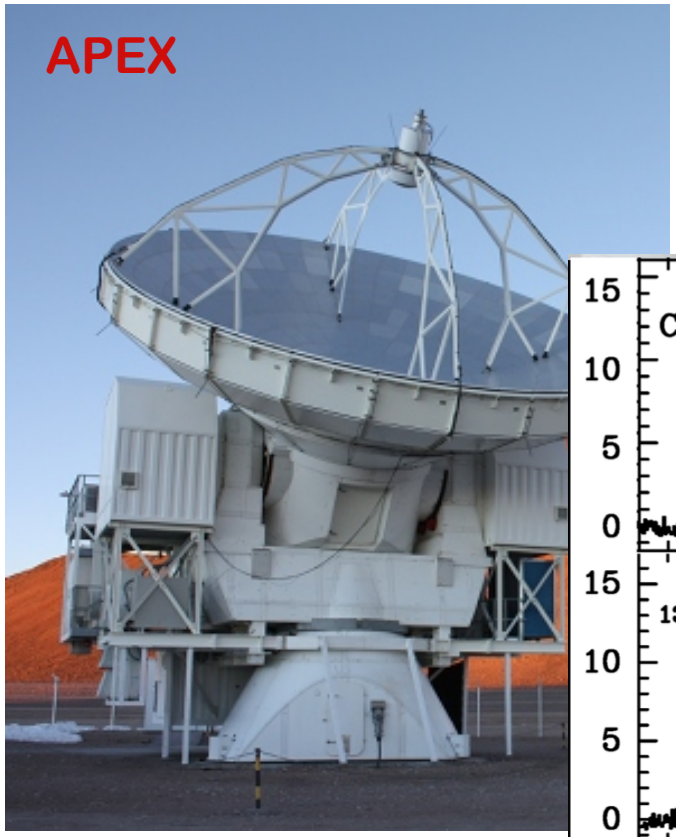
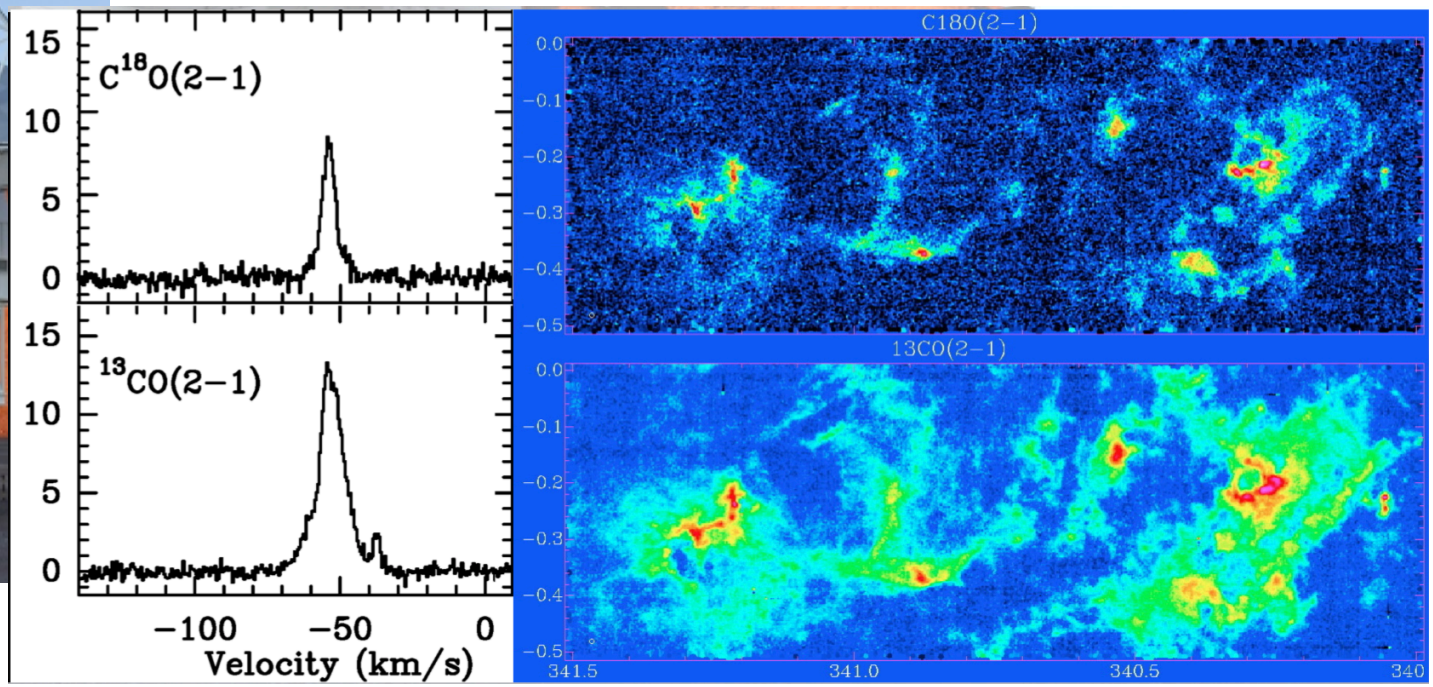
SEDIGISM

Structure, excitation, and dynamics of the inner Galactic interstellar medium

University of Kent



Overview of the Survey and 1st Full Data Release



Schuller et al. 2017, A&A, 504, 415

James Urquhart

On behalf of the SEDIGISM team and the APEX Partners

University of Kent

Astronomy & Astrophysics manuscript no. output
January 28, 2020
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SEDIGISM: Structure, excitation, and dynamics of the inner Galactic interstellar medium★

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[13] Euro[illegible] [illegible]vatory, Karl-Schwarzschild-Str. 2, D-85748 Garching bei München, Germany
[14] A[illegible] [illegible]n Institute, Liverpool John Moores University, 146 Brownlow Hill, Liverpool, L3 5RF, United Kingdom
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January 28, 2020

43 Researchers from 19 Institutions

Schuller et al. 2017
A&A, 631, A124

Publication of Core Papers and Data Release

University of Kent

Paper I
SEDIGISM: Structure, excitation, and dynamics of the inner Galactic interstellar medium
Schuller et al., 2017, A&A, 601, 124

Paper II
SEDIGISM Survey: First data release and overview of Galactic structure
Schuller et al., 2021, MNRAS, 500, 3064

Paper III
SEDIGISM Survey: Molecular clouds in the inner Galaxy
Duarte-Cabral et al., 2021, MNRAS, 500, 3027

Paper IV
SEDIGISM-ATLASGAL: Physical and star-forming properties of molecular clouds and dense clumps across the Galactic disk
Urquhart et al., 2021, MNRAS, 500, 3050

Paper V
SEDIGISM Survey: The influence of spiral arms on the molecular gas distribution of the inner Milky Way
Colombo et al., 2021, A&A, Submitted.

Other Papers

- SEDIGISM: the kinematics of ATLASGAL filaments ; Mattern, M., Kauffmann, J., Csengeri, T., Urquhart, J. S., Leurini, S., Wyrowski, F., Giannetti, A., Barnes, P. J., Beuther, H., Bronfman, L., Duarte-Cabral, A., Henning, T., Kainulainen, J., Menten, K. M., Schisano, E., Schuller, F., **2018, A&A, 619, 24.**
- HII regions and high-mass starless clump candidates. I. Catalogs and properties; Zhang, S.; Zavagno, A.; Yuan, J.; Liu, H. Figueira, M. Russeil, D. Schuller, F. Marsh, K. A. Wu, Y., **2020, A&A, 637, 40.**
- Molecular envelope around the HII region RCW 120; Kirsanova, M. S. Pavlyuchenkov, Ya N. Wiebe, D. S. Boley, P. A. Salii, S. V. Kalenskii, S. V. Sobolev, A. M. Anderson, L. D., **2019, MNRAS, 488, 5641.**
- A multiwavelength study of filamentary cloud G341.244-00.265; Yu, Nai-Ping, Xu, Jing-Long, Wang, Jun-Jie, **2019, A&A, 622, 155.**
- Massive and low-mass protostars in massive "starless" cores; Pillai, Thushara, Kauffmann, Jens, Zhang, Qizhou, Sanhueza, Patricio, Leurini, Silvia, Wang, Ke, Sridharan, T. K., Koenig, Carsten, **2019, A&A, 622, 54.**

Primary Goals

- Investigate the effect of Galactic environment on earliest stages of High-mass Star formation
- Link between clumps, filaments, clouds and GMCs
- Large scale detailed view of the 3D structure of the Galactic ISM, from clump scales (~ pc) to Galactic scales (spiral arms ~ 10s kpc)

Survey Coverage

- Spectral Line Survey (^{13}CO + $C^{18}O$) of the Southern Galactic plane
  - 300° < ℓ < 18°, |b| < 0.5°
  - 29° < ℓ < 31°, |b| < 0.5°
  - total coverage is 84 deg^2

Taylor & Cordes (1993), Cordes (2004)

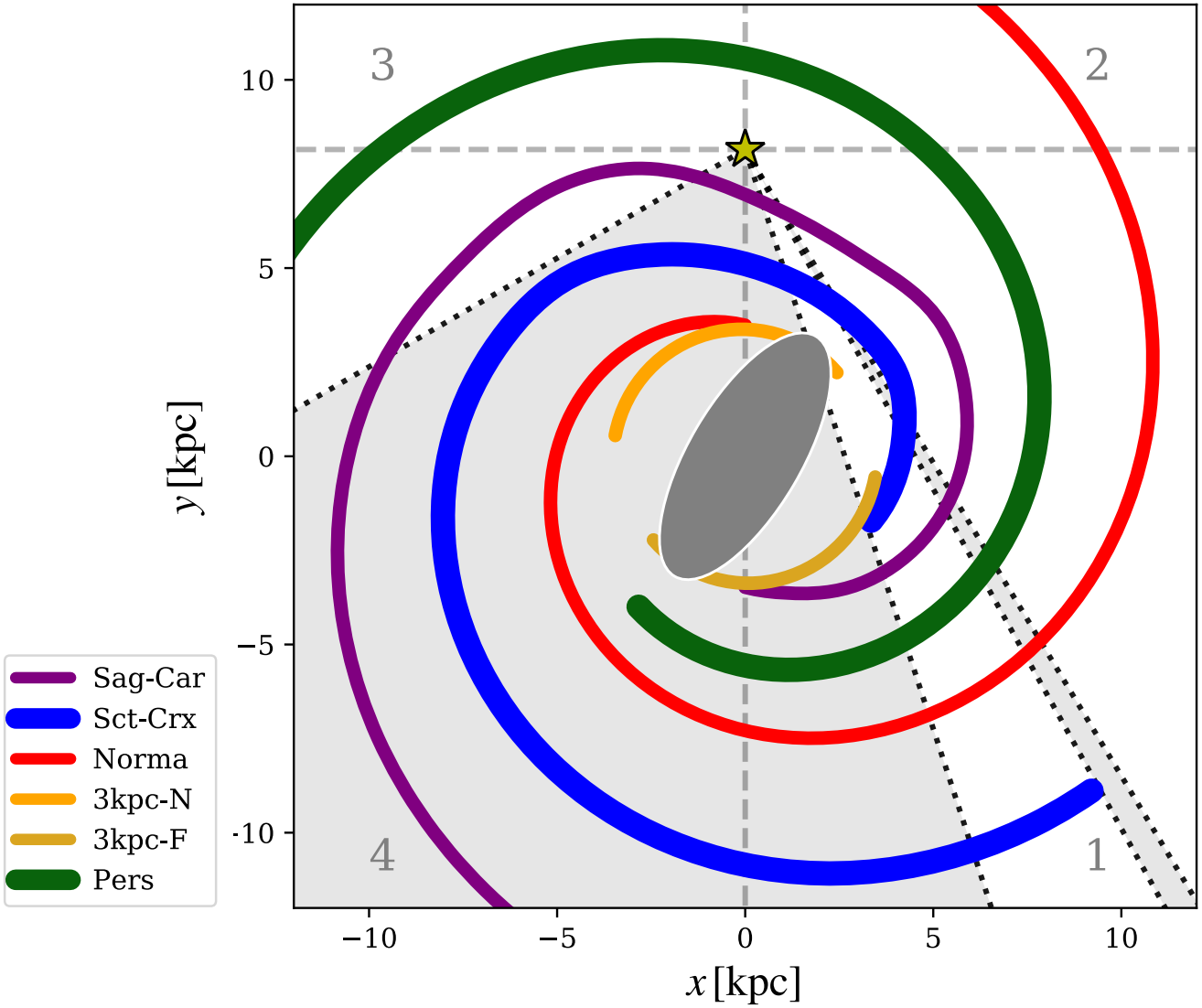

Image Credit: Alex Pettitt

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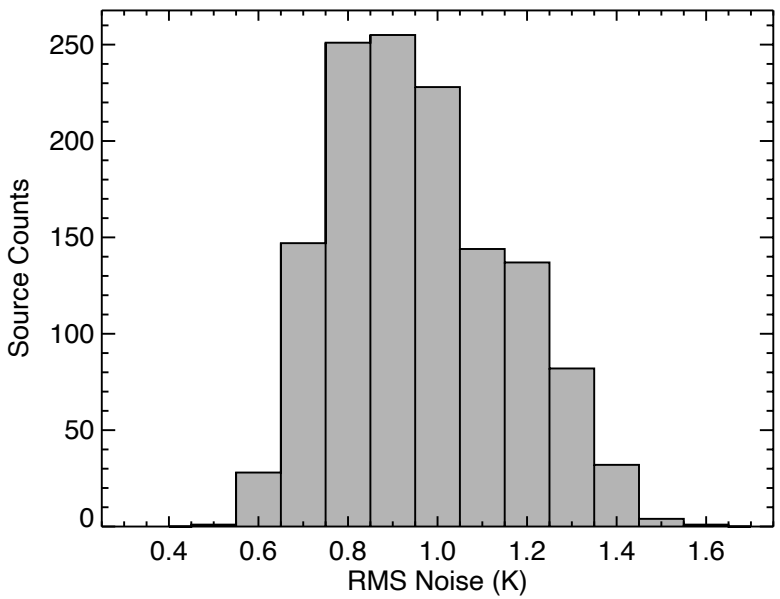
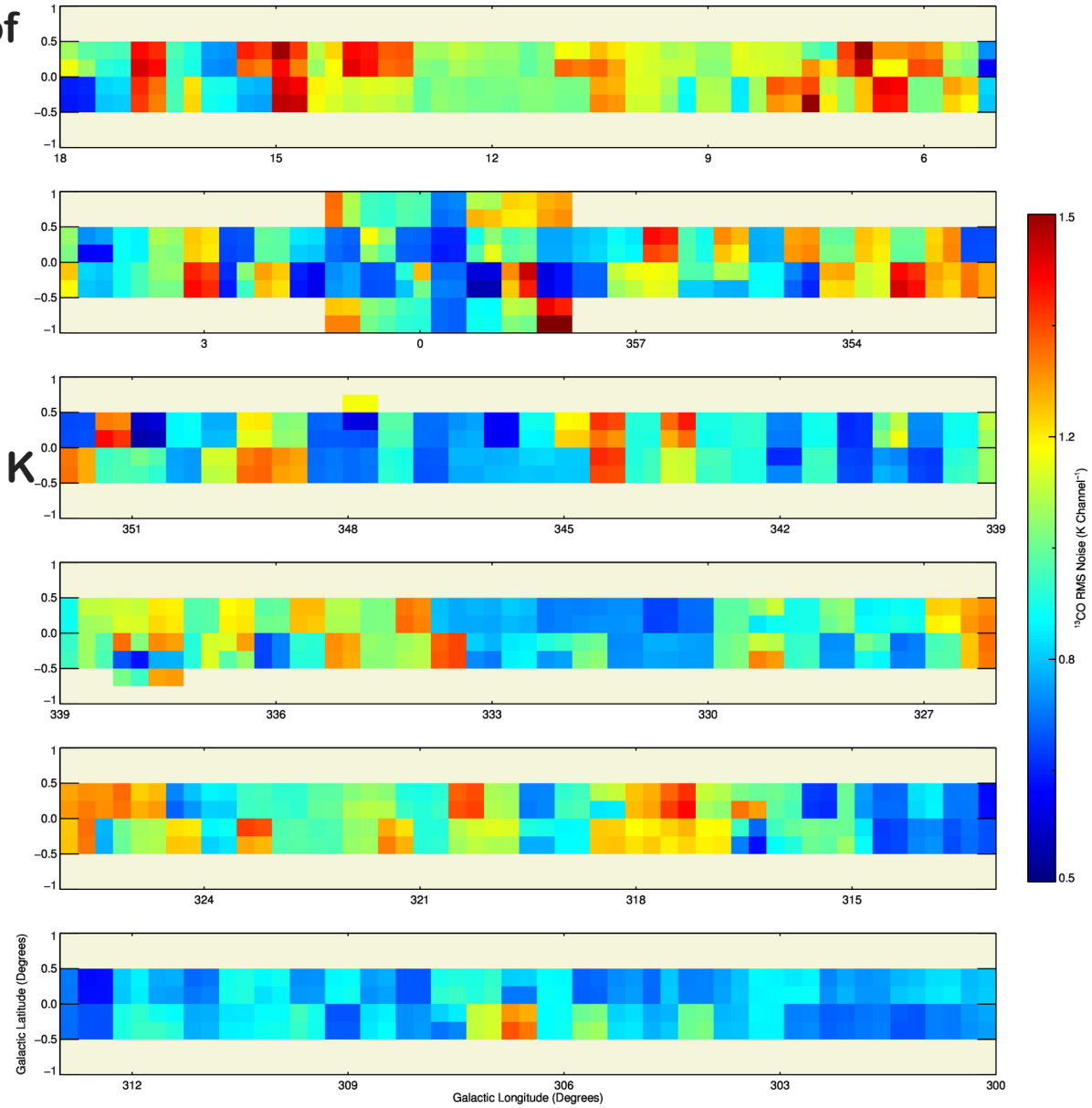
- Using the SHFI receiver with ang. resolution of ~30″ and sensitivity ~1 K





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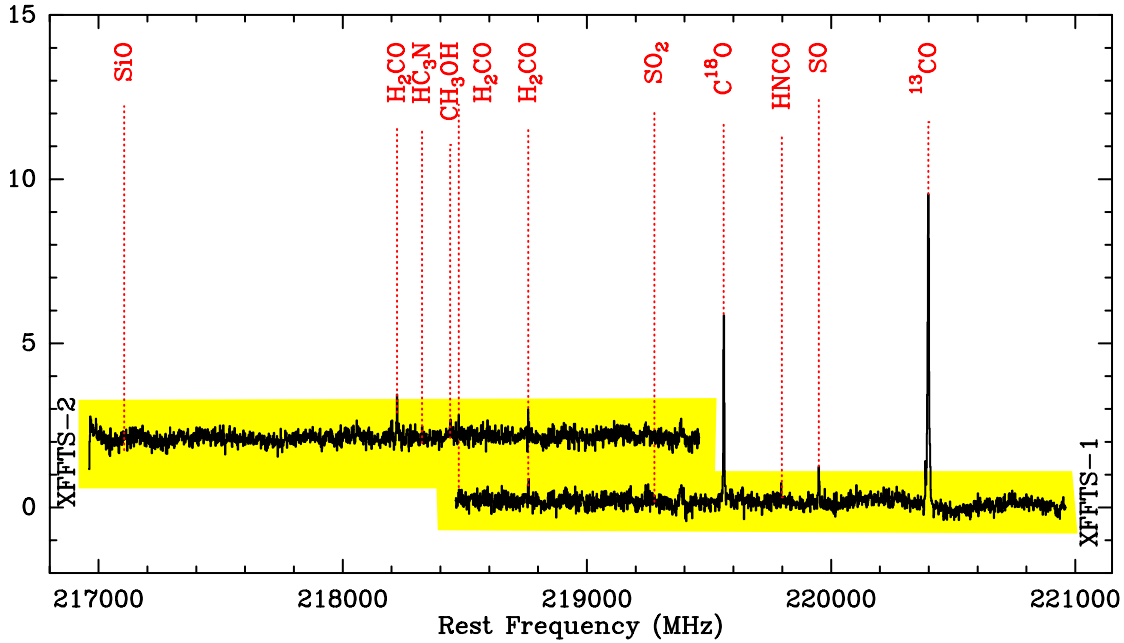
- Set up covers 4 GHz bandwidth



Species	Transition	Frequency (GHz)	E_L (K)
CH_3CN	J = 12–11, K = 0	220.7473	58.3
^{13}CO	J = 2–1	220.3987	5.3
SO	J = 5–4	219.9494	24.4
HNCO	J = 10–9, K = 0	219.7983	47.5
$C^{18}O$	J = 2–1	219.5604	5.3
SO_2	J = 22–23, K = 7–6	219.2760	342.2
H_2CO	$(3_{2,1}–2_{2,0})$	218.7601	57.6
H_2CO	$(3_{2,2}–2_{2,1})$	218.4756	57.6
CH_3OH	J = 4–3, K = 2–1 E	218.4401	35.0
HC_3N	J = 24–23	218.3247	120.5
H_2CO	$(3_{0,3}–2_{0,2})$	218.2222	10.5
SiO	J = 5–4	217.1050	20.8

Schuller et al. 2017, A&A, 631, A124

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Survey Coverage

- Spectral Line Survey (^{13}CO + $C^{18}O$) of the Southern Galactic plane
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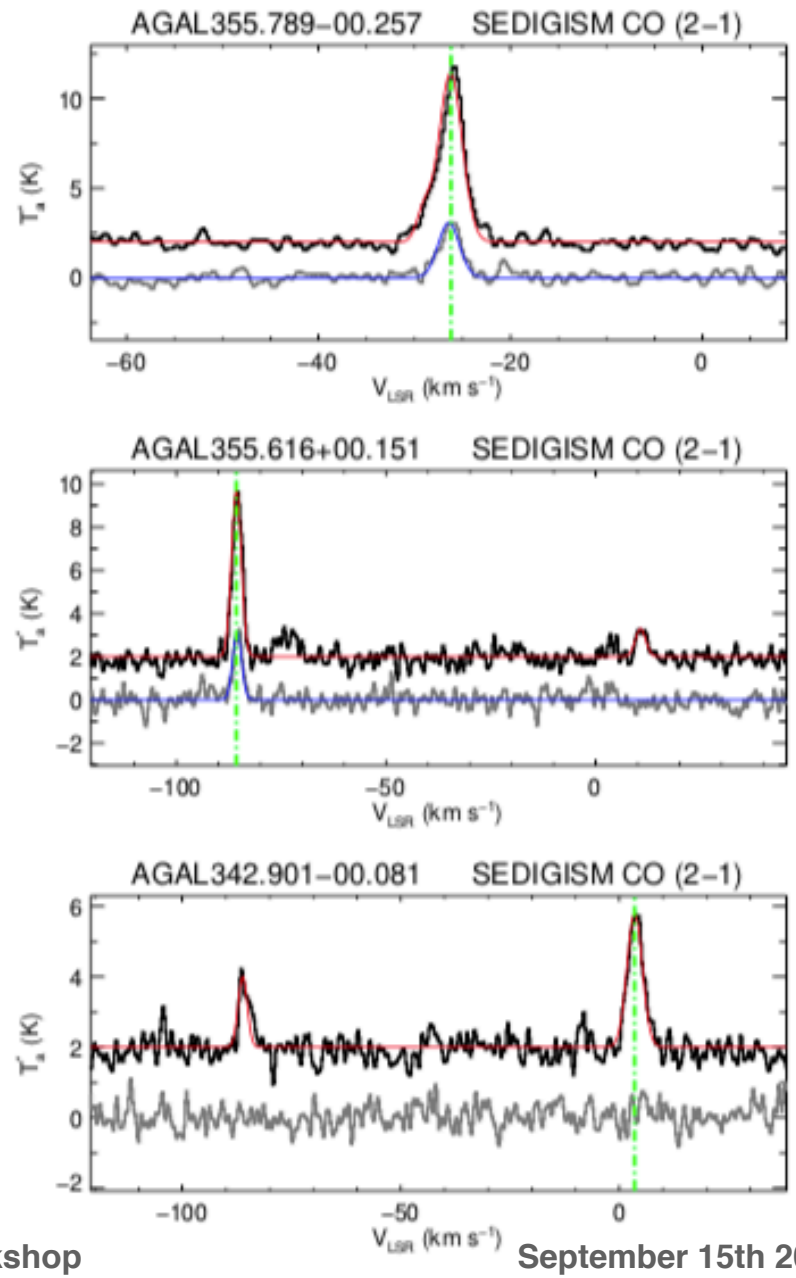
The survey consists of $> 12 \times 10^6$ spectra



Urquhart et al. 2021, MNRAS, 500, 3050

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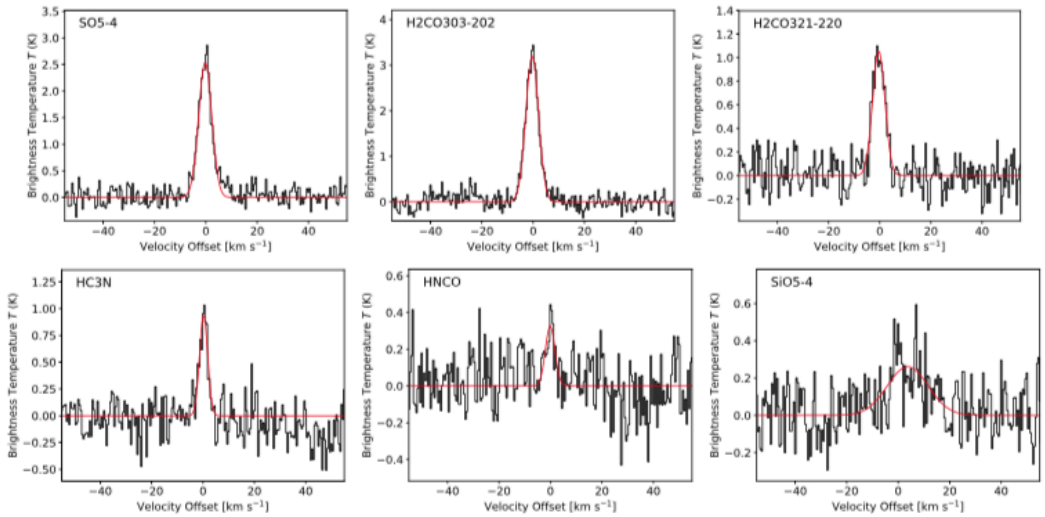
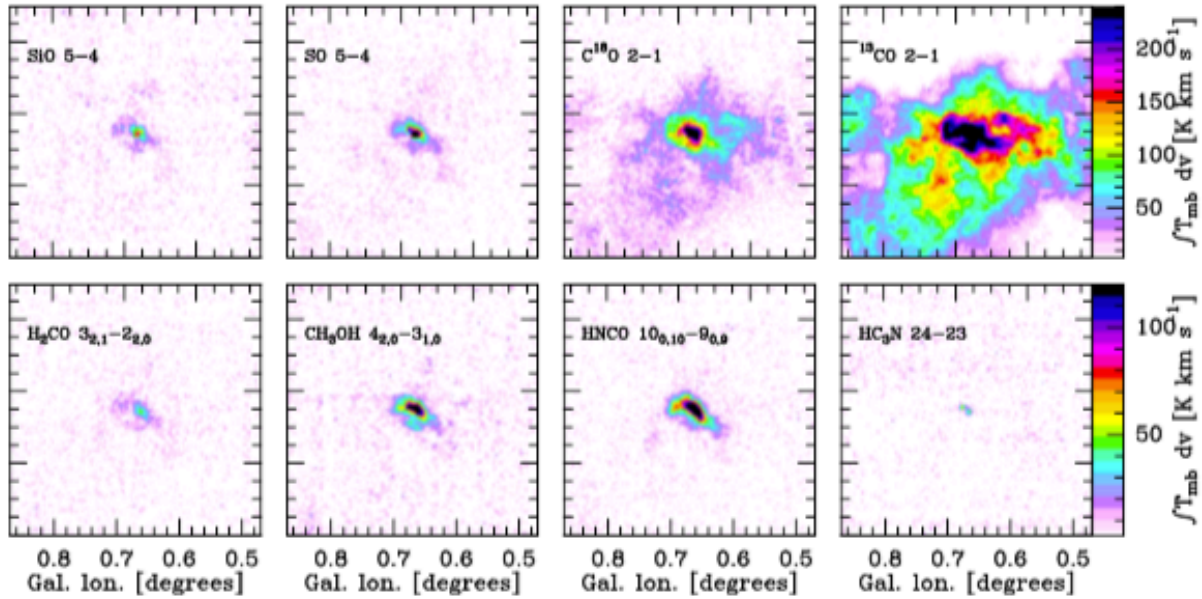
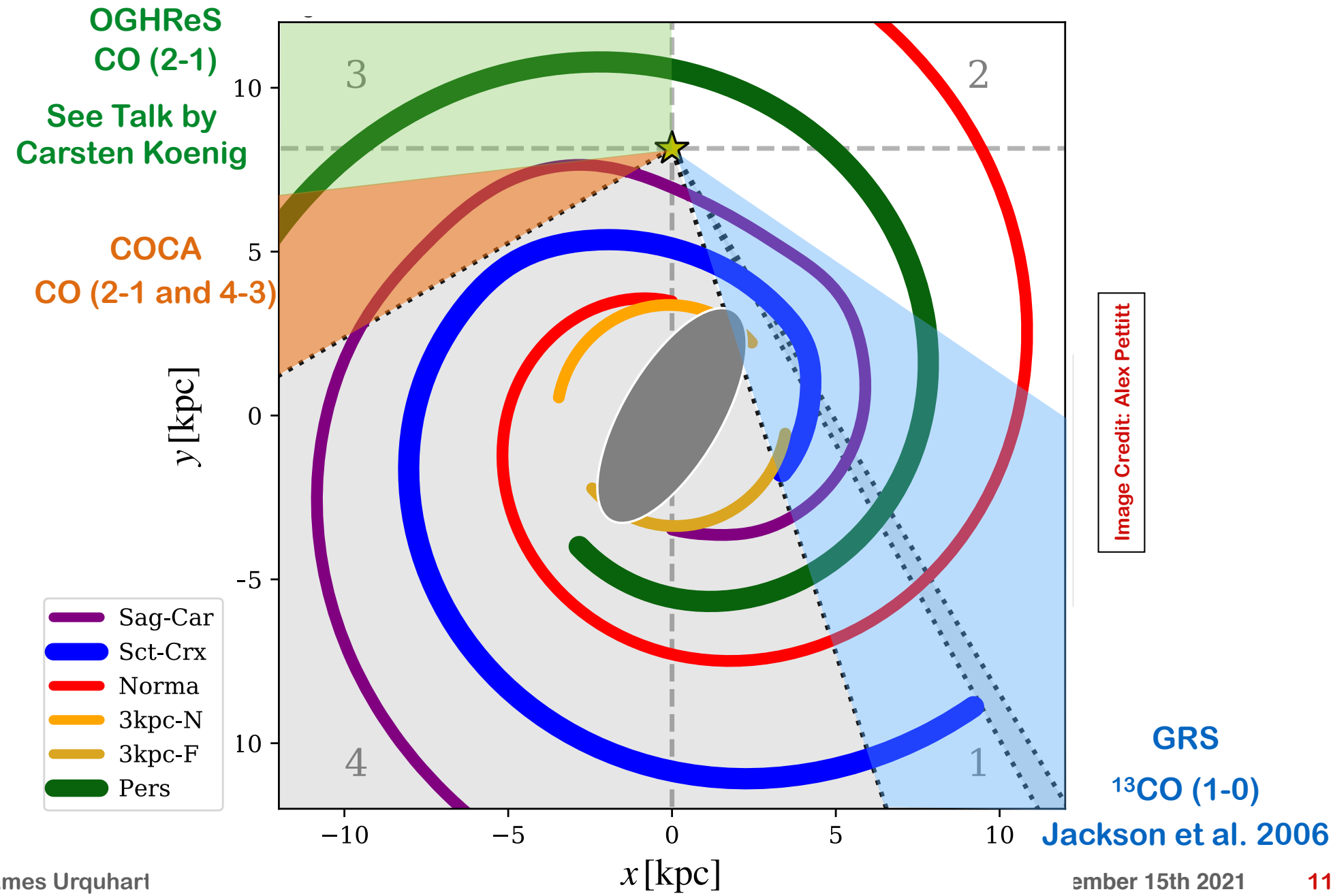
- Using the SHFI receiver with ang. resolution of ~30″ and sensitivity ~1 K
- Set up covers 4 GHz bandwidth
- Observations
  - started Aug 2013
  - ended Sept 2017
- Total time ~ 821 hours
  - Chile 90h
  - Sweden 223h
  - ESO 212h
  - MPI 296h



Schuller et al. 2021, MNRAS, 500, 3064



Complementary Surveys



Complementary Surveys

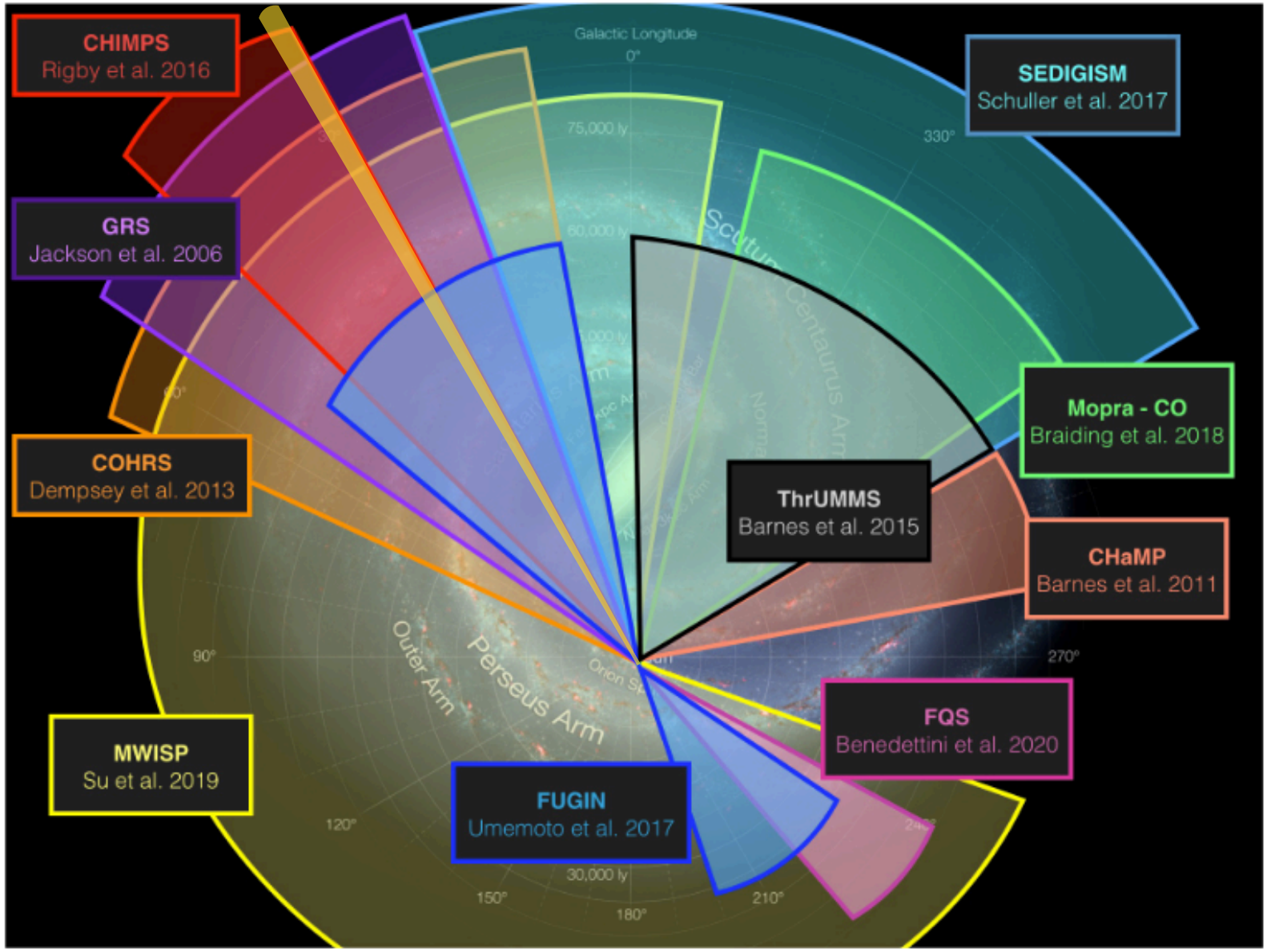
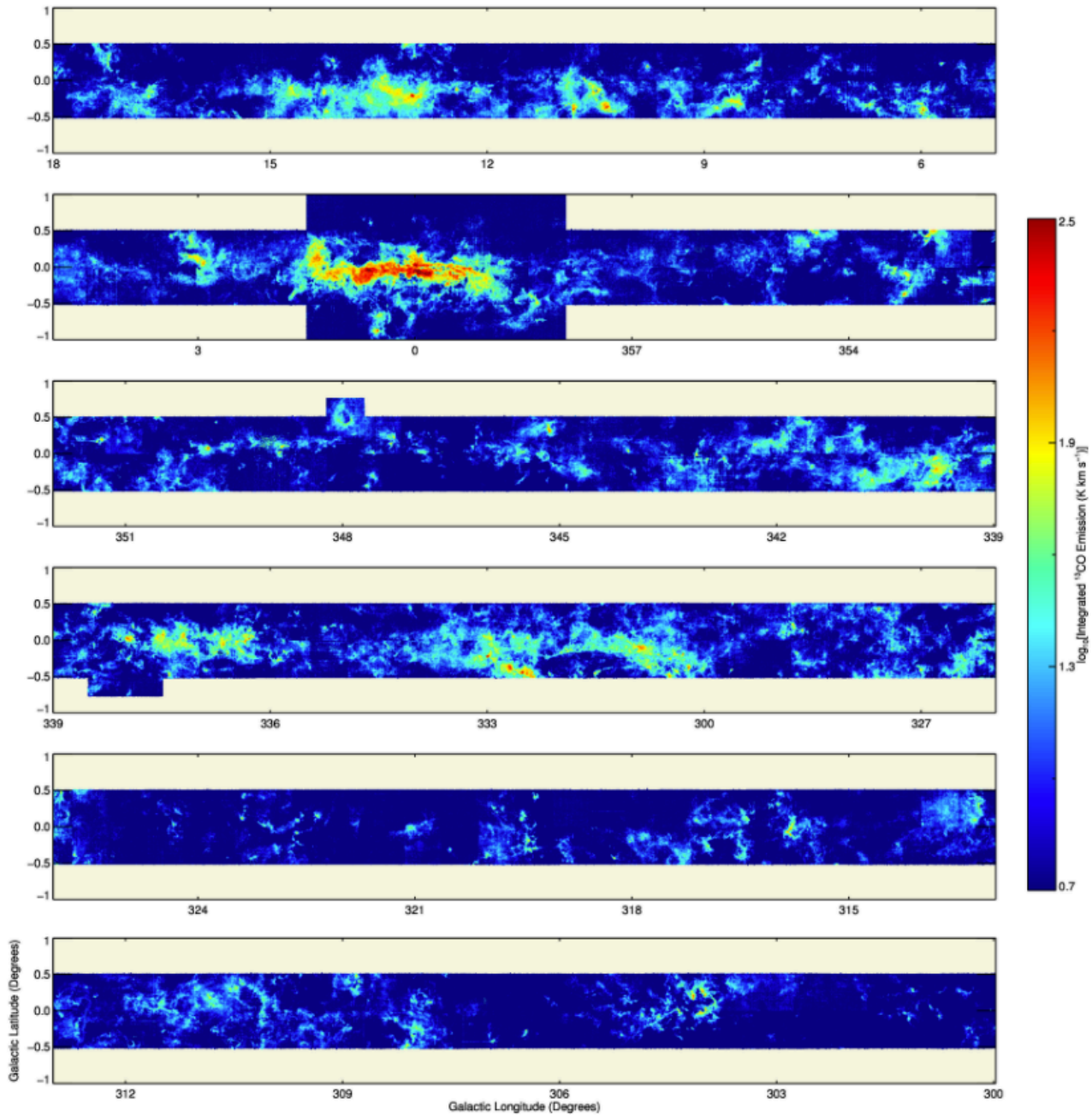


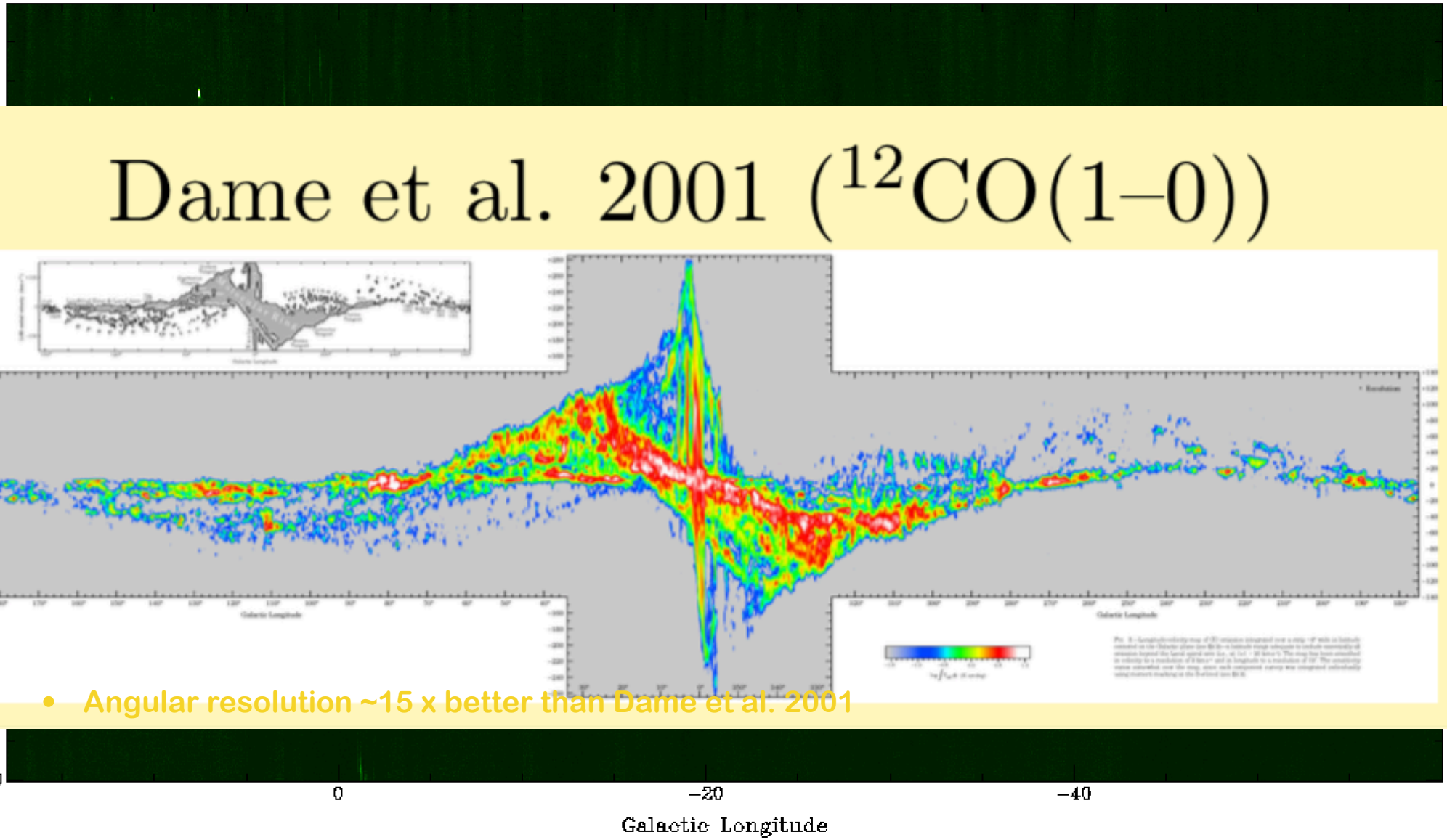
Image Credit: Dario Colombo

Integrated ^{13}CO ℓb map

Schuller et al. 2021, MNRAS, 500, 305

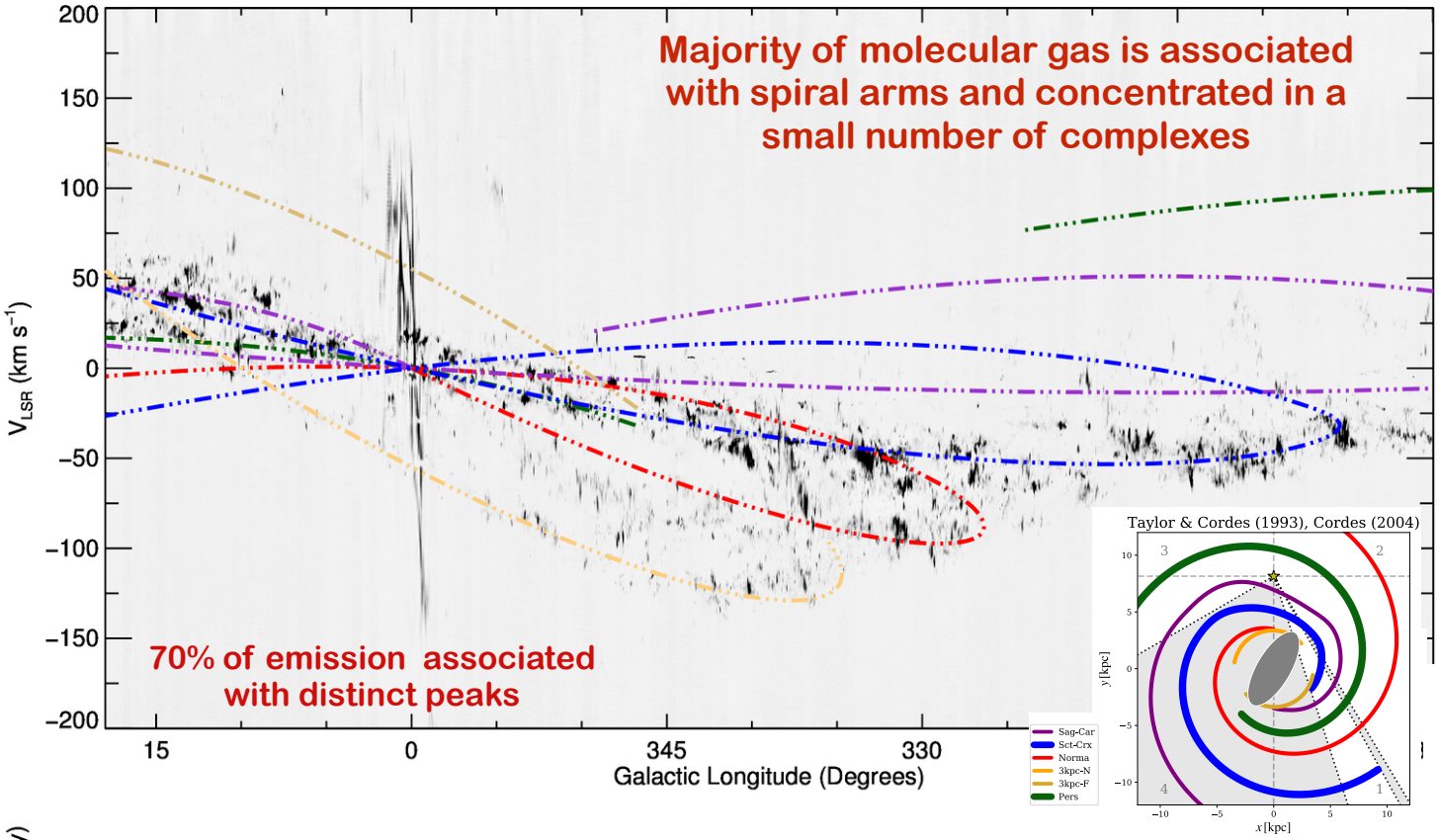


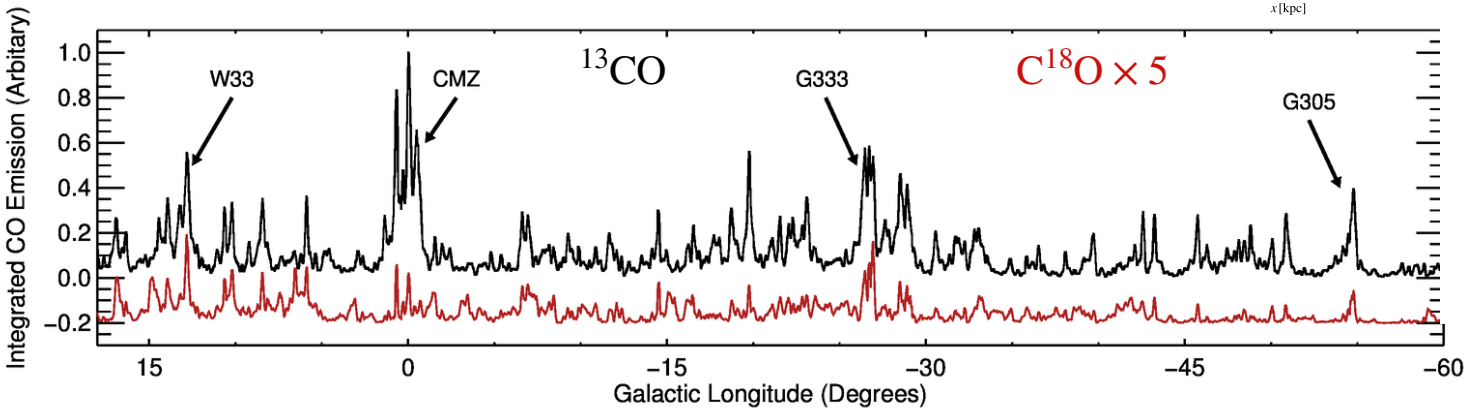
Integrated ^{13}CO ℓv map



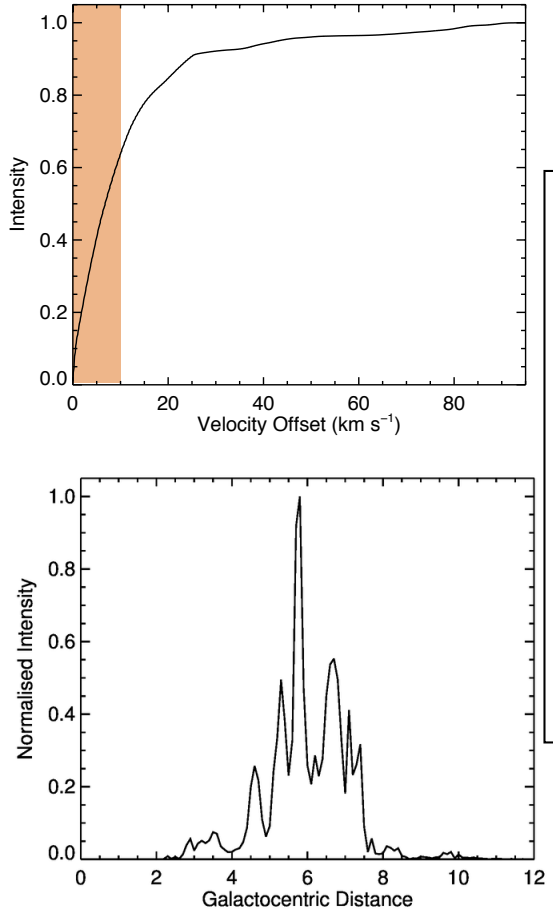
- Angular resolution ~15 x better than Dame et al. 2001

Integrated ^{13}CO ℓv map





Association of ^{13}CO with spiral arms

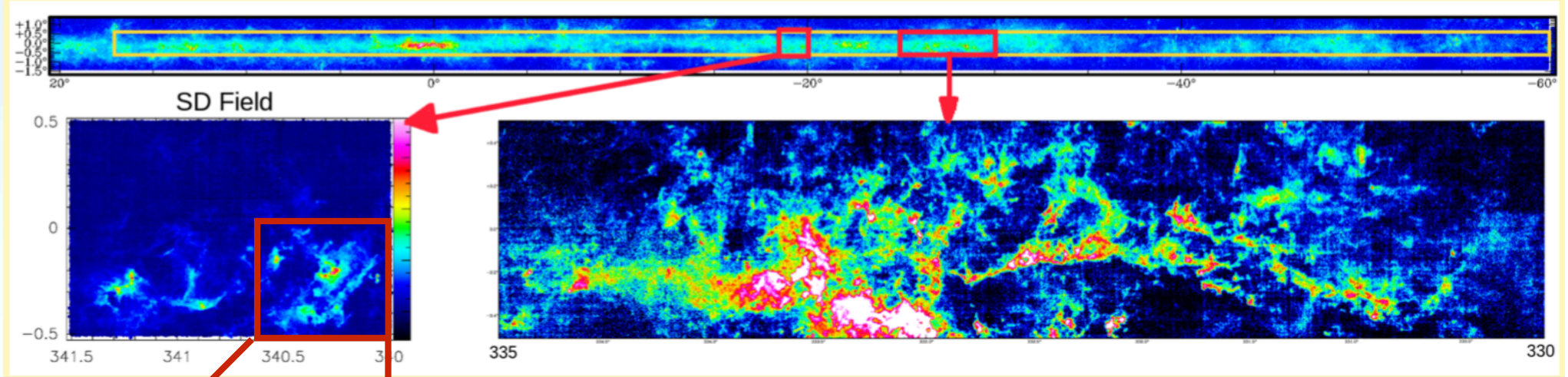


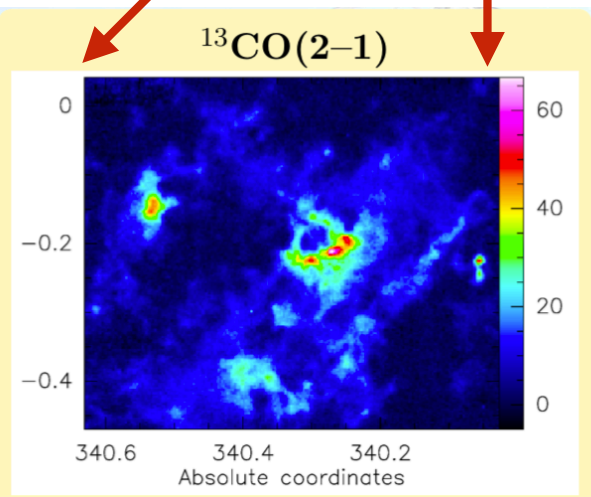
Schuller et al. 2021, MNRAS, 500, 305

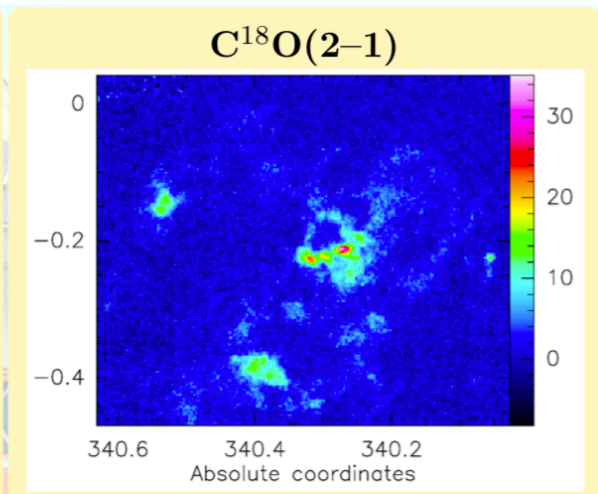
Integrated ^{13}CO ℓb map

University of Kent

Full survey: 80 deg^2



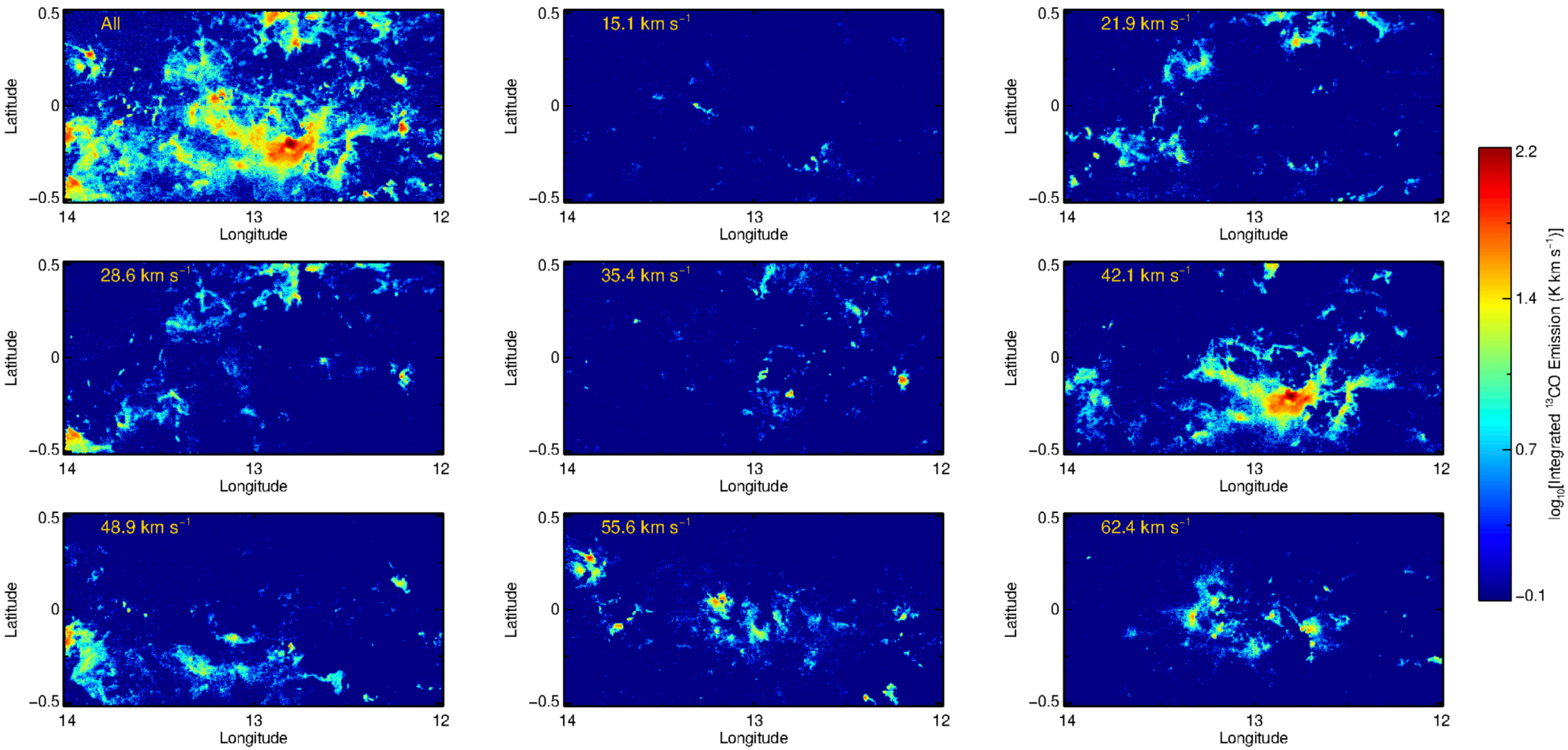




Emission integrated between

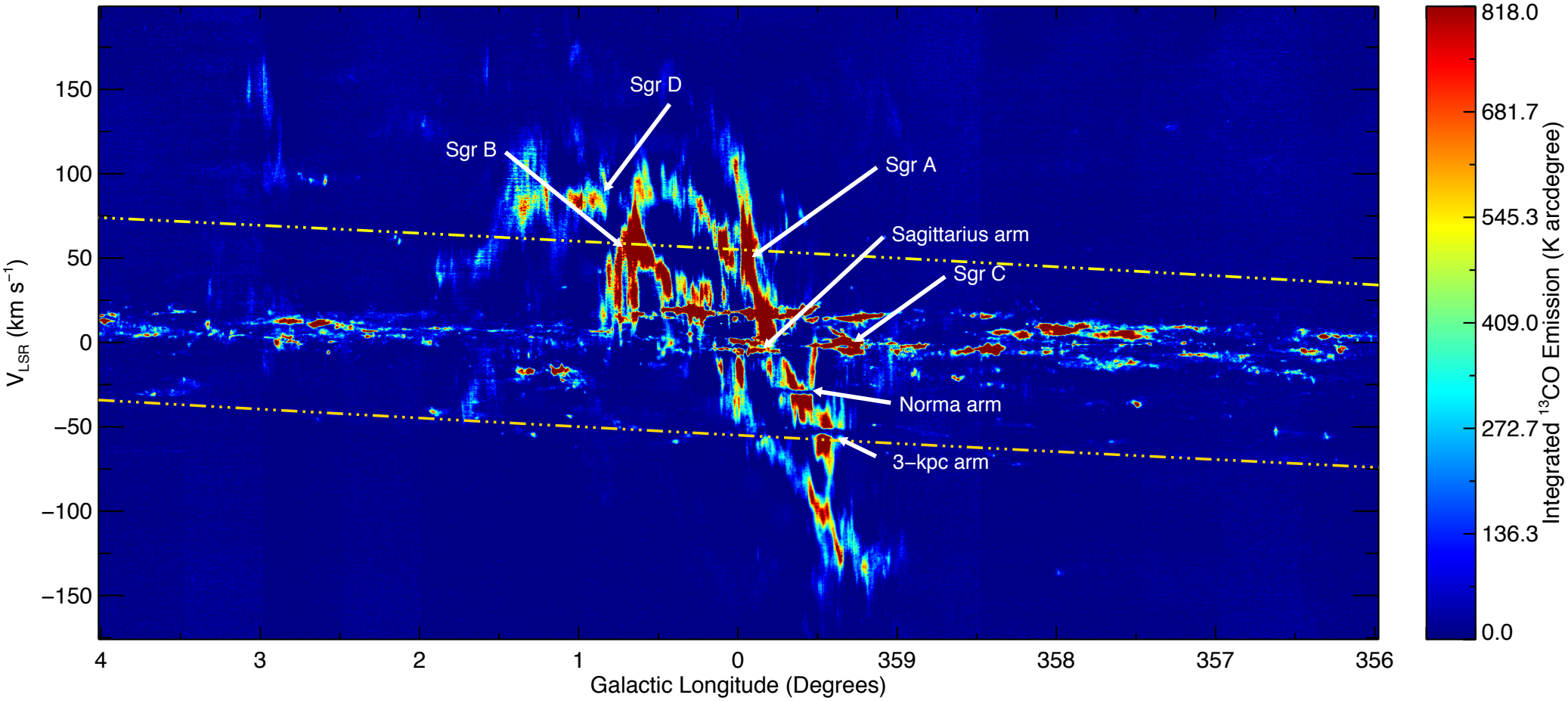
$$-48\,\mathrm{km\,s^{-1}} \leq v_{\mathrm{lsr}} \leq -44\,\mathrm{km\,s^{-1}}$$

Channel Maps Towards W33



Schuller et al. 2021, MNRAS, 500, 305

Channel Maps Towards W33



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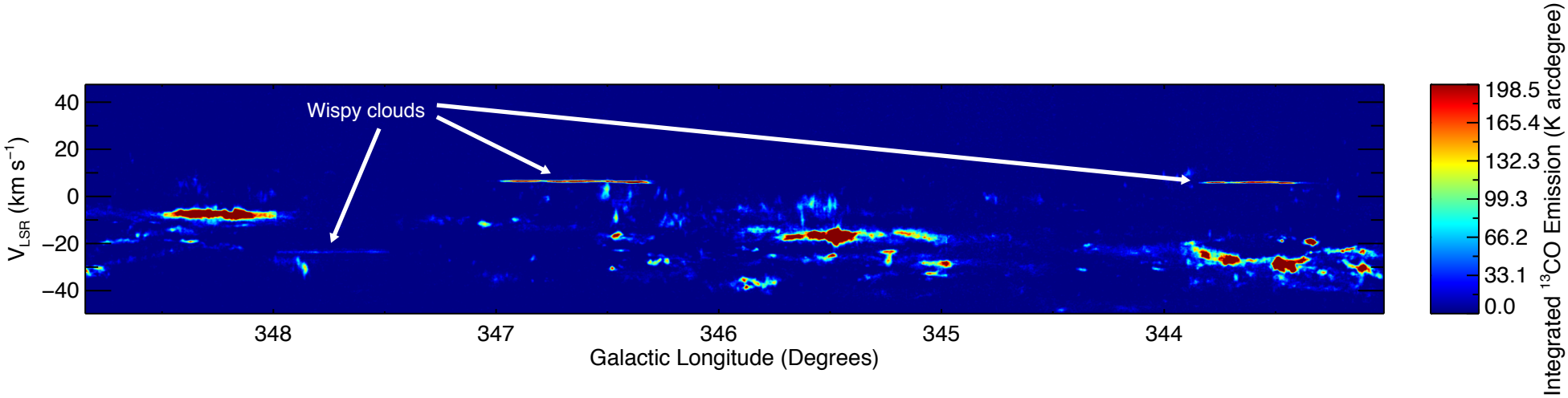

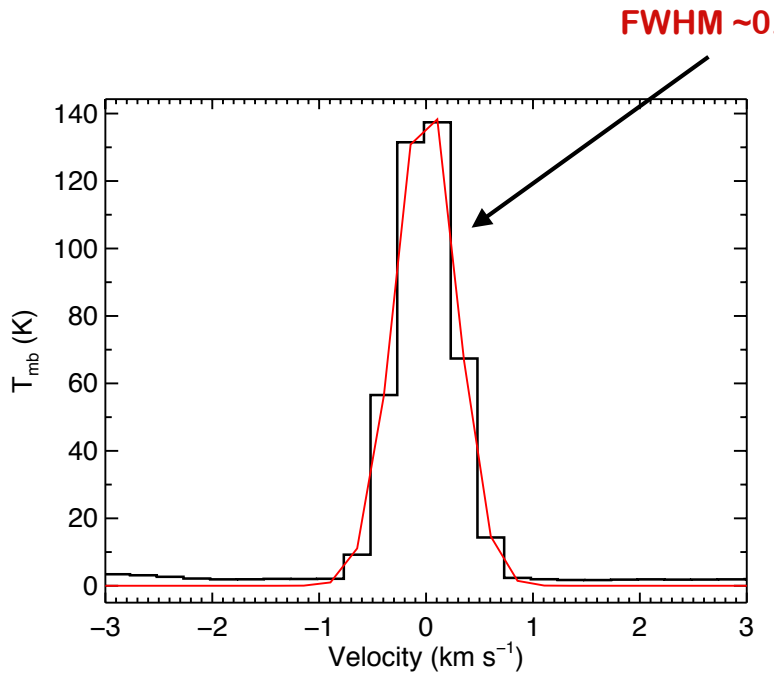

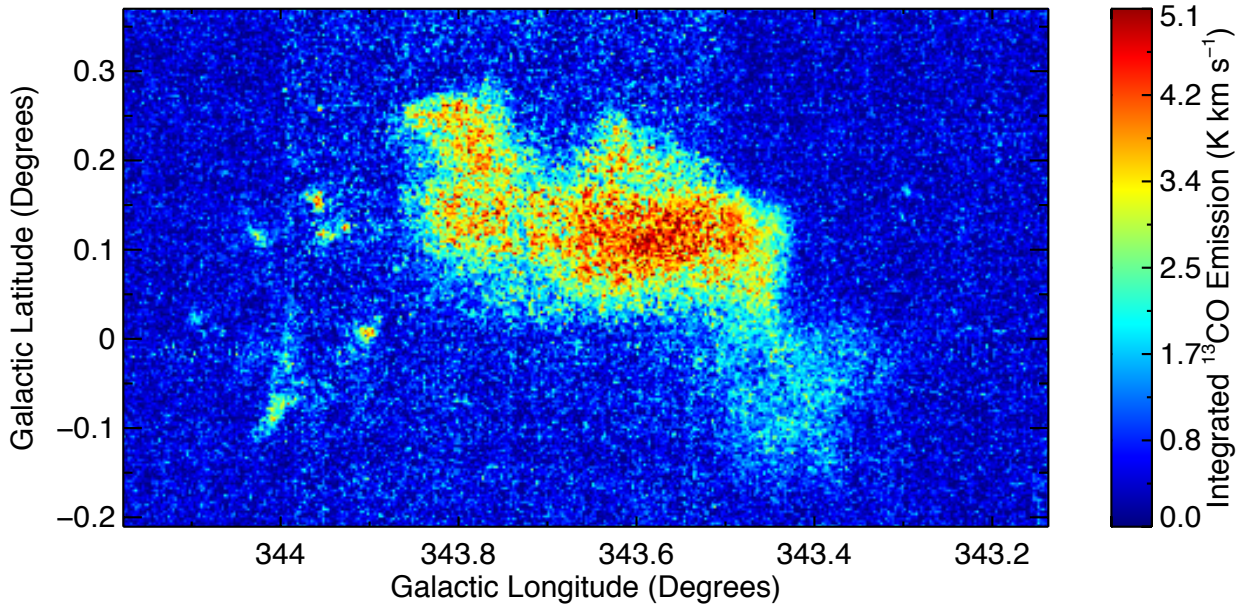

Schuller et al. 2021, MNRAS, 500, 305

Summary: Galactic Structure Working Group

Royal Astronomical Society August 2017

Summary: Galactic Structure Working Group

University of Kent

SEDIGISM Papers

Core Papers

The Overview Paper (Paper 1: Schuller et al.)

↓

Overview of
Galactic Structure (Paper 2: Schuller?)
(Presentation of the data and examination of the longitude-velocity distribution with respect to spiral arms and other large scale features)

↓

Catalogue of GMC (Paper 3: Duarte Cabral)
(Structures and distances to full sample. More detailed investigation into the structures and association with spiral arms)

↓

SFE/CFE (Paper 4: Urquhart?)
(Combining ATLASGAL with SEDIGISM to estimate the Clump Formation Efficiency/SFE as a function of RGC)

↓

Other Stuff (Paper 5: A.N.Other)
(Some other interesting stuff)

Urquhart, 2017, RAS Meeting

Royal Astronomical Society August 2017

Summary: Cool Signature Banner

Summary: Publication of Core Papers

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SEDIGISM Papers

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Summary: Data Release

SEDIGISM

The SEDIGISM Data Server

Overview

The table below presents links to download data-cubes of the other molecular lines found within the bandwidth of the SEDIGISM survey. The data has been processed with a dedicated pipeline running in CLASS, which is part of the GILDAS software. Each cube is available in fits format. Each cube covers 2 deg in longitude centered at the indicated position, over +/-0.5 deg in latitude. The pixel size is 9.5" and the velocity resolution is 0.5 km/s.

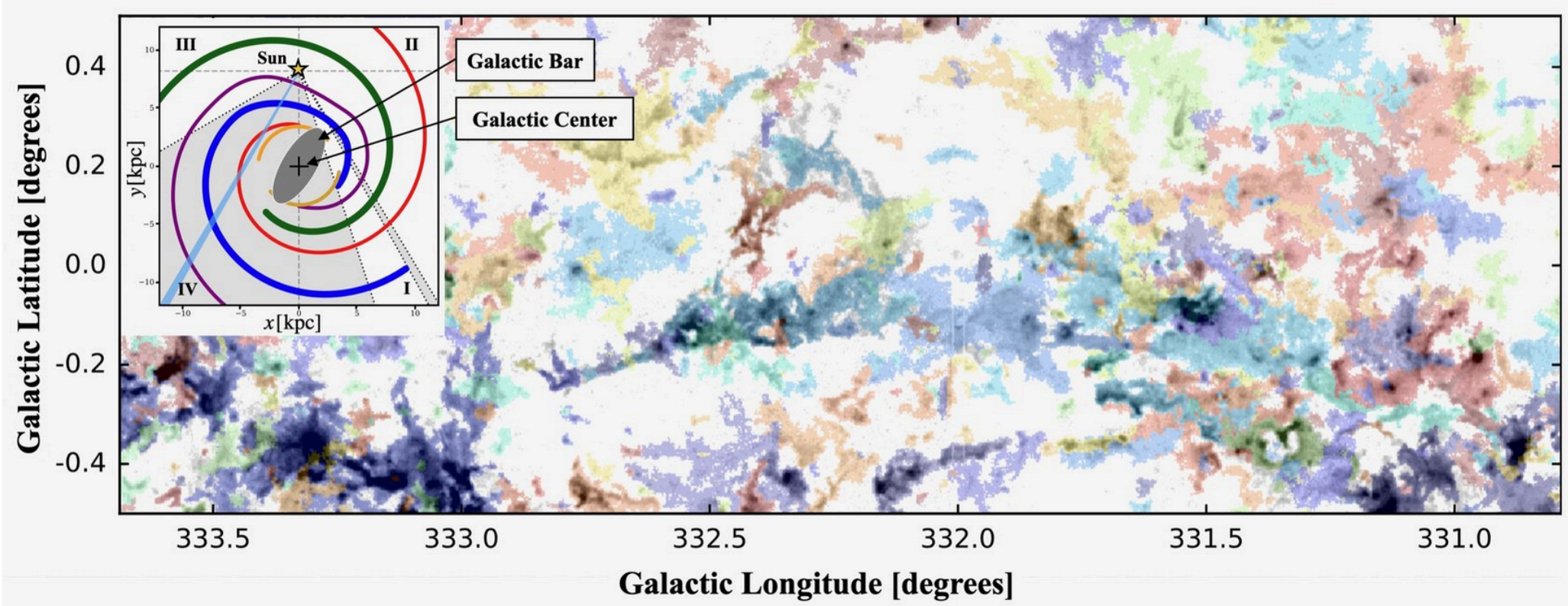
Reduced and Calibrated Cubes

SEDIGISM Data Products

Gal. Long.	CH_3OH (420-310) Fits	H_2CO (303-202) Fits/th>	H_2CO (321-220) Fits	H_2CO (322-221) Fits	HC_3N Fits	HNCO Fits	SiO (5-4) Fits	SO_2 Fits	SO (5-4) Fits
Field Centre = G000°	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file
Field Centre = G001°	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file
Field Centre = G002°	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file
Field Centre = G003°	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file	fits file

https://sedigism.mpifr-bonn.mpg.de/index.html

Summary: Press Release

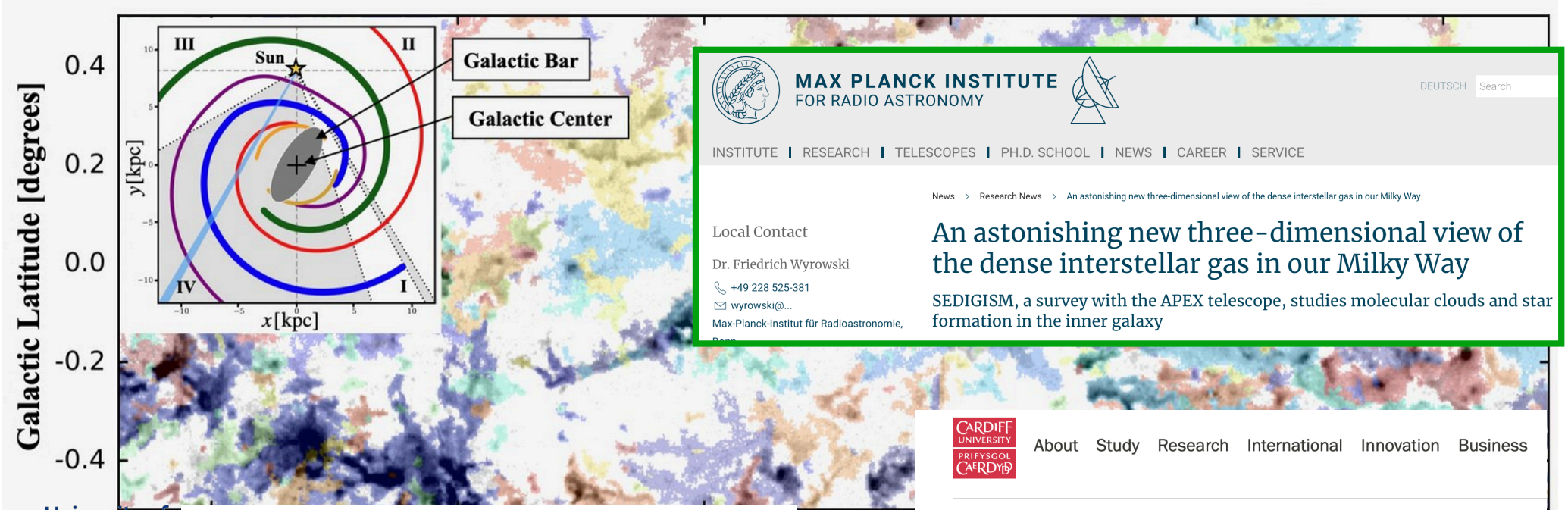


Main image: Example of the clouds identified in a small section of the SEDIGISM survey (~5% area covered); each cloud… [more]

© Ana Duarte-Cabral, Alex Pettitt and James Urquhart

SEDIGISM

Summary: Press Release



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News > Research News > An astonishing new three-dimensional view of the dense interstellar gas in our Milky Way

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Dr. Friedrich Wyrowski

+49 228 525-381

wyrowski@...

Max-Planck-Institut für Radioastronomie,

An astonishing new three-dimensional view of the dense interstellar gas in our Milky Way

SEDIGISM, a survey with the APEX telescope, studies molecular clouds and star formation in the inner galaxy

University of Kent

Main image: E … SEDIGISM

© Ana Duarte

Astrophysicist leads APEX telescope survey mapping of Milky Way structure

Olivia Miller

3 December 2020

Science

APEX, the 12-metre Atacama Pathfinder Experiment telescope, located on Chajnantor Plateau in the Chilean Atacama Desert. Photo credit: Carlos A. Duran - ESO

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Physics with Astro (Hons)

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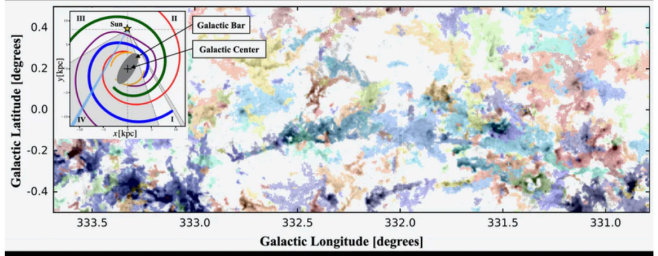
Scientists peer into the 3D structure of the Milky Way

3 December 2020



Summary: Publication of Core Papers

University of Kent

Paper I

SEDIGISM: Structure, excitation, and dynamics of the inner Galactic interstellar medium

Schuller et al., 2017, A&A, 601, 124 .

Paper II

SEDIGISM Survey: First data release and overview of Galactic structure

Schuller et al., 2021, MNRAS, 500, 3064

Paper III

SEDIGISM Survey: Molecular clouds in the inner Galaxy

Duarte-Cabral et al., 2021, MNRAS, 500, 3027

Paper IV

SEDIGISM-ATLASGAL: Physical and star-forming properties of molecular clouds and dense clumps across the Galactic disk

Urquhart et al., 2021, MNRAS, 500, 3050

Paper V

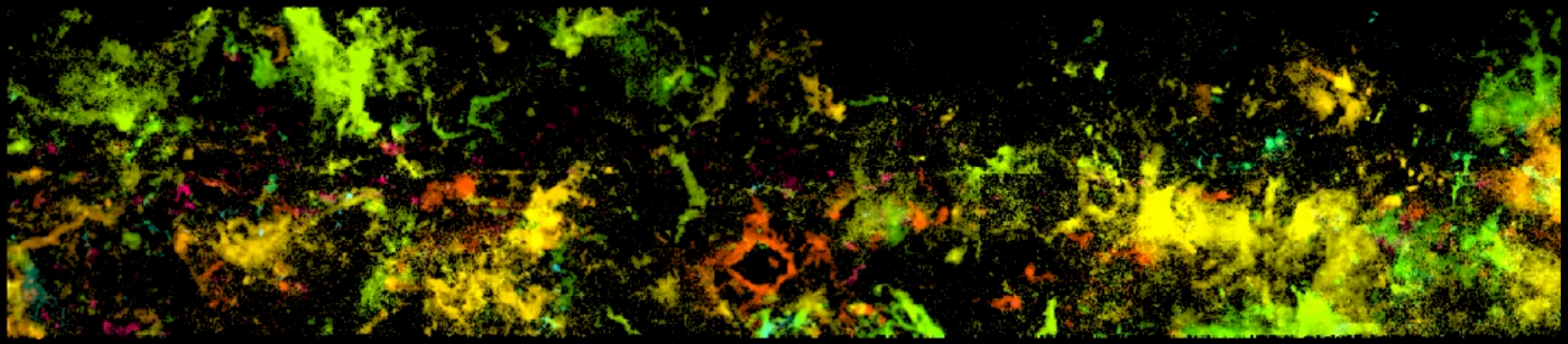
SEDIGISM Survey: The influence of spiral armson the molecular gas distribution of the inner Milky Way

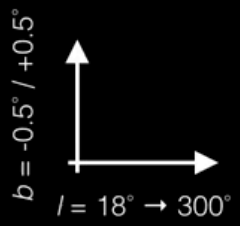
Colombo et al., 2021, A&A, Submitted.

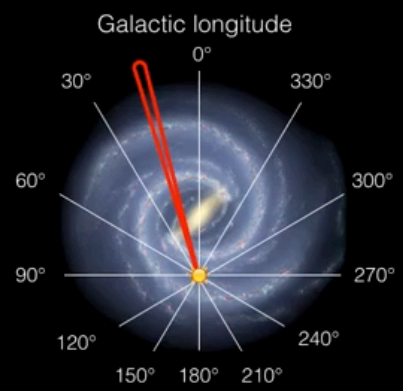
Summary

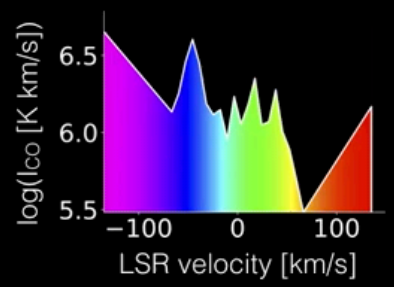
- The SEDIGISM Survey has been completed we are about make the 1st Full Data Release (DR1)
- Complete census of cold, dense ISM ($N_{\mathrm{H_2}} > 3 \times 10^{21}\,\mathrm{cm}^{-2}$), from $30''$ to Galactic scales
- 1000s of clouds, GMCs, complexes and filamentary structures
- This will coincide with 3 core papers that will provide an overview of the survey
- Data products will be:
  - calibrated fits cubes for all of the transitions
  - catalogue of parameterised GMCs (distances, masses, sizes, densities)
  - set of masks that map voxels on to individual GMC

Thanks You









https://www.youtube.com/watch?v=W85WYk2aYqo

Credit: D. Colombo, V. Kalinova & the SEDIGISM consortium