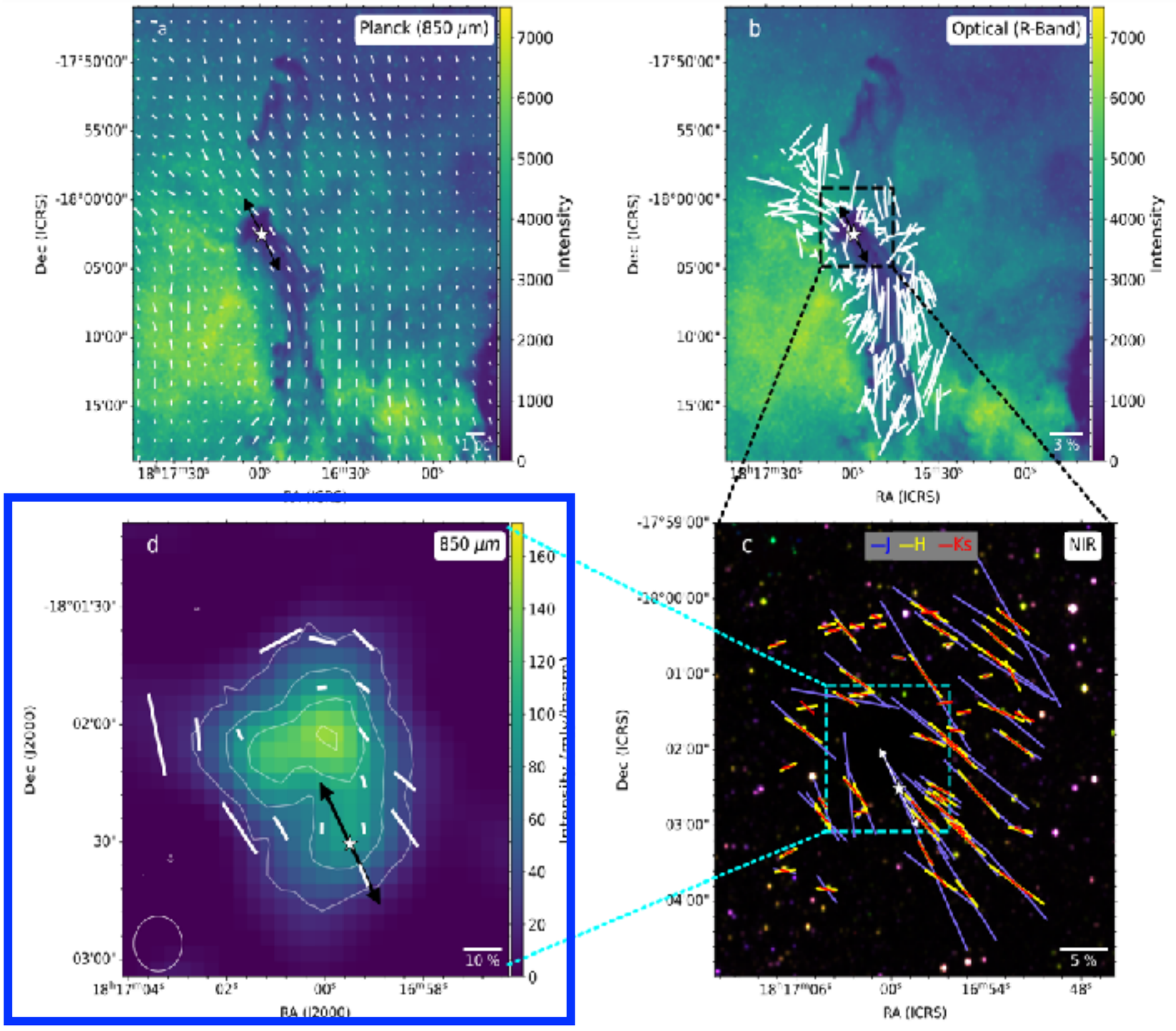
Fig. 1: Evolutionary stages of high-mass star formation. Cartoon credit: Dr. Cormac R. Purcell.

Magnetic fields on different spatial scales of the L328 cloud, S. Gupta et al. MNRaS arXiv:2412.19701

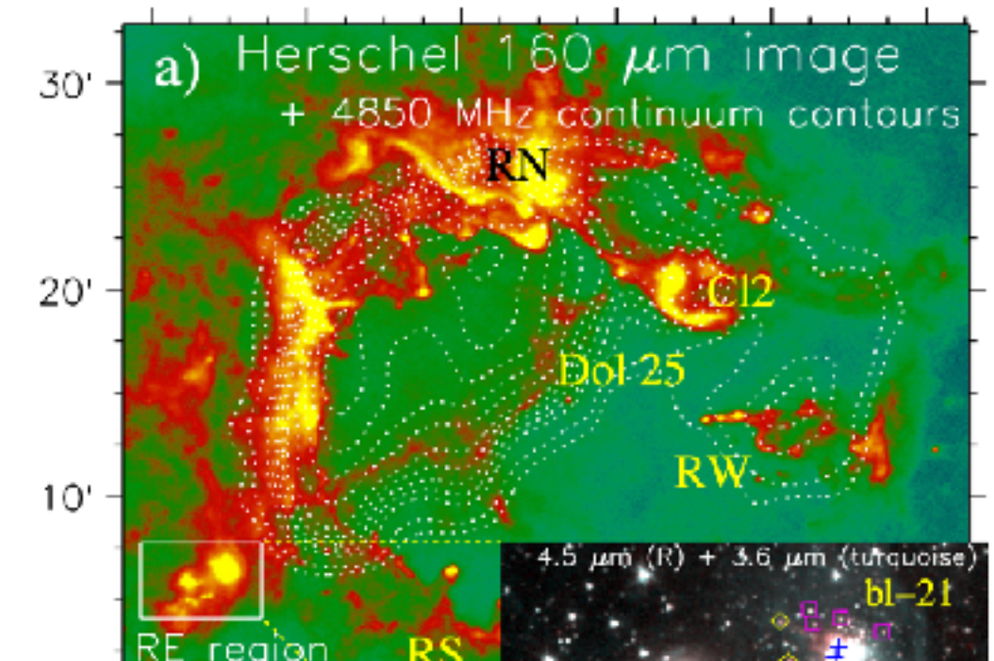
$B = 50.5 \pm 9.8\ \mu$G

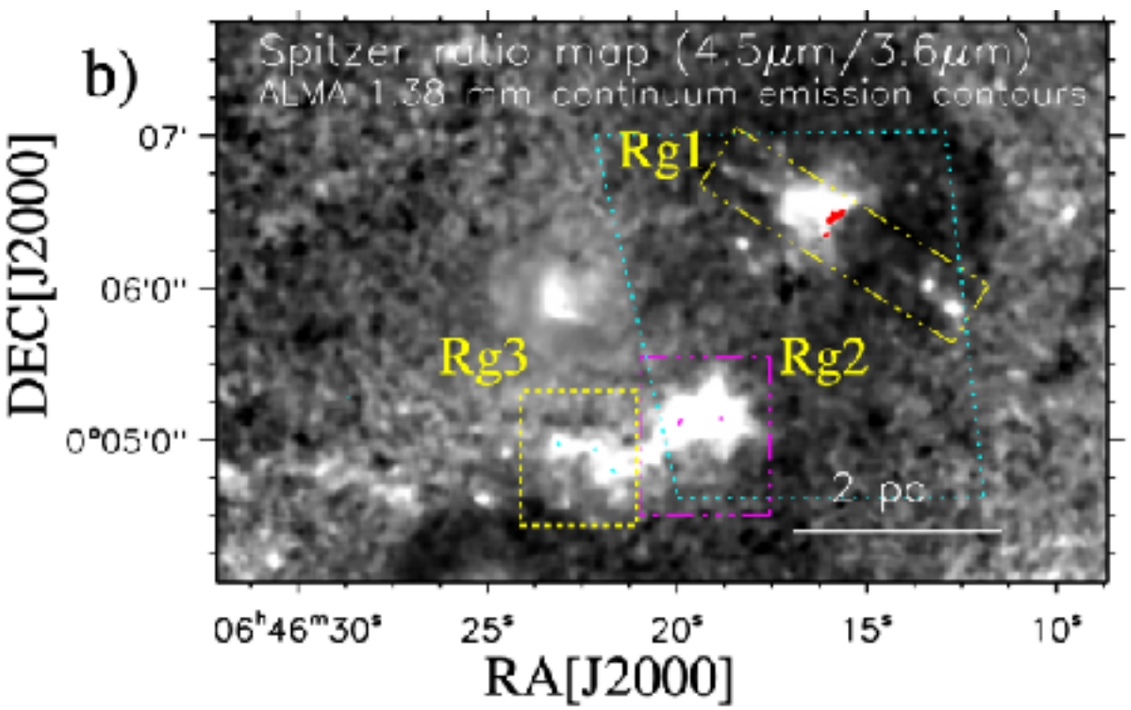
SCUBA-2/POL-2 at 850 μm in 2018 March (M18AP033; PI: Archana Soam) and in 2019 May and June (M19AP014; PI: Chang Won Lee)

JCMT



Uncovering the hidden physical structures and protostellar activities in the Low-Metallicity S284-RE region: results from ALMA and JWST, A.R. Jadhav et al. ApJ arXiv:2412.20364





HII region