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AKARI OBSERVATIONS FOR EIGHT DENSE MOLECULAR CORES

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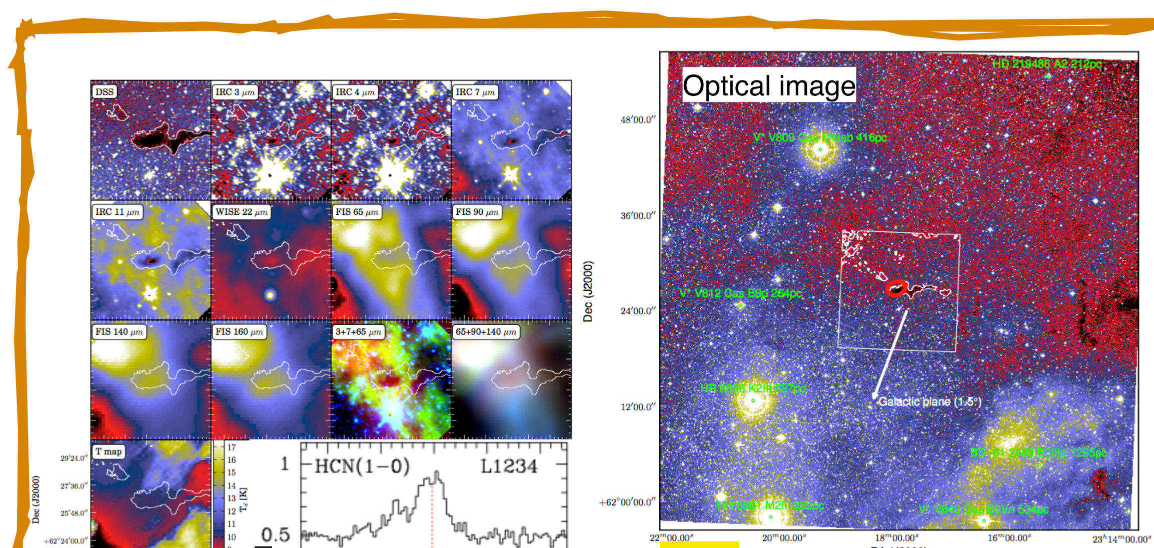
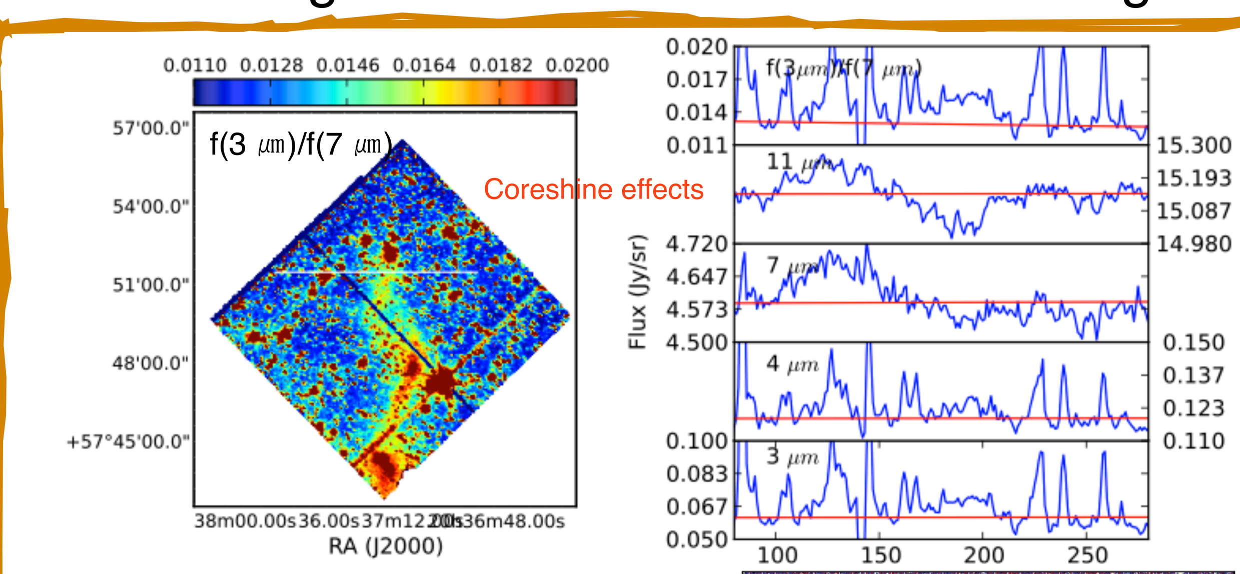
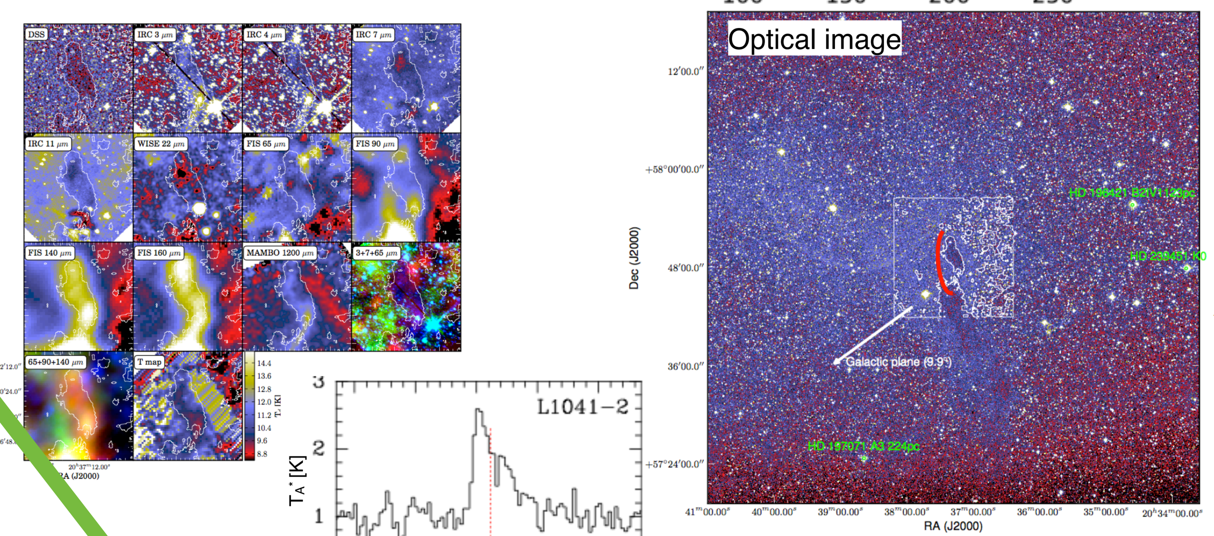
We present results of infrared observations toward eight dense molecular cores with the AKARI space telescope at eight bands (3, 4, 7, 11, 65, 90, 140, and 160 micrometers). These cores were previously known to be starless, and show characteristic features in their molecular lines such as a broad line width and/or asymmetric line shapes indicative of inward motions. With complementary IR data from WISE Space Telescope and our ground-based radio observations in N_2H^+ and HCN 1-0 lines, two of eight cores are found to harbor faint protostars and thus no longer starless. At least two new protostars having a bolometric luminosity of 0.3 -1.8 L_{sun} are identified in regions of L1582A and L1041-2, and seem to force the environment of the cores more turbulent than other starless cores, explaining the very broad N_2H^+ line widths (0.51 and 0.38 km/s) shown in L1582A and L1041-2, respectively. On the other hand, others are confirmed to be starless and may be at the moment of changing their dynamically stable to unstable status. Their far-infrared images at over 65 micron indicate that all these cores seem to be externally affected by nearby stars or Galactic interstellar radiation fields and to begin to expand or oscillate which may lead to trigger the inward motions in the cores for resulting in eventual star formation. We find interesting core-shine effects in five dense cores in near- and mid-infrared images at 3-11 micrometers implying existence of an average of 0.1 micrometer-size dust grains and will discuss their implication in the star forming process in the cores.

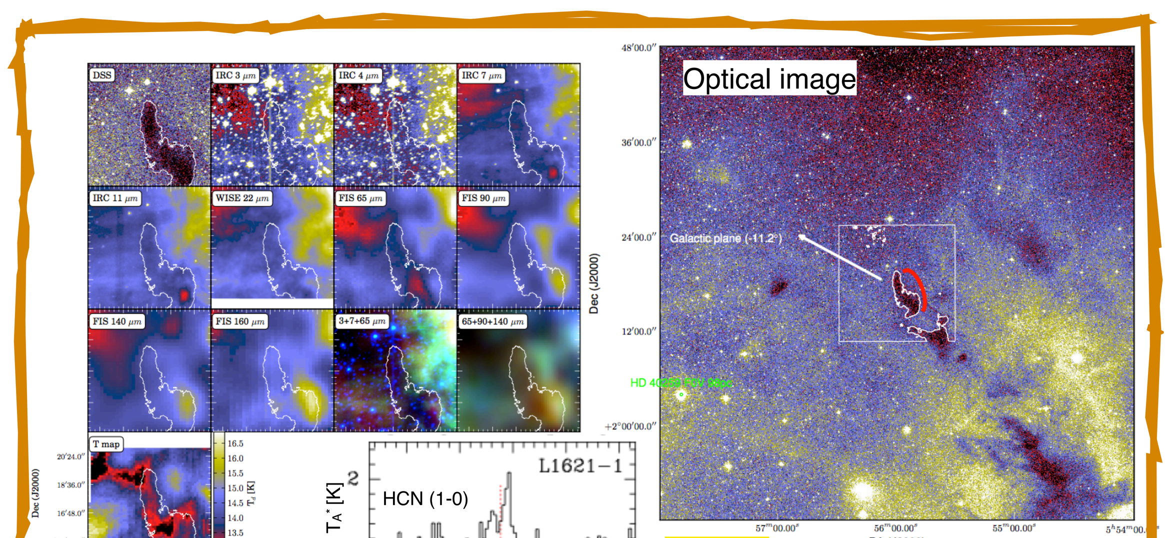


L1234
d=300 pc
ΔV_{N2H+}=0.41±0.05 km/s
HCN: ambiguous asymmetry profile

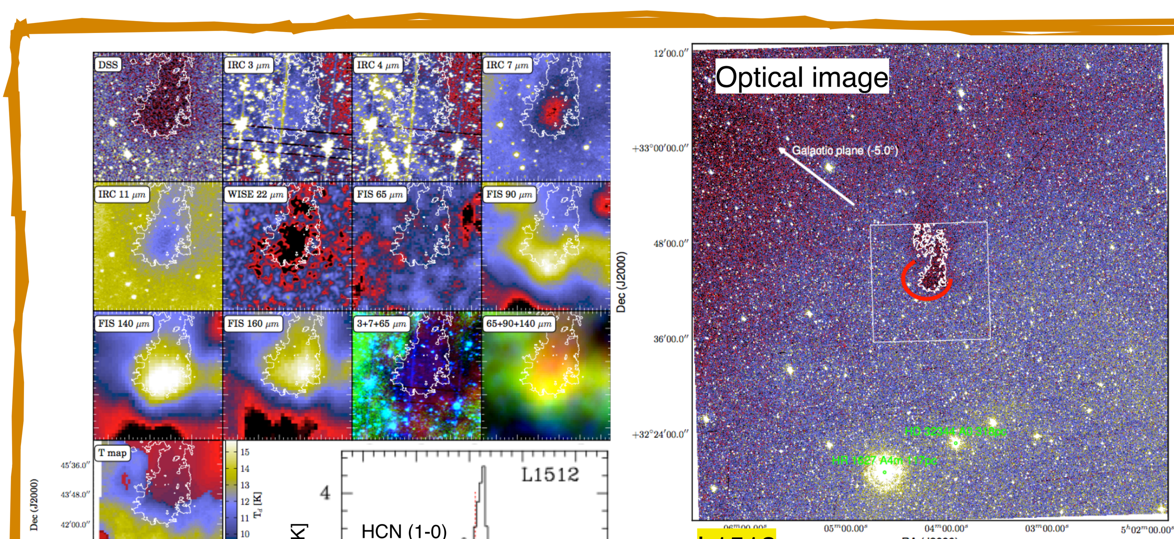




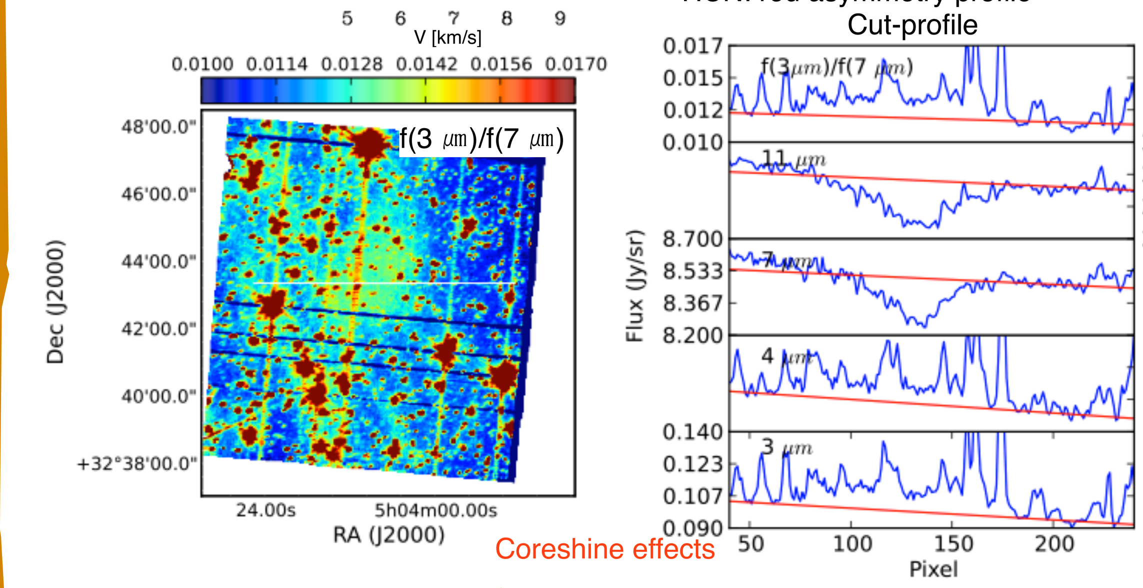
L1041-2
d=440 pc
ΔV_{N2H+}=0.38±0.06 km/s
HCN: blue asymmetry profile

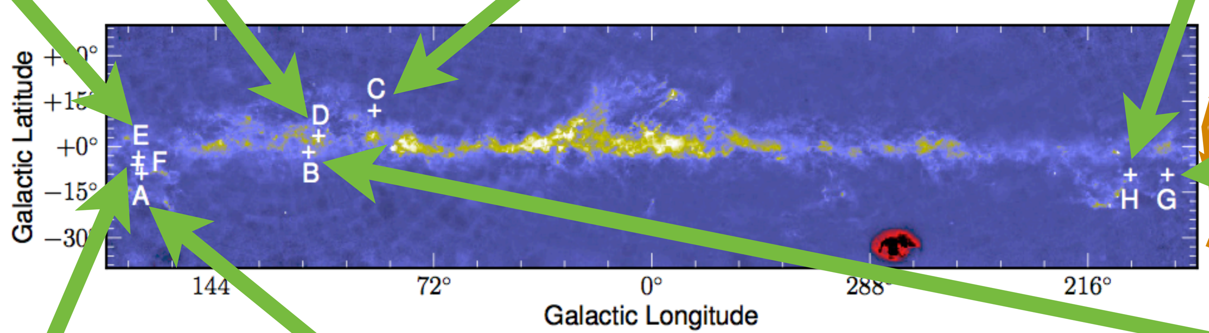


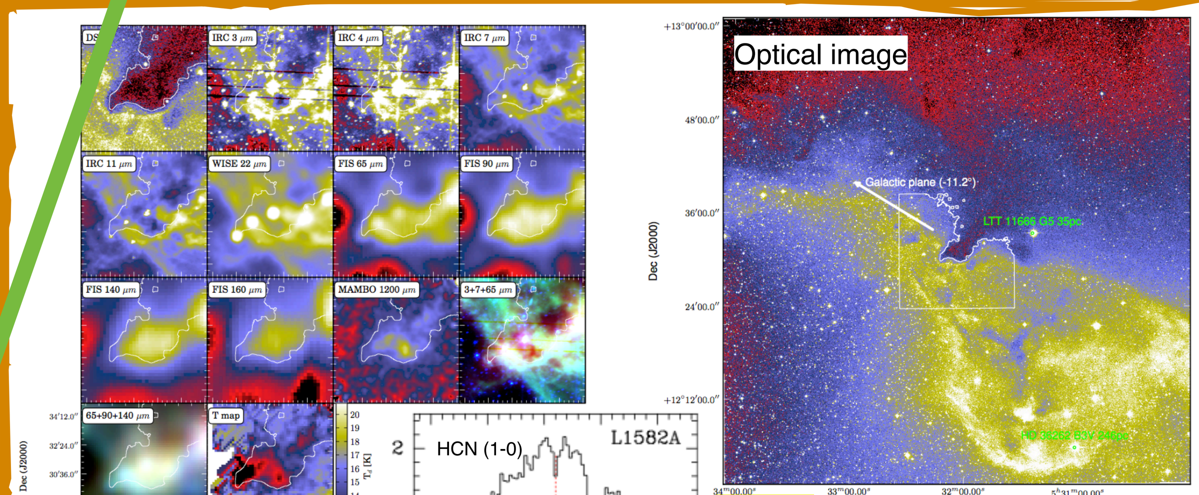
L1621-1
d=500 pc
ΔV_{N2H+}=0.24±0.07 km/s
HCN: red asymmetry profile



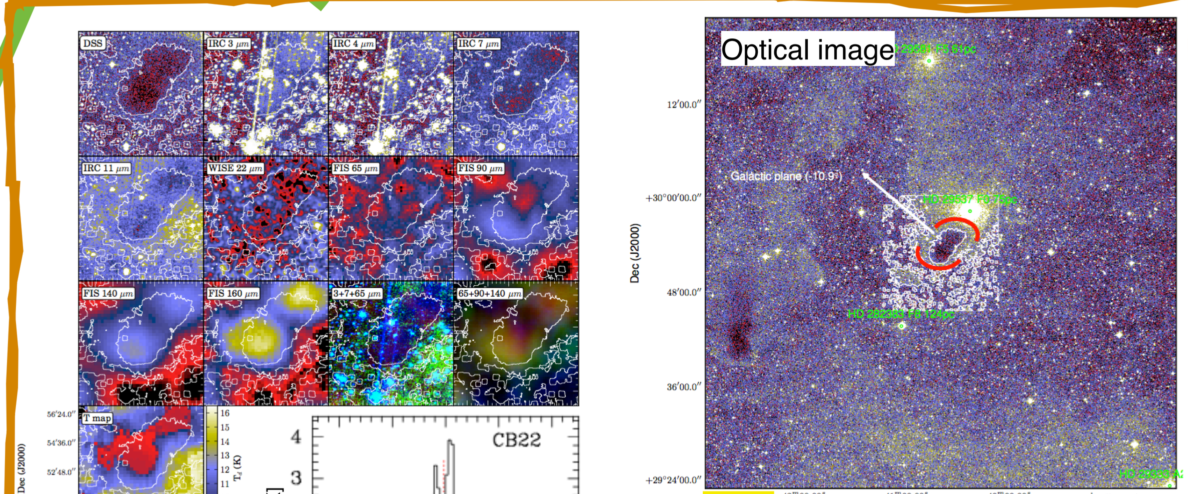
L1512
d=140 pc
ΔV_{N2H+}=0.19±0.01 km/s
HCN: red asymmetry profile



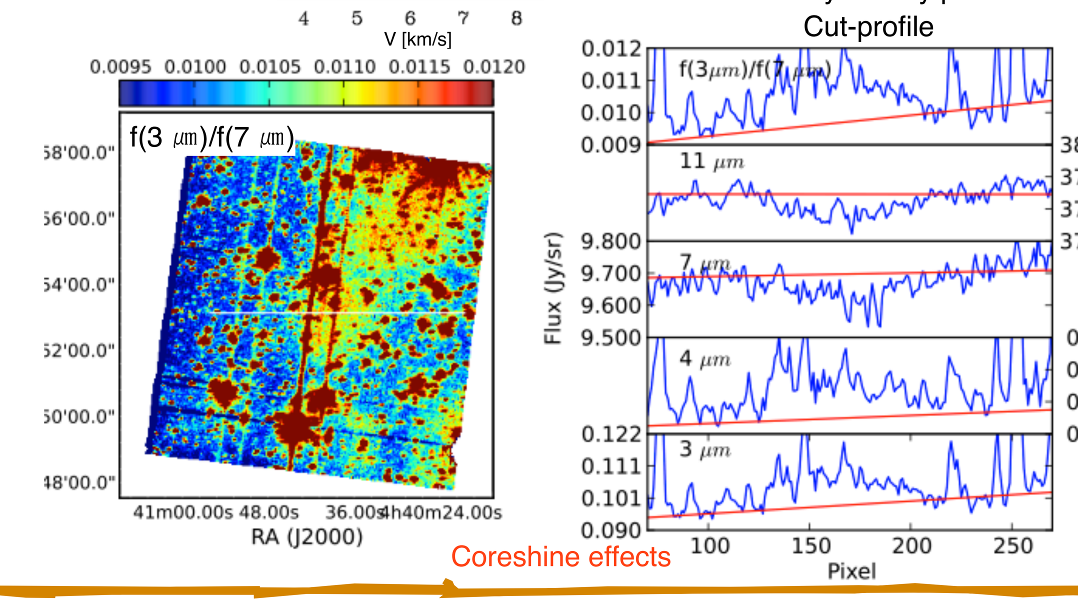


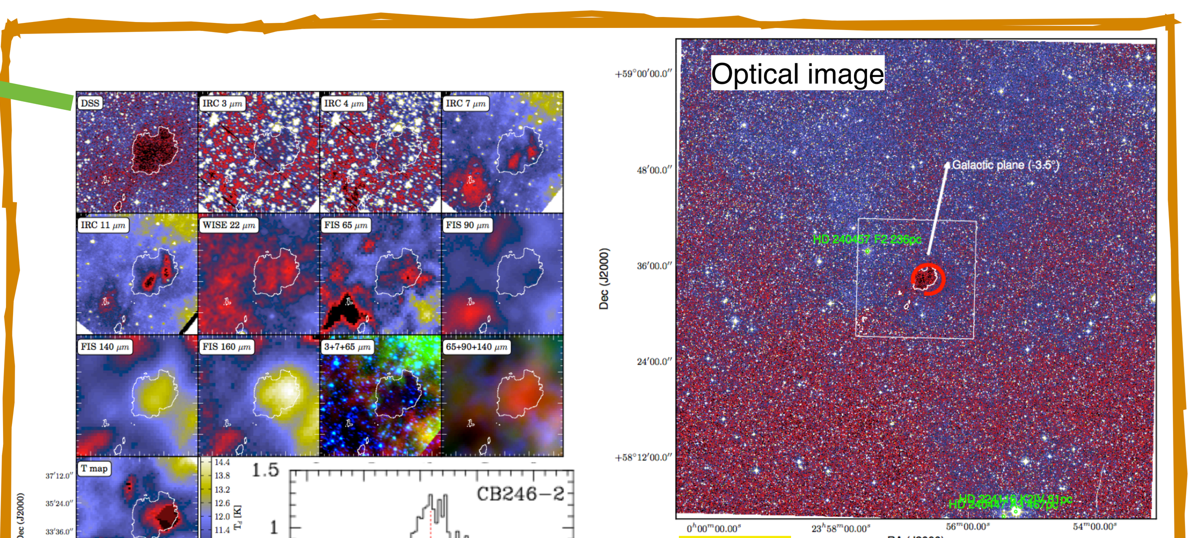


L1582A
d=400 pc
ΔV_{N2H+}=0.51±0.06 km/s
HCN: ambiguous asymmetry and broad linewidth profile

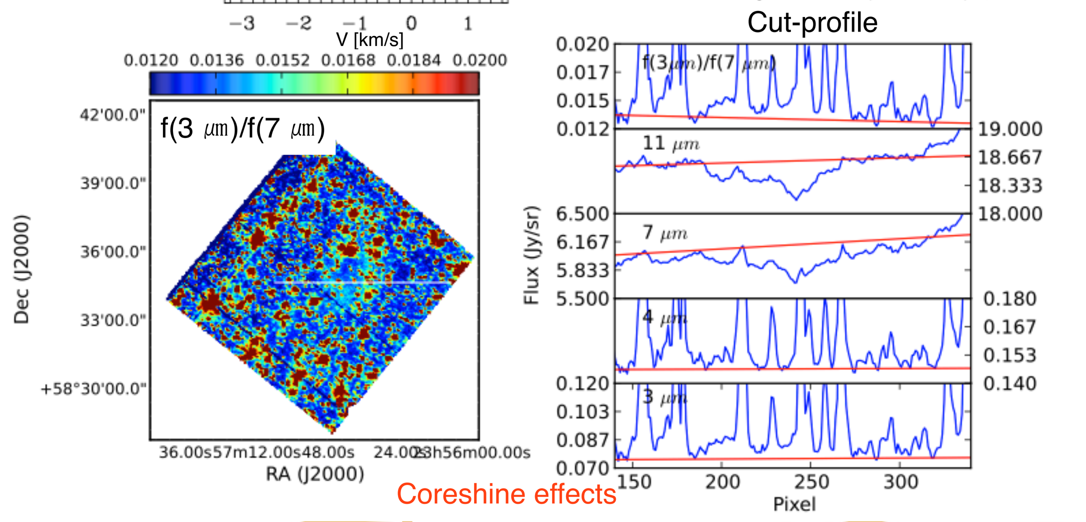


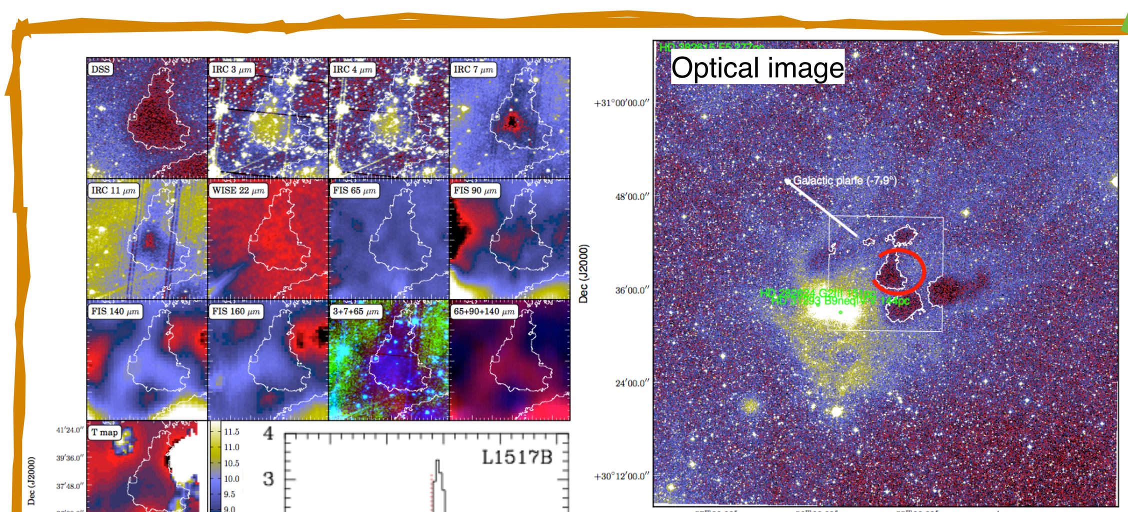
CB22
d=140 pc
ΔV_{N2H+}=0.17±0.01 km/s
HCN: red asymmetry profile



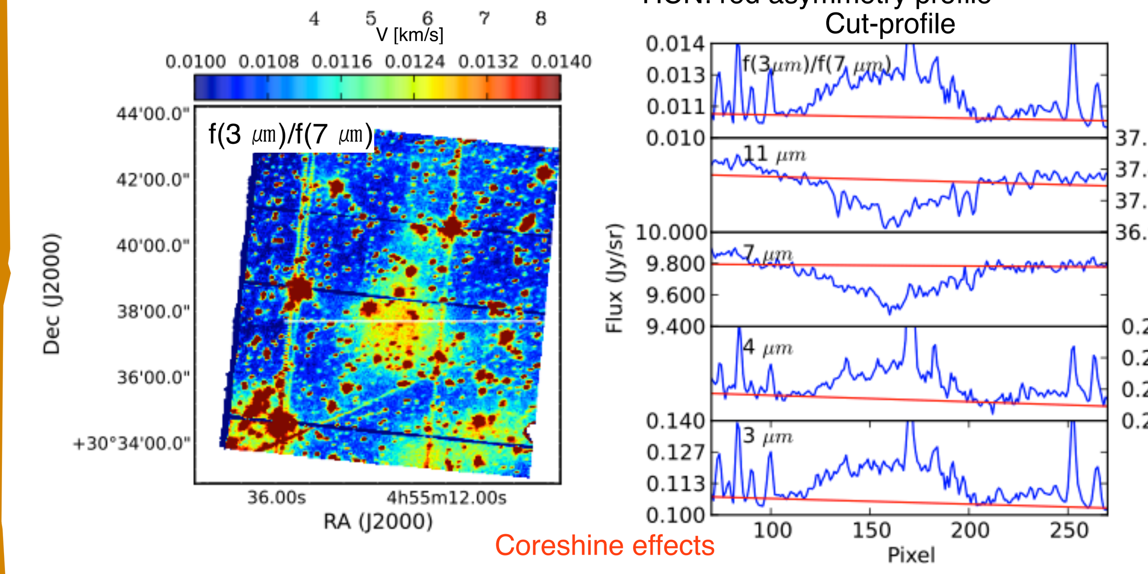


CB246-2
d=140 pc
ΔV_{N2H+}=0.22±0.02 km/s
HCN: ambiguous asymmetry profile

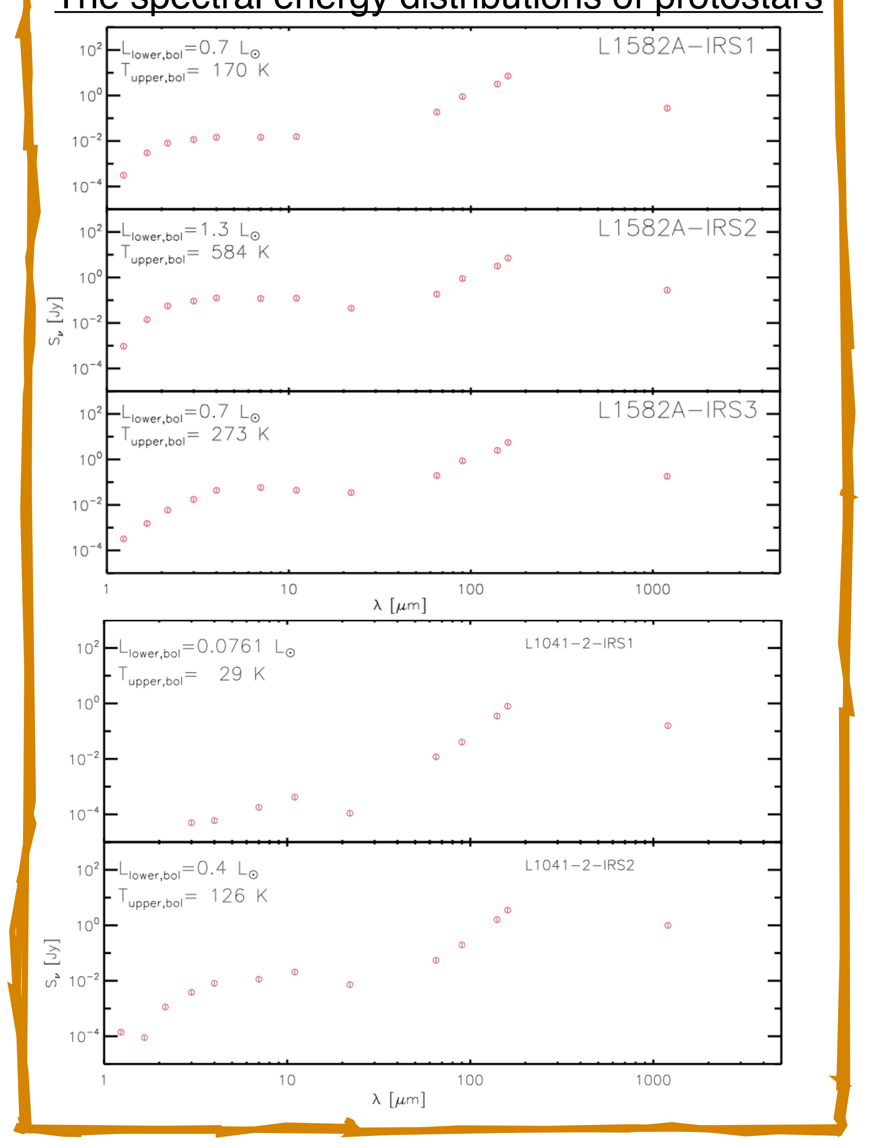




L1517B
d=140 pc
ΔV_{N2H+}=0.21±0.02 km/s
HCN: red asymmetry profile



The spectral energy distributions of protostars



The properties of the external sources

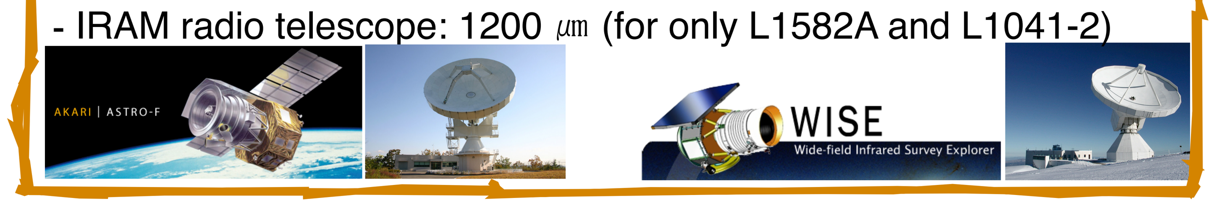
Core	Source	Position hh:mm:ss.ss±dd:mm:ss.s	Distance parsec	Spectral type	Separation arcmin
CB22	HD 282383	04:41:02.99+29:43:40.5	124	F8	10.57 SE (0.43 pc at 140 pc)
CB22	HD 29537	04:40:22.68+29:58:20.0	75	F0	6.52 NW (0.27 pc at 140 pc)
L1517B	HD 31293	04:55:45.85+30:33:04.3	144	B9neqIV-V	7.67 SE (0.31 pc at 140 pc)
L1512	HR 1627	05:04:36.91+32:19:13.0	117	A4m	24.61 SE (1.0 pc at 140 pc)
L1582A	λ Ori (Collinder 69)	05:35:06.00+09:56:00.0	438	B	161.42 SE (18.78 pc at 400 pc)
L1582A	RNO43	05:32:23.00+12:49:54.0	···	YSO	19.42 NE (2.26 pc at 400 pc)
L1621-1	Ori OB1b	05:34:00.00-01:30:00.0	440	OB	400.94 SW (58.31 pc at 500 pc)
L1041-2	IRAS 20361+5733	20:37:20.59+57:44:12.8	···	YSO	5.15 S (0.66 pc at 440 pc)
L1234	V* V812 Cas	23:20:48.92+62:24:45.2	264	B9p	19.91 E (0.74 pc at 300 pc)
L1234	IRAS 23158+6208	23:17:58.90+62:24:28.1	···	YSO	2.19 S (0.19 pc at 300 pc)

Observation data

- *AKARI* space telescope: 3, 4, 7, 11, 65, 90, 140, and 160 ㎛
- KVN radio telescopes: HCN (1-0) and N_2H^+ (1-0) molecular lines

Complementary data

- *WISE* space telescope: 22 ㎛
- IRAM radio telescope: 1200 ㎛ (for only L1582A and L1041-2)



Key points

- Eight dense molecular cores
  - Starless: CB22, CB246-2, L1234, L1512, L1517B, and L1621-1
  - No longer starless: L1041-2 and L1582A
    - A few protostars of $L_{lower,bol}$~0.3-1.8 $L_\odot$
    - Molecular lineprofiles
      - N_2H^+(1-0): ΔV(core with protostars)≈2xΔV(starless core)
      - HCN(1-0): blue asymmetry indicating inward motions
- Coreshine effects by 0.1-㎛ size dust from 3-11 ㎛ images
  - CB22, CB246-2, L1512, L1517B, and L1041-2
- External heating features for all dense molecular cores from 90 ㎛ image and the temperature map
  - by spectral O-F type stars, young stellar objects, or Galactic radiation field