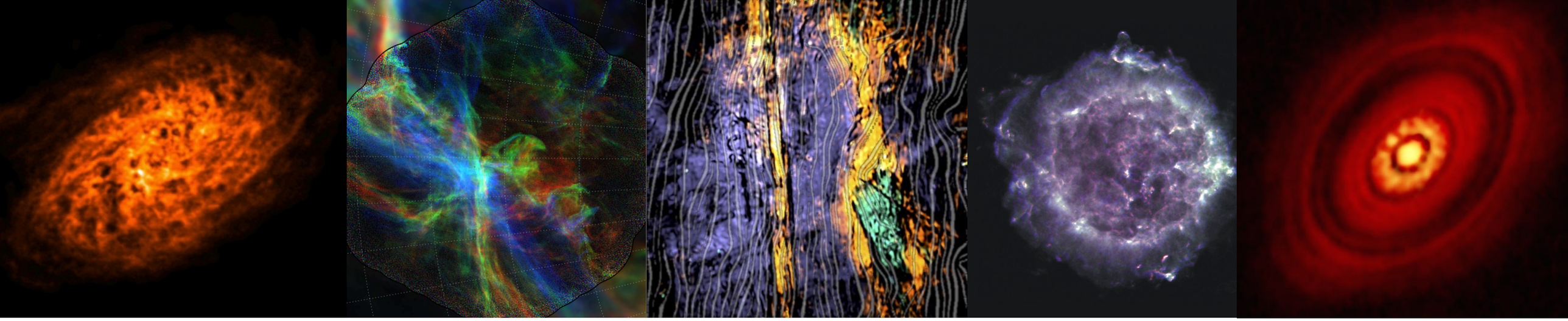


The French astronomical community towards the SKAO

Marc-Antoine Miville-Deschênes
AIM, CEA-Saclay

with contribution from

Dominique Aubert, Sylvain Bontemps, François Boulanger, Cecilia Ceccarelli, Patrick Charlot, Françoise Combes, Stéphane Corbel, Emanuele Daddi, Marian Douspis, Jean-Mathias Griessmeier, Laurent Lamy, Mathieu Langer, Sophie Masson, Michel Pérault, Antoine Petiteau, Valeria Pettorino, Philippe Salomé, Benoit Semelin, Jean-Luc Starck, Gilles Theureau, Charlote Vastel, Susanna Vergani, Nicole Vilmer, Annie Zavagno, Philippe Zarka

General remarks

- The “SKA community” in France is a evolving concept

- There is no official membership except for the registration to the Scientific Working Groups

- There are several scientists that use radio data in their studies, these are likely to be at the forefront of the involvement in SKA projects

- There are a even larger group of scientists that are used to do multi-wavelength studies and that have shown an interest in using SKA or that have published works on predictions.

Action Spécifique SKA-LOFAR

Creation in 2009
previous direction :
Michel Tagger (2009-2012)
Stéphane Corbel (2012-2021)

Conseil Scientifique

- Dominique Aubert (OBAS)
- Sylvain Bontemps (LAB)
- Baptiste Cecconi (LESIA)
- Françoise Combes (LERMA)
- Mickael Coriat (IRAP)
- Marian Douspis (IAS)
- Chiara Ferrari (OCA)
- Benjamin Godard (LPENS/LERMA)
- Guilaine Lagache (LAM)
- Sophie Masson (LPP)
- Marc-Antoine Miville-Deschênes (AIM)
- Benjamin Quertier (LAB)
- Gilles Theureau (LPC2E)
- Cedric Viou (USN)
- Philippe Zarka (LESIA)

Activities for 2022

- Journée SKA-France 2022 (10/11/2022)
- Workshop on astro-chemistry of cores/corinos (Bordeaux 29-30/11/2022)
- Workshop on LSB galaxies in the SKA era (Paris, 1-2/12/2022)
- Workshop on cosmic magnetism and Faraday rotation (Paris, 5-6/12/2022)

14 SKA Science working groups

HI Galaxy Science

Epoch Of Reionization

Pulsars

Magnetism

Cradle of Life

Cosmology

Our Galaxy

Gravitational Waves

Extragalactic Spectral Line

Transients

VLBI

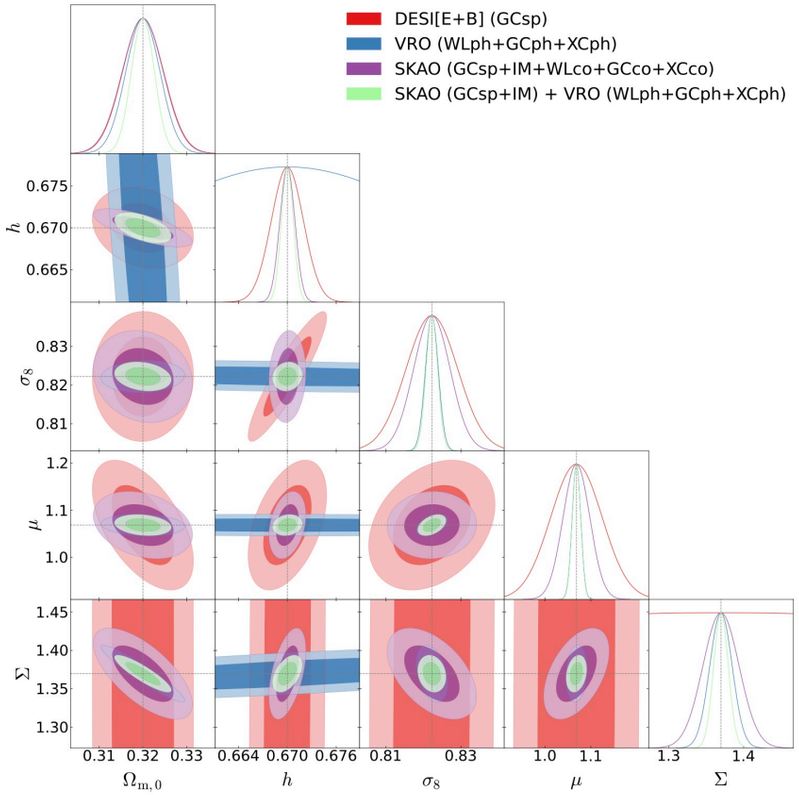
Solar, Heliospheric & Ionospheric Physics

Extragalactic Continuum

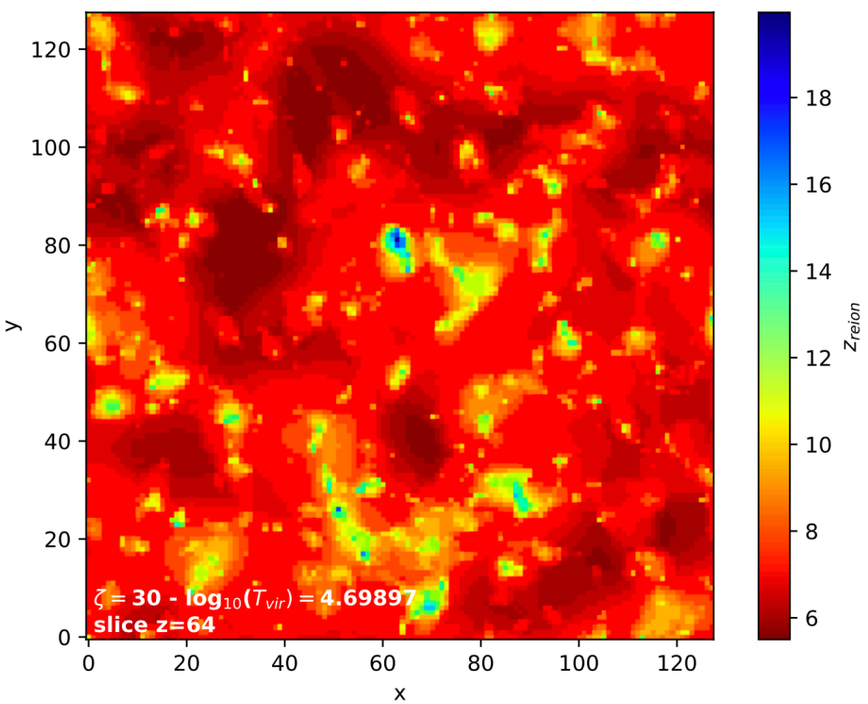
High Energy Cosmic Particles

Early Universe, Cosmology and LSS

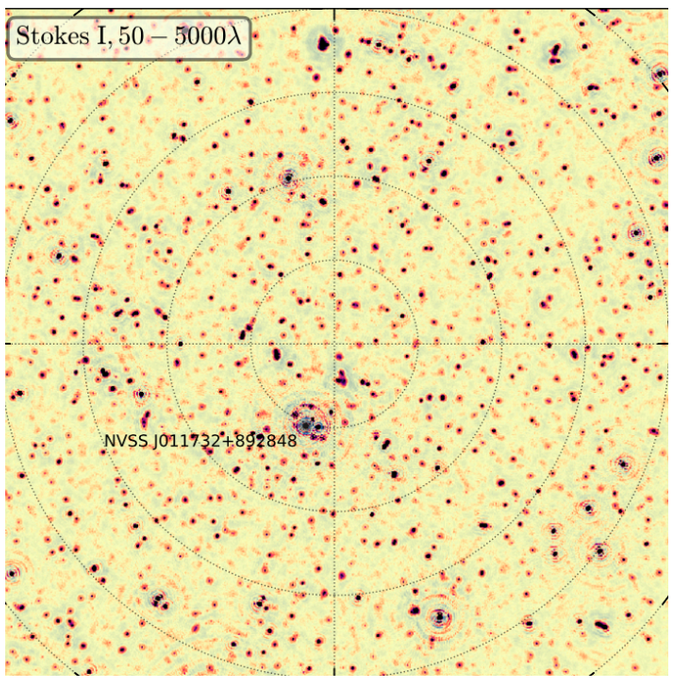
- Teams involved : Strasbourg, LERMA, IAS, AIM, OCA, LAM, LPENS
- Scientific topic : reionisation, cosmic dawn, large-scale structures, cosmological models, cosmic magnetism, galaxy clusters
- Expertise : theory and numerical simulations, observation signal 21cm (Nenufar), radio-CMB/LSS cross-correlation, physics of clusters and IGM, image reconstruction, component separation, statistical inference, Galactic foregrounds
- Contact : Erwan Allys, Reza Ansari, Dominique Aubert, François Boulanger, Marian Douspis, Chiara Ferrari, Mathias Kilbinger, Guilaine Lagache, Mathieu Langer, Valeria Pettorino, Simon Prunet, Benoit Semelin, Jean-Luc Starck



Casas+2022
Constraining gravity with radio-optical synergies



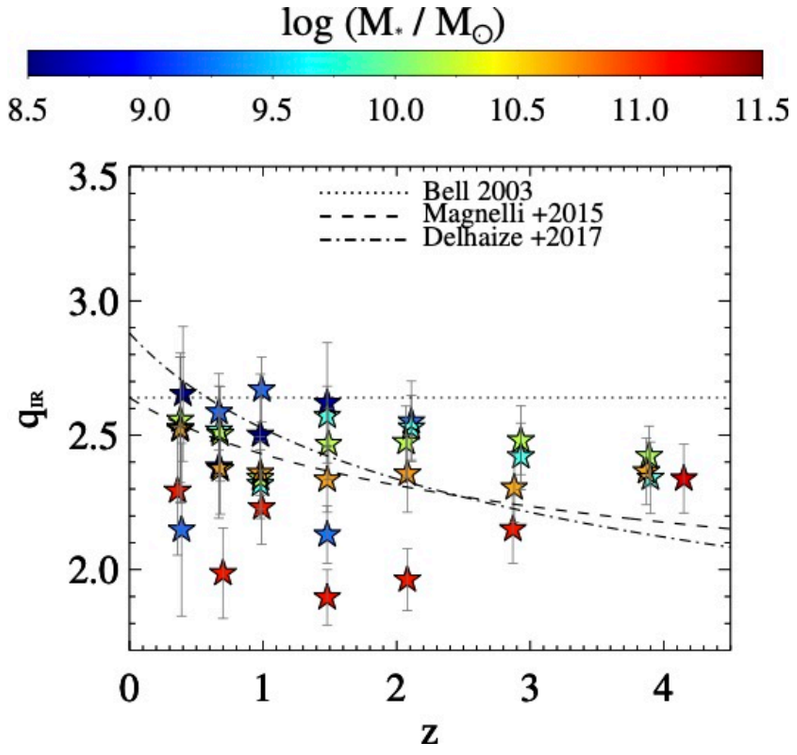
Thélie+2022
Topology of reionisation redshifts



Mertens+2022
Upper limits on 21cm P(k) at z=9.1 with LOFAR

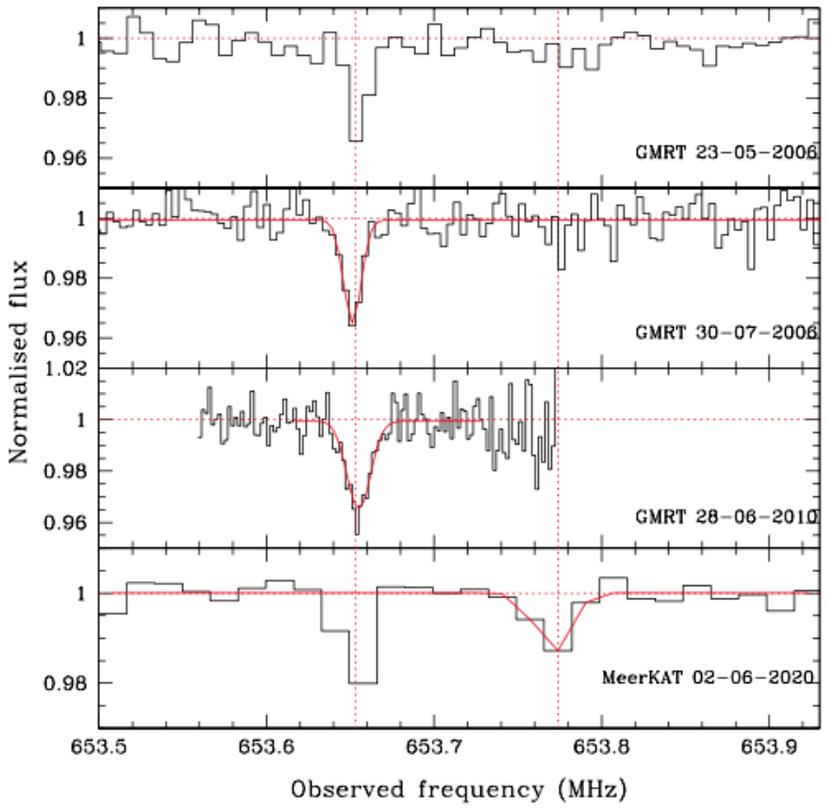
Galaxies - spectral lines and continuum

- Teams involved : LERMA, IAP, AIM, OCA, LAM, GEPI, CRAL
- Scientific topic : use of continuum as tracer of star formation, AGN activity, galaxy clusters
- Contact : Mathieu Béthermin, Alessandro Bosseli, Françoise Combes, Emanuele Daddi, David Elbaz, Chiara Ferrari, Pascale Jablonka, Jens-Kristian Krogager, Guilaine Lagache, Matthew Lehnert, Benjamin Magnelli, Simona Mei, Anne-Laure Melchior, Pasquier Notrdaeme, Patrick Petitjean,
Gabriel Pratt, Philippe Salomé, Cyrille Tasse, Patrice Theule



Delvecchio+(2021)
radio-infrared relation is nearly redshift-invariant since z=4 (VLA)

Sabater+(2021)
LOTSS (LOFAR)

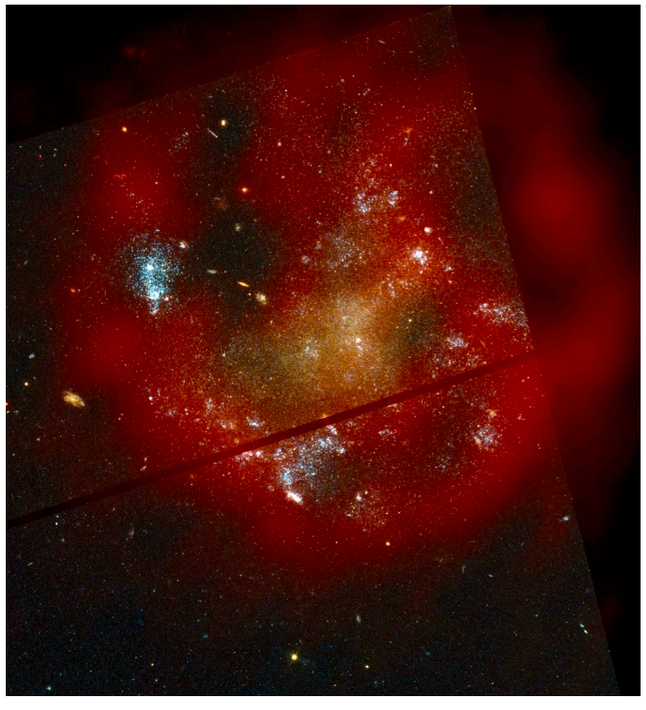


Srianand+(2022)
MeerKAT detection of HI absorption at z=1.17

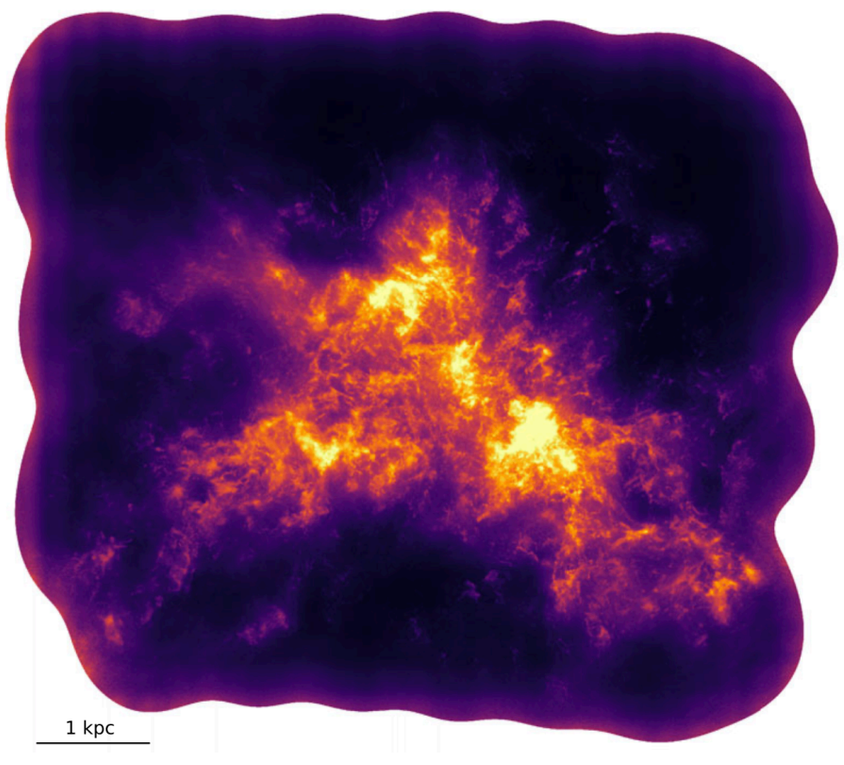
HI galaxy

- Teams involved : LERMA, AIM, LPENS, LAM, Strasbourg
- Scientific topic : physics of HI, thermal instability, turbulence, galactic structure, HI in galaxies
- Expertise : analysis of large 21 cm datasets, emission and absorption, multi-phase numerical simulations
- Leadership : physics of the HI in the MW and nearby galaxies
- Contact : Matthieu Béthermin, Samuel Boissier, Albert Bosma, Alessandro Bosseli, Françoise Combes, Pierre-Alain Duc, Benjamin Godard, M-A Miville-Deschênes, Philippe Salomé

Xu+(2022)
0.6 MPc HI structure in Stephan's quintet with FAST



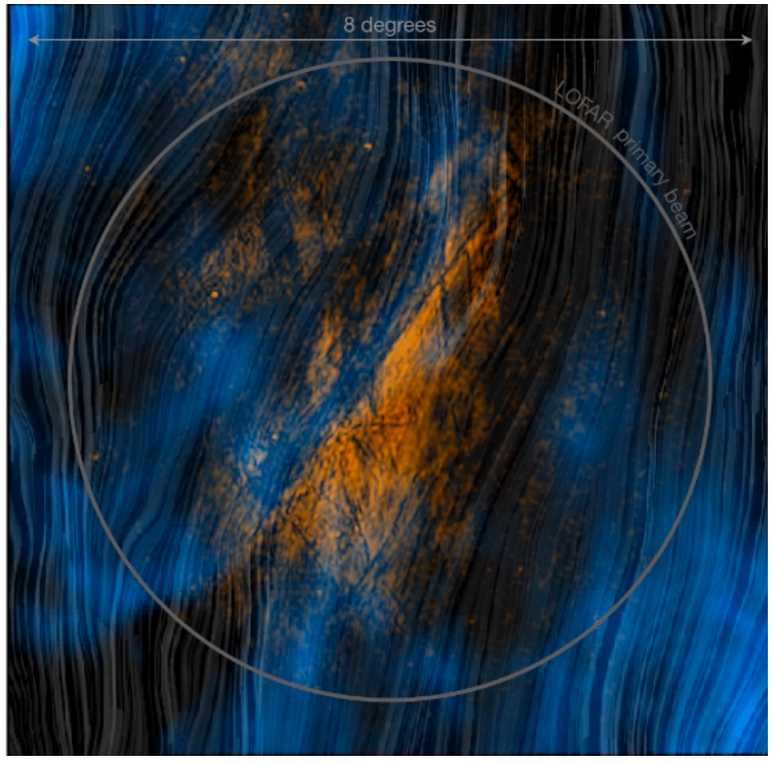
De Blok+(2022)
Meerkat HI commissioning of HI galaxy



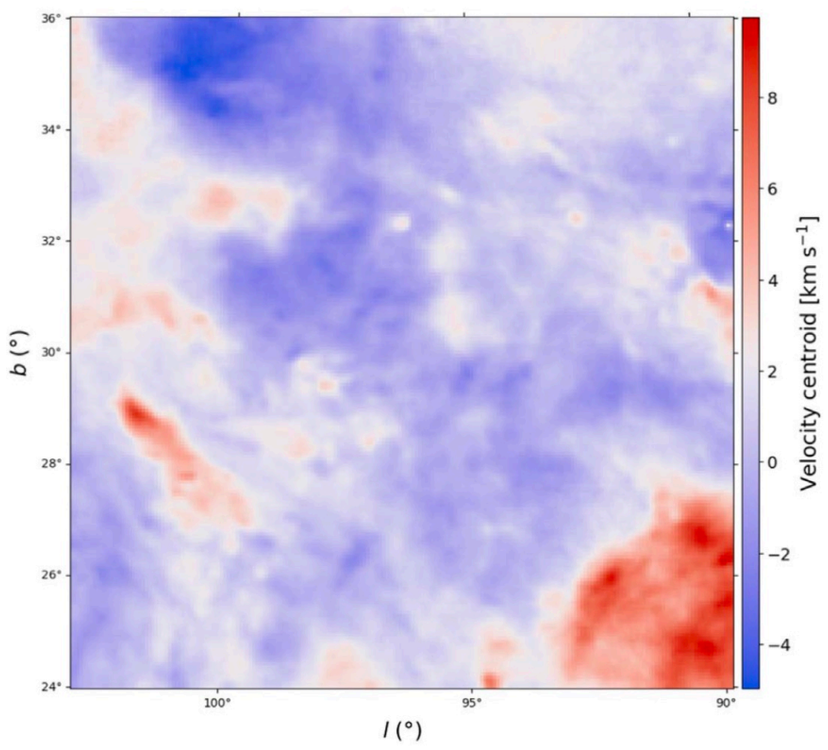
Pingel+(2022)
The SMC at 21 cm with ASKAP

Interstellar medium

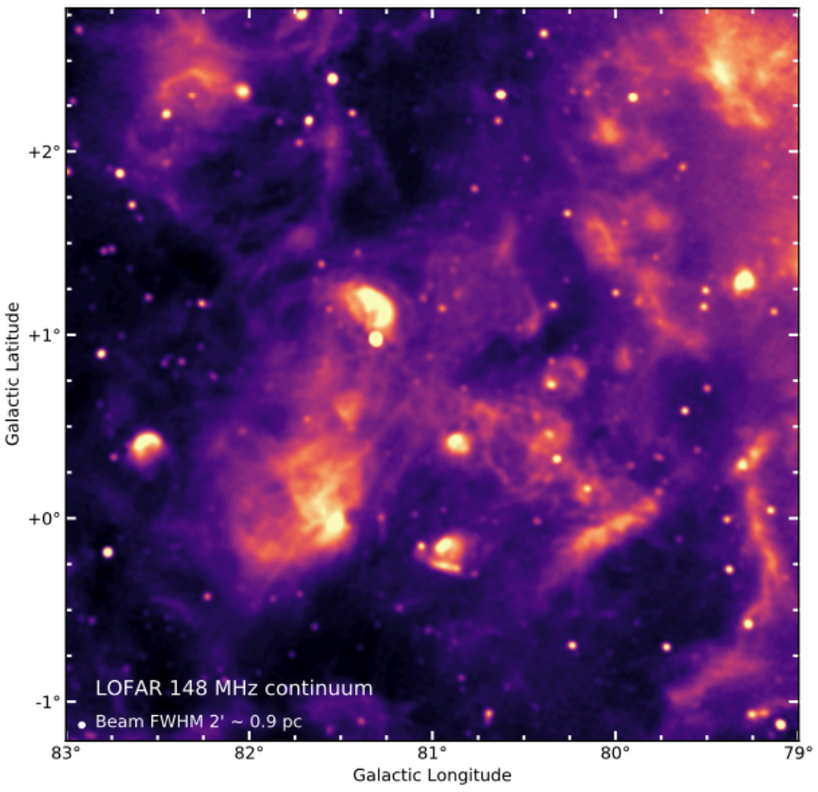
- Scientific topic : Interstellar structure formation (MHD, multi-phase) : HI, molecular clouds, massive proto-stars and HII regions, shocks, supernova remnants, interstellar dust
- Expertise : 21cm, free-free, synchrotron, Faraday rotation, RRL, Zeeman, numerical simulations, statistical descriptions of non-stationary fields, ISM modelling, multi-wavelength
- Teams involved : LPENS, AIM, IAS, LAM, IRAP, LAB, IPAG, LERMA
- Contact: Erwan Allys, Sylvain Bontemps, François Boulanger, Edith Falgarone, Katia Ferrière, Benjamin Godard, Antoine Gusdorf, Patrick Hennebelle, François Levrier, M-A Miville-Deschênes, Philippe Salomé, Nathalie Ysard, Annie Zavagno



Bracco+2020
The multiphase and magnetised HI seen by LOFAR



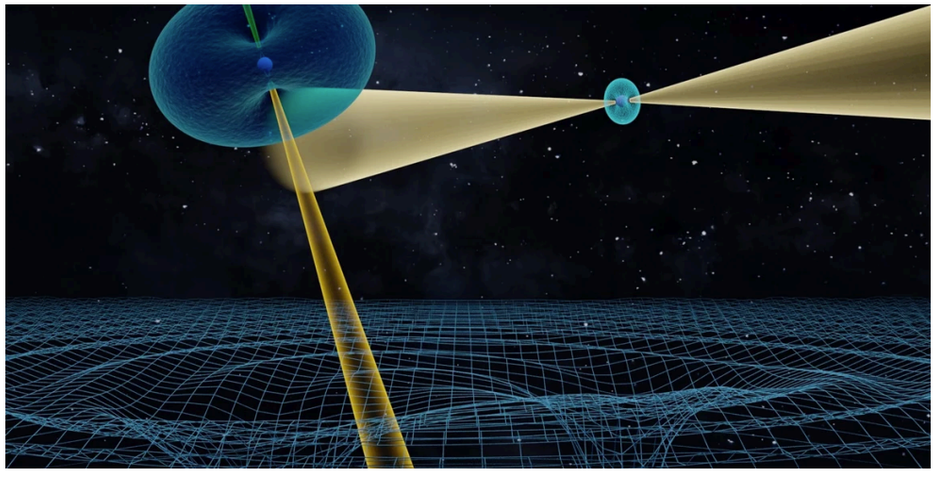
Marchal+(2021)
Turbulence in the WNM of the Milky Way



Emig+2022
Cygnus X at 148MHz with LOFAR

Pulsars and gravitational waves

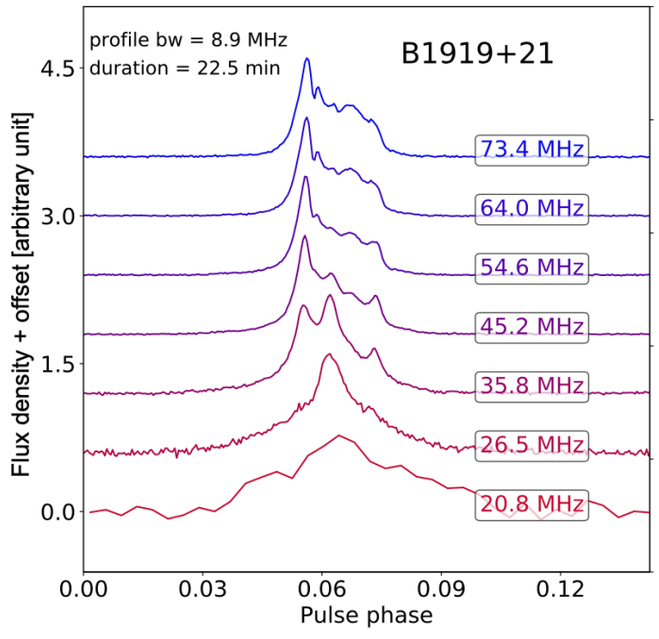
- Teams involved : LPC2E, USN, APC, LUTh, IRAP, AIM, LESIA
- Scientific topic : low frequency gravitational waves - PTA, test of gravity, physics of pulsars, fast radio bursts
- Expertise and leadership : instrumentation and pipeline for pulsar chronometry, PTA data analysis, test of gravitation with binary systems, FRB
- Contact : Gilles Theureau, Jean-Mathias Griessmeier, Baptiste Cecconi, Louis Bondonneau, Ismael Cognard, Lucas Guillemot, Guillaume Voisin, Cherry Ng



Kramer+(2021)
Gravity tests with a double pulsar

Voisin+(2020)
Test of general relativity with a pulsar in a triple star system

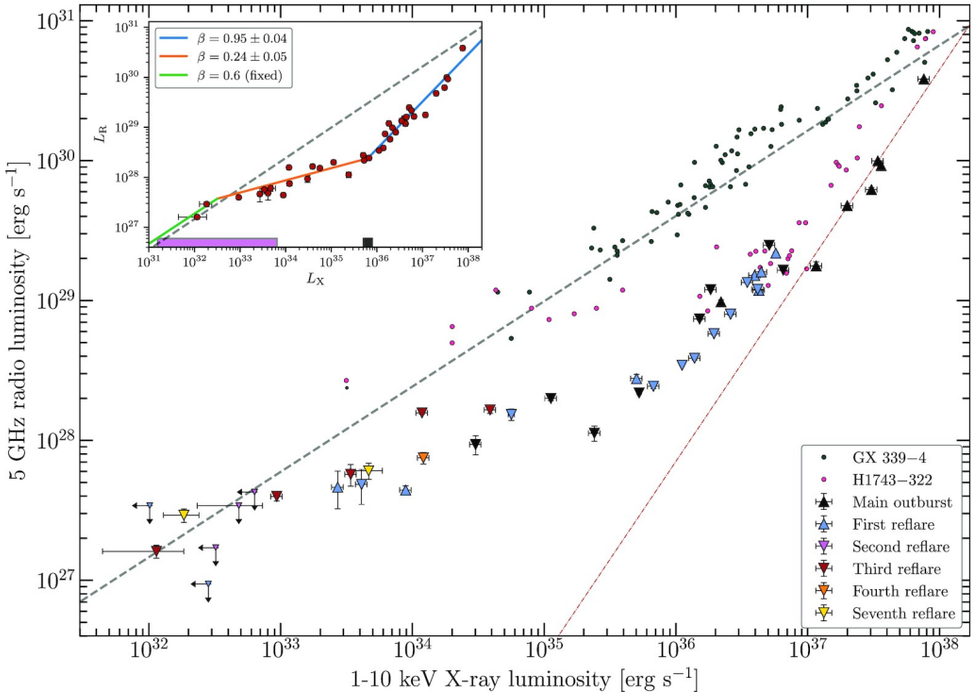
Implication in the International and European PTA
Antoniadis+(2022)
Chen+(2021)



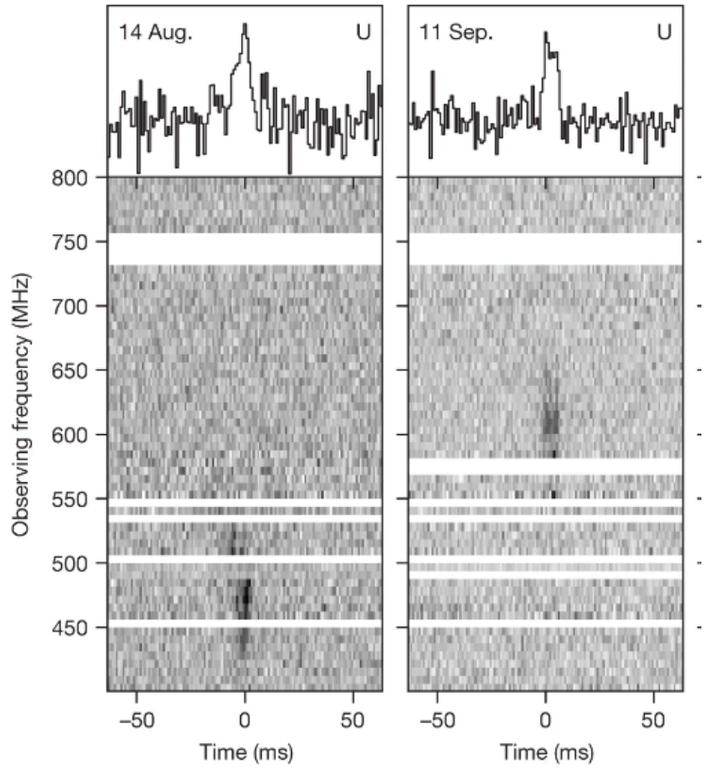
Pulsar with NenuFAR, LOFAR and MeerKAT
Bondonneau+(2021,2020)
Bailes+(2020)

Transients

- Teams involved : AIM, USN, LESIA, IRAP, LPC2E
- Scientific topic : Gamma-ray burst, kilonovae, accreting systems, jets, black holes, relativistic plasma, Fast Radio Bursts
- Expertise : theory, multi-wavelength observations of transients, multi messagers (EM - GW), signal reconstruction
- Contact : Stéphane Corbel, Mickael Coriat, Susanna Vergani, Cherry Ng



Carotenuto+(2021)
radio/X-ray correlation of a black hole transient

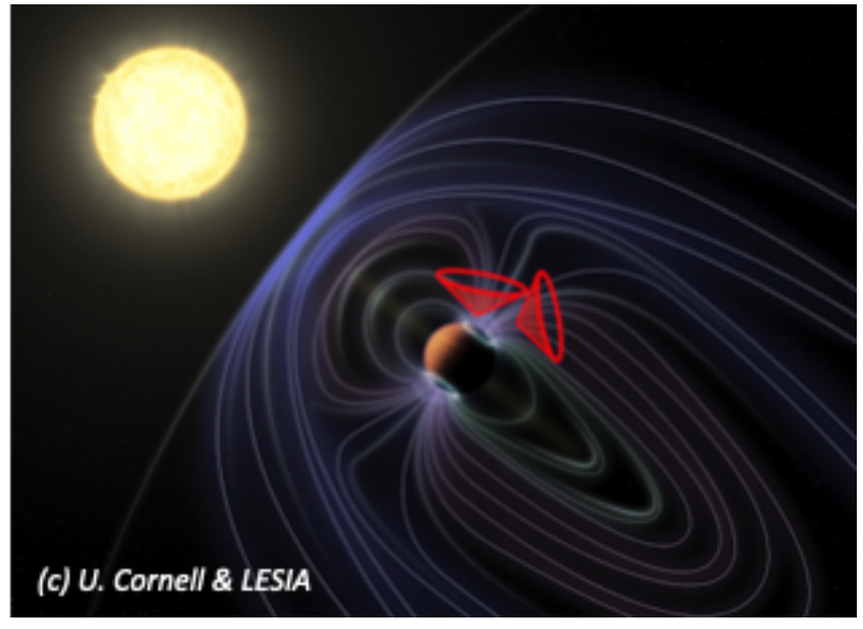


CHIME/FRB collaboration+(2019)
Ng, Cherry corresponding author
A second source of repeating fast radio bursts

Cradle of Life

Detection radio of exoplanets, star-planet interaction, stellar emission, Jupiter

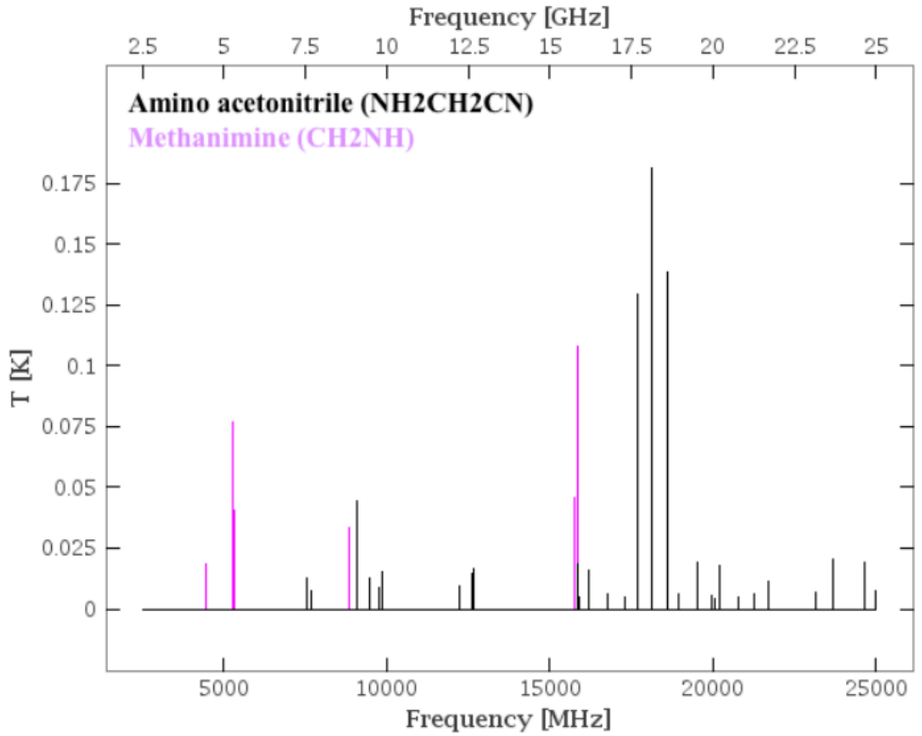
- Expertise : LOFAR, Nenufar data analysis, predictions, theory
- Teams involved : LESIA, LPC2E, LAM, GEPI
- Contact: Philippe Zarka, Jean-Mathias Griessmeier, Laurent Lamy, Cyril Tasse, Baptiste Cecconi, Julien Girard



Turner+(2021) - Potential first detection of exoplanetary radio signal

Pre-biotic chemistry of early star formation

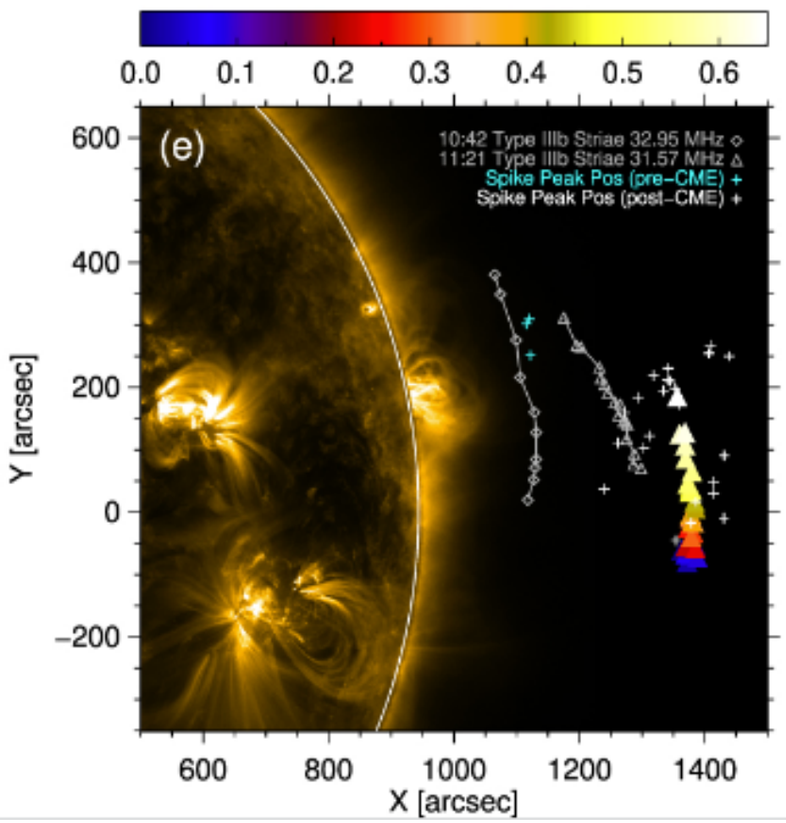
- Expertise : chemistry modelling and data analysis, VLA observations
- Teams involved : IPAG, IRAP, LAB
- Contact: Cecilia Ceccarelli, Audrey Coutens, Charlote Vastel



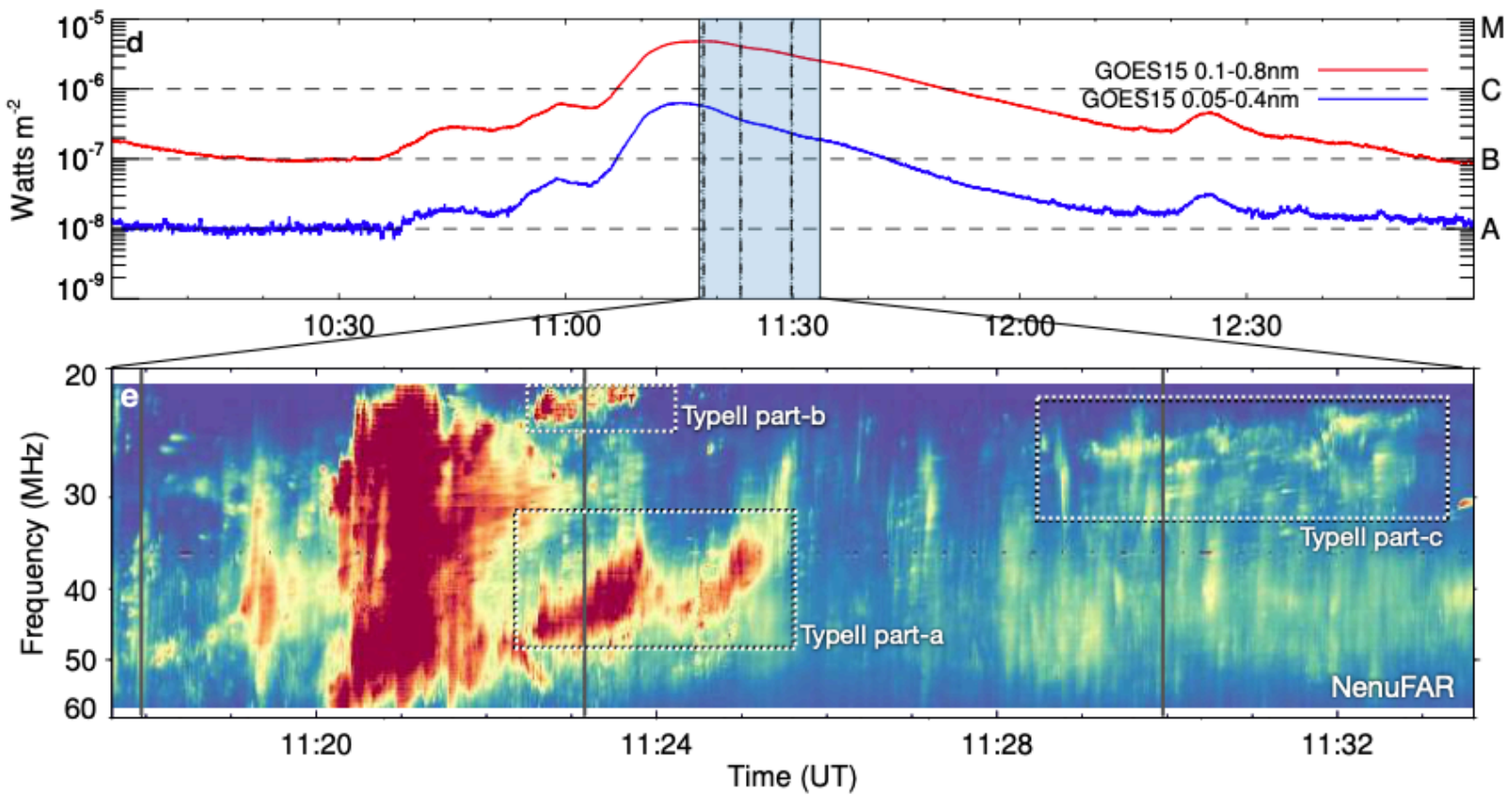
Acero+(2017)
CASSIS simulation for glycine precursors

Solar physics

- Teams involved : LESIA, LPP
- Scientific topic : Heliosphere
- Expertise : Time-frequency analysis of solar flares data (Nenufar), numerical simulations,
- Leadership : multi-instrument / multi-messager analysis of solar flares, theory
- Contact : Sophie Masson, Nicole Vilmer, Baptiste Cecconi, Carine Briand



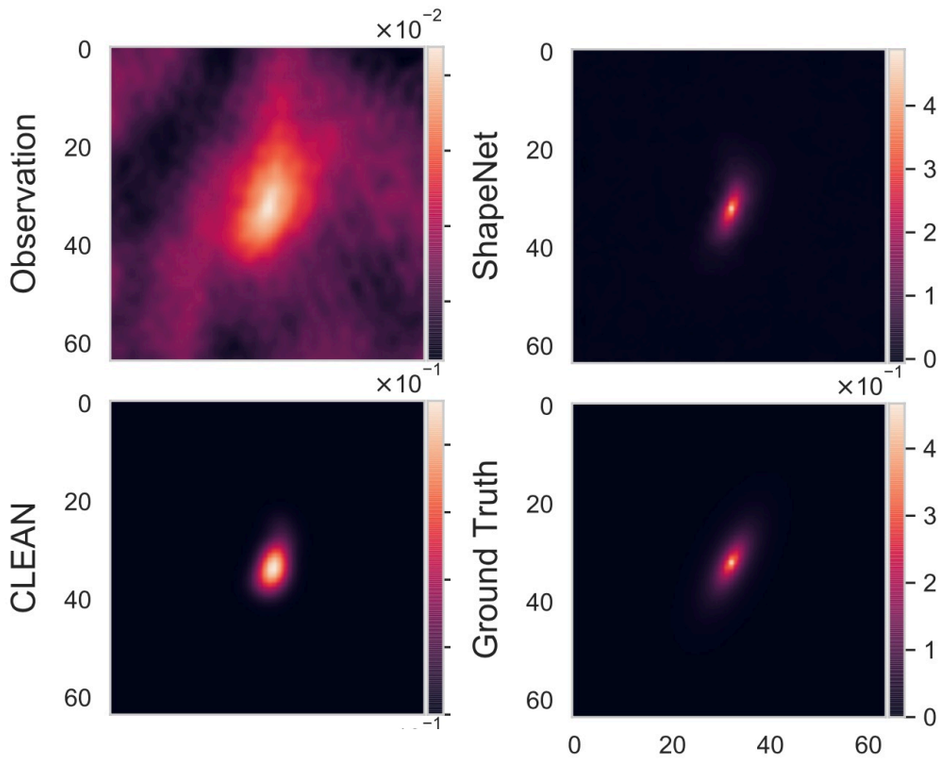
Clarkson+(2021)
First time-frequency observation of Solar radio spikes - LOFAR



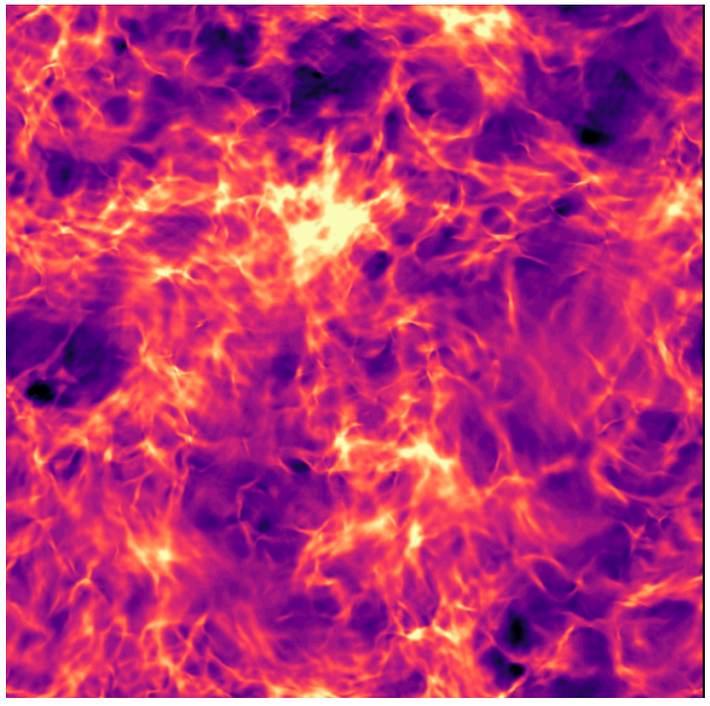
Carley+(2021)
Shock propagation through turbulent plasma in the Solar Corona - NENUFAR

Data analysis

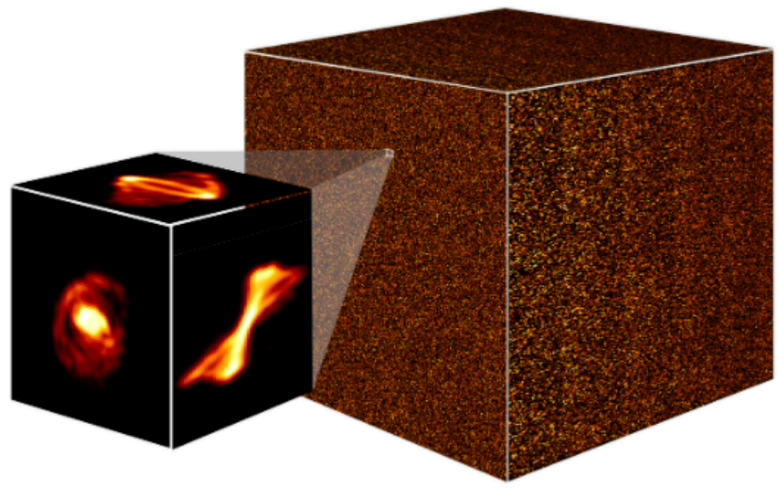
- Radio image reconstruction : several developments by Observatoire de Paris, AIM
- Spectro-imagery decomposition : e.g. Marchal et al. 2019 - AIM
- Visualisation of data cubes : Yatis developped by P. Salomé (yatis.obspm.fr)
- Statistical description of non-stationary fields : LPENS team (Allys, Boulanger, Levrier e.g. Allys et al. (2020)), LAB
- SKA Data Challenge : MINERVA winner of SDC2, preparation for SDC3
- Cross-correlation statistics (triangle correlation function ou sample variance) : e.g. Gorce et al. 2019 - IAS
- Inférence signal 21 cm using Machine Learning : e.g. Doussot et al. 2019 - LERMA



Nammour+2022
Shape constraint for galaxy image deconvolution



Régaldo-Saint Blancard+2022
Use of Scattering Transform to generate synthetic ISM maps



Cornu+(in prep)
MINERVA - winner of the SKA Data Challenge 2

Summary

- **Main scientific topics**
  - Pulsars / grav wave and transients : USN, LPC2E, AIM
  - Galaxies and galaxy clusters : Observatoire de Paris, AIM, IAS, LAM, Strasbourg, OCA
  - Cosmology and EoR : Observatoire de Paris, Strasbourg, AIM, IAS, OCA
  - Solar / stellar / (exo)planetary science : Observatoire de Paris, LPP
  - Interstellar medium : LPENS, AIM, IRAP, LAB, IPAG, LAM

- **Involvement in France**
  - At least 80 identified active permanent scientists (55 are registered to one or several SKA SWG)
  - 15 laboratories
  - Several ANR/ERC radio-related fundings (EXORADIO, TOSCA…)

- **Several precursors are available right now** - a unique opportunity to prepare for SKA : LOFAR, Observatoire de Nançay / Nenufar, ASKAP, MWA, MeerKAT, HERA…

- **Several on-going observational Key programs**
  - 17 Nenufar Key Scientific Programs
  - MeerKAT Key programs : MHONGOOSE, …
  - LOFAR : LOTSS, Solar and Space Weather, Galactic plane…
  - ASKAP : GASKAP, …

How to get involved ?

- Register to one or more SKA Science Working Groups
  - https://www.skao.int/en/science-users
- Get in contact with the Action Spécifique SKA-LOFAR
  - as-ska-lofar.fr
  - register to the AS SKA-LOFAR newsletter