Evidence of Cloud-Cloud Collision in S235 Complex

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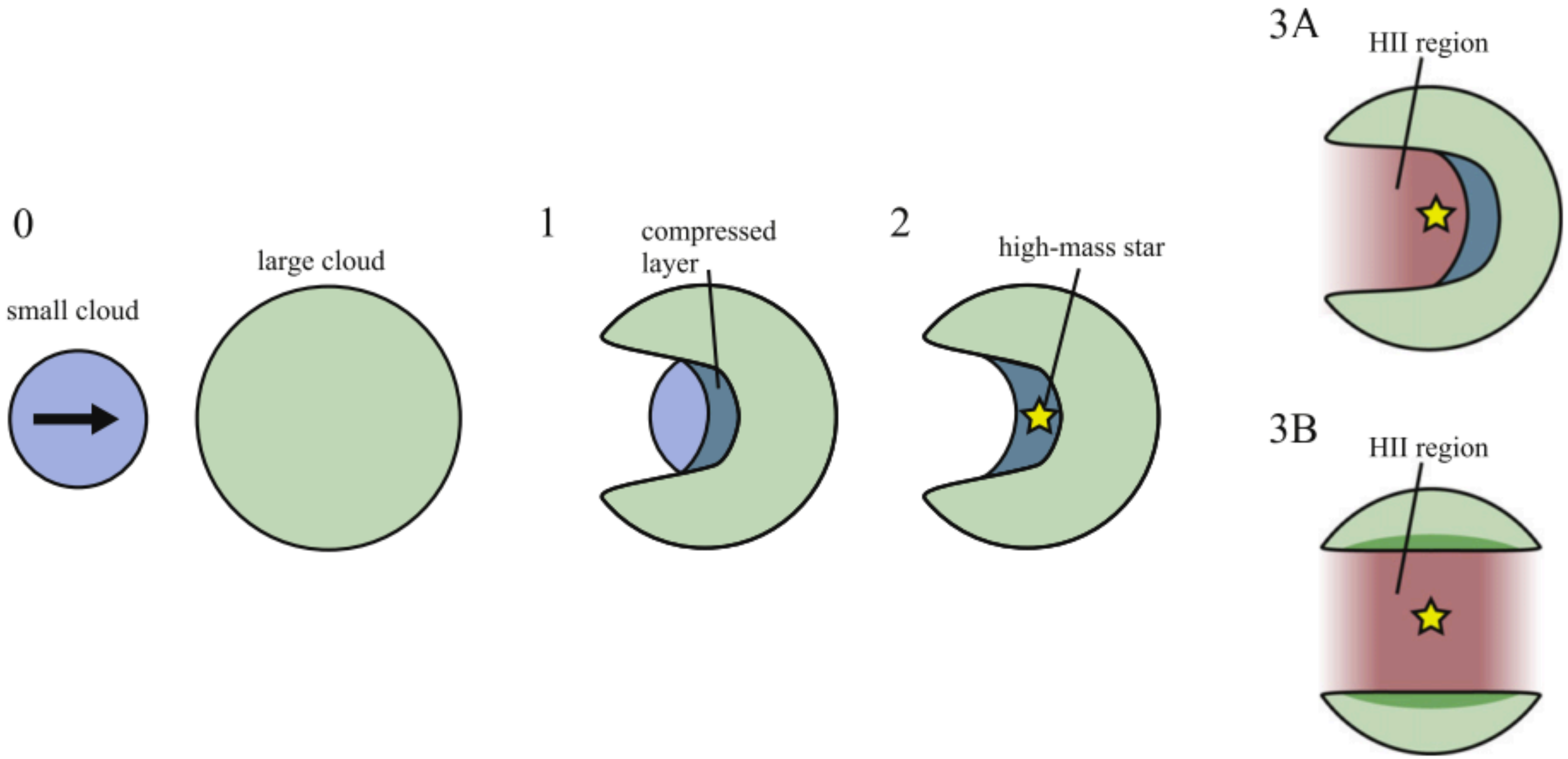
1. Background

Basic scenario of cloud-cloud collision introduced by Habe & Ohta (1992)



Credit: Torii et al. 2015

Examples of collision

Table 1. Comparisons between the cloud-cloud collision regions.

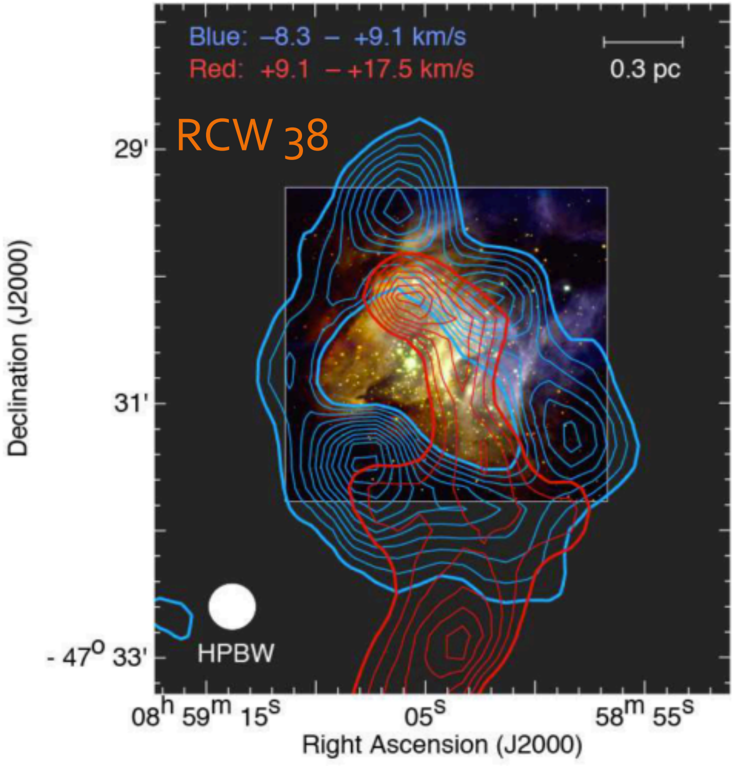
Name	cloud mass [$\times 10^3$ $M_\odot$]	column density [$\times 10^{22}$ cm^{-2}]	relative velocity [$km\ s^{-1}$]	complementary distribution	bridge feature	cluster age	number of O stars	reference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
RCW 38	(20, 3)	(10, 1)	12	no	yes	~0.1	~20	[1]
NGC 3603	(70, 10)	(10, 10)	15	no	yes	~2	~30	[2]
Westerlund 2	(90, 80)	(20, 2)	16	yes	yes	~2	14	[3, 4]
DBS2003 179	(200, 200)	(8, 5)	20	yes	yes	~5	> 10	[5]
ONC (M 42)	(20, 3)	(20, 1)	~7	yes	no	< 1	~10	[6]
ONC (M 43)	(0.3, 0.2)	(6, 2)	~7	yes	no	< 1	1	[6]
RCW 120	(50, 4)	(3, 0.8)	20	yes	yes	~0.2	1	[7]
N159W-South	(9, 6)	(10, 10)	~8	no	no	~0.06	1	[8]
N159E-Papillon	(5, 7, 8)	(4, 4, 6)	~9	no	no	~0.2	1	[9]
M 20	(1, 1)	(1, 1)	7.5	yes	yes	~0.3	1	[10]
L 1188	(1.2, 2.7)	(1, 1.2)	~2	no	yes	~1	0	[11]
S 235	(10, 10)	(3, 3)	5	yes	yes	~1	1	This work

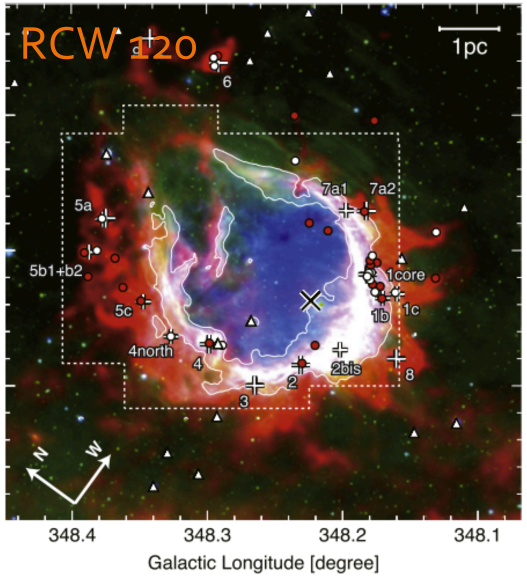
2~20 km/s

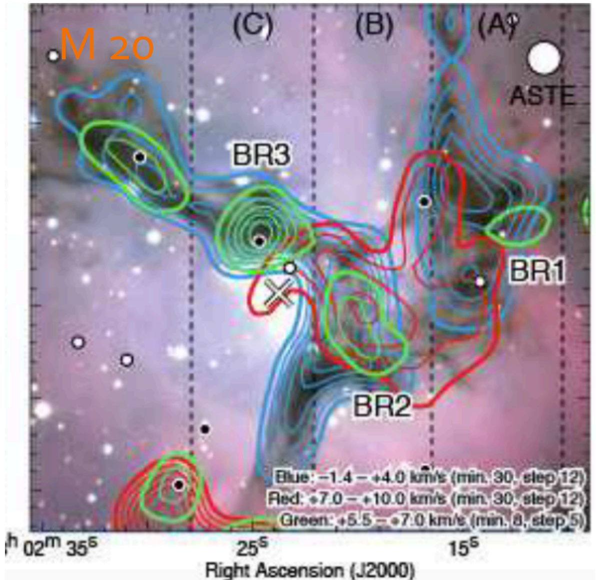
Super star clusters

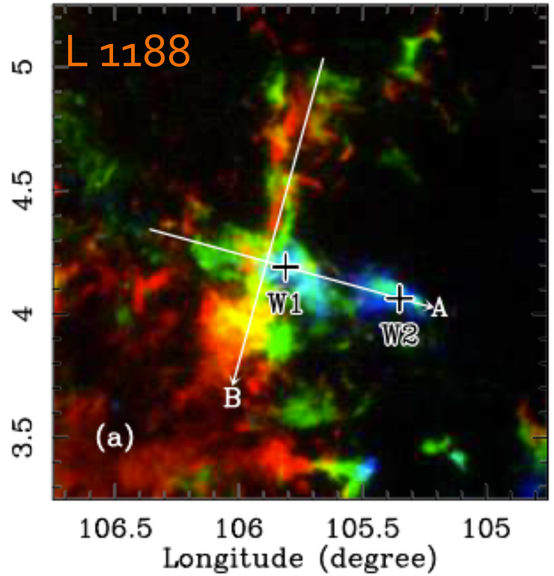
Typical HII regions

Low- or intermediate-star formation

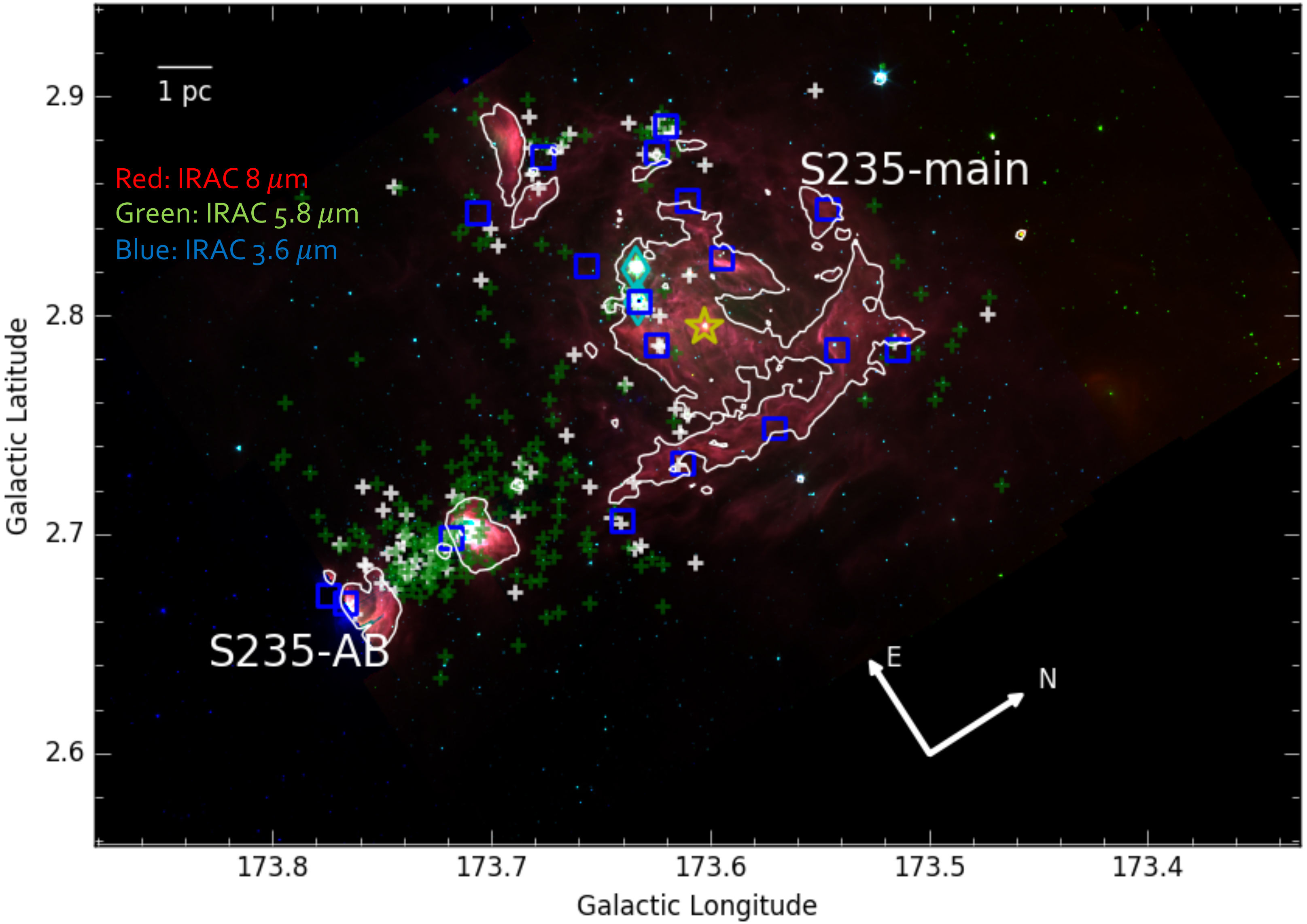








Color composite image of S235 complex.

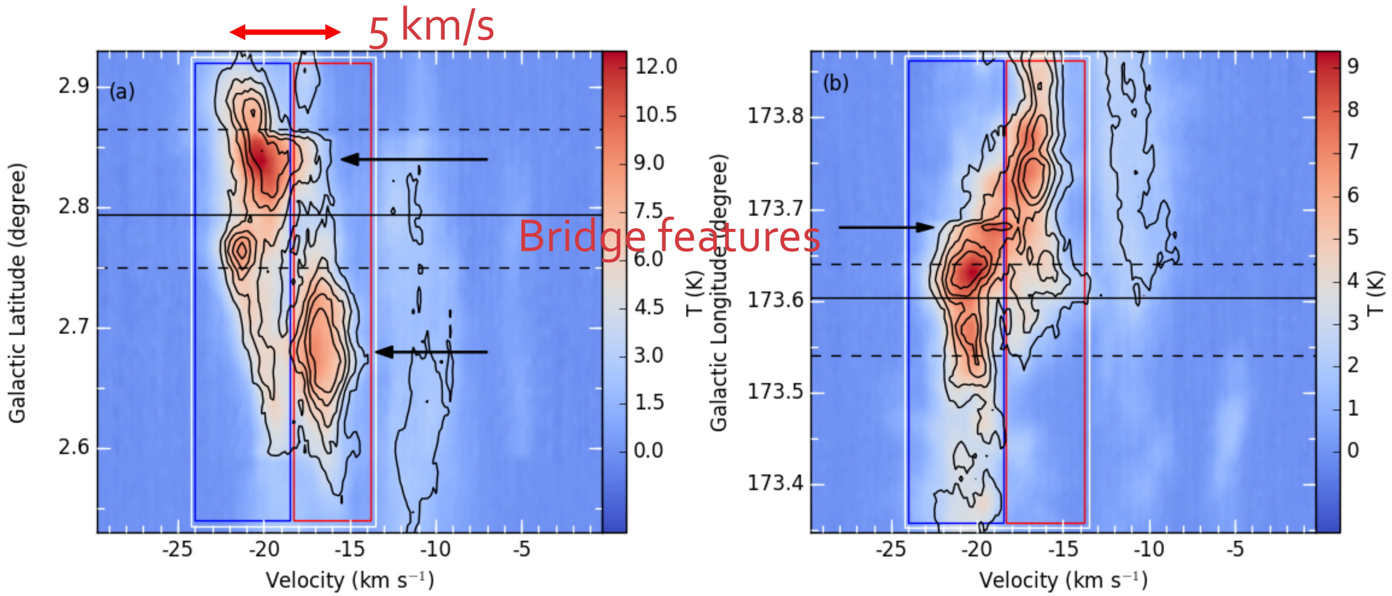


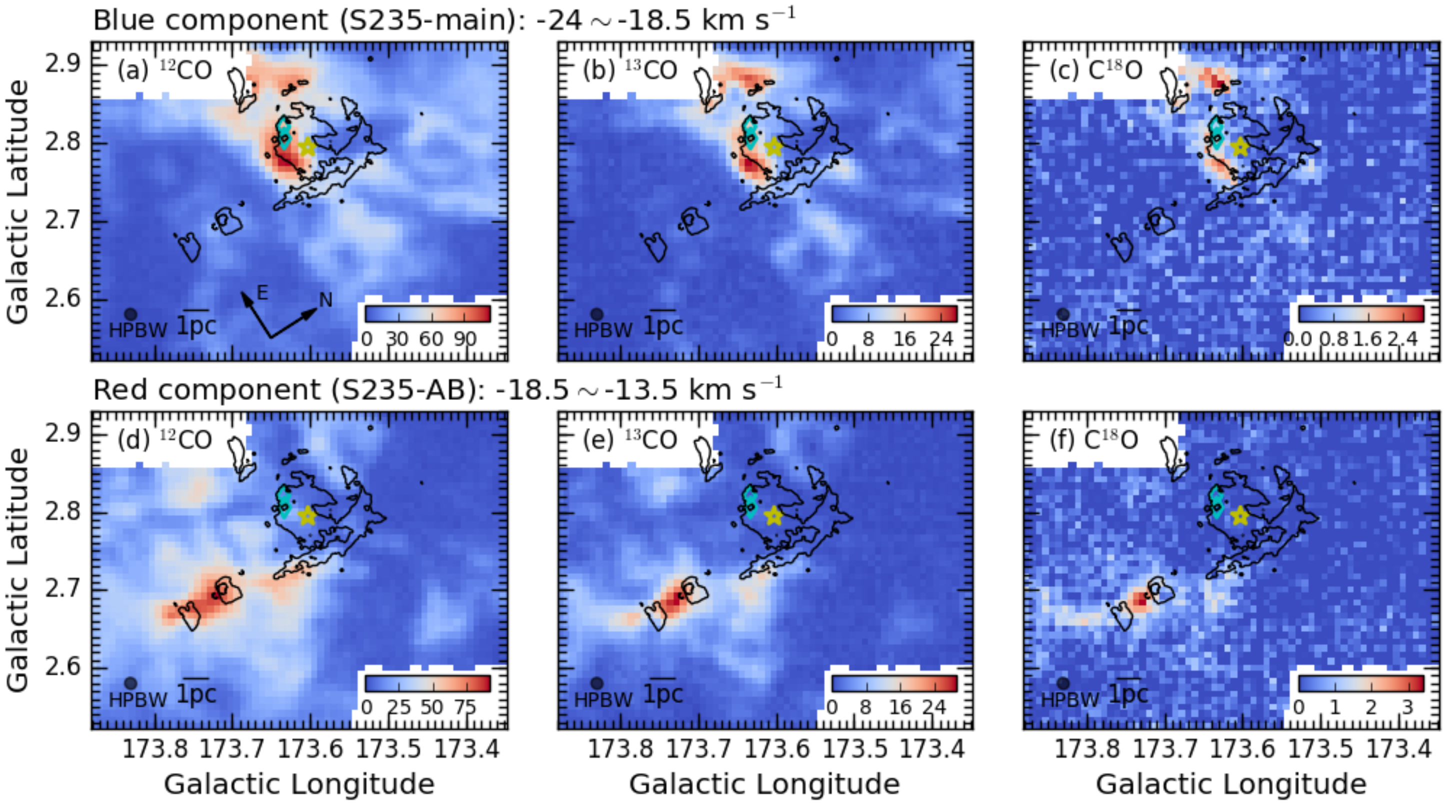
CO, 13CO, C18O (1-0) are from PMO-14m

2.Collision Evidence in S235

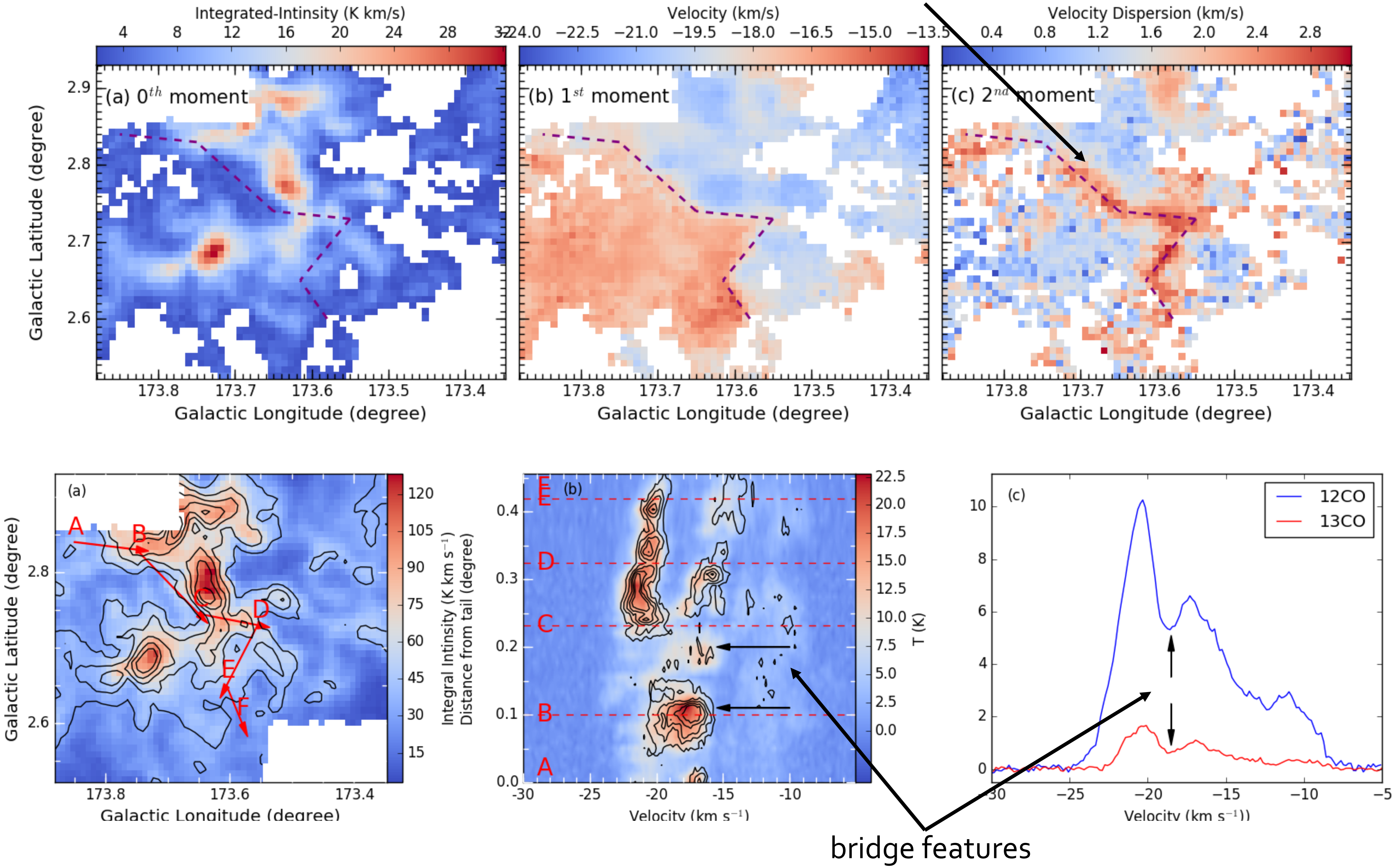
Evidence 1: 5 km/s velocity separation.

Evidence 2: velocity bridge features

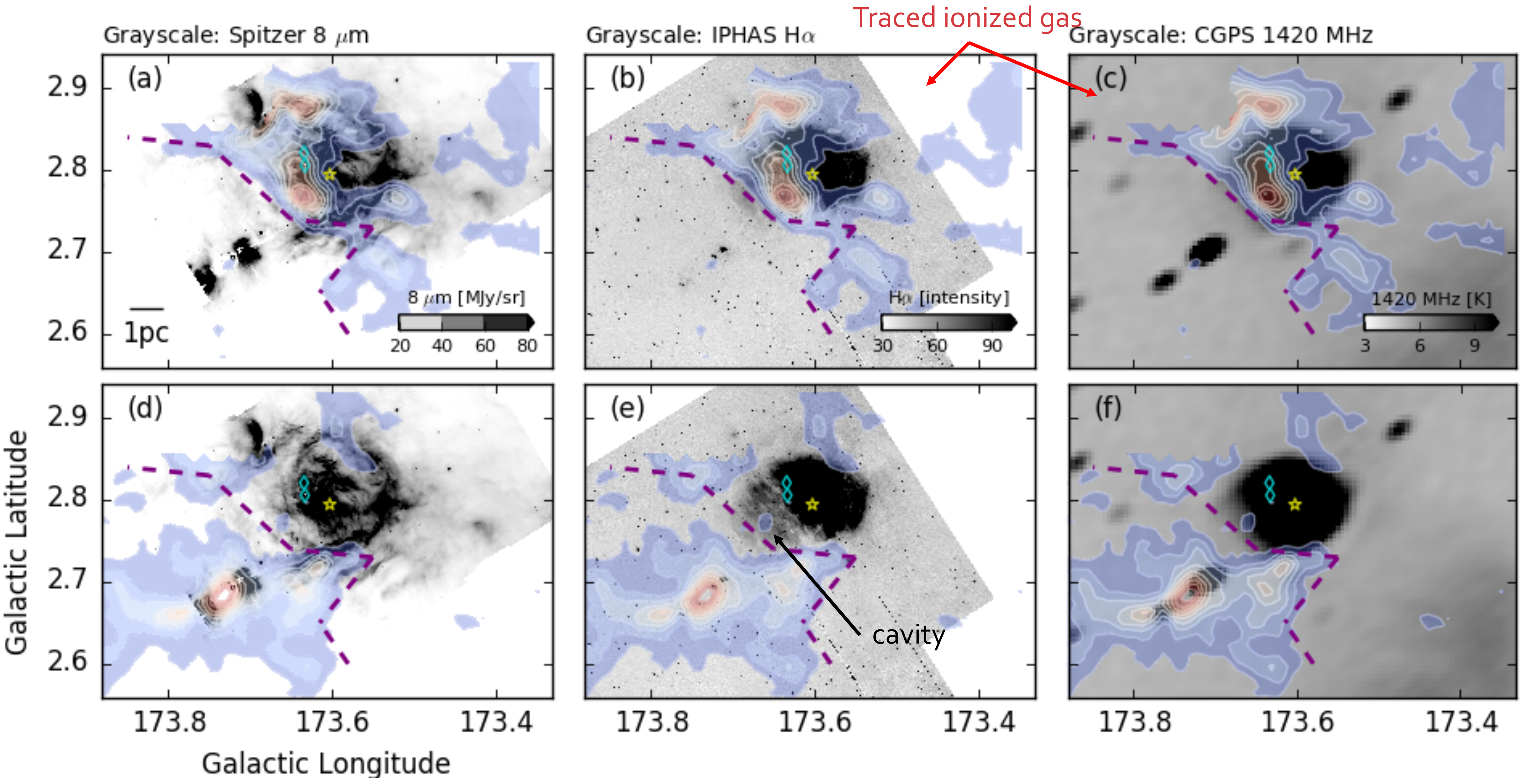




Evidence 3: colliding interface: velocity dispersion grater than 2 km/s



Evidence 4: complementary distribution in different wavelengths



3.Summary

- 1. **5 km/s velocity separation** of blue-shifted and red-shifted cloud shows the colliding motion of S235-main and S235-AB.
- 2. **The velocity bridge features** connecting the two clouds indicate current colliding process.
- 3. **The colliding interface** can be traced by complementary morphology, large velocity gradients and high velocity dispersion of two clouds.
- 4. **The complementary distribution** between the two clouds and ionized gas support physical interaction between them.

4. Future work

- Propose JCMT CO 3-2 observations toward S235.
  mapping size: 30′ x 25′
  goal: probe the excitation condition and density properties of the colliding interface with LVG analysis.

- Star formation triggered by cloud-cloud collision.