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# The Australian SKA Pathfinder & Galactic Science

**Naomi McClure-Griffiths**

**CSIRO Astronomy & Space Science**

*Fresh View of the Radio Sky 20-21 Sep 2011*





INDIAN  
OCEAN

CORAL  
SEA

Darwin

NORTHERN  
TERRITORY

QUEENSLAND

Alice Springs

WESTERN  
AUSTRALIA

Murchison Radio  
Astronomy Observatory

Perth

SOUTH  
AUSTRALIA

Adelaide

NEW SOUTH  
WALES

ACT

Sydney

Canberra

VICTORIA

Melbourne

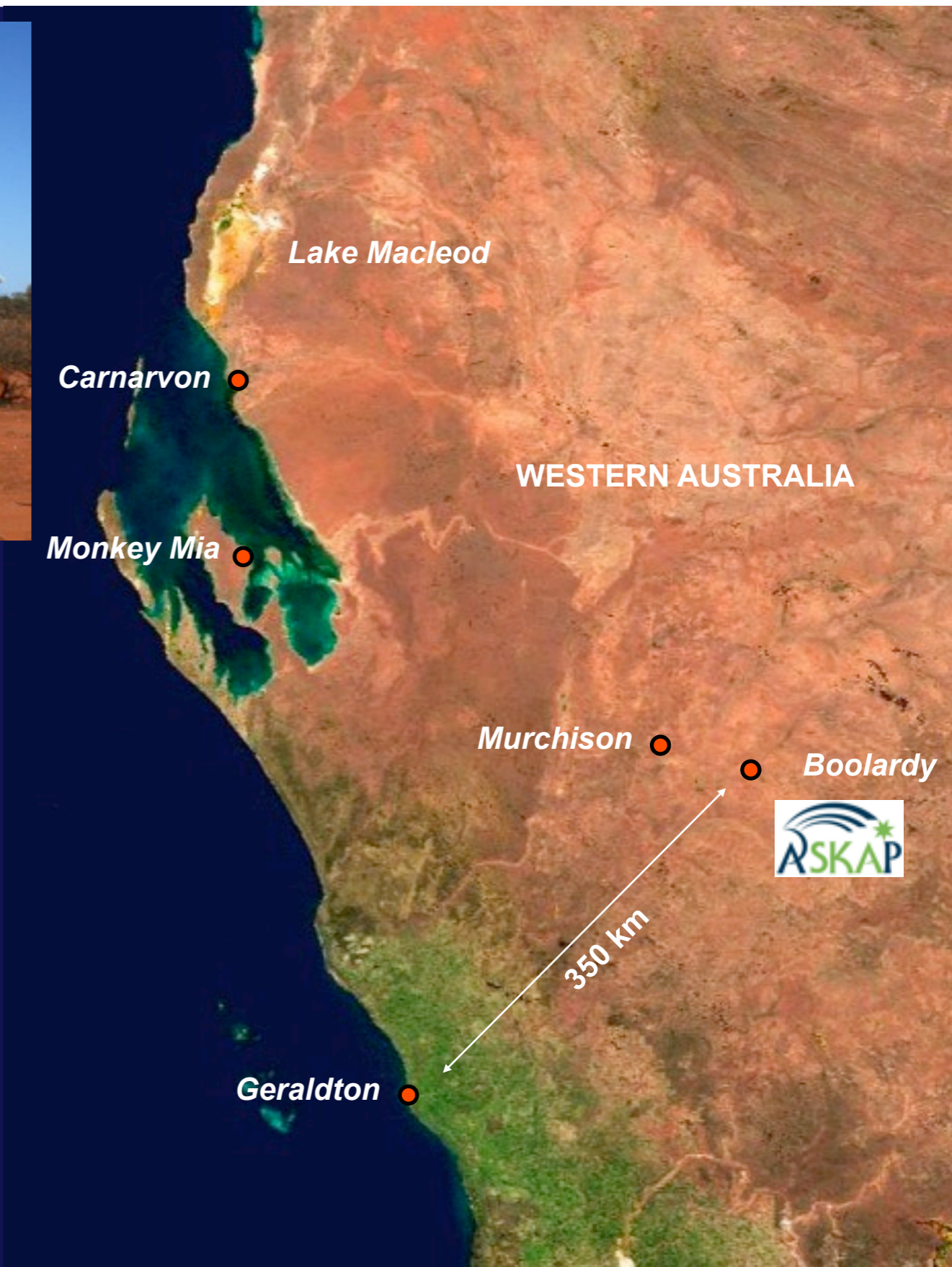
SOUTHERN OCEAN

TASMANIA

Hobart

Brisbane



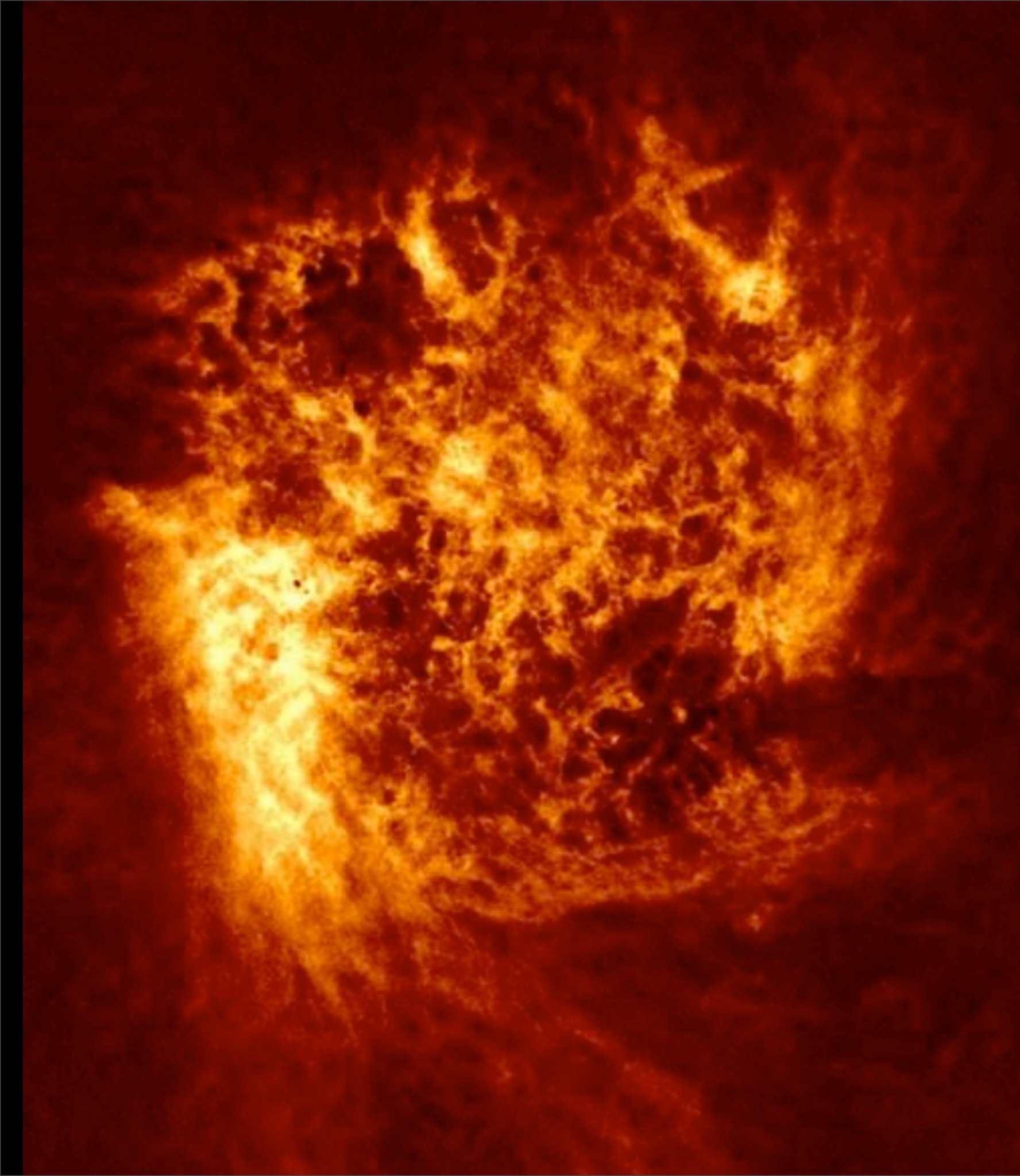




# ASKAP Design Specifications

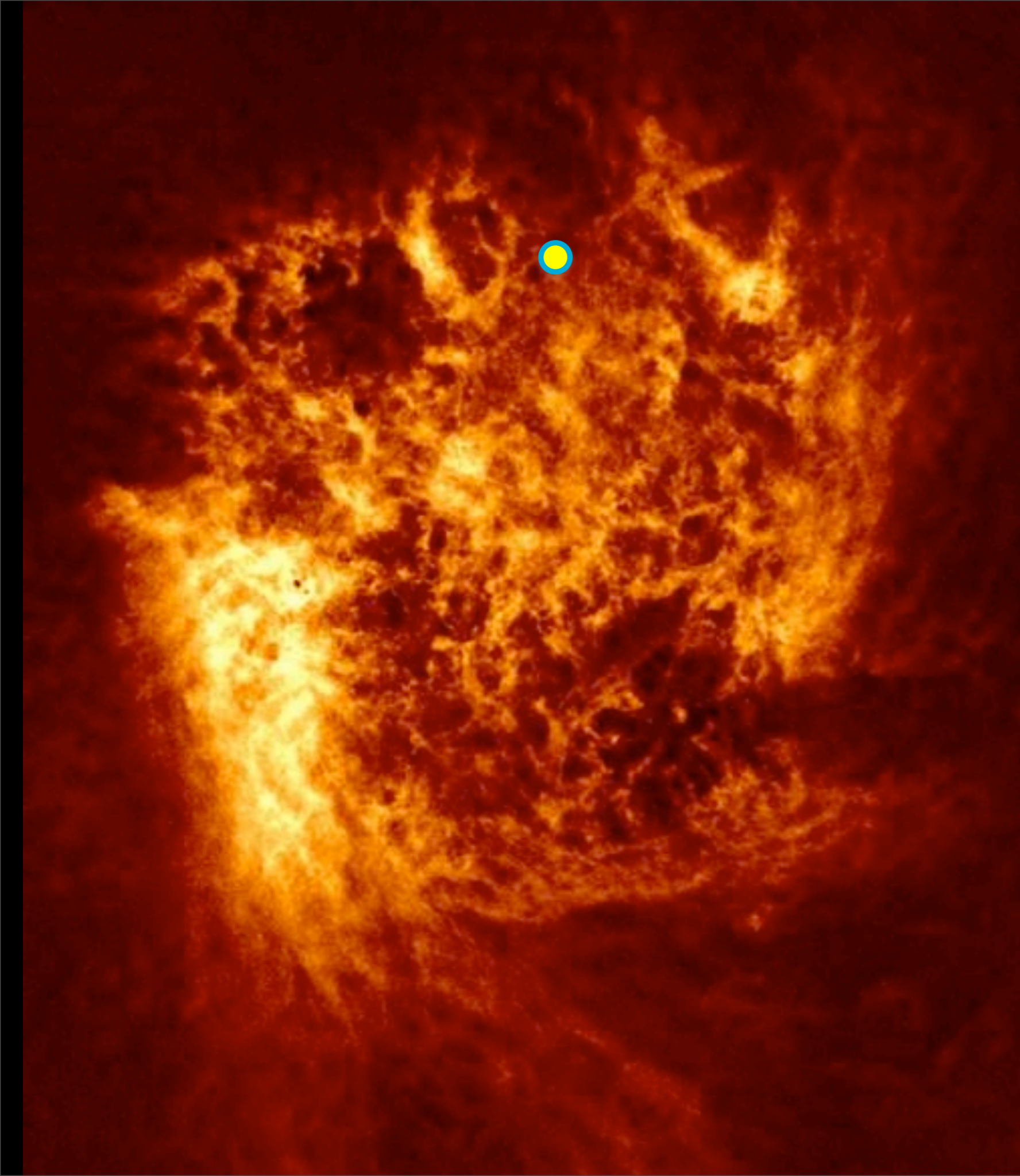
- Number of antennas 36 (630 baselines)
- Antenna diameter 12 m
- Collecting Area 4072 m<sup>2</sup>
- Maximum baseline 6 km
- Angular resolution 20 arcsec
- Sensitivity 65 m<sup>2</sup>/K
- Frequency range 700 – 1800 MHz
- Focal plane phased array 188 elements (92 dual pol)
- Field of view 30 deg<sup>2</sup>
- Processed bandwidth 300 MHz
- Number of channels 16 384
- Correlator integration time 5 sec





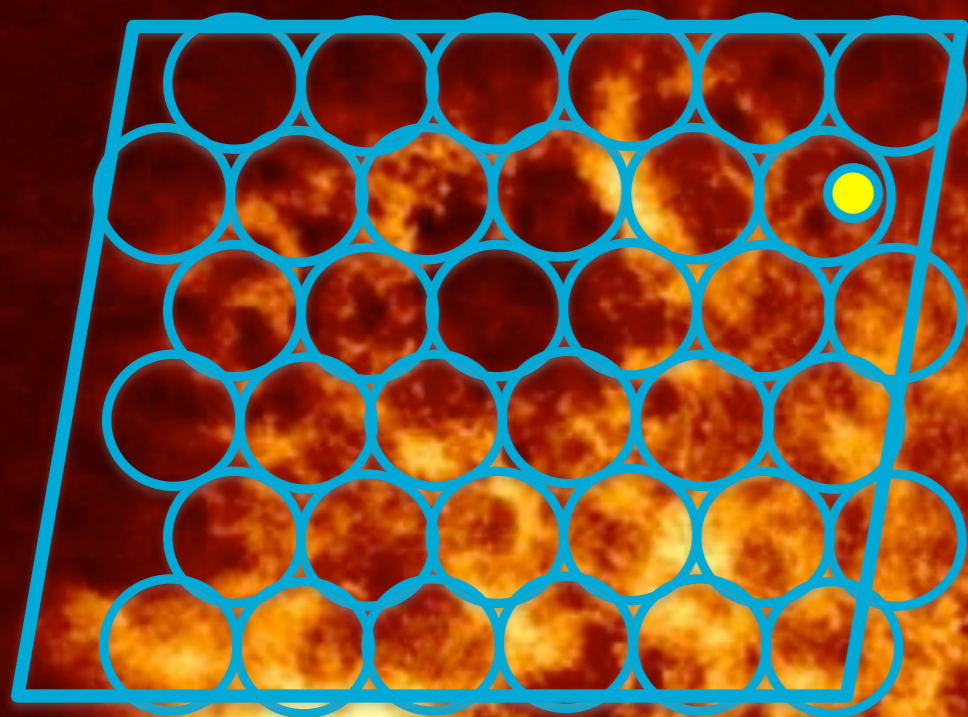
LMC HI ATCA +  
Parkes mosaic  
(Kim et al 1999)





LMC HI ATCA +  
Parkes mosaic  
(Kim et al 1999)



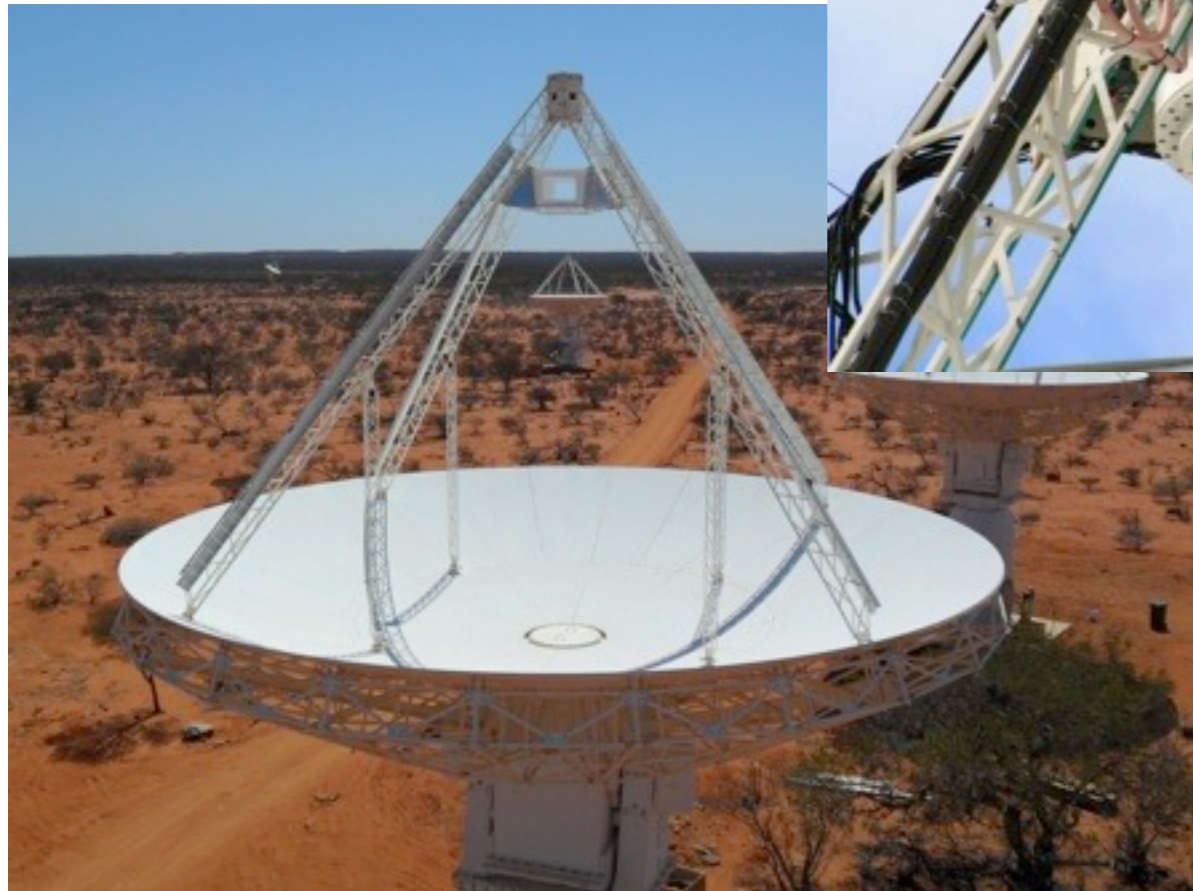
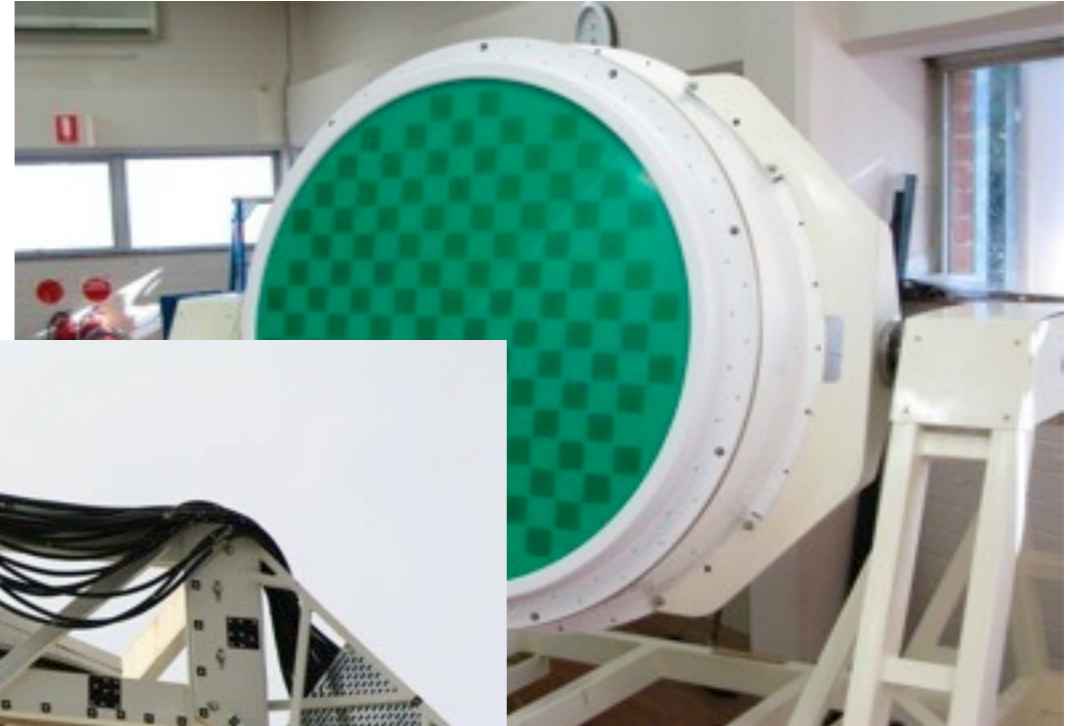
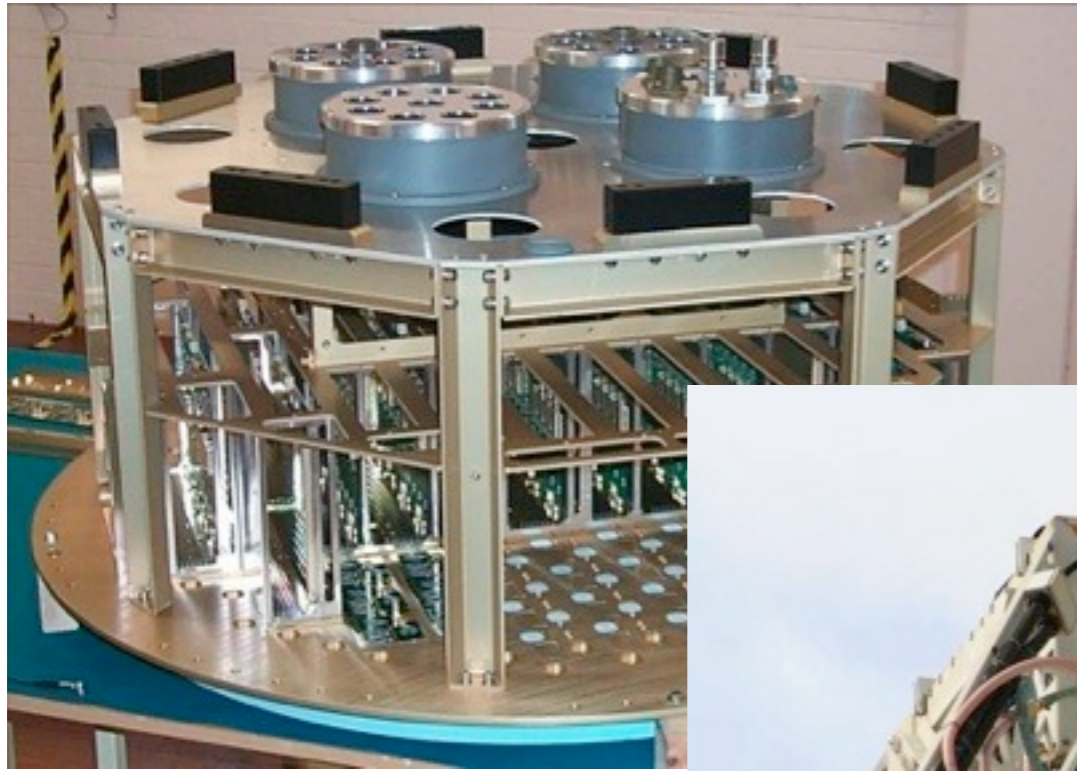


LMC HI ATCA +  
Parkes mosaic  
(Kim et al 1999)

1344 ATCA pointings=  
4 ASKAP fields



# ASKAP Status

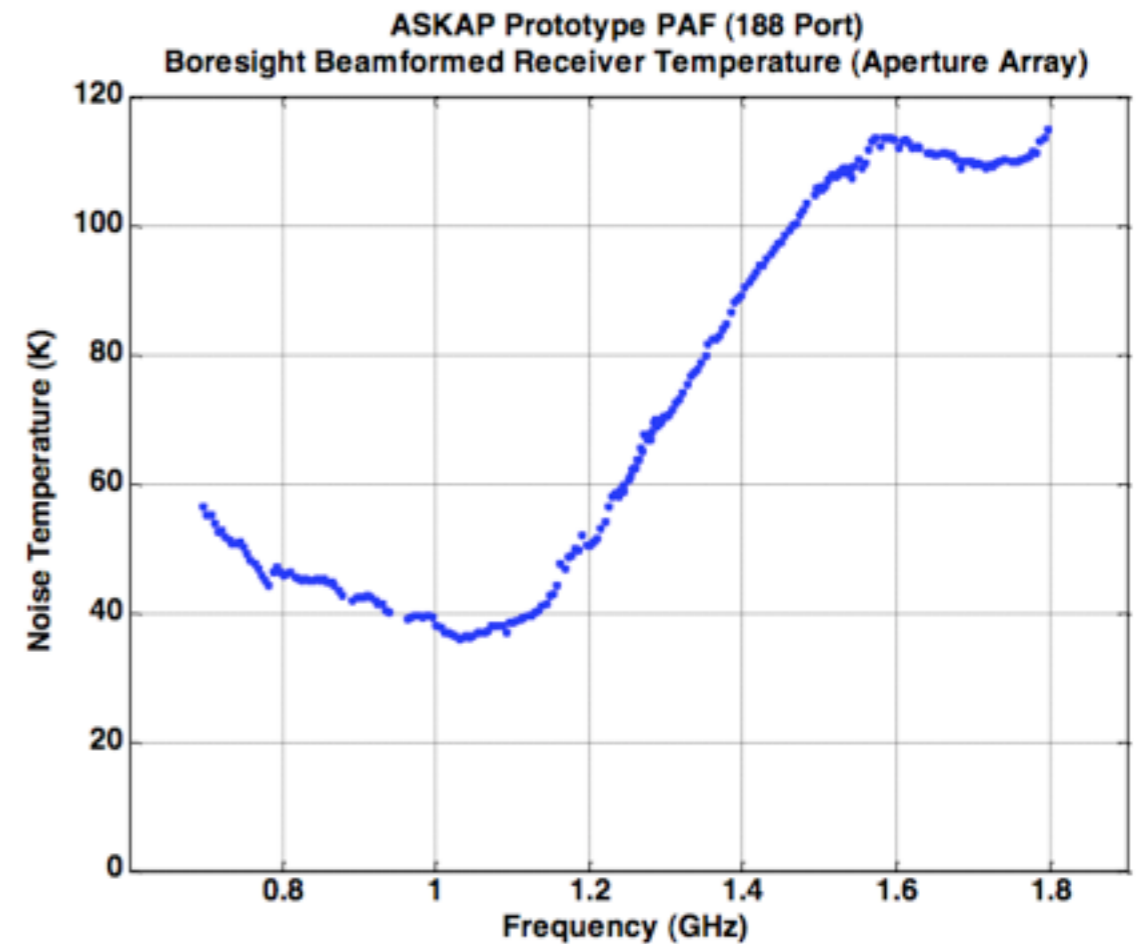




# Current Status

- Mid West Radio-quiet Zone (RQZ) legislated
- Phased Array Feed (PAF) tested on Parkes 12m, performs!
- MRO roads all laid out
- 30 antenna foundations excavated
- 9 antennas constructed
- MRO fibre link to Geraldton in place, to Perth nearly complete

$T_{\text{sys}}$  results from full PAF in ground testing (hot/cold load)



Performs well below 1.2 GHz. Mismatched impedance at higher freqs can be fixed with minor tweak to PAF design



# ASKAP – Upcoming Timeline

- PAF on MRO antenna *Oct 2011*
- Six PAFs on 6 antennas (BETA) *Sept – Dec 2011*
- Limited BETA observing *start Oct 2011*
  - Commissioning with some single pixel feeds
  - aim is to generate basic data files
  - primary BETA capability *April 2012*
- MRO Infrastructure complete *late December 2011*
- Full ASKAP operations *end of 2013*



# Galactic Science with ASKAP: GASKAP

CREDIT: Nidever, et al., NRAO/  
AUI/NSF and Meilinger



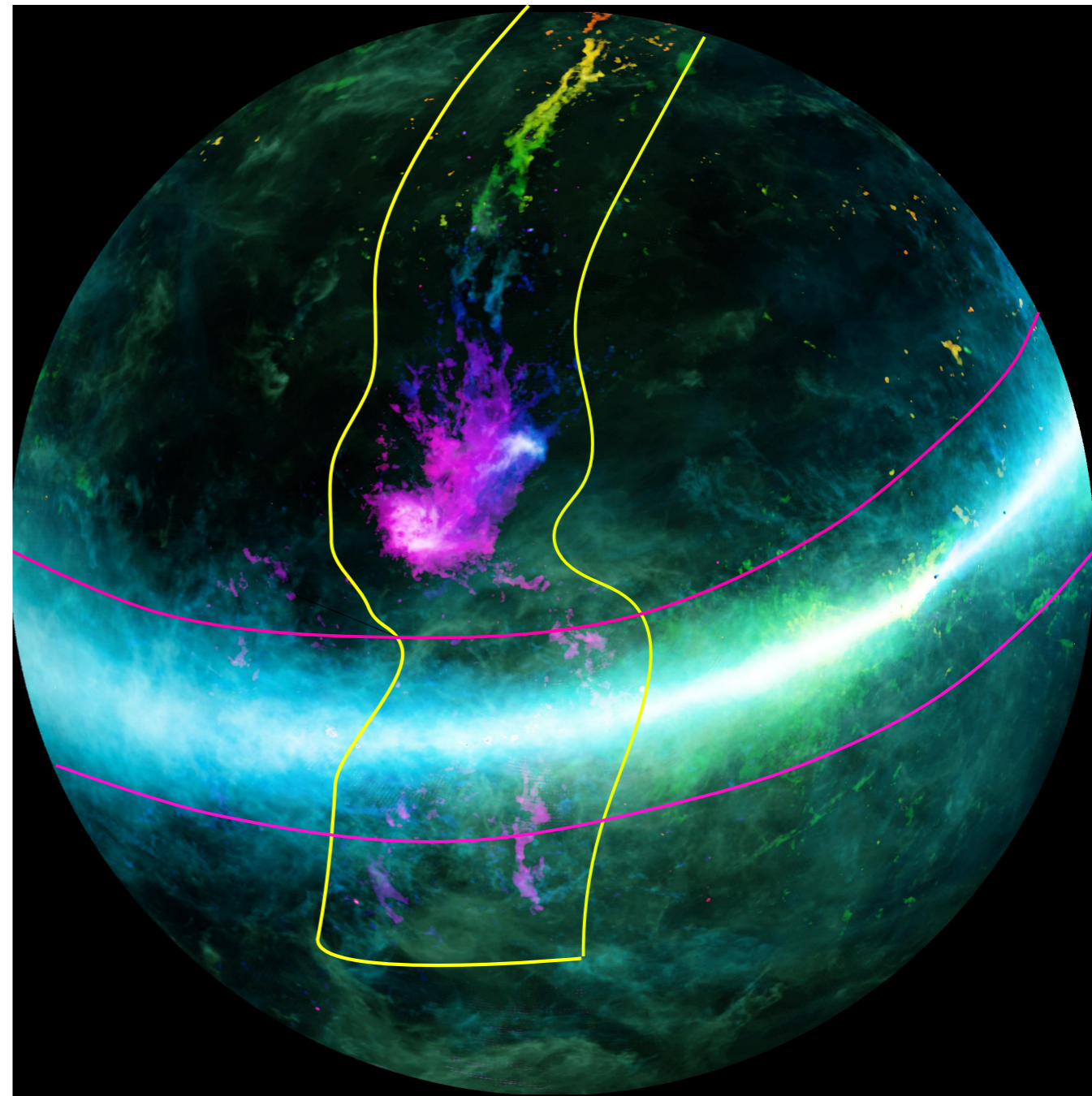


# GASKAP

PIs: Dickey & McClure-Griffiths

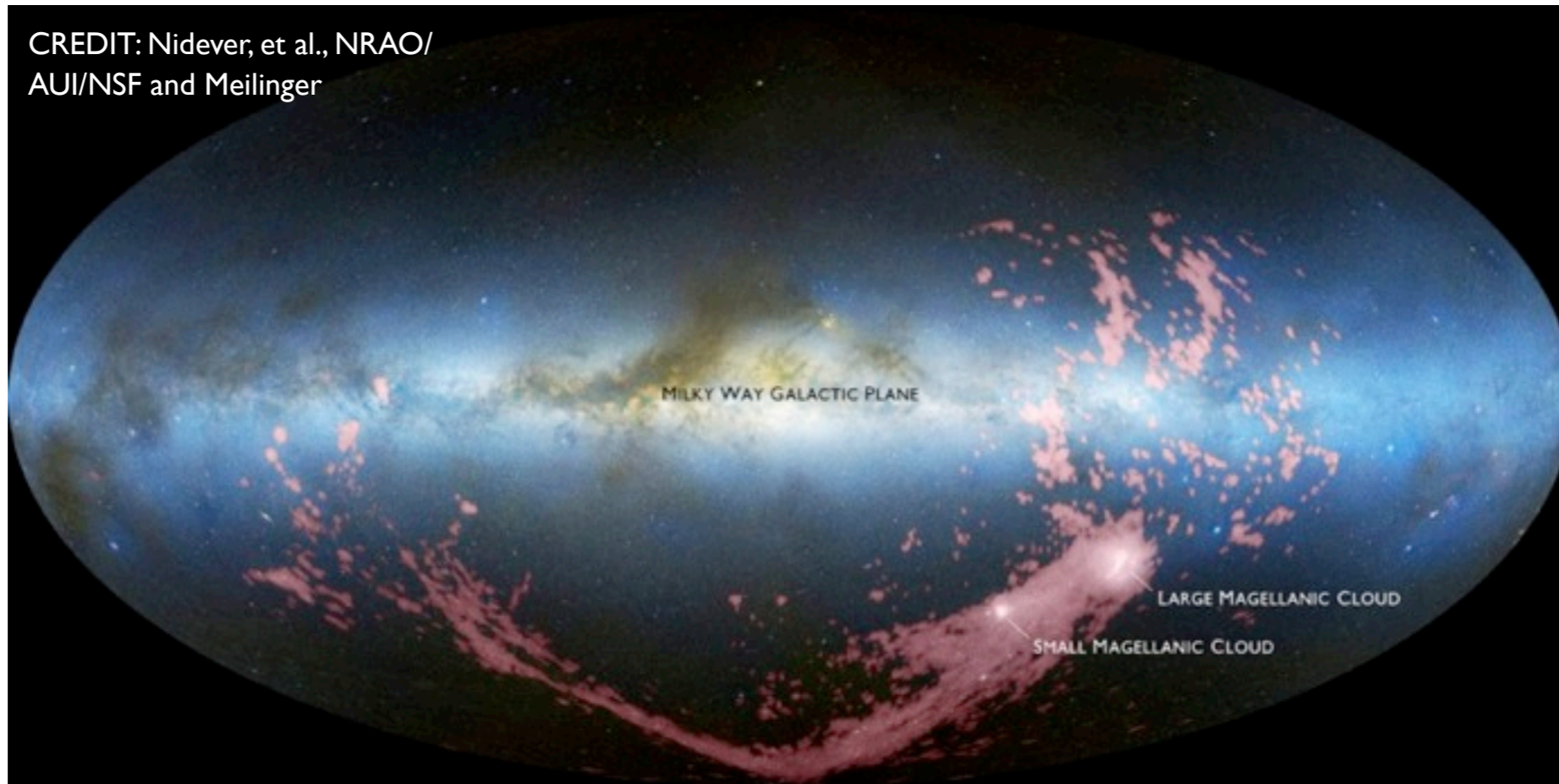
Aim: To study the evolution of the Milky Way and Magellanic Clouds through their interstellar gas and star formation

- Survey of the Galactic plane and Magellanic System:
  - HI  $\lambda 21$ -cm emission and absorption
  - OH  $\lambda 18$ -cm diffuse emission and absorption
  - OH  $\lambda 18$ -cm masers
- More than order of magnitude more sensitive



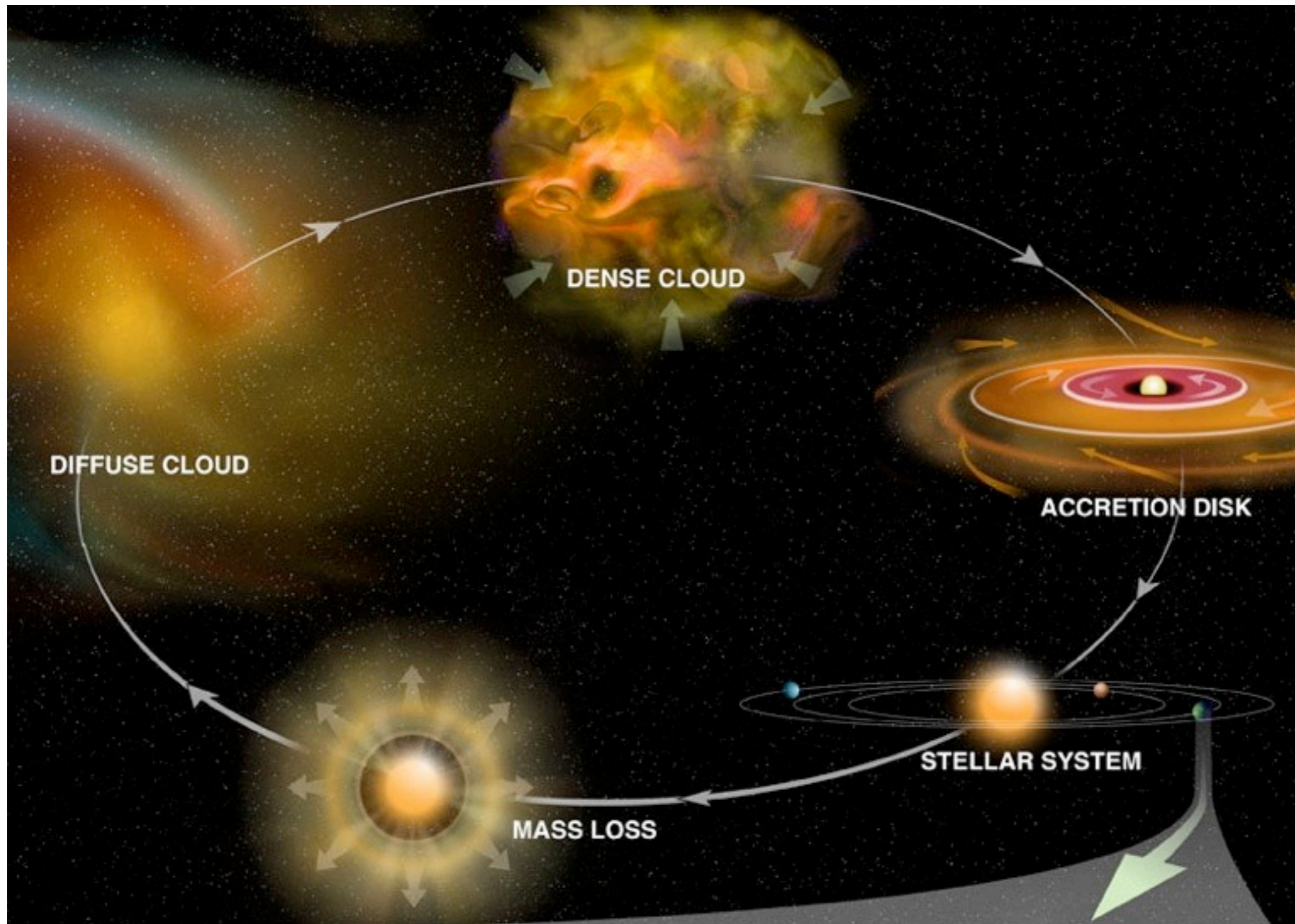


# GASKAP Science



- How does gas cool in the ISM?
- Energy flow between the Galactic disk & halo
- OH masers as tracers of stellar birth & death and Galactic Structure
- Magellanic Stream as a template for Galaxy fuelling
- How does the evolutionary cycle of matter differ in the Milky Way, LMC and SMC?

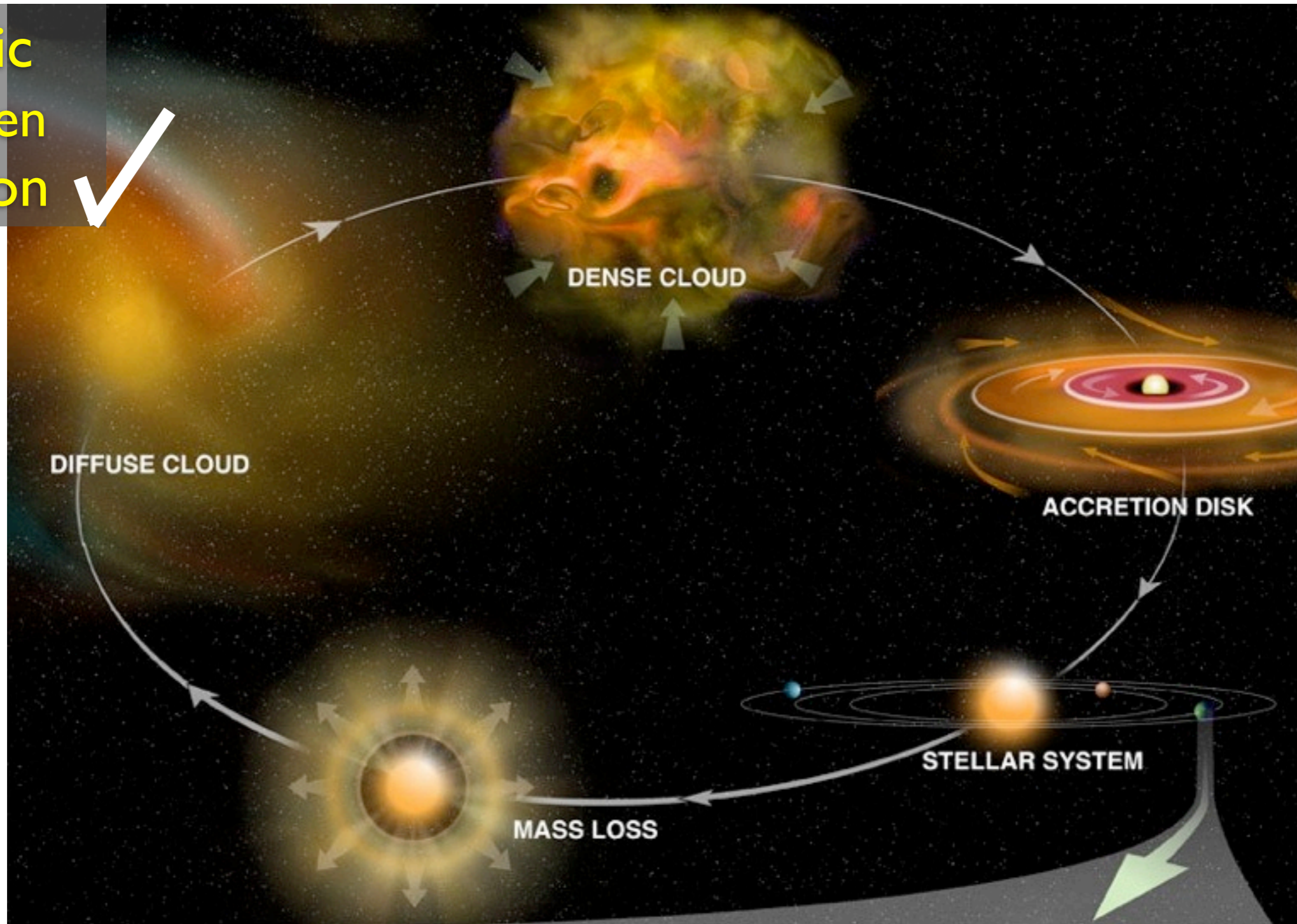
# The Cycle of Galaxy Evolution





# The Cycle of Galaxy Evolution

Atomic hydrogen emission ✓

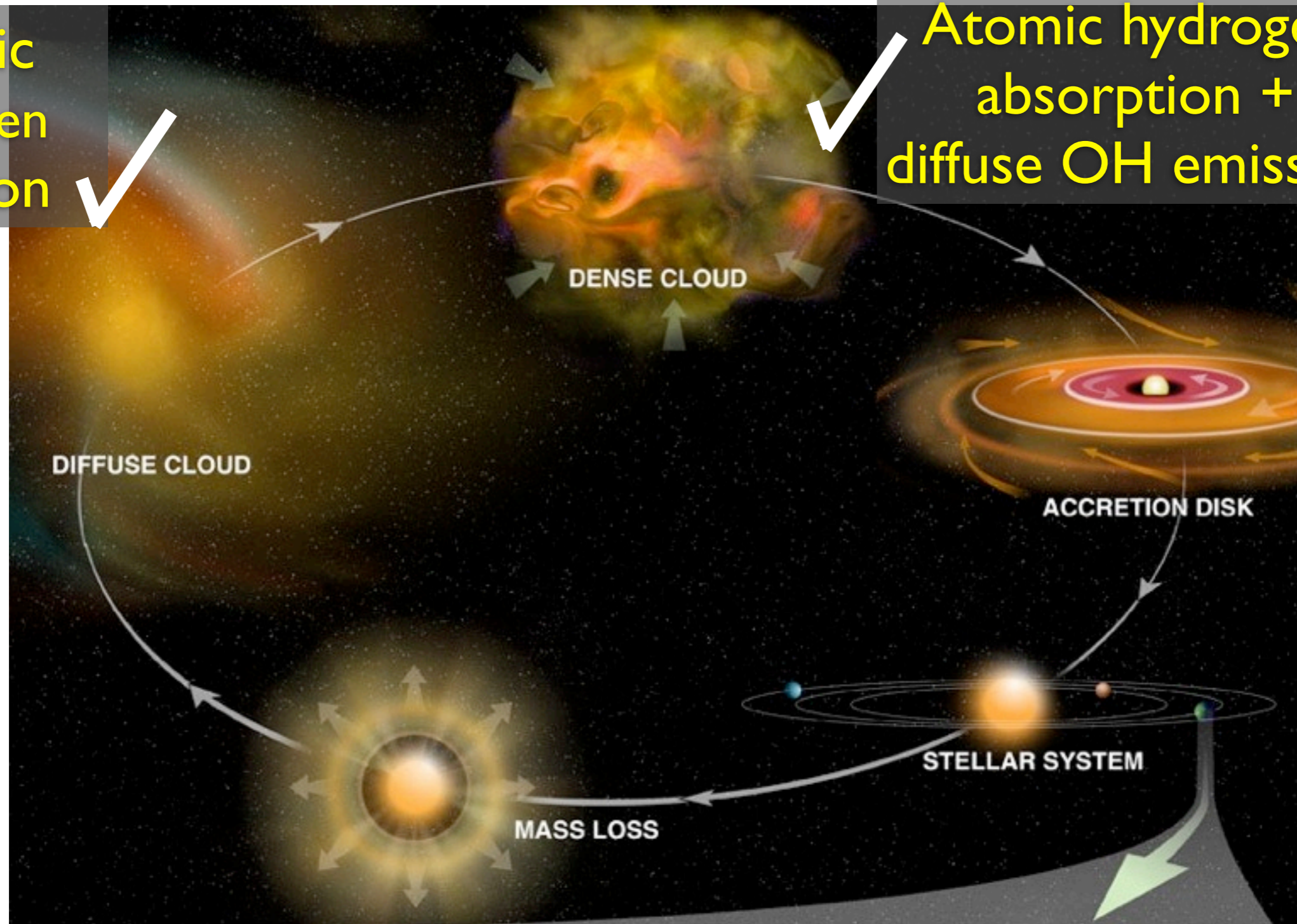




# The Cycle of Galaxy Evolution

Atomic hydrogen emission

Atomic hydrogen absorption + diffuse OH emission



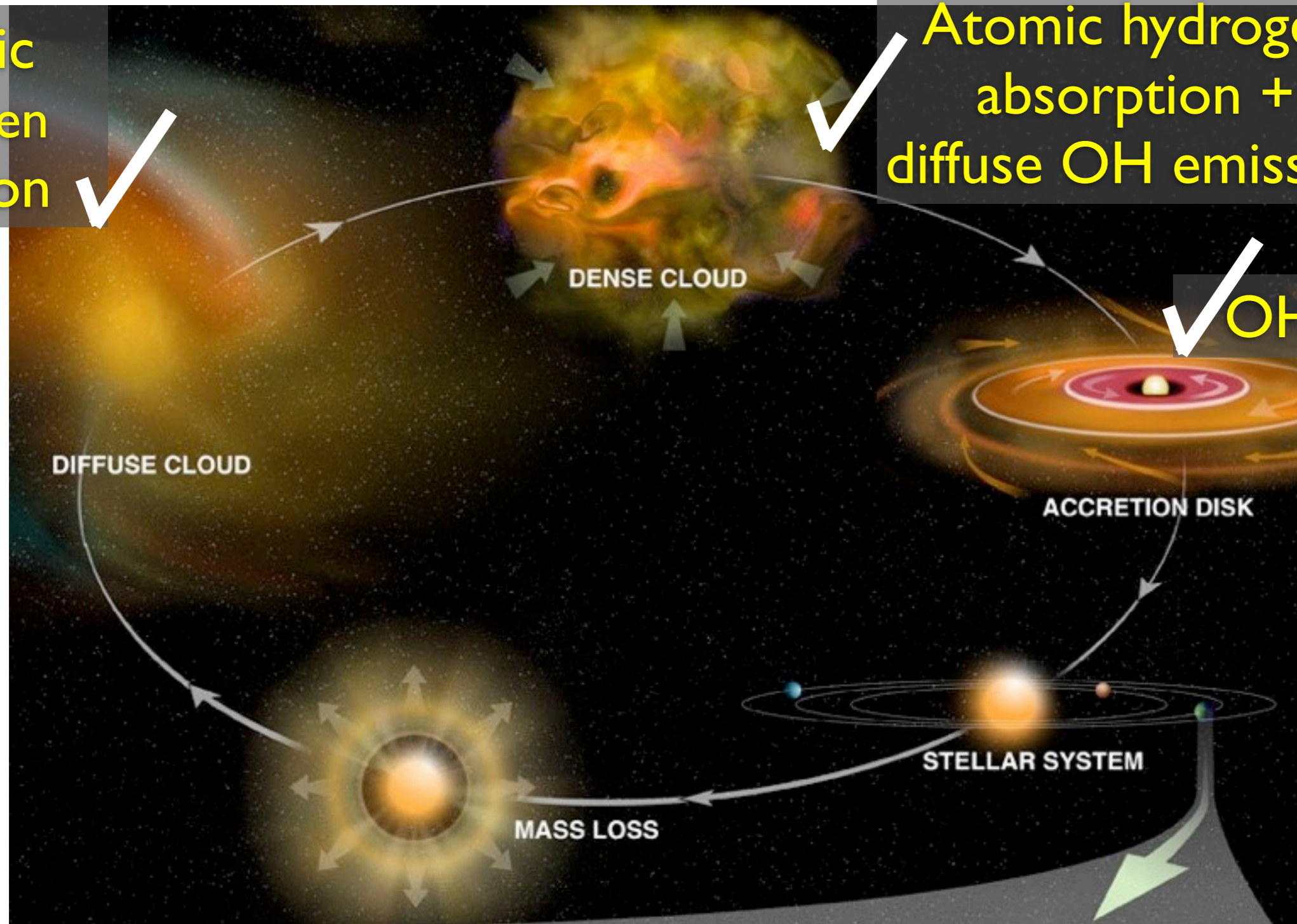


# The Cycle of Galaxy Evolution

Atomic hydrogen emission

Atomic hydrogen absorption + diffuse OH emission

OH masers





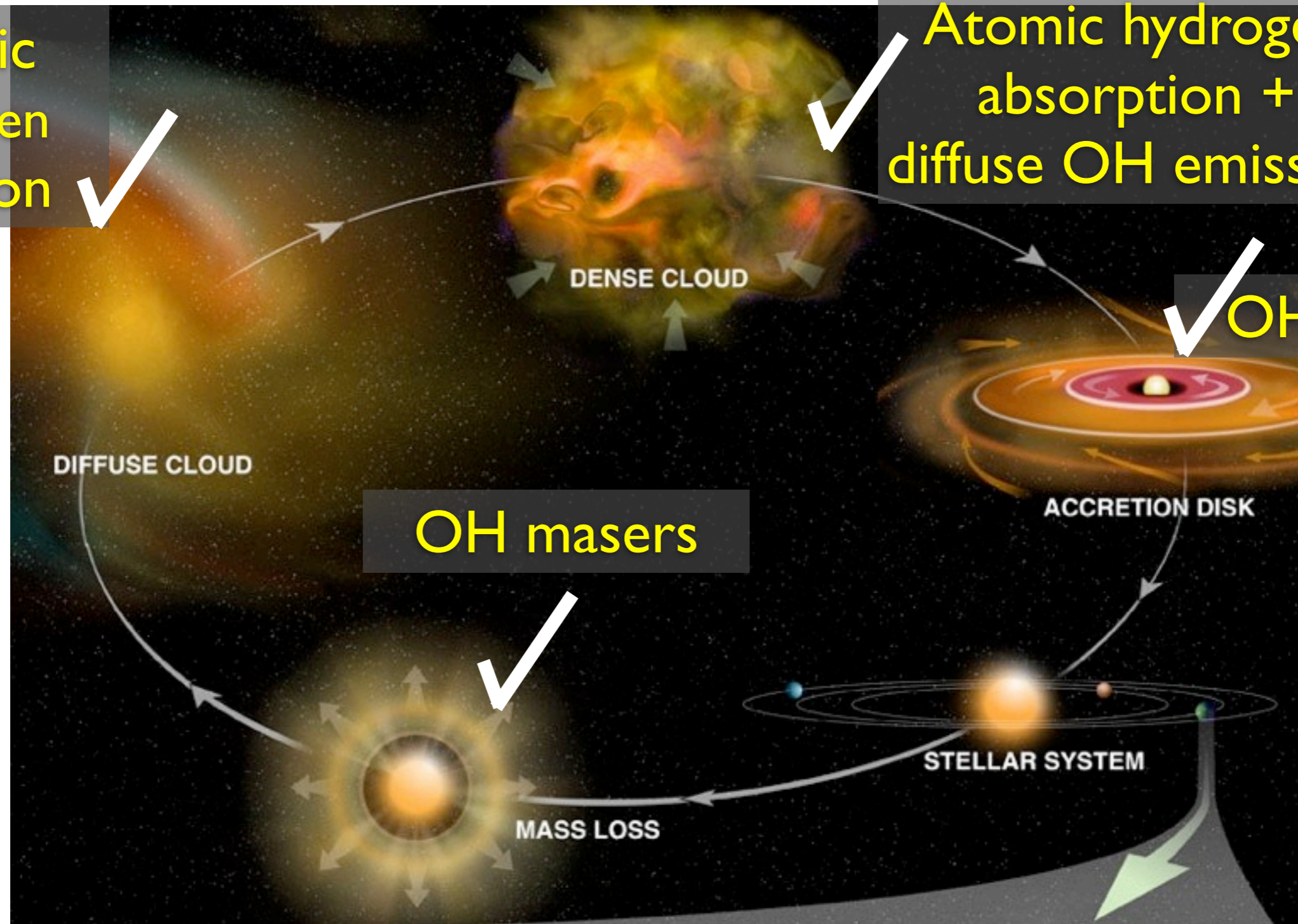
# The Cycle of Galaxy Evolution

Atomic hydrogen emission

Atomic hydrogen absorption + diffuse OH emission

OH masers

OH masers





# The Cycle of Galaxy Evolution

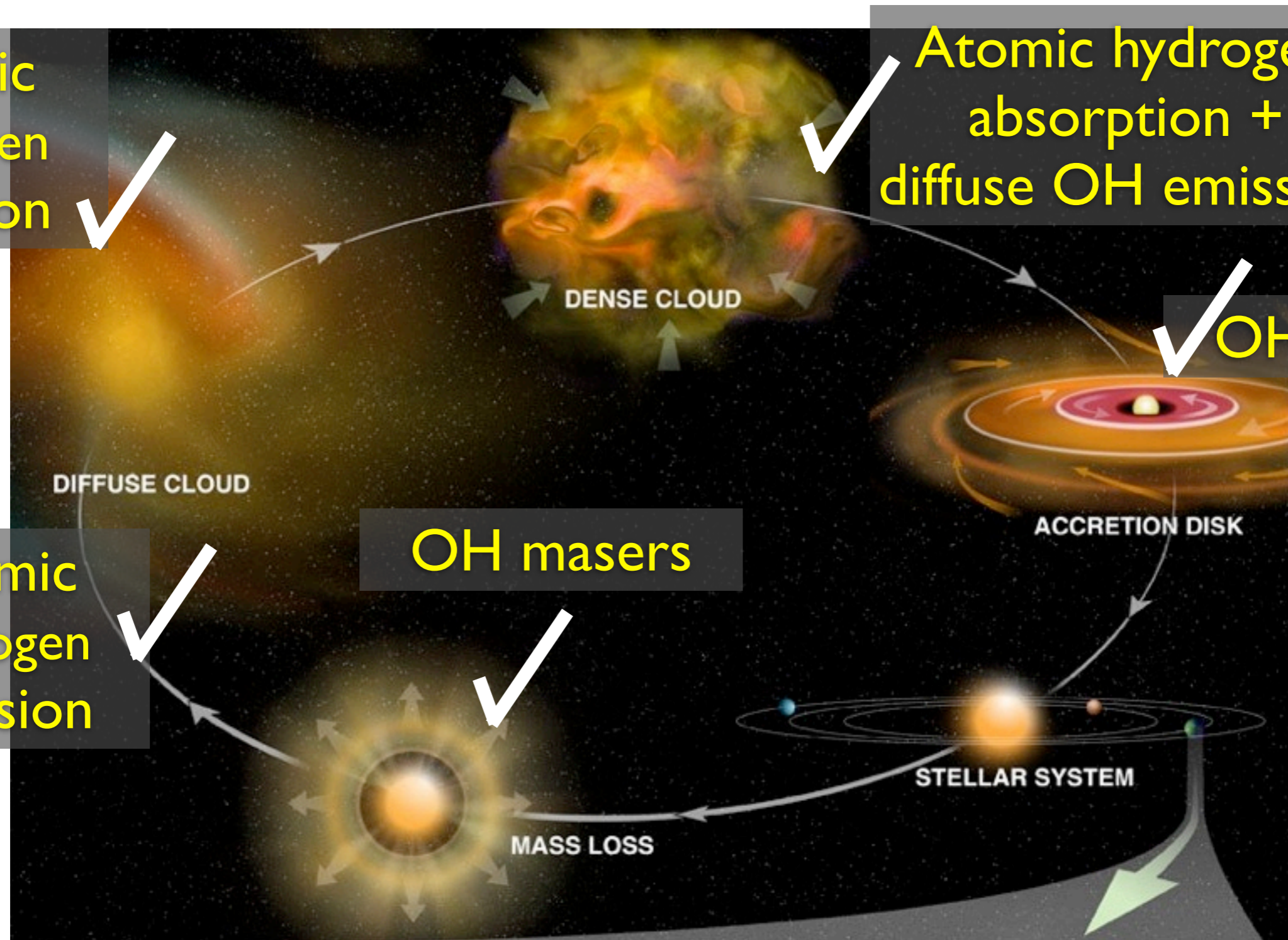
Atomic hydrogen emission

Atomic hydrogen absorption + diffuse OH emission

OH masers

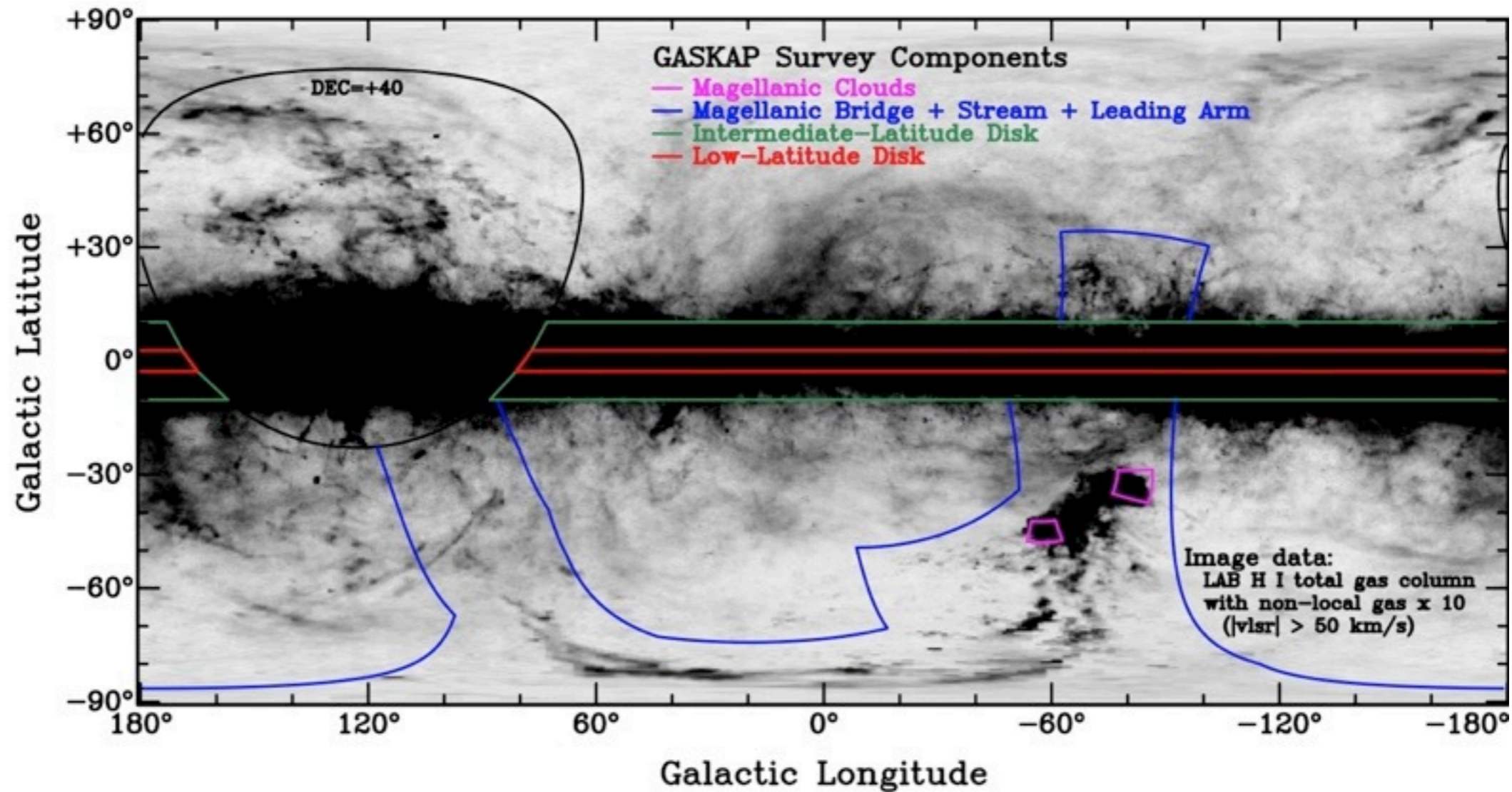
Atomic hydrogen emission

OH masers





# GASKAP Survey area



Frequency Coverage:

1416.4-1424.4 MHz (HI line  $|v| < 840$  km/s)

1610-1614 MHz, 1662-1670 MHz (OH lines)

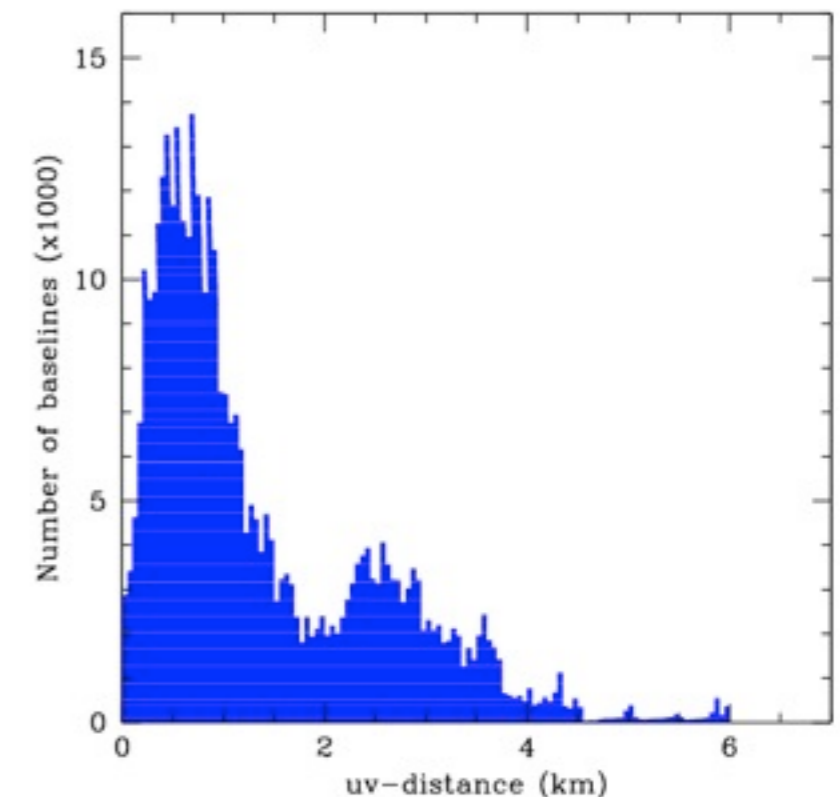
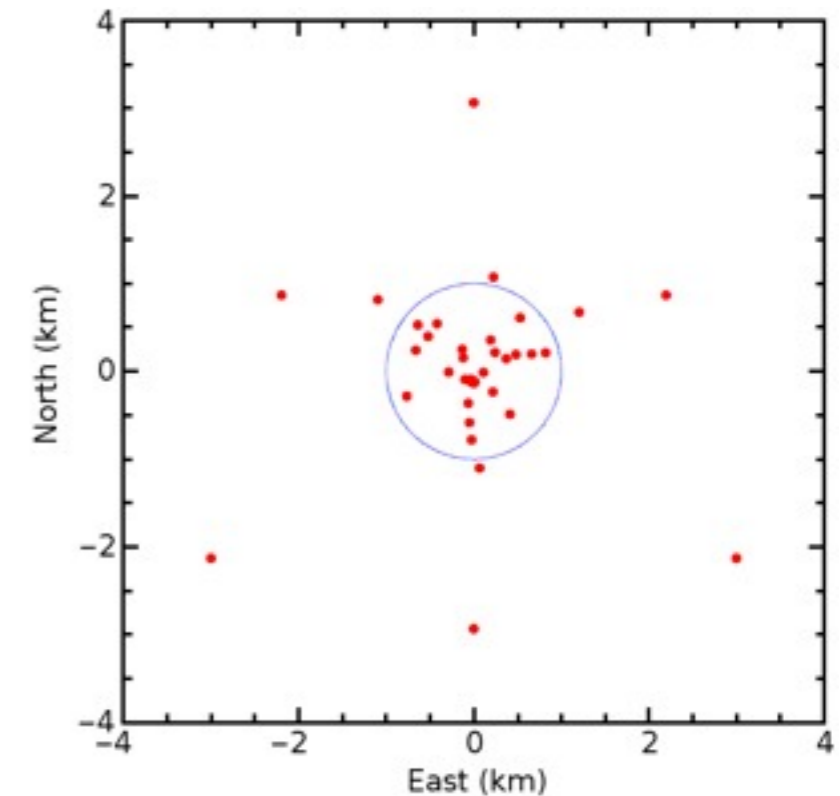
all with resolution 1.157 kHz = 0.25 km/s

observed simultaneously with two polarizations



# Why ASKAP is perfect for GASKAP

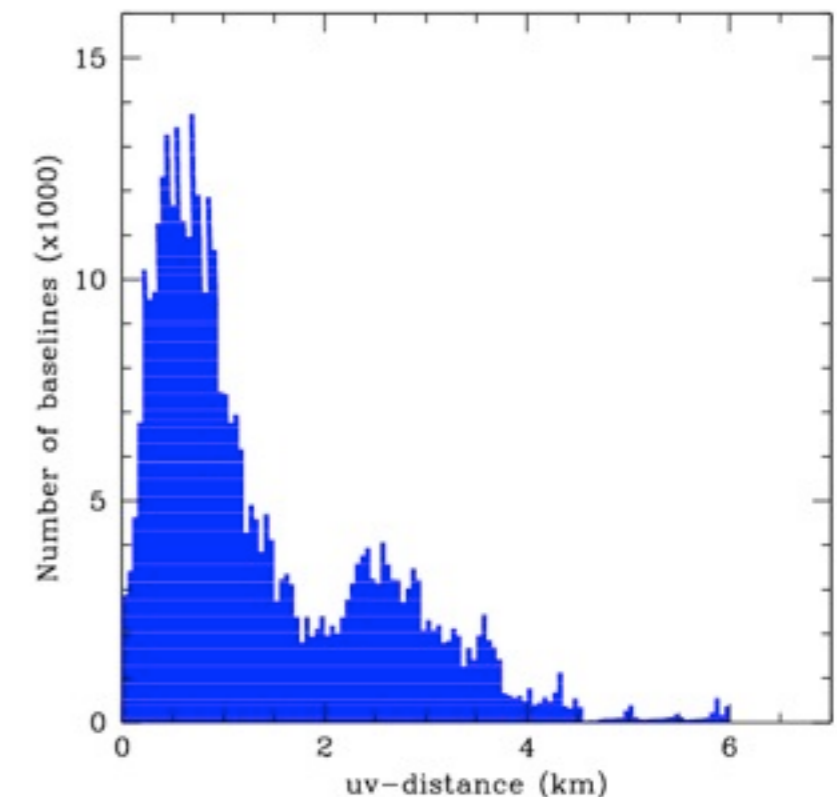
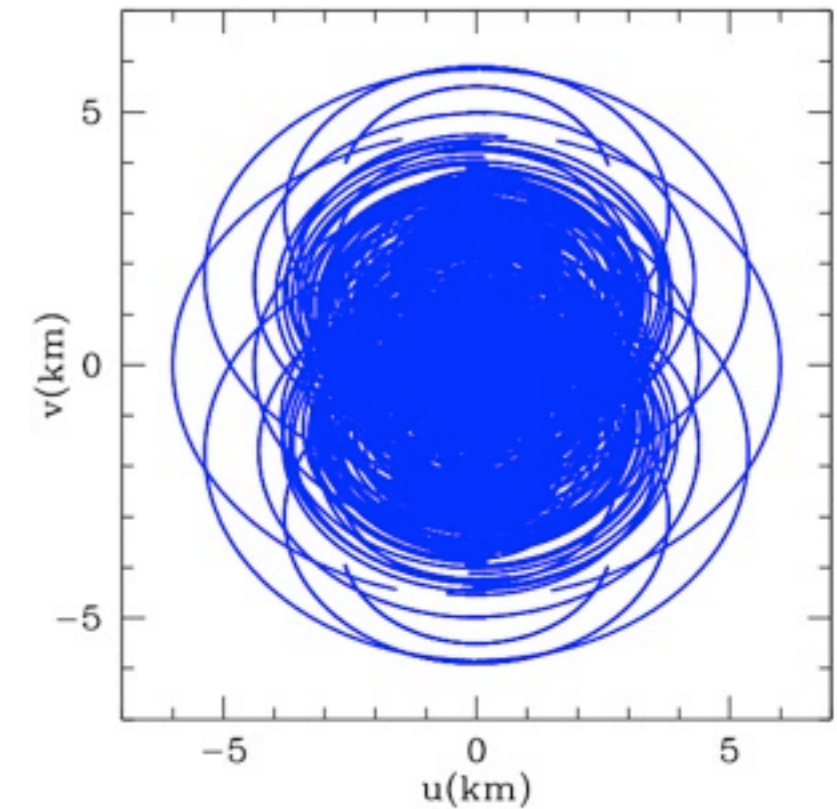
- ASKAP has:
  - short baselines to probe diffuse emission
  - long baselines to probe OH masers and HI absorption
  - survey speed
  - flexible spectrometer (zoom modes)





# Why ASKAP is perfect for GASKAP

- ASKAP has:
  - short baselines to probe diffuse emission
  - long baselines to probe OH masers and HI absorption
  - survey speed
  - flexible spectrometer (zoom modes)



# RMS noise ( $1\sigma$ ) in brightness temperature (K)

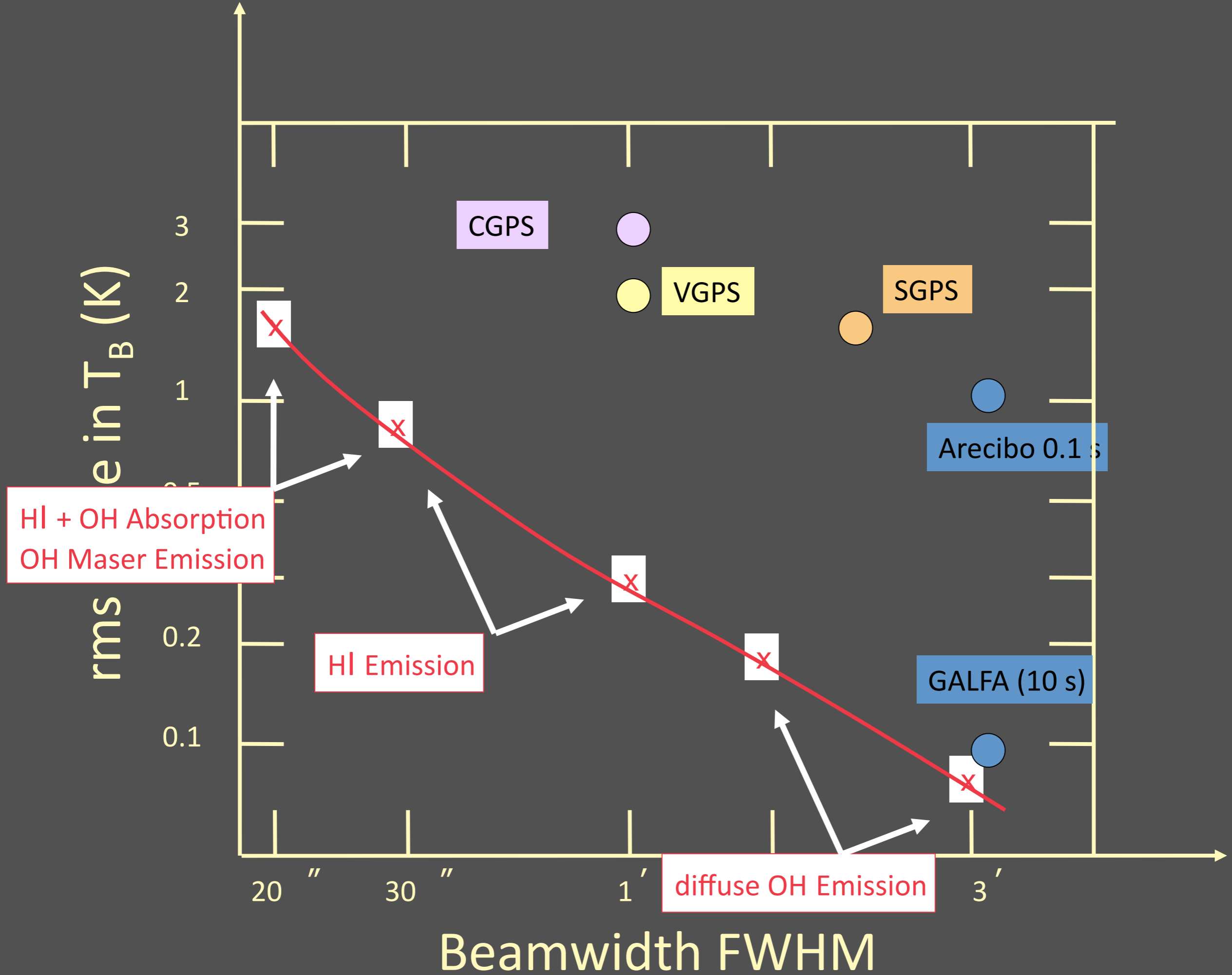
FWHM area	20''	30''	60''	90''	180''	Srms (mJy)
C(200h)	0.77	0.41	0.14	0.094	0.038	0.3
A (50h)	1.5	0.81	0.28	0.19	0.076	0.6
B+D (12.5h)	3.1	1.6	0.56	0.38	0.15	1.2

C = Magellanic Clouds

A = Galactic Plane

B+D = Intermediate Latitudes + Magellanic Stream





# GASKAP + APERTIF Galactic and Magellanic Evolution Survey (GAMES)

