

Voyage2050

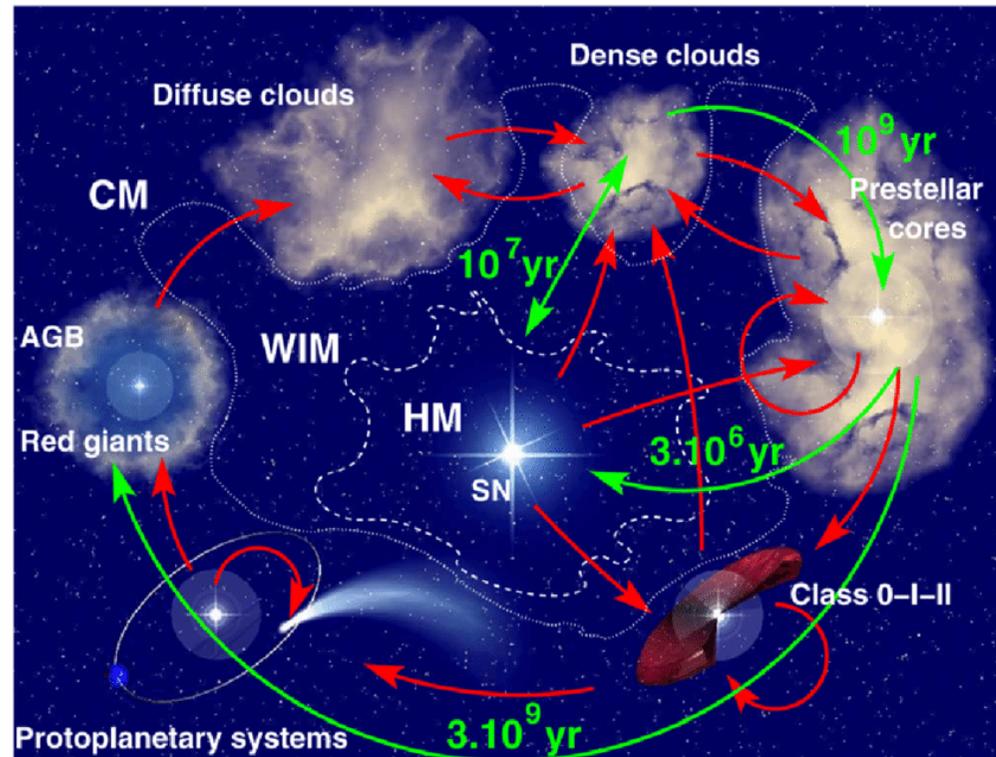
Astrochemistry, star formation, and the interstellar medium

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Cycle of the ISM in galaxies

From diffuse clouds to stars and eventually back to diffuse clouds



White papers, total 9 : 3 UV , 3 FIR, (1+1) THz and 1 in-situ

Author	Title
Hendrik Linz et al.	Bringing high spatial resolution to the Far-infrared - A giant leap for astrophysics Astrochemistry
Martina Wiedner et al.	Origins Space Telescope: From First Light to Life (Mission of Opportunity)
Vianney Lebouteiller et al.	A complete census of the gas phases in and around galaxies: far-UV spectropolarimetry as a prime tool for understanding galaxy evolution and star formation
Ana Inés Gómez de Castro et al.	Closing gaps to our Origins. The UV window to the Universe
Miriam Garcia	Massive Stars in Extremely Metal-Poor Galaxies: a Window into the Past UV
Dimitra Rigopoulou et al.	The Far Infrared Spectroscopic Surveyor
Leonid Gurvits et al.	TeraHertz Exploration and Zooming-in for Astrophysics (THEZA)
Robert F. Wimmer-Schweingruber et al.	In-situ Investigations of the Local Interstellar Medium
Jean-François Lampin	LUNES : LUNar tErahertz teleScope Expanding the electromagnetic window

A complete census of the gas phases in and around galaxies: far-UV spectropolarimetry as a prime tool for understanding galaxy evolution and star formation

Vianney Lebouteiller et al. & (Ana Inés Gómez de Castro et al.)

FUV (912 - 2000 Å) absorption spectropolarimetry: HI, H₂, D, CO, CH, CII, CII*, OVI...

Large samples of line of sights in the Galaxy, other galaxies and QSO

Chemistry and physics of the diffuse ISM:

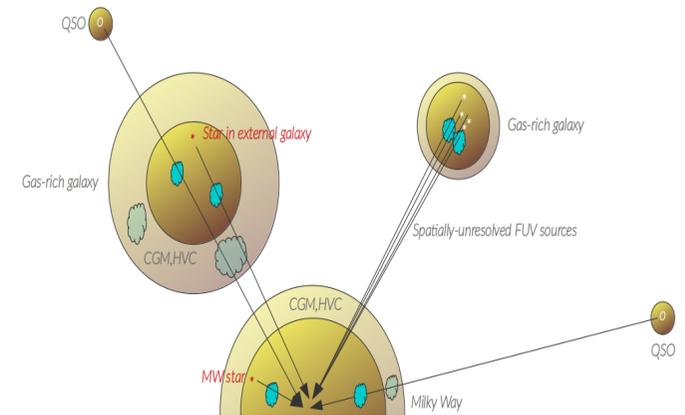
- How is the ISM structured? How do phases interact?
- What are the gas ionizing and heating mechanisms?
- What drives the chemistry?

Precision measurement of magnetic field:

- What is the role of magnetic field in the ISM phases and star formation?

The ISM properties in external galaxies and gas flows in the CGM

- Is there evidence of metal-free gas accretion?
- Does star formation proceed in cold atomic gas in quasi-pristine environments at redshift~0?
- Are there enough CGM clouds to sustain star formation through accretion?
- How are the galactic halos energized?



A complete census of the gas phases in and around galaxies: far-UV spectropolarimetry as a prime tool for understanding galaxy evolution and star formation

Vianney Lebouteiller et al. & (Ana Inés Gómez de Castro et al.)

Vianney Lebouteiller et al.:

Mission: L-type, Effective area $> 40\,000\text{ cm}^2$, spatial resolution 10 mas, spectropolarimetry capabilities with spectral resolution $R > 120\,000 - 200\,000$
ESA contribution to LUVOIR. The **POLLUX** instrument supported by CNES

Ana Inés Gómez de Castro et al.

Mission: L-type, 6-10 meter telescope with angular resolution 10 mas, spectroscopy with $R=20,000-100,000$, spectropolarimetry, $R=80,000$, Integral field spectroscopy $R=500-1000$

Massive Stars in Extremely Metal-Poor Galaxies: a Window into the Past UV

Miriam Garcia et al.

Spectroscopy in the 3600-7000 Å with spectral resolving powers of 1000, 8000, 50000

Characterization of a significant sample of XMP massive stars (from galaxies at 1-4 Mpc) with $Z < 0.2$

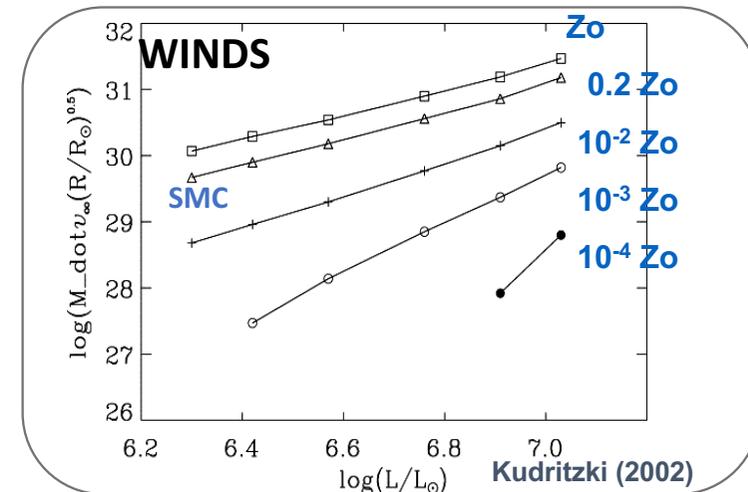
Stellar evolution: Breaking the frontier of the SMC metallicity ($0.2 Z_{\odot}$)

What are the physics processes in massive stars in pristine systems?

How does the feedback change as a function of metallicity?

- GRBs, SNe, SLSNe progenitors
- Formation of $>30M_{\odot}$ black holes in binary systems (GW150914)?

What is the effect of metallicity in the IMF?

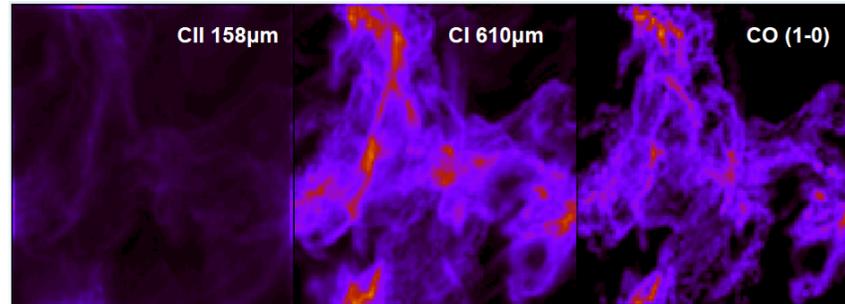


Mission: L type: 10 m class telescope operating in the UV-optical-NIR

ESA contribution to LUVOIR with a multi-object optical spectrograph with $R = 1000, 8000$ and 50000 .

The Far Infrared Spectroscopic Surveyor

Dimitra Rigopoulou et al.



Large scale mapping in 4 selected far-IR lines (CI, OI, CII and NII) at very high spectral resolution
Galactic plane, nearby Galaxies and blind fields

How the gas transforms into stars and how their feedback impact the ISM:

- How does the Interstellar Medium vary with environment?
- How do molecular clouds form?
- What regulates Star Formation in galaxies ?
- How much gas is in 'CO-dark' clouds and how does it impact on modes of SF?
- What is the impact of radiative feedback on the ISM?

Mission: M-type, 1-2 meter class telescope operating in the 4 bands in the 63 to 370μm range
high resolution spectroscopy with multibeam heterodyne receivers

In-situ Investigations of the Local Interstellar Medium

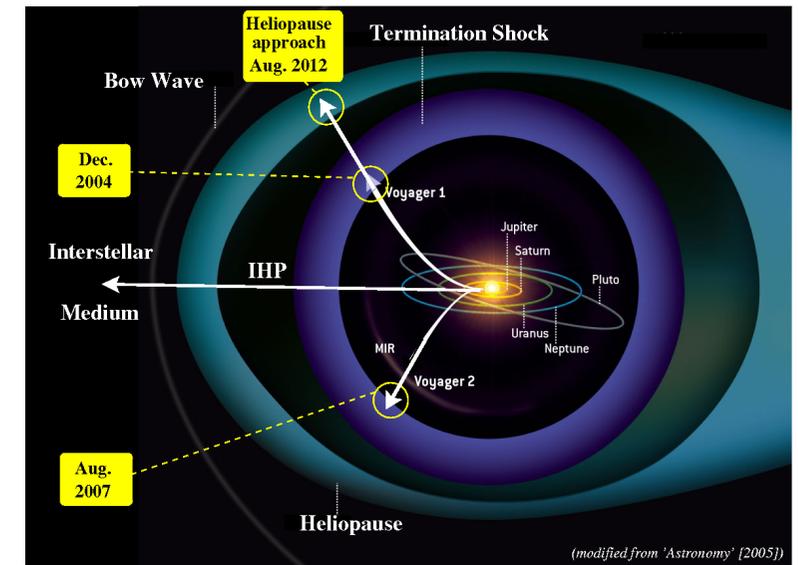
Robert F. Wimmer-Schweingruber et al.

Measure:

- Composition of the local interstellar medium?
- Properties of the interstellar magnetic field?
- Properties and dynamics of the interstellar neutral component?
- Properties and dynamics of interstellar dust?

How do they relate to the diffuse ISM?

Mission: L type with international collaboration.



TeraHertz Exploration and Zooming-in for Astrophysics (THEZA)

Leonid Gurvits et al.

High resolution imaging (0.01" to 0.1") of water lines at sub-mm wavelengths

Water in protoplanetary disks:

- ice lines – tracers of dust grains dynamics

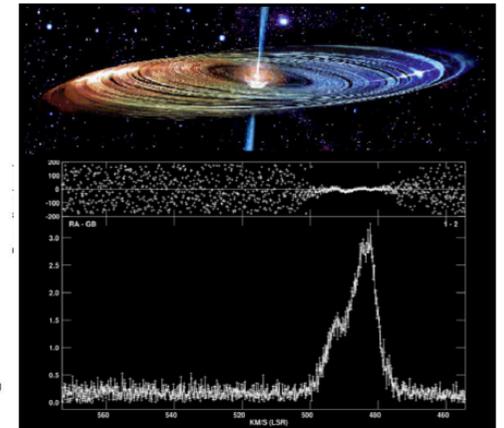
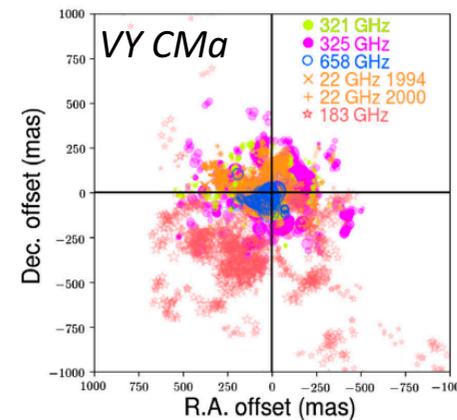
Cold water vapour reservoirs :

- understanding the ``disk – protoplanet'' dynamics

Water in exoplanets:

- from planet formation to biospheres

Mission: L-type, Space interferometer with 2-3 medium size antennas operating from 300 μm to 1.5 mm with heterodyne receivers
Medium-Earth orbits and very high spectral resolution



LUNES : LUNAr tErahertz teleScope Expanding the electromagnetic window

Jean-François Lampin

Observatory on the moon:

Telescope : > 10 m (target 30m) operating at THz (1- 10THz /30-300 μm)

High spectral resolution provided by heterodyne receivers

Scientific potential:

Astrochemistry: from light hydrides (e.g H_2O , OH^+ , .) to very complex molecules organic molecules

ISM : main coolant lines (CI, CII, OI, OII, NII, ..), CO-dark gas (HD)

Explore a wide range of objects from protoplanetary discs to high-z galaxies