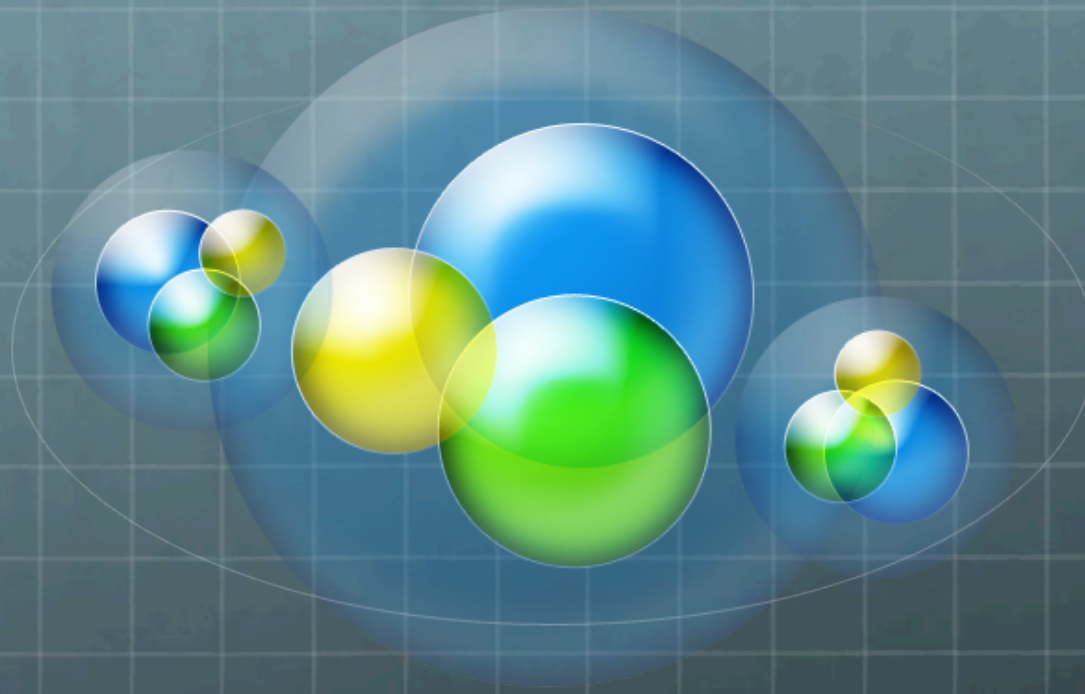


# ILP related activities at LERMA: 2 examples

Benoît Semelin  
on behalf of the galaxy team

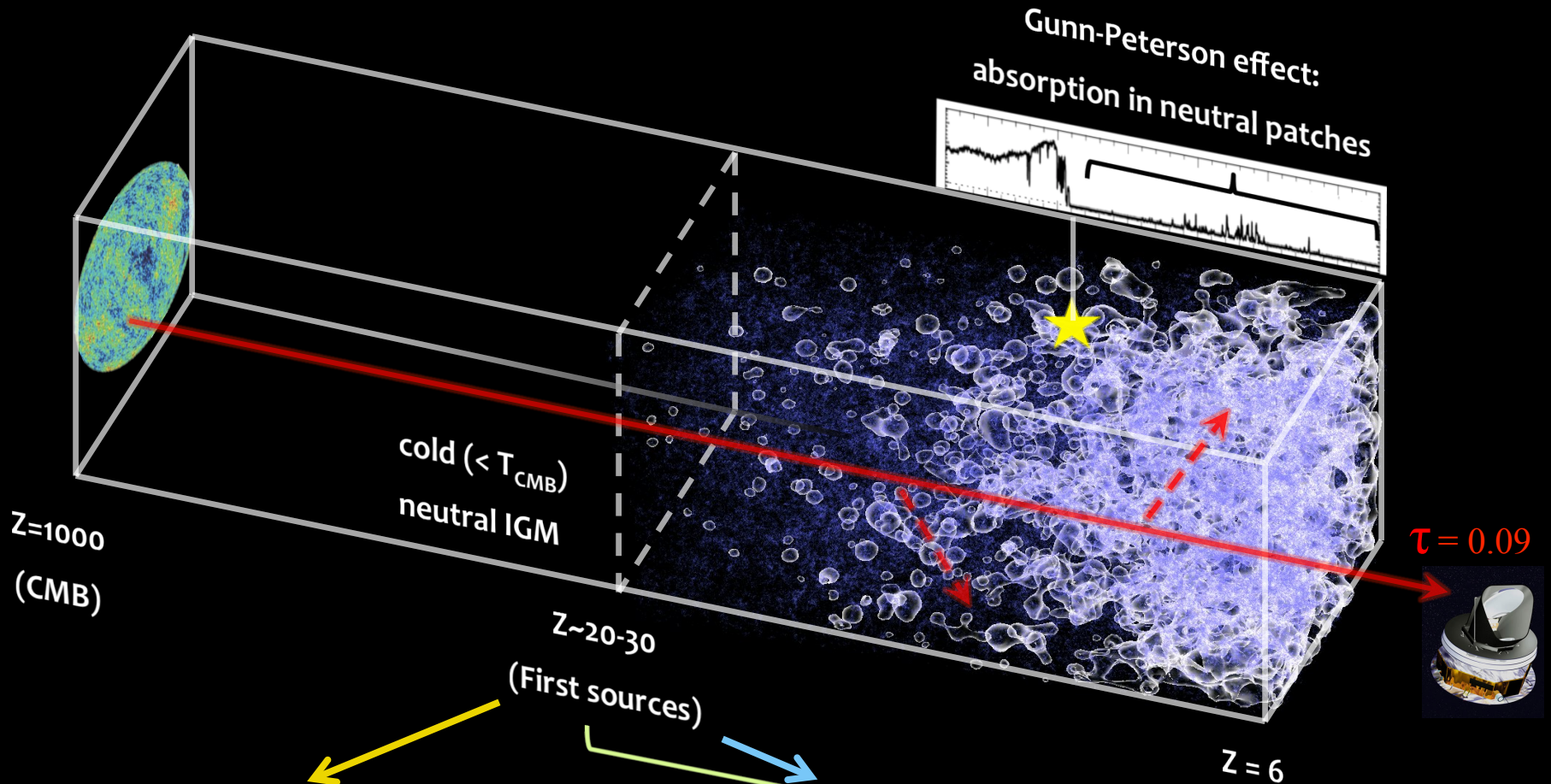
ILP day - 13 March 2014




# The Epoch of reionization

(B. Semelin et al.)

# The epoch of reionization



Massive stars:

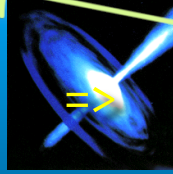


Ionizing UV + some X-ray

21 cm tomography

LOFAR (2013) SKA (2020)

Quasars:



More X-rays

- Nature of the sources
- Luminosity function
- Cosmology
- ...

# Upcoming 21 cm signal observations with the LOFAR and SKA radio-interferometers



## LOFAR (2013)

Netherland

Cost:  $\sim 10^8$  euros

Collecting area:  $> 0.1 \text{ km}^2$

Powerspectrum detection ( $6 < z < 11$ )

Low res imaging ( $15'$ )



## SKA (2020)

Australia and South Africa

Cost:  $\sim 10^9$  euros

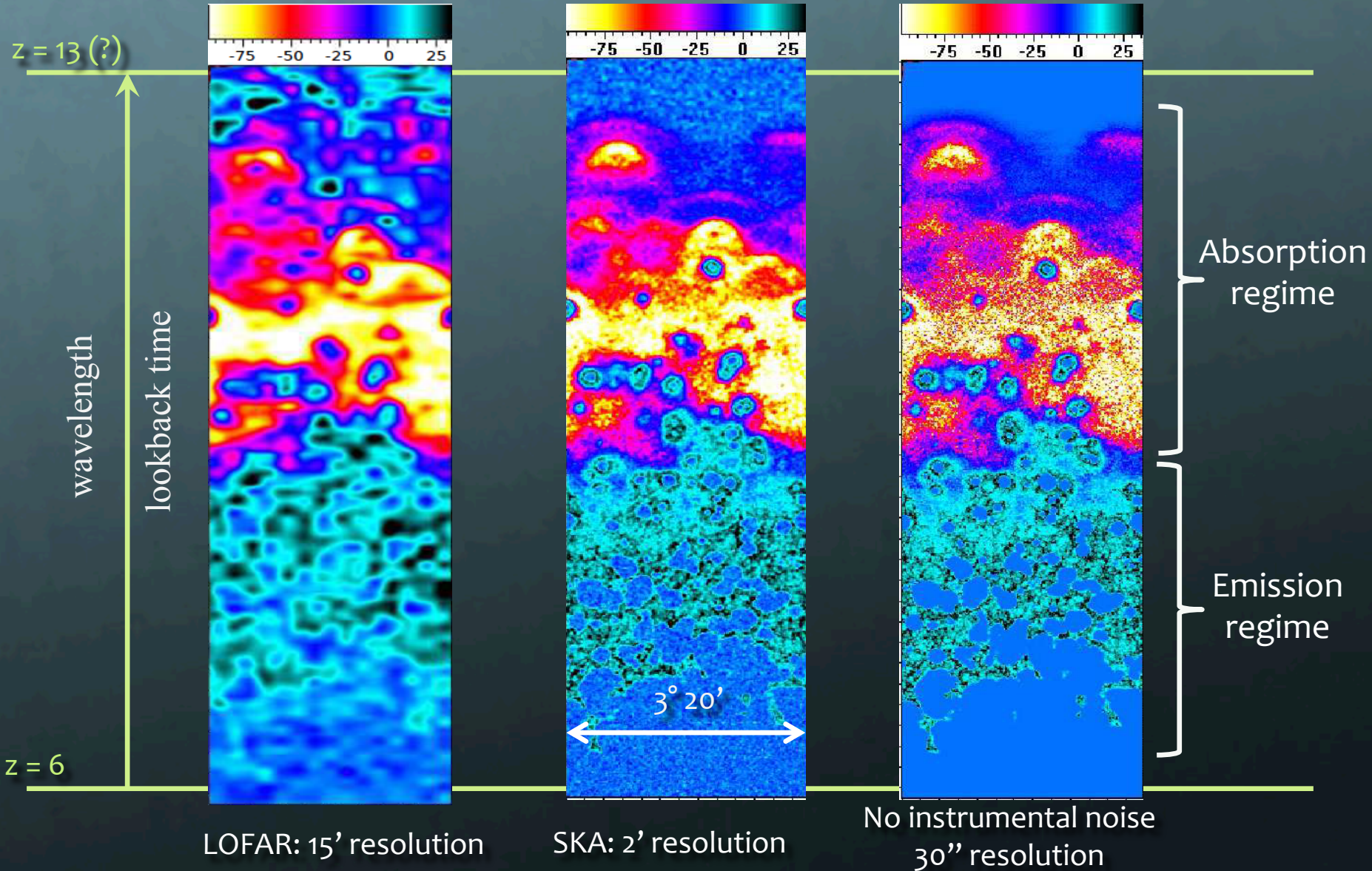
Collecting area:  $> 1 \text{ km}^2$

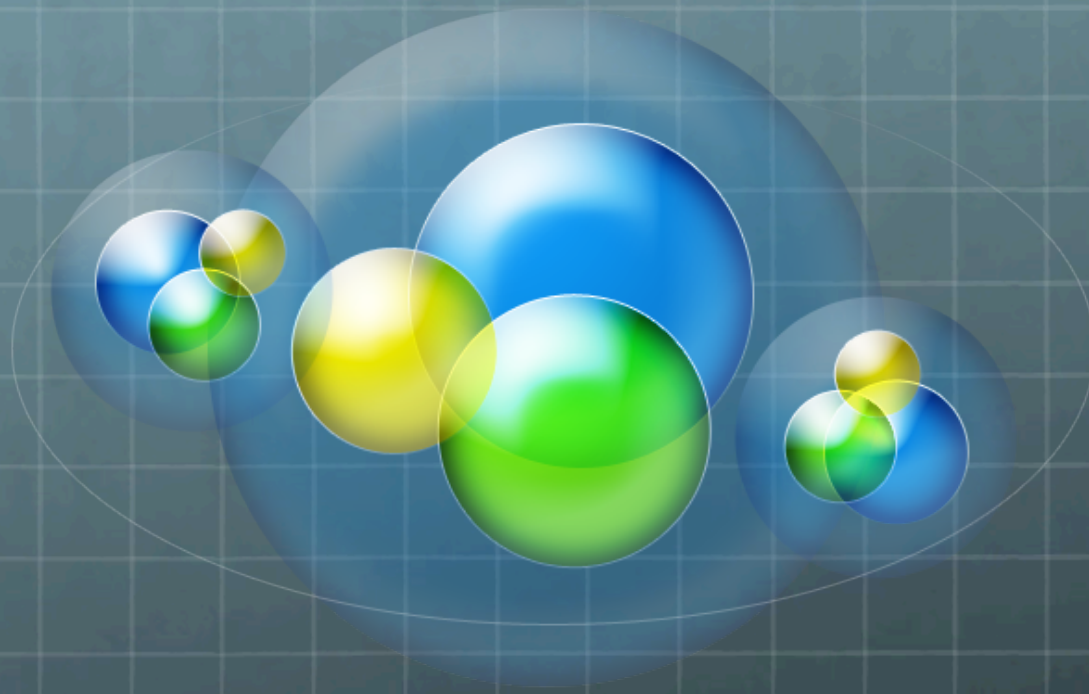
Tomography with  $2'$  res ( $6 < z < 25$ )

# Simulated 21cm signal

(Zawada et al. 2014)

$$\delta T_B \propto 28 \text{ mK} (1 + \delta)(1 + x_i) \left( \frac{T_S - T_{\text{CMB}}}{T_S} \right) \left( 1 + \frac{1}{H} \frac{dv}{dr} \right)^{-1}$$





# Cosmic star formation history

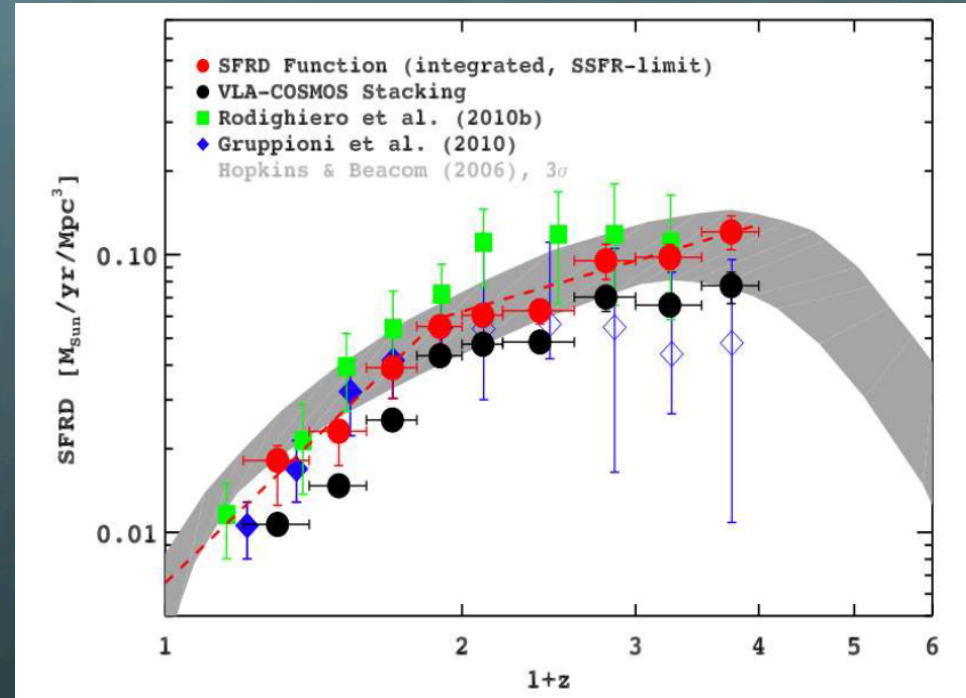
(F. Combes et al.)

# Some questions about cosmic star formation

What is the history of the average Star Formation Rate (SFR) density in the universe?

How does SFR relates to:

- ✓ Molecular mass
- ✓ Gas mass
- ✓ Baryonic mass
- ✓ Total mass



*Karim et al 2011*

Answers from large observation programs at IRAM/NOEMA (mm interferometers)

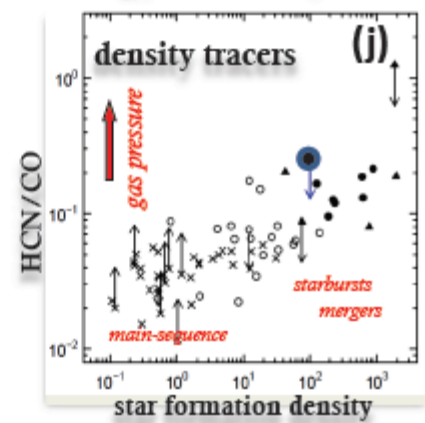
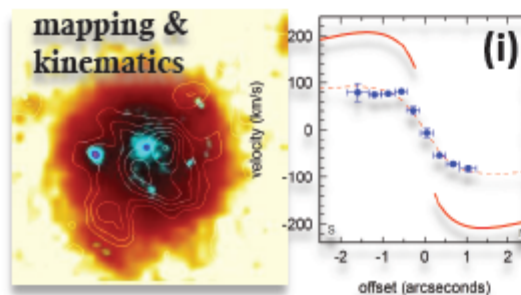
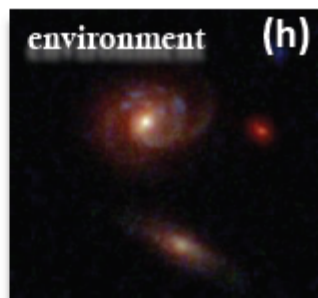
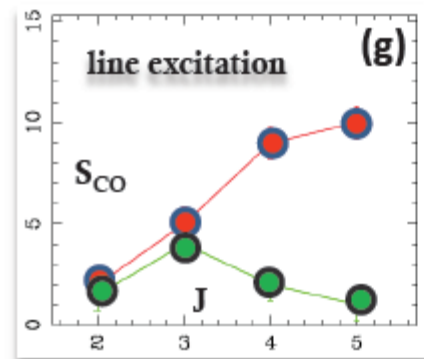
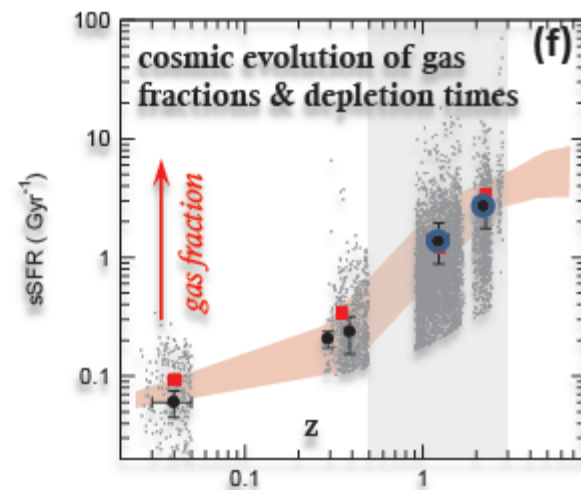
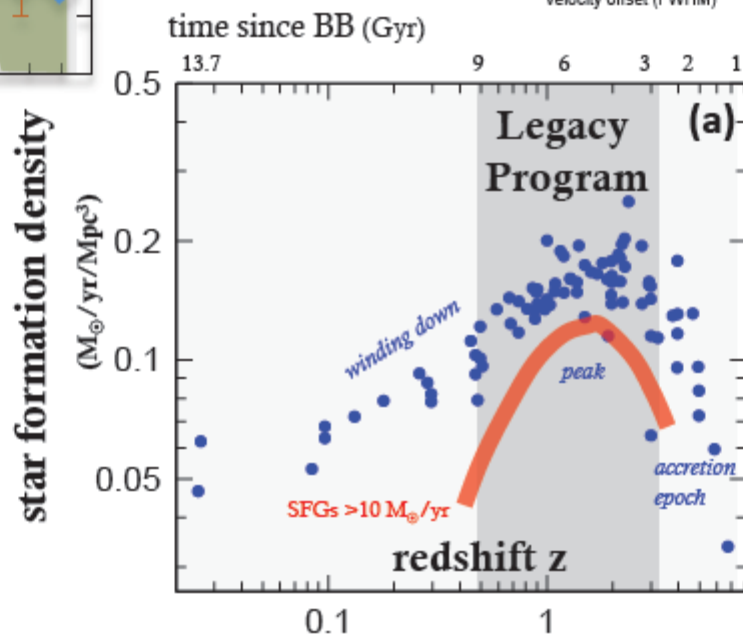
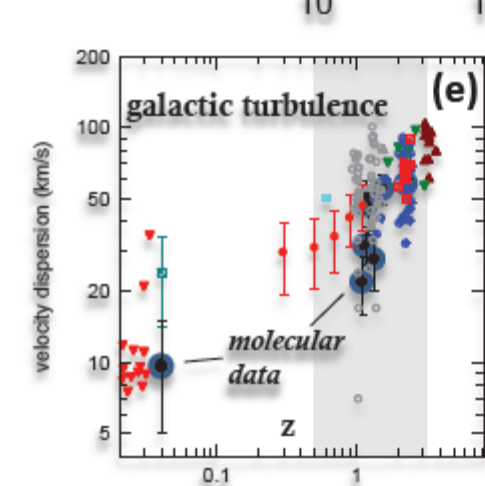
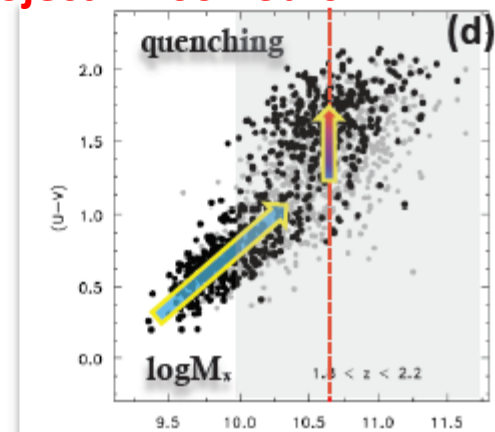
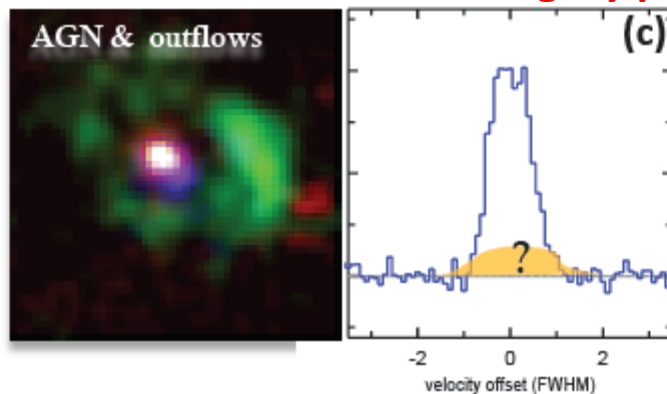
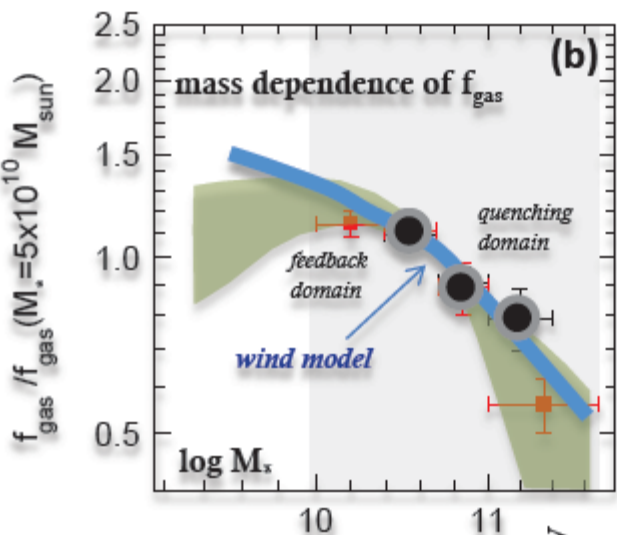
6  $\rightarrow$  12 antennas (diam 15 m)

2 km baselines

In the french alps (plateau de Bure)



# NOEMA legacy project: 1700 hours





And a lot more...

- Study of cooling flows (P. Salomé et al.)
- Radiative hydrodynamics simulations of primordial galaxies (B. Semelin et al.)
- Observations of constant (non-)variation (F. Combes et al.)
- ...