Star formation and disk evolution history of a sparse region: The Coronet cluster

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A multiwavelength view of the Coronet cluster

24, 100, 160 µm
A multiwavelength view of the Coronet cluster

- Optical images reveal a 13pc extended cloud at 170 pc. The Coronet is a small part of it, around some HAeBe stars. [Loren 1979; Marraco & Rydgren 1981; Taylor & Storey 1982; Wilking+1985; Knude & Hog 1998]

- Several mm/submm observations reveal embedded objects. [Henning+1994; Chini+2003; Groppi+2004; Nutter+2005]

- X-ray observations reveal a moderate number of interm. and low-mass TTS. [Garmire&Garmire 2003; Forbrich & Preibisch 2007]


  - Spitzer data show disks in all stages of evolution [Sicilia-Aguilar+2008; Peterson+2011]

- Extinction maps reveal that star formation happens in the densest parts [Kainulainen+2009]

- APEX/LABOCA data show several dense clumps and some disks/protostars [Sicilia-Aguilar+ 2011]

And now: Herschel/PACS!
Why multiwavelength? Too much going on!

- Star formation
- Disks
- Dust grain evolution
- Accretion/shocks
- ...

JHK extinction

24, 870 µm
The inhabitants of the Coronet

1 pc (at 170 pc)

24, 100, 160 µm
The inhabitants of the Coronet

Cloud all around
(~4300/120 $M_{\text{sun}}$ [Cappa de Nicolau & Pöppel 91, Harju+93])

24, 100, 160 $\mu$m

Intermediate-mass stars
(R CrA, TY CrA, T CrA)

CTTS/WTTS
(SCrA, G-85, CrA-159, G-87,...)

Protostars
(IR57w/e, IRS5a/b, IRS2, V710,G-122,...)

HH objects
(G-80,...)
The birth of the Coronet members

The cluster center:

a compact group of new-born stars,
mostly progenitors of HAeBe and massive TTS
The birth of the Coronet members

The cluster center:

New-born binaries, bubbles, very low-mass protostars
More members to be born?
Places with no (evident) star formation
Places with no (evident) star formation

24,100,160 µm

24,100,160,870 µm

24,100,160,870 µm
The intermediate-mass stars with disks

Disk models: RADMC (Dullemond & Dominik 04)
The low-mass stars with disks (I)

Multiwavelength data plus RADMC [Dullemond & Dominik 2004] models
The low-mass stars with disks (II)

Strong disk evolution:

Processed grains, settled disks, globally depleted disks, inside-out evolution (gaps/holes), maybe truncated disks?
Disk masses, age, and evolution
The cluster is 1-2 Myr-old and 1.3pc across, but we find:

- Ongoing star formation (intermediate and low-mass *)
- HAeBe and massive CTTS with various types of disks:
  - Normal disks
  - Disks with inside-out evolution: holes, gaps
  - Depleted and truncated disks
  - Debris disks (not detected with Herschel)
  - Most disks with very low masses ($10^{-4}$ - $10^{-6}$ $M_{\text{sun}}$), among the M-type CTTS
Does the environment play a role?

**Sparse clusters:**
Evolutionary differences?
Formation differences?
Low numbers/selection effects?

[ Fang et al., A&A in press ]
Summary

Multiwavelength study, now including Herschel Coronet cluster /CrA region, 170 pc, 1-2 Myr

Ongoing star formation (binaries and singles)

Disk evolution seen among cluster members:
- Inside-out: holes, gaps
- Global dust depletion

Moderate disk fraction: typical of sparse regions?

Waiting for ALMA, JWST, ...