Science @ CDS

Scientific diversity at CDS

- **Information discovery and processing**

  Ontology, semantics, resource discovery — **S. Derrière, F. Genova**
- **Stellar astronomy**

  Circumstellar matter, AGB/post-AGB stars, surveys — **C. Loup**
- **Galactic astronomy**

  Binary stars, X-ray surveys — **A. Nebot**

  ISM, star formation — **L. Cambrésy, H. Arab**

  Galactic disk formation, surveys, simulations — **A. Siebert**
- **Extragalactic astronomy**

  Epoque of reionization, nearfield cosmology — **P. Ocvirk, J. Sorce**

  AGNs, VO science — **M. Allen**

  ISM, nearby galaxies — **C. Bot, J. Chastenet**

  Cluster galaxy evolution, gal. centers, GPS sources — **B. Vollmer**

Scientific interactions

- **with the « Equipe Galaxies »:**

  common projects, common meeting

- **with the « Equipe Hautes Energies »:**

  common projects, exchange of expertise

- **participation in large projects:**

  XMM, Planck, Herschel, RAVE, GAIA, JWST

- **wide scientific collaborations**

- **use of large telescopes and surveys:**

  VLT, HST, Spitzer, JVLA, 2MASS, SDSS, IRAS,

  Herschel, Planck

The role of CDS scientists

- part of integrated team together with documentalists and engineers
- selection and validation of scientific data
- validation of the data description
- scientific advice for / supervision of the development and evolution of CDS services

Scientific input

All CDS scientists contribute their

- expertise
- view on astronomy and information science
- experience with CDS services
- new ideas

All CDS scientists contribute to

- the daily workflow/data ingestion
- the development and evolution of the CDS services

Scientific responsibilities

• SIMBAD	**C. Loup**, L. Cambrésy, A. Siebert, C. Bot, A. Nebot, P. Ocvirk, B. Vollmer
• VizieR	**P. Ocvirk**, C. Bot
• Aladin	**C. Bot,** A. Nebot
• Nomenclature	**B. Vollmer**
• Dissemination	A. Nebot, C. Bot, S. Derrière
• Special operations	A. Siebert, L. Cambrésy

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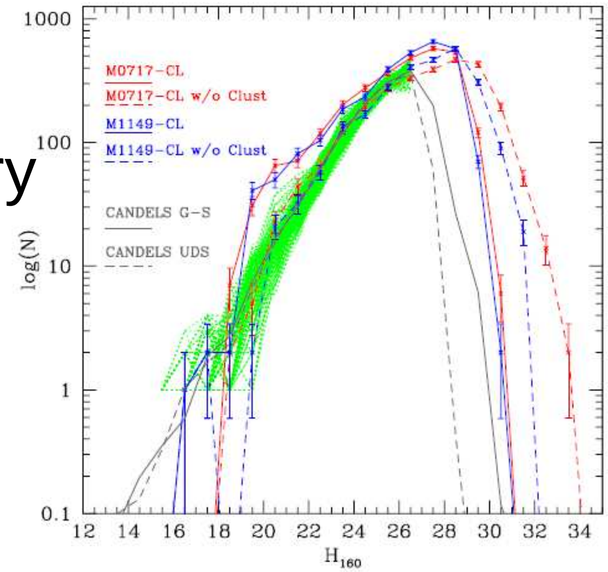
ASTRODEEP Frontier Fields catalogues

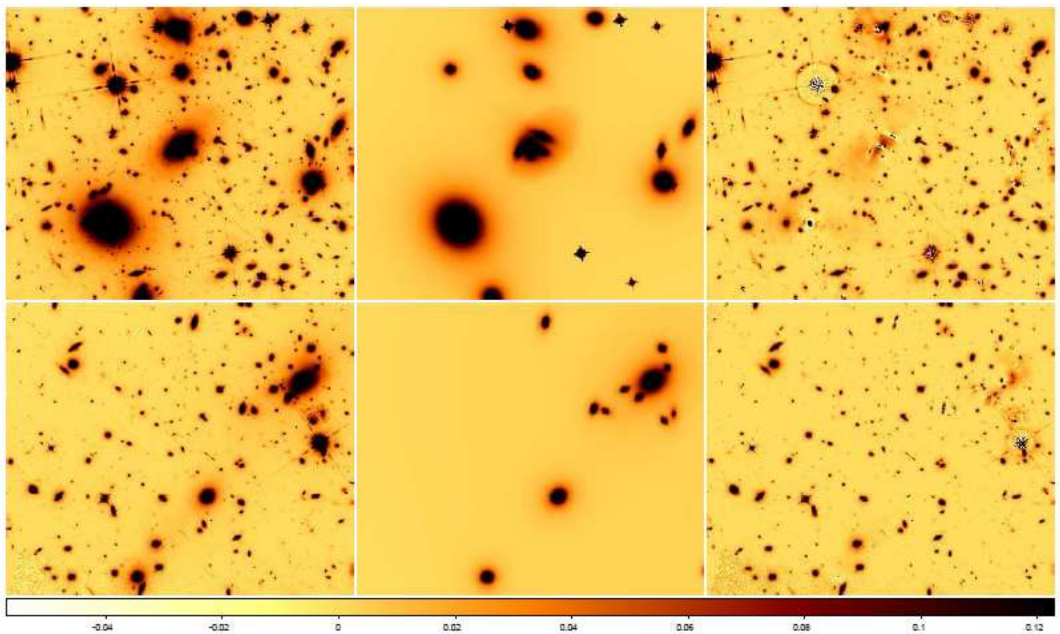
(S. Derrière)



Merlin et al., 2016
Castellano et al., 2016
Di Criscienzo et al., 2017

Multi-wavelength photometry for 4 galaxy clusters and parallel fields
- 10 bands : HST, Ks, IRAC

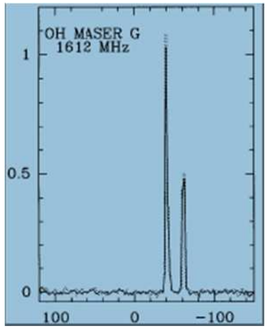
Source extraction with TPHOT algorithm removing foreground light of bright sources and intra-cluster light
- 10^7 $M_\odot$ out to z=6
- up to H~32-34

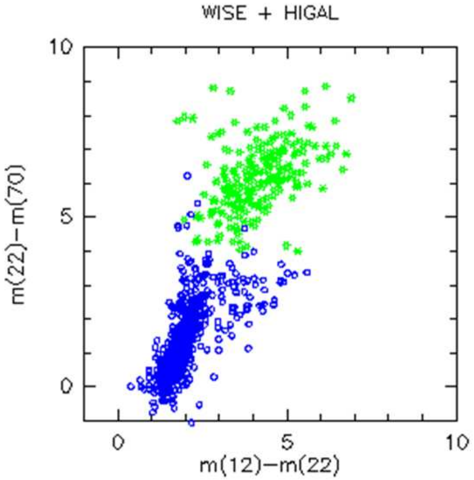


OH/IR stars versus YSOs with maser site (C. Loup)

Sample :

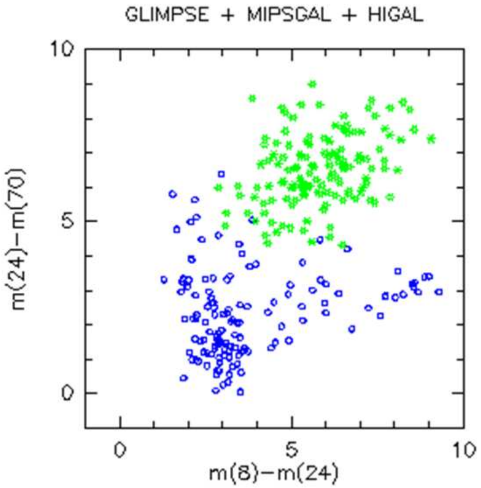
- 2000 OH/IR stars
- double-peaked → AGB or PAGB stars →
- mass-loss up to 10^{-4} Mo/yr
- single dish or interferometric surveys
- 500 YSOs :
- known OH emitters
- + MMB survey of CH3OH





Identification :

- OH/IR stars between themselves (Vlsr)
- IRAS MSX AKARI WISE GLIMPSE MIPSGAL HIGAL →



Results

- OH/IR stars can be as red as YSOs in the Mid-IR
- Far-IR or/and environment required

Red objects in the galactic plane

Classifications based on Mid-IR only : 30-40% in error

- Previous estimate : 30-50% AGB / 50-70% YSO
- New estimate : 70-90% AGB / 10-30% YSO

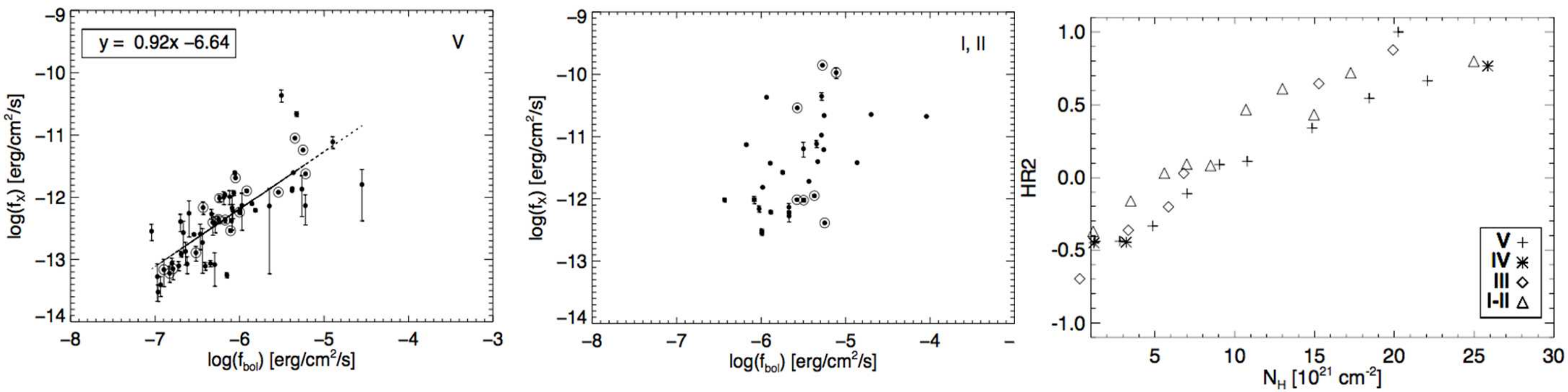
X-ray emission of O stars (A. Nebot)

A study of X-ray properties of massive stars with respect to their evolution status

132 O stars in the Milky Way identified by optical spectra and with X-ray counterpart.

- Dwarf stars follow a $L_x/L_{bol} \sim 10^{-6}$, a relationship that breaks for supergiants.
- Supergiant stars have harder X-ray spectra than dwarf stars.
- X-ray luminosity of dwarf stars depends on stellar wind parameters (mass loss rate, wind density, kinetic energy, and stellar wind momentum) while no such correlation is seen for supergiant stars.

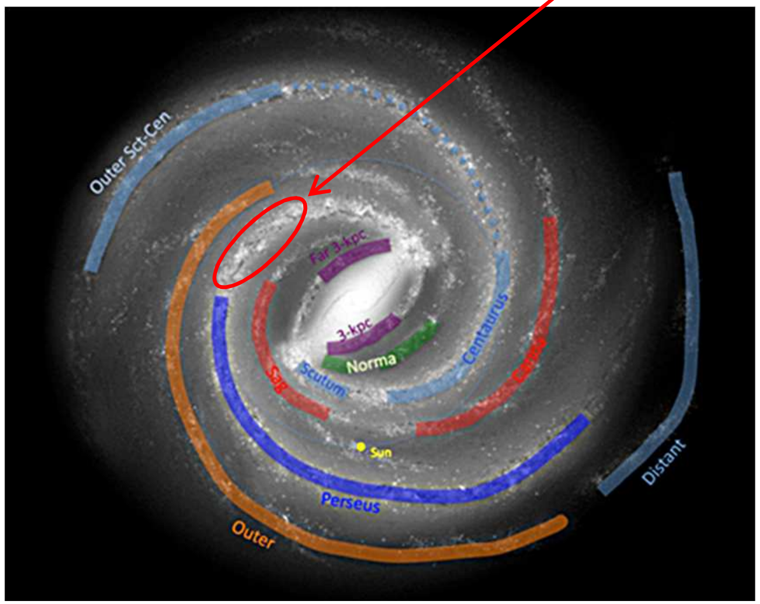
Nebot Gomez-Moran, A. & Oskinova, L. in prep.

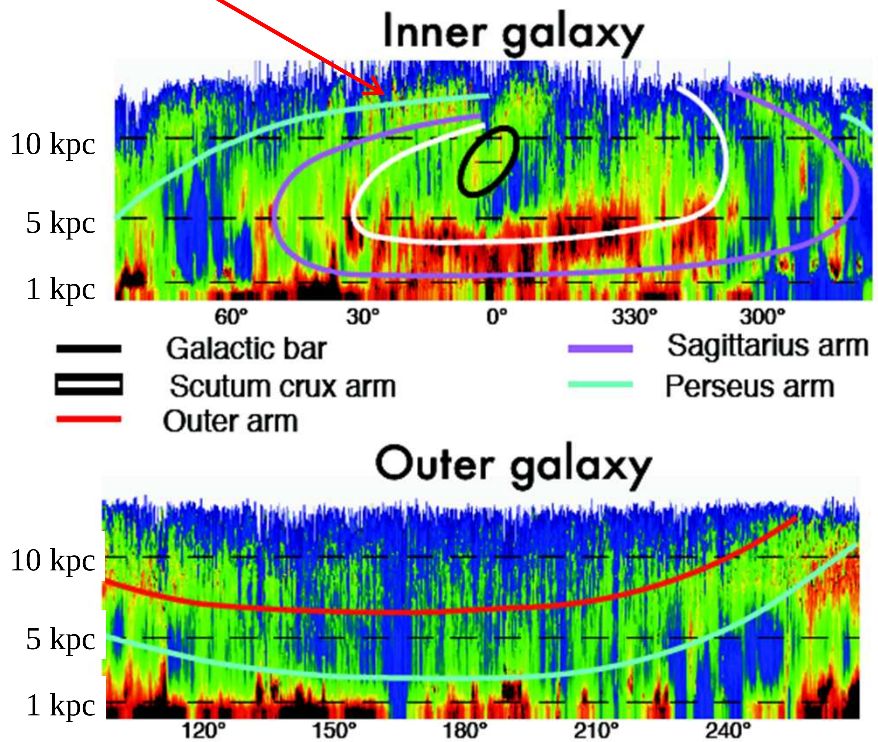


- 3D extinction map of the Galactic plane (*Arab, Cambrésy, et al., in prep.*)
  - from 2MASS and the Besançon model using *D. Marshall (AIM/CEA)* method
  - **first detection** of the **Perseus arm** behind the Galactic bulge
- Next: comparison with dust and gas emission to derive ISM properties along the line of sight (*PCMI program: GALETTE*)

Perseus arm

Confirmed structures in color (Dame, Thaddeus)

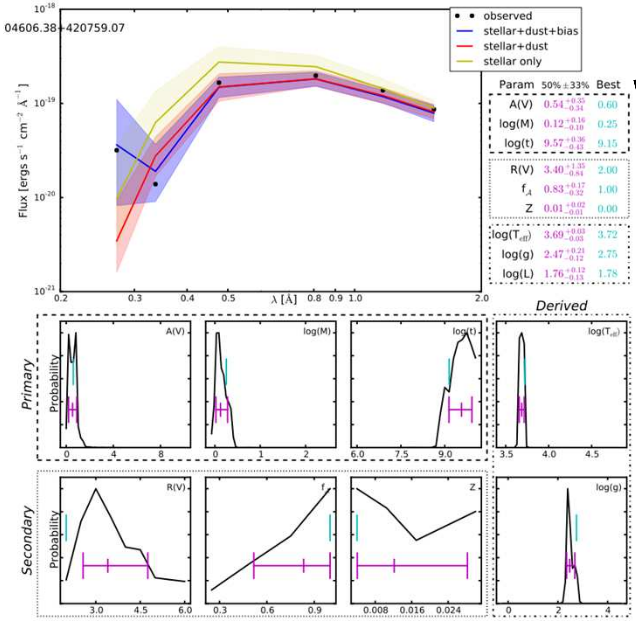




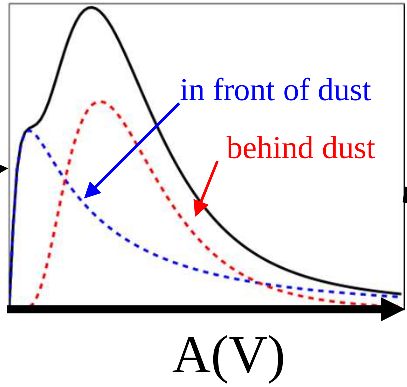
MegaBEAST : Arab et al. 2017 (in prep)

Hierarchical model for dust extinction and stellar parameter mapping in nearby galaxies

from BEAST SED fitter (Gordon et al. 2016)

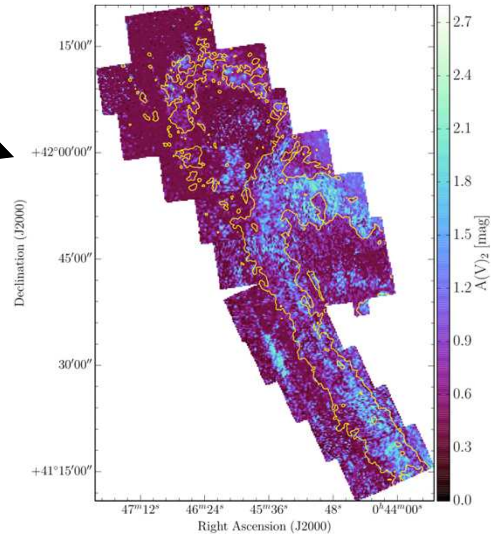


Stellar age, mass and metallicity + A(V), R(V) and Extinction curve's shape

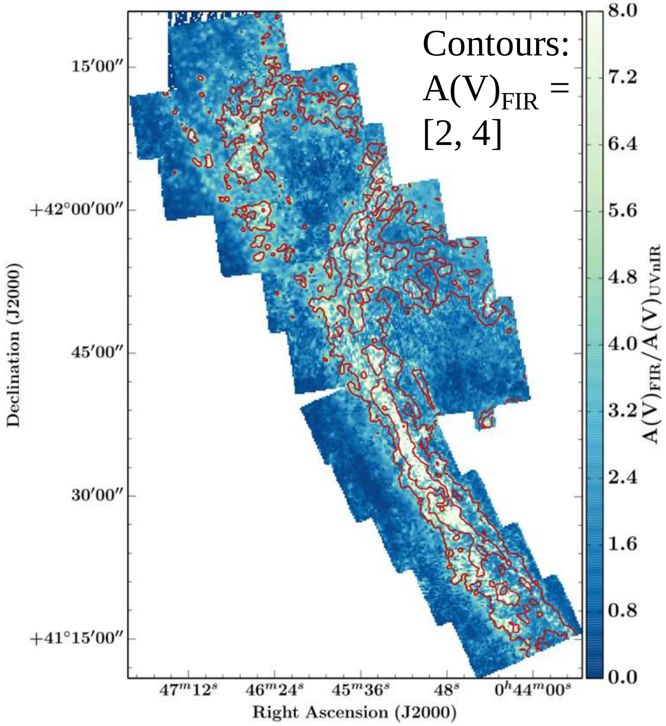


Fit the parameter distribution in a pixel

Get a parameter map (e.g. A(V))



Results on ~40 millions stars in M31 (PHAT survey)



Ratio map $A(V)_{FIR}/A(V)_{MegaBEAST}$

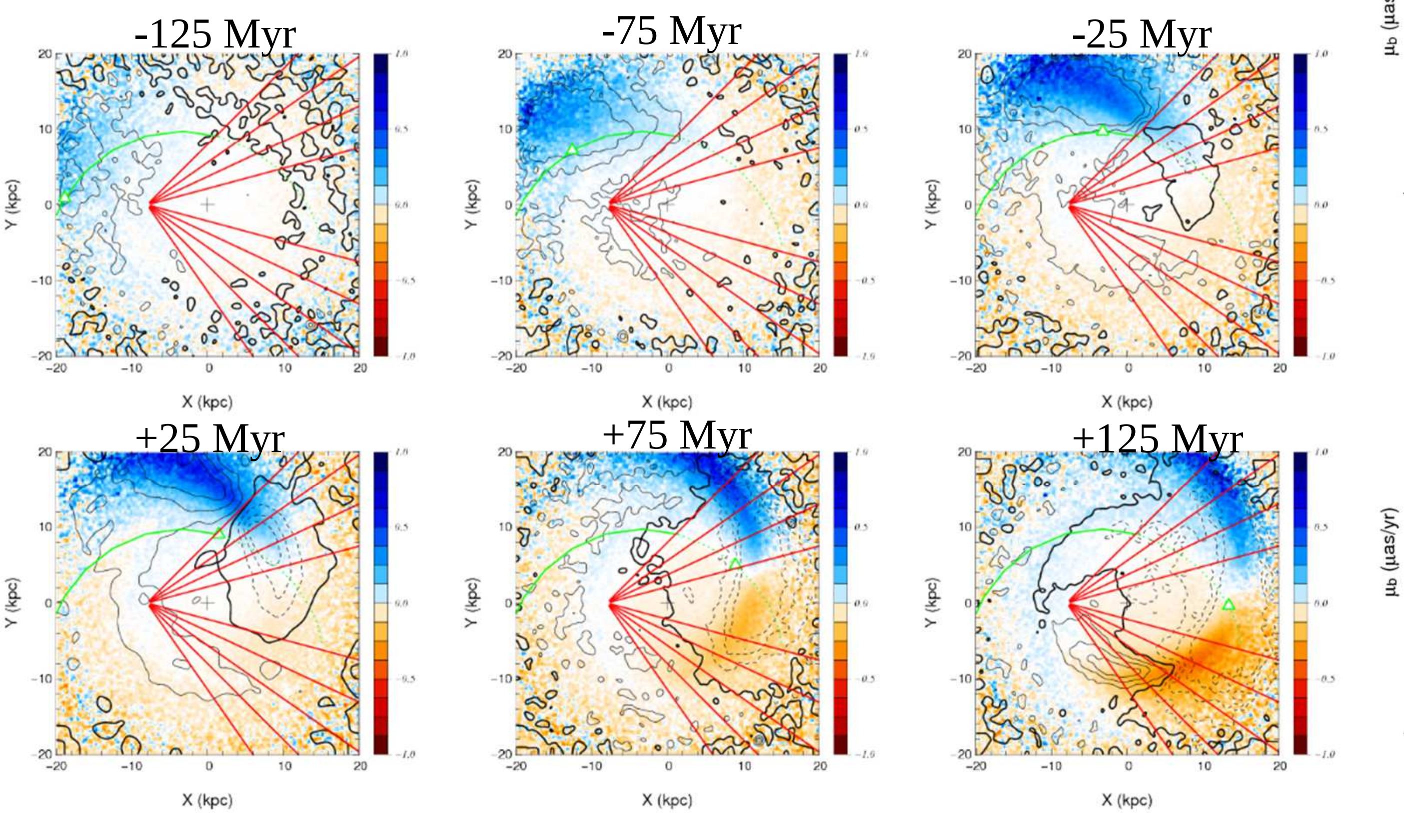
Shows regions affected by dust emissivity enhancement

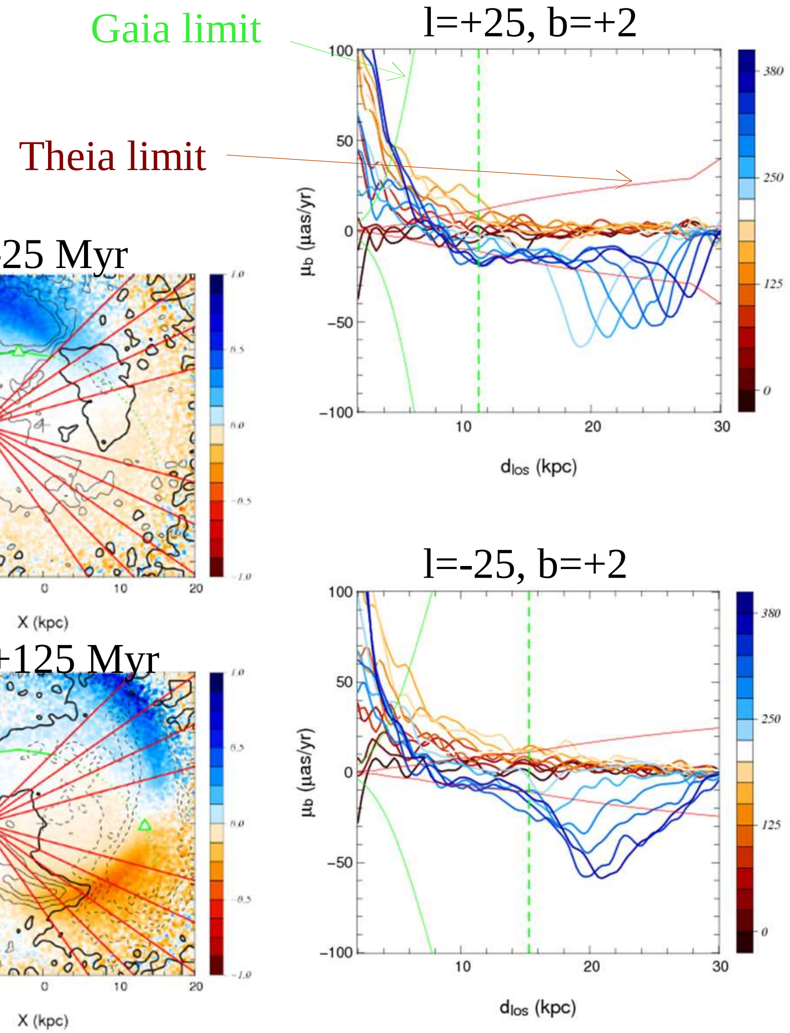
Consistent with dust coagulation in dense regions

Simulations of the development of bending modes due to satellite interaction : case study for Theia (A. Siebert)

Time evolution: astrometric signature in μ_b over 300 Myr

Color: mean vertical displacement in kpc
Contours: bending mode in vertical velocity space via a local linear model of the vertical velocity field

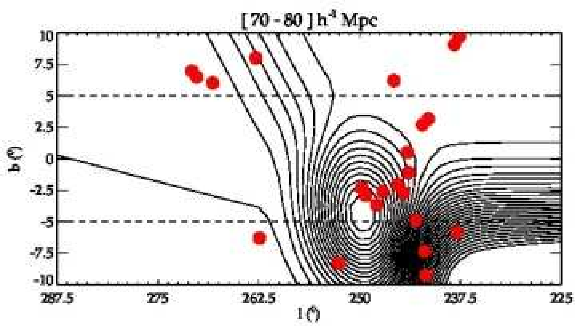


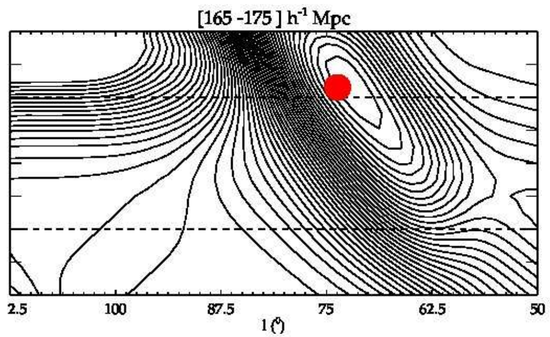


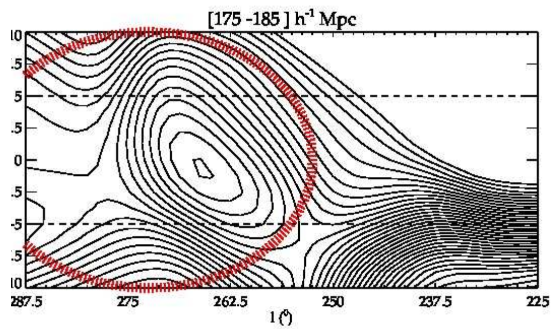
Local Universe-like Simulations (Sorce et al. 2017c)

2017 result: Using local Universe-like simulations
to predict structures in the Zone of Avoidance

Average density field (contours) of constrained realizations of the local Universe.
3 slices of the Zone of Avoidance at different distances from us:







Puppis 3 cluster
tiny red filled circles = galaxies (CDS-VizieR)
(Chamaraux & Masnou 2004)

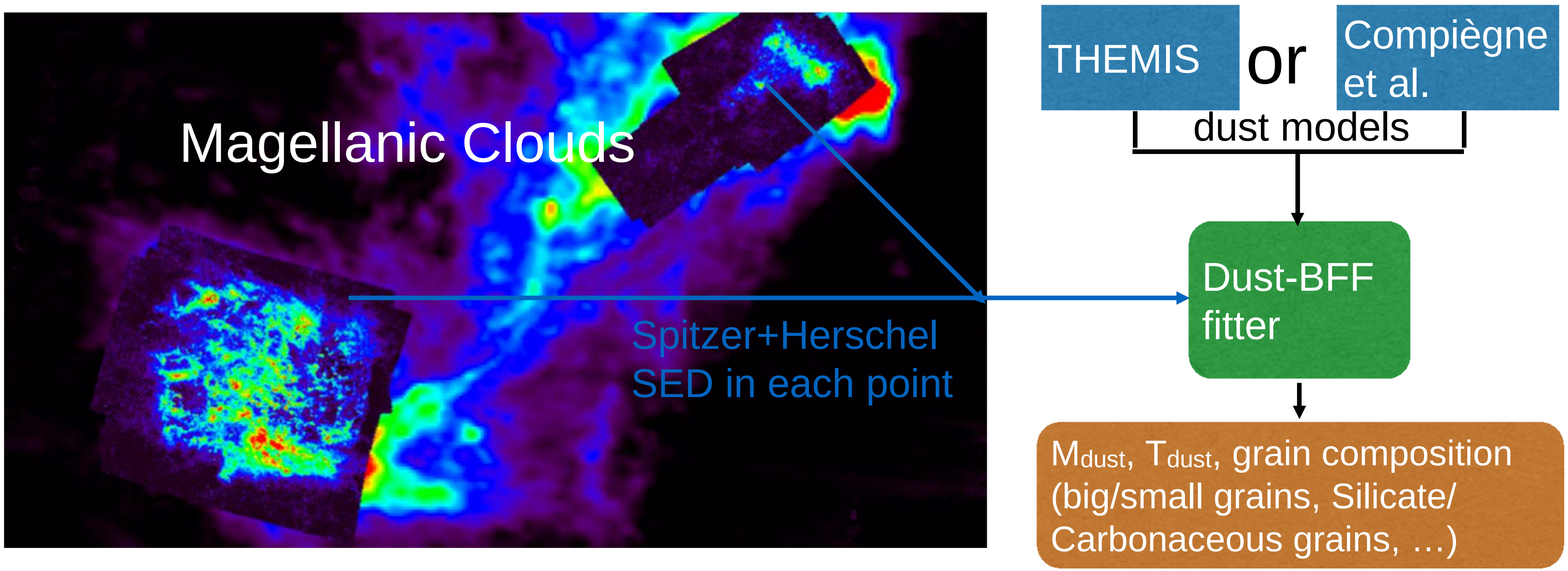
Cygnus A cluster
red filled circles = cluster (CDS-VizieR)
(CIZA project, Ebeling et al. 2002)

Vela Supercluster
ellipse = predictions from observations
(Kraan-Korteweg et al. 2017)

- Other 2017 results: improving the technique to build local Universe-like simulations (Sorce et al. 2017a,b)
- Ongoing project: zoom-in simulations of the Virgo cluster

Dust emission in the Magellanic Clouds

Chastenet J., Bot C., Gordon K., et al. (2017)

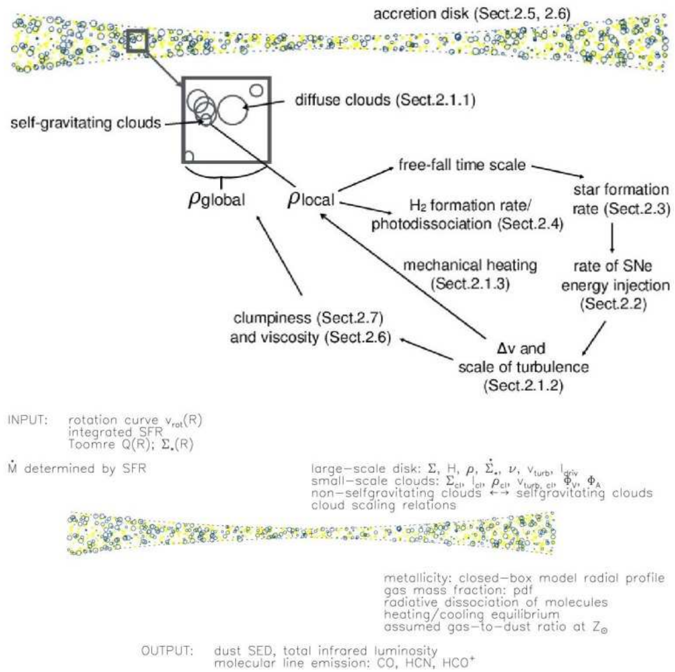


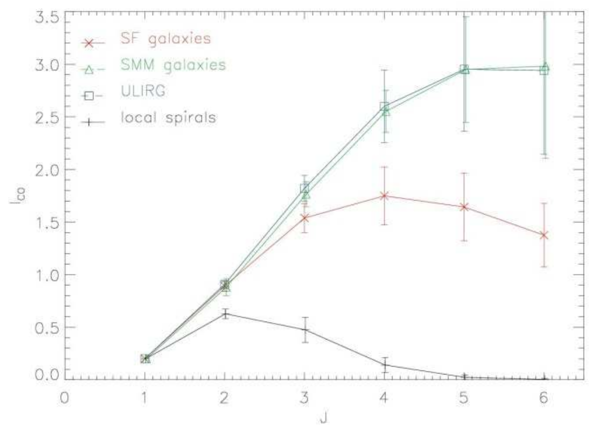
- <u>THEMIS dust model</u> better reproduces shape of SED in Magellanic Clouds
- **Silicates/Carbon ratio has to be different in SMC than in the Milky Way** (10 times lower) -> different grain composition/formation

Predicting HCN, HCO^+, multi-transition CO, and dust emission of star-forming galaxies

Vollmer, Gratier, Braine & Bot (2017)

- Analytical model for clumpy accretion disks applied to galactic gas disks
- Input: size, integrated star formation rate, stellar mass radial profile, rotation curve, and Toomre *Q*
- Output: total gas mass, HI/H_2 mass, the gas velocity dispersion, IR luminosity, IR spectral energy distribution, CO spectral line energy distribution (SLED), HCN(1–0) and HCO^+(1–0) emission
- CO conversion factor, influence of IR pumping on HCN emission, star formation laws





Conclusion

- Scientists are part of an integrated team
- Scientific diversity is vital for the CDS
- External and internal acknowledgement of the scientific value is welcome
- active science @ CDS
- CDS scientists mostly rely on external collaborations
- Scientific independence is important