GOALS-JWST: Pulling Back the Curtain on the AGN and Star Formation in VV 114

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We present results from the James Webb Space Telescope (*JWST*) Director's Discretionary Time Early Release Science (ERS) program 1328 targeting the nearby, Luminous Infrared Galaxy (LIRG), VV 114. We use the MIRI and NIRSpec instruments to obtain integral-field spectroscopy of the heavily obscured Eastern nucleus (V114E) and surrounding regions. The spatially resolved, high-resolution, spectra reveal the physical conditions in the gas and dust over a projected area of 2-3 kpc that includes the two brightest IR sources, the NE and SW cores. Our observations show for the first time spectroscopic evidence that the SW core hosts an AGN as evidenced by its very low 6.2μm and 3.3μm PAH equivalent widths (0.12 and 0.017 μm respectively) and mid and near-IR colors. Our observations of the NE core show signs of deeply embedded star formation including absorption features due to aliphatic hydrocarbons, large quantities of amorphous silicates, as well as HCN due to cool gas along the line of sight. We detect elevated [Fe II]/Pfα consistent with extended shocks coincident with enhanced emission from warm H_2, far from the IR-bright cores and clumps. We also identify broadening and multiple kinematic components in both H_2 and fine structure lines caused by outflows and previously identified tidal features.

VV114 ($L_{IR} \sim 4.5 \times 10^{11} L_{\odot}$)

- 短い波長に支配的なVV114W
- IR emissionに支配的なVV114E
  - ALMA
    - 豊富なcold, dense gas
    - overlap regionのshocked gas
    - molecular outflow
    - possible buried AGN

→ UV/optical で暗く、IRで明るい
high-z IR luminous mergerのanalog

JWST/MIRI, NIRSpecのIFS

- VV114Eの特にNE & SW corsと
  その周辺の空間分解した性質
- Evans+2022: MIRI imaging
  - NE: Starburst
    (以前はAGNと思われていた)
  - SW: AGN

→ IR分光によって、
SB, AGN, shockなどを探る

SW core → AGN

- Low PAH 3.3um & 6.2um EQW
  → Seyfert2 LIRGsのM273と類似
  (隣のaperture dも影響を受けて近い値)
- Strong 3-5um continuum
  → flux density ratio vs EW図でAGNと分類

NE core → Embedded SB

- 強い9.7umのsilicate吸収、結晶性silicate、
  脂肪族炭化水素、HCN吸収
- 今回のデータからはAGNの兆候なし
  - Arp220と近いEQW vs EQW図上の位置
- 6.2um EWが低いが、compact powerful SBである
  II Zw 96なども同様の傾向
  → 6.2um EQWが下がるようなダスト加熱？

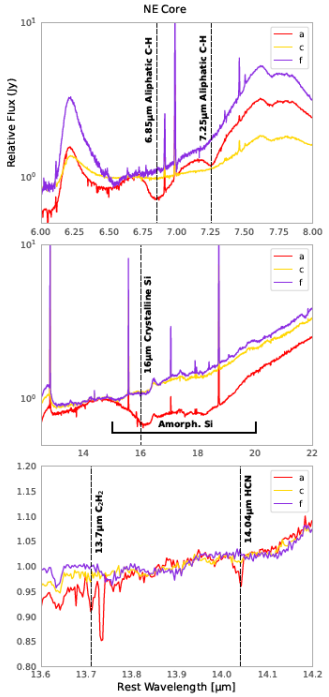
NW diffuse gas (f, g, h, i) → Shocked

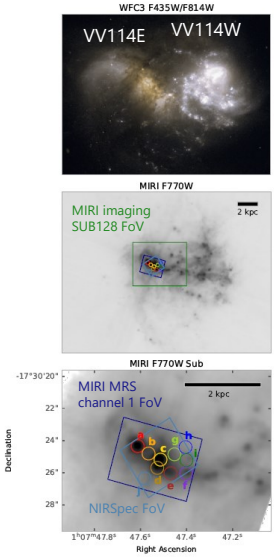
- 高い[FeII]/Pfα
- H2輝線のFWHMが大きい

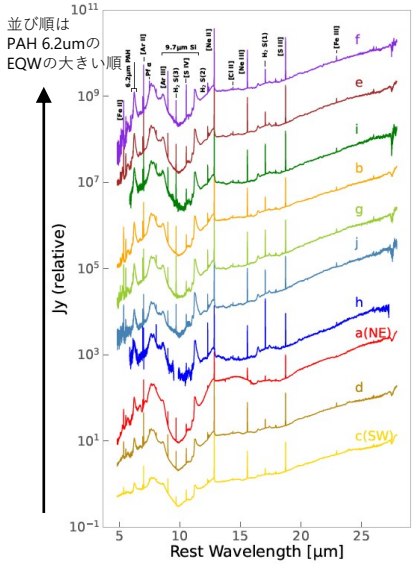
→ Shock = Saito+2017, 2018のALMA観測で示唆された
overlap regionと一致する

Tidal arm (j)

- [NeII]のblue-, red-shifted wing
- [FeII]/Pfα ~ 9 → Tidal featureでもshocked gas

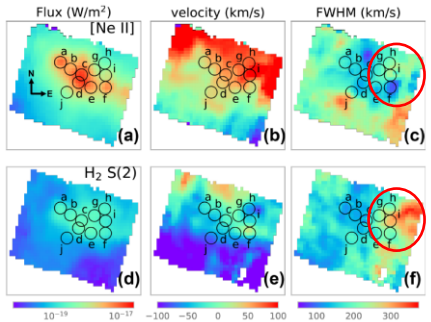


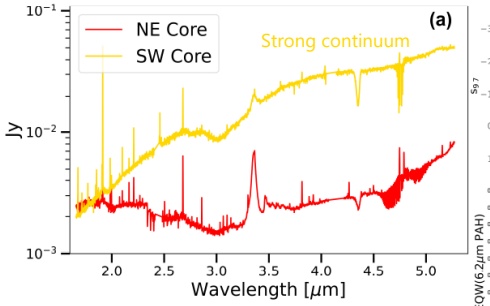


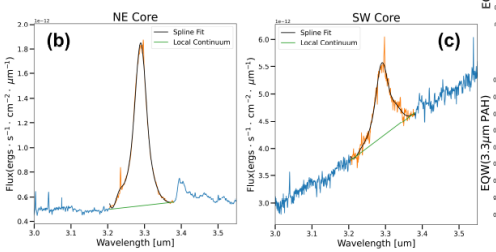
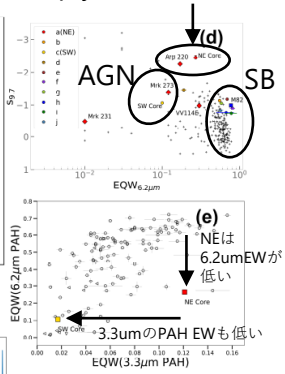
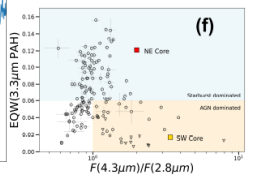


Region ID	$EQW_{3.3}$	$EQW_{6.2}$	$s_{9.7}$	[Fe II] 5.34	FWHM	Pfα	FWHM
a (NE Core)	0.121±0.001	0.264±0.018	-2.45±0.03	7.41±0.22	194±13	1.56±0.62	142±37
b		0.514±0.017	-1.13±0.03	11.6±0.29	186±12	2.83±0.58	148±21
c (SW Core)	0.017±0.001	0.106±0.002	-1.06±0.01	7.49±0.40	178±14	4.76±0.92	154±20
d (directly SE of SW core)		0.199±0.015	-1.44±0.02	9.87±0.38	166±13	4.92±0.88	135±18
e		0.652±0.015	-1.17±0.04	7.64±0.19	185±12	2.23±0.37	152±18
f (Deeply embedded star cluster)		0.720±0.062	-0.90±0.04	3.09±0.13	153±13	2.55±0.37	120±13
g		0.491±0.036	-1.05±0.02	5.03±0.20	221±14	0.79±0.16	192±25
h		0.34±0.17	-0.75±0.04	2.32±0.57	147±29	0.24±0.17	160±73
i		0.56±0.14	-0.73±0.05	2.78±0.39	231±26	1.08±0.36	224±44
j		0.359±0.045	-0.82±0.01	2.30±0.14	270±17	0.24±0.07	243±43

Values of the 3.3 and 6.2μm EQW, 9.7μm silicate strength, as well as line fluxes (10^{-18} W/m^{-2}) and FWHM (km s^{-1}, corrected for instrumental broadening) for emission line features measured in our extracted regions that were used in our analysis and discussion. This table is a subset of the total measurements, a machine readable version of the full table is available online.







Deeply embedded SB