SOFIA observations of S106: Dynamics of the warm gas

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S106 in context

Planck all sky image

Cyxgnus X
S106 in context

Planck all sky image

FCRAO $^{13}$CO survey
~30 sq.deg.
S106 in context

FCRAO $^{13}$CO survey

40' x 30'
S106 in context

FCRAO $^{13}$CO survey

Subaru near-IR

40' x 30'

Star-forming Region S106 IRS4
Subaru Telescope, National Astronomical Observatory of Japan
February 13, 2001

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SOFIA observations of S106: Dynamics of the warm gas

**S106:**
HII-region/PDR/molecular cloud complex
Single late-type O-star

**SOFIA/GREAT observations:**
[CII] and CO 11-10

**Complementary data:**
Submm continuum (350 μm) SHARC-II
Low-J CO lines IRAM 30 m
Various continuum images

SUBARU near-IR image (Oasa et al. 2006)
SOFIA observations of S106: Dynamics of the warm gas

S106:
HII-region has an hour glass shape
Small inclination angle
Cavity walls partly eroded

SUBARU near-IR image (Oasa et al. 2006)
SOFIA observations of S106: Dynamics of the warm gas

**S106:**
- HII-region has an hour glass shape
- Small inclination angle
- Cavity walls partly eroded

SUBARU near-IR image (Oasa et al. 2006)
Integrated intensities

Color: [CII]
Contours: CO 11-10

Color: near-IR, SUBARU
Contours: [CII]
Integrated intensities

Color: [CII]
Contours: CO 11-10

Color: 350 μm continuum, SHARC-II
Contours: [CII]

CII tends to avoid submm continuum
Integrated intensities

Color: 350 μm continuum, SHARC-II
Contours: [CII]

CII tends to avoid submm continuum
Better tracer of ionized gas

Color: 1.4 cm continuum, VLA
Contours: [CII]
The dark lane

Shadow of small scale disk?

Extinction in high column density gas?

Color: near-IR, SUBARU
Contours: 350 μm continuum, SHARC-II
The dark lane

Shadow of small scale disk?

Extinction in high column density gas?

Color: near-IR, SUBARU
Contours: 350 μm continuum, SHARC-II
Velocity channel maps

CO 11-10 cont. on
[CII] color
1. -6 to -3 km/s
2. -3 to  1 km/s
3.  0 to  4 km/s
Velocity channel maps

CO 11-10 cont. on
[CII] color
1. -6 to -3 km/s
2. -3 to 1 km/s
3. 0 to 4 km/s

[CII] contours on
SUBARU near-IR warm dust
Velocity channel maps

[CII] contours on SUBARU near-IR
1. -6 to -3 km/s
2. -3 to 1 km/s
3. 0 to 4 km/s

[CII] contours on Submm continuum cold dust
Evaporation or ablation of S106 FIR?
Velocity channel maps

CO 11-10 cont. on [CII] color
1. -6 to -3 km/s
2. -3 to 1 km/s
3. 0 to 4 km/s

[CII] contours on $^{13}$CO 2-1, IRAM 30 m
Spectra

![Graph of Spectra]

- SOFIA [CII]
- SOFIA CO 11–10
- IRAM 12CO 1–0
- IRAM 13CO 1–0
- IRAM C18O 1–0 x 4
- IRAM 12CO 2–1
- IRAM 13CO 2–1

Offset (0",0") S106 IR

![Image of the Orion Nebula]
Spectra

Offset (0'',0'')
S106 IR

Offset (30'',30'')
North-east lobe

R. Simon, I. Physikalisches Institut, Universität zu Köln
SOFIA Community Task Force tele talk, 11/14/2012
Spectra

SOFIA [CII] SOFIA CO 11–10
IRAM 12CO 1–0
IRAM 13CO 1–0
IRAM C18O 1–0 x 4
IRAM 12CO 2–1
IRAM 13CO 2–1

Offset (0",0")
S106 IR

Offset (30",30")
North–east lobe

Offset (25",−10")
Molecular cloud

Velocity (km/s)
Summary

- Morphology and kinematics
  - Complexity only visible in channel maps, very important to gain better understanding of the nebula
  - [CII] bright, broad lines, tracing high velocity gas at the interfaces of HII region and molecular cloud
  - No counterpart in other line tracers
  - CO 11-10 more confined to the warmer, higher density gas
  - To disentangle contributions from HII region, shocks, and PDR requires modelling

- Dark lane
  - Not just the shadow of a small disk around the star, traces the warm, high column surface of the molecular cloud