DINGO's Walkabout Through the Deep HI Universe

International Centre for Radio Astronomy Research

an

ASTOUNDING STORIES OF SUPER-SCIENCE

narrated by

Attila Popping

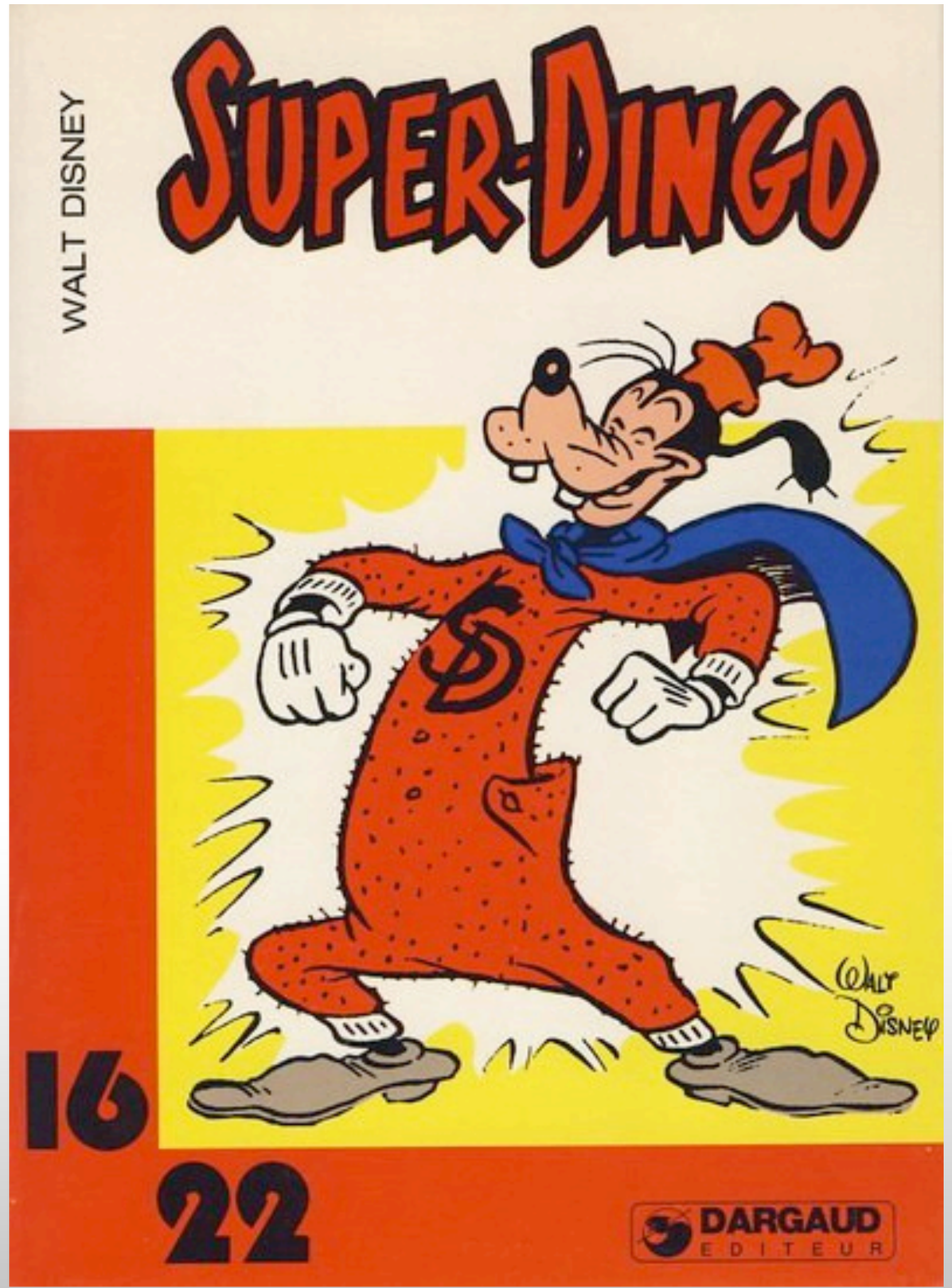
Curtin University

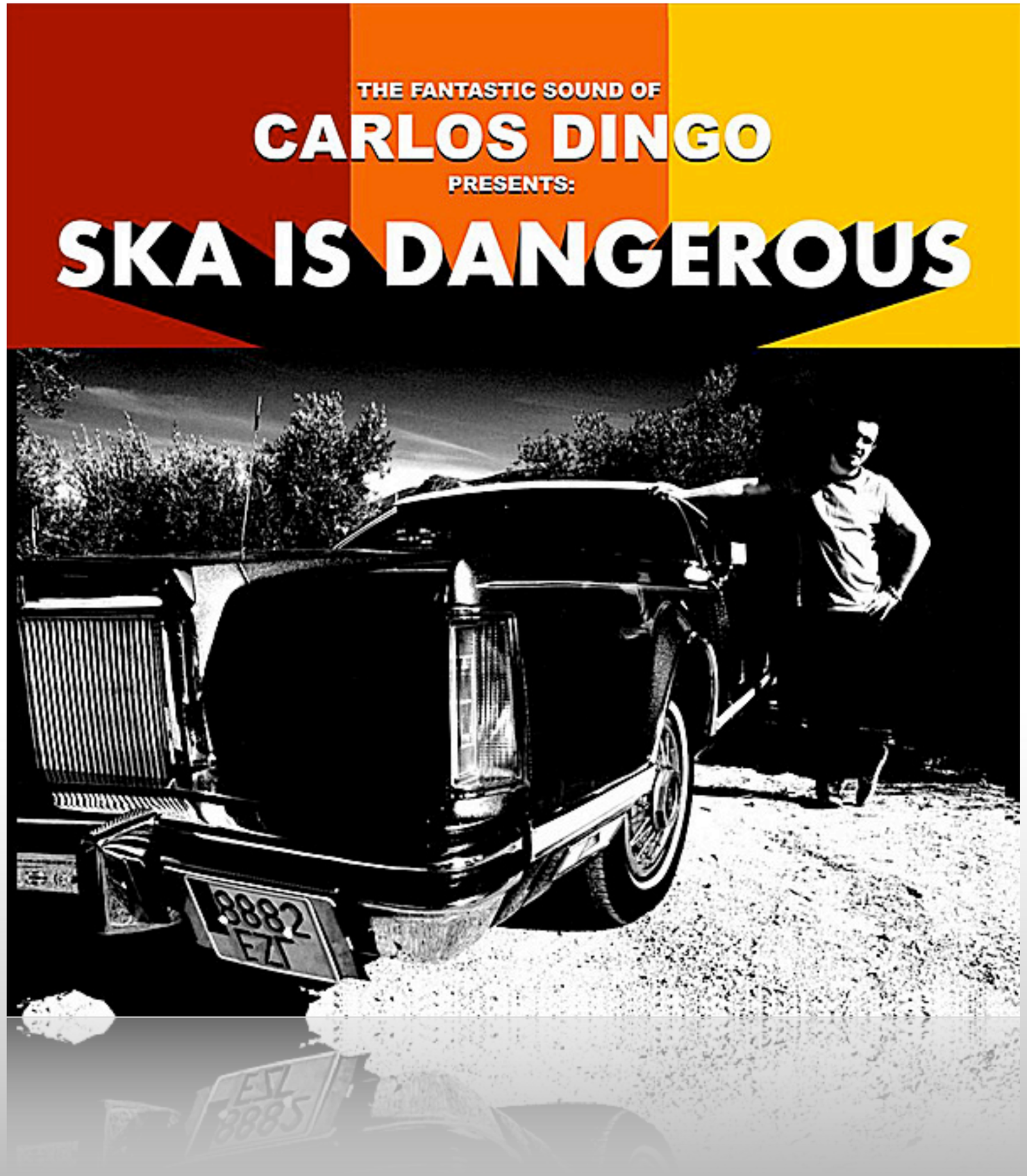
The Government of Western Australia

The University of Western Australia
Achieve International Excellence

Inaugural Symposium of Super Science Fellows

Hobart, 18-20 April 2012


WALT DISNEY
SUPER-DINGO
16
22
DARGAUD
EDITEUR

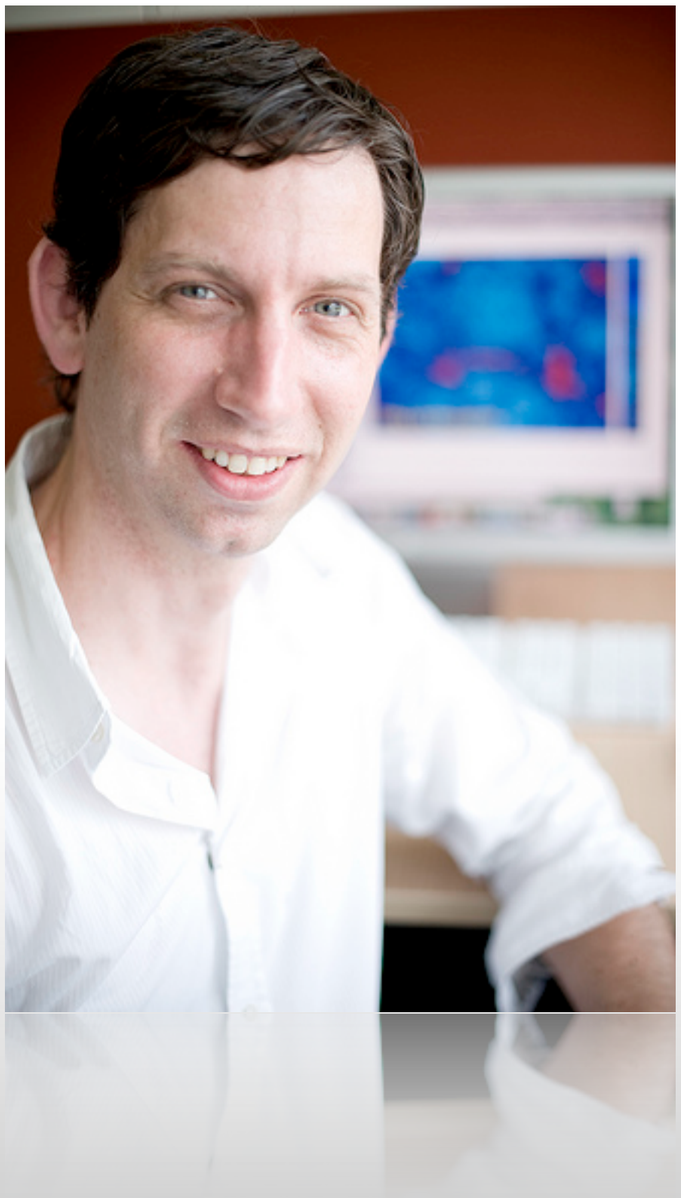


The SKA is in a very difficult process of the final site selection, no further comments ....

Deep Investigations of Neutral Gas Origins

DINGO

The Dingo Master

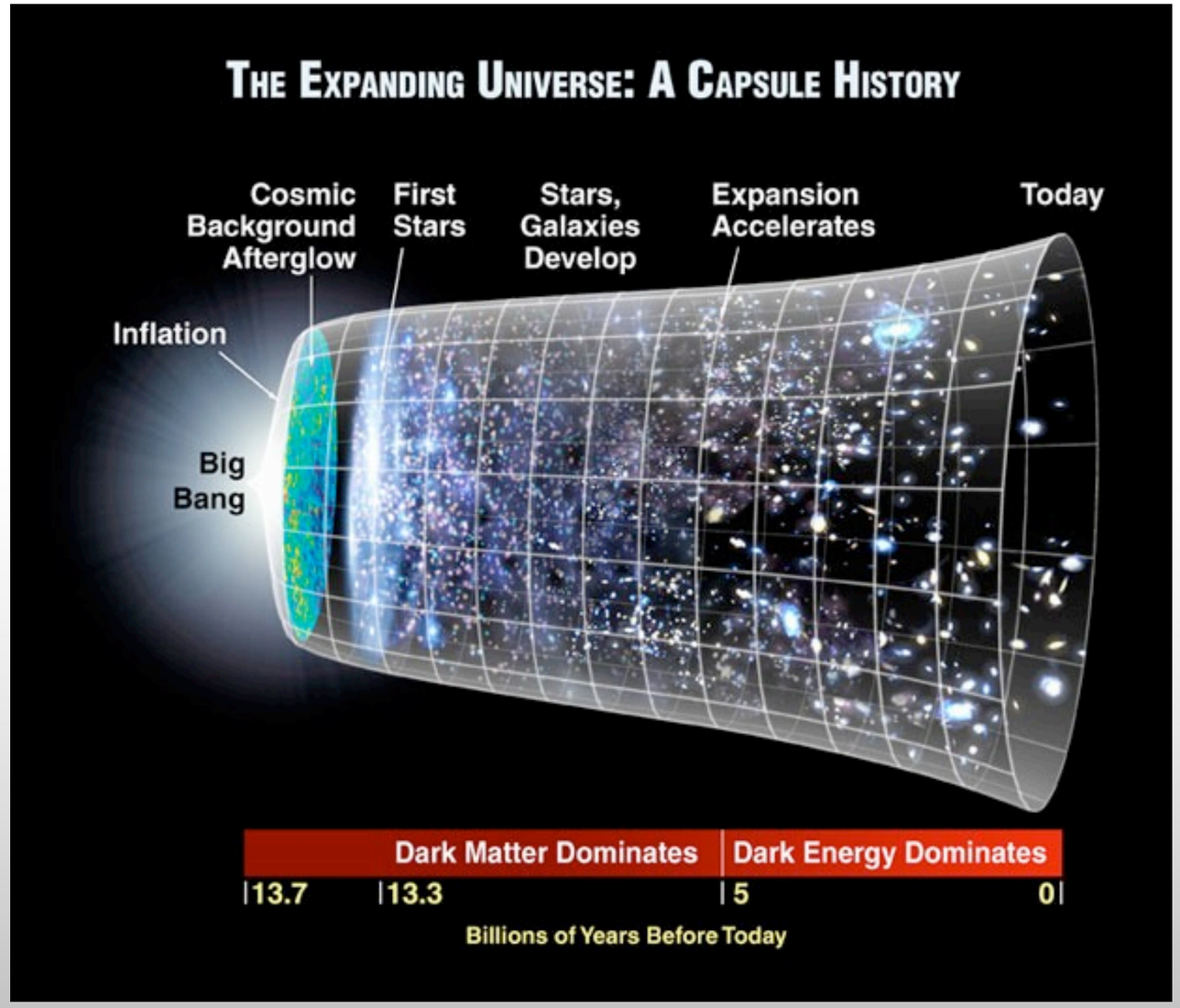


PI: Martin Meyer

- One of the ASKAP Survey Science Projects
- Deep HI survey on ASKAP

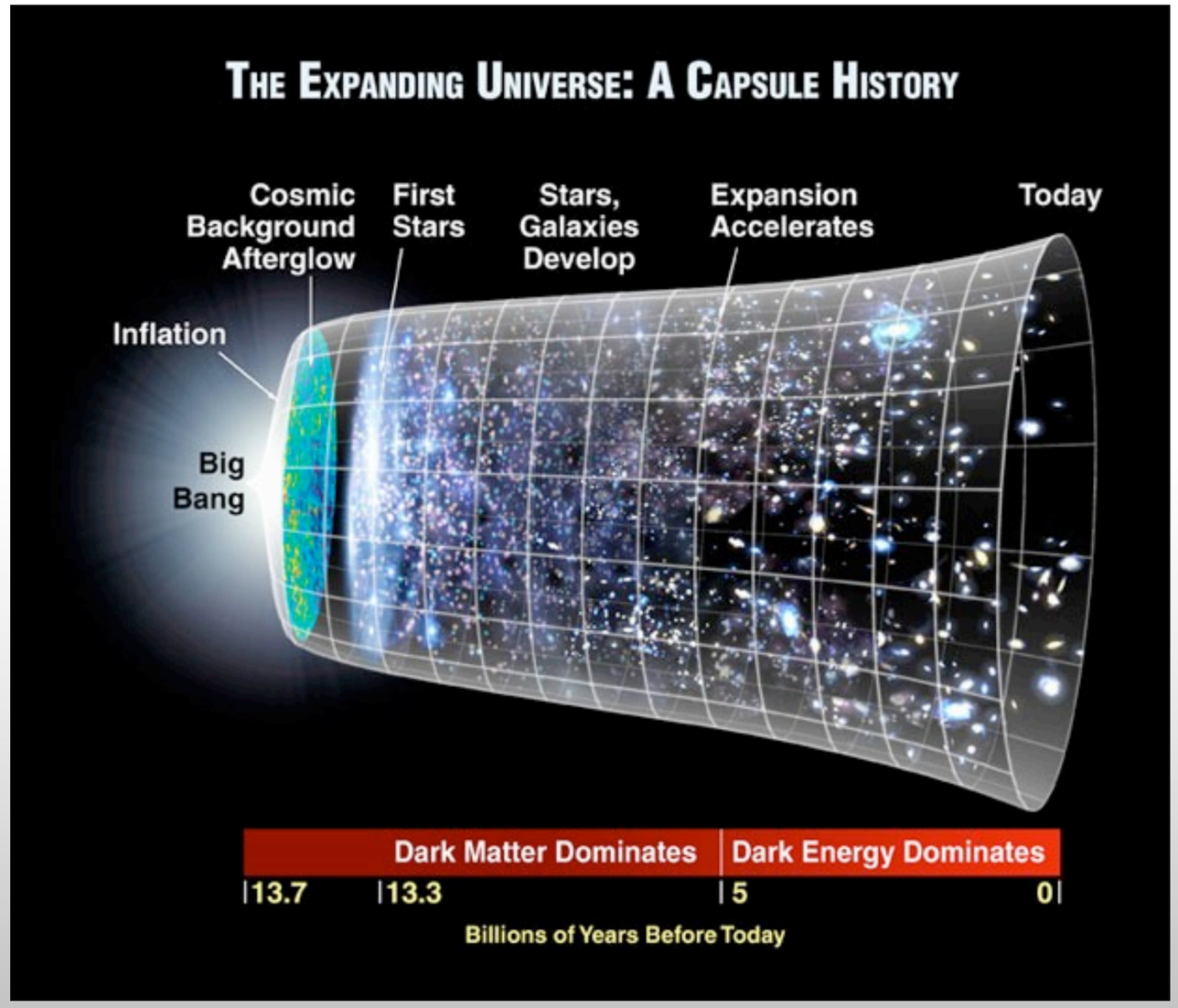
Dingo's walkabout: A long journey through unknown space on an unknown telescope

Importance of HI



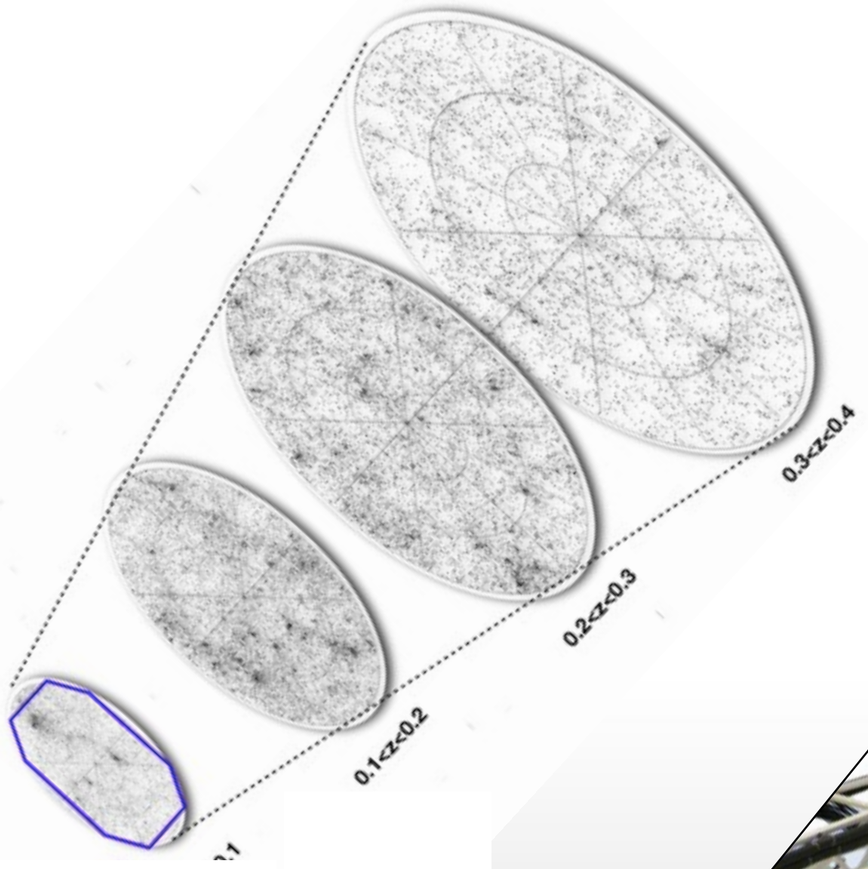
Importance of HI

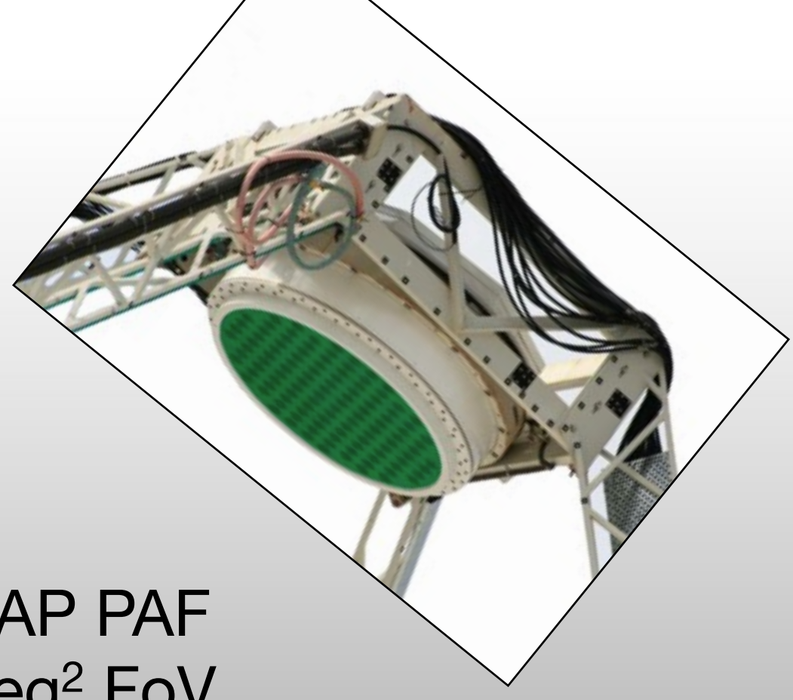
- Fundamental galactic ingredient
- Fuel for star formation
- Tracer of galaxy kinematics
- Tracer of environmental
- Optically thin, direct interpretation
- Alternate window on universe



DINGO Configuration:

- **UDEEP**: ~50k gals, 2 fields (60 deg^2), 0.1<z<0.43, 2500 hours/field
- **DEEP**: ~50k gals, 5 fields (150 deg^2), z<0.26, 500 hours/field

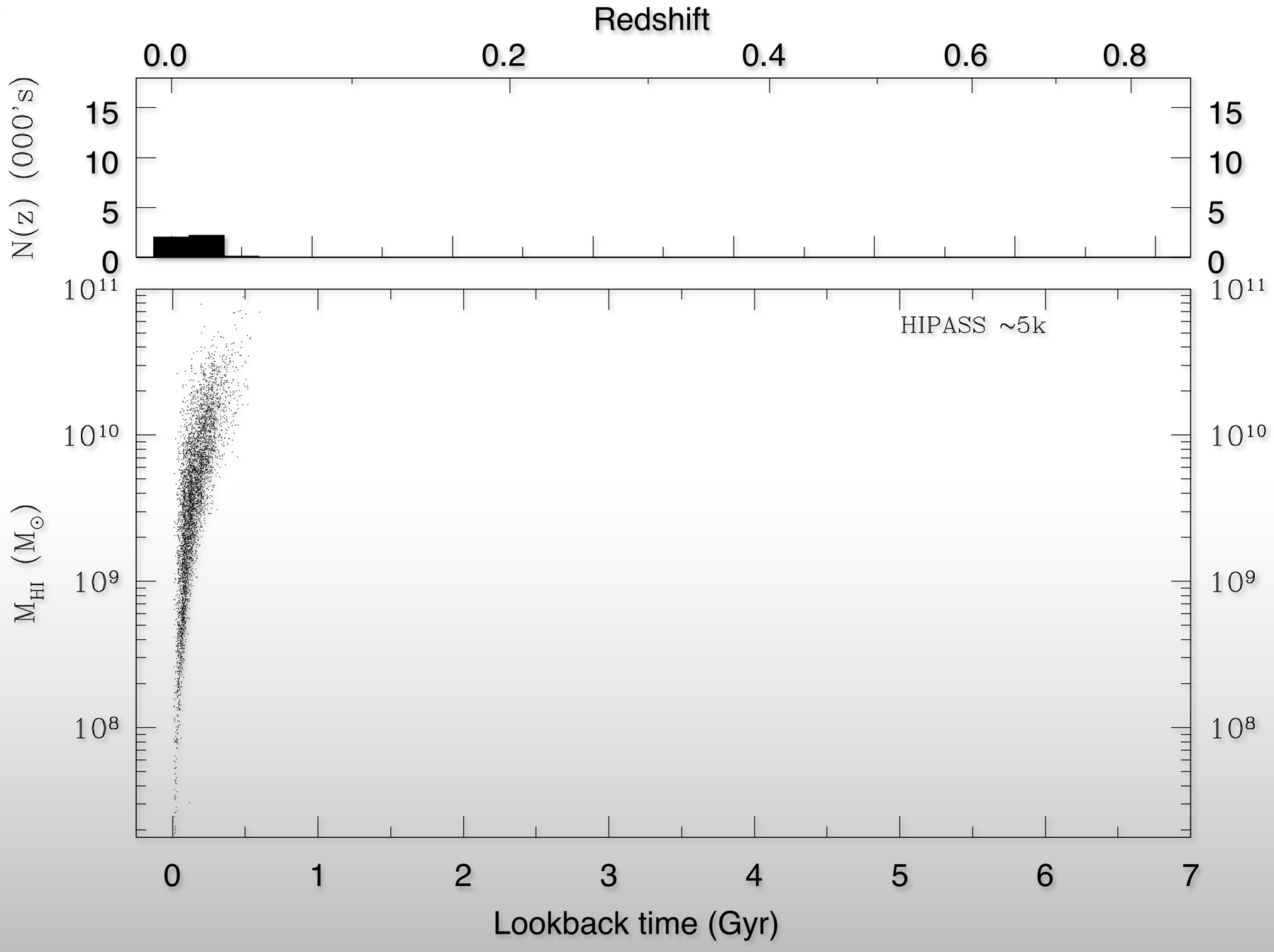




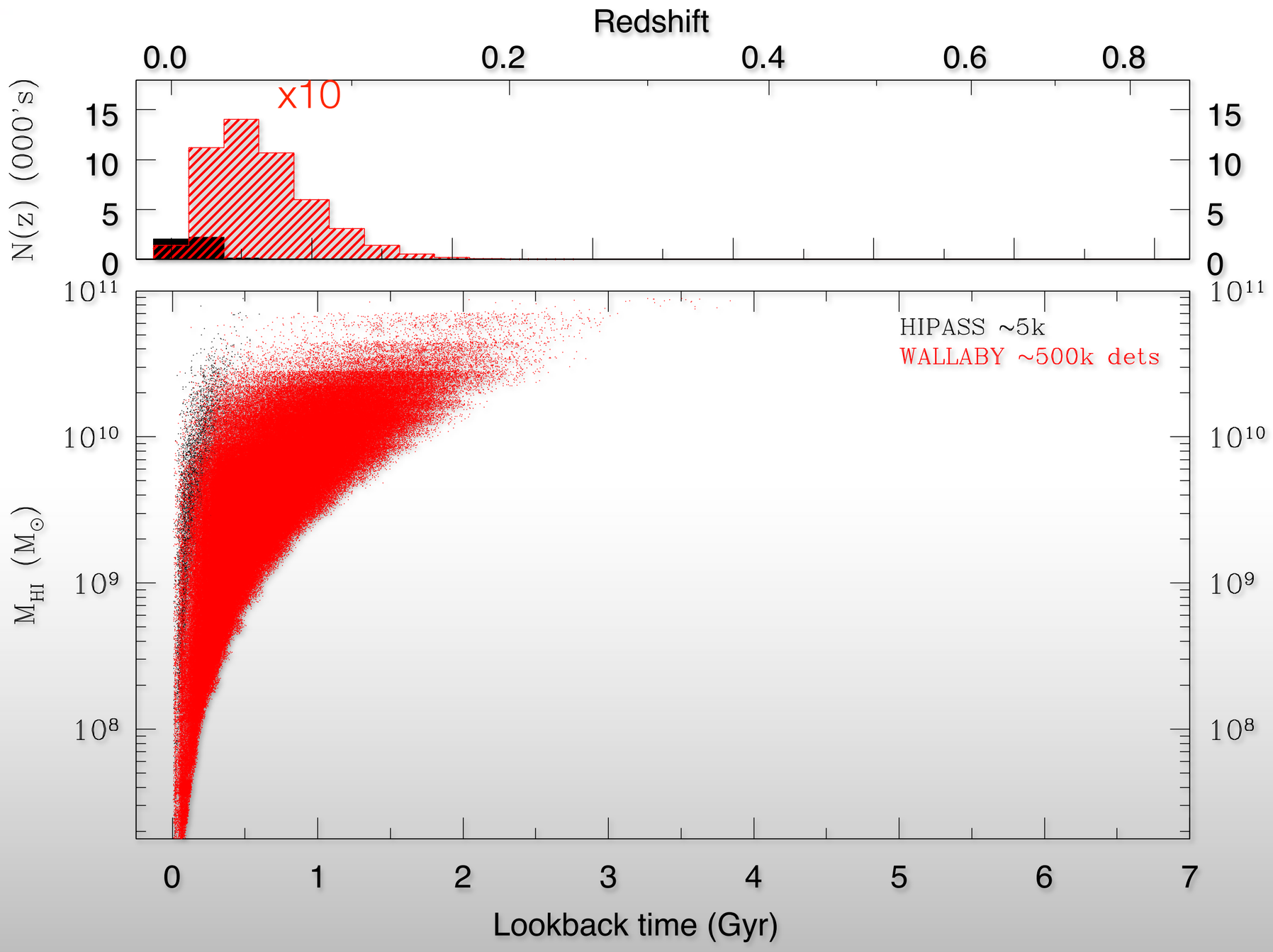
ASKAP PAF
30 deg^2 FoV

DINGO

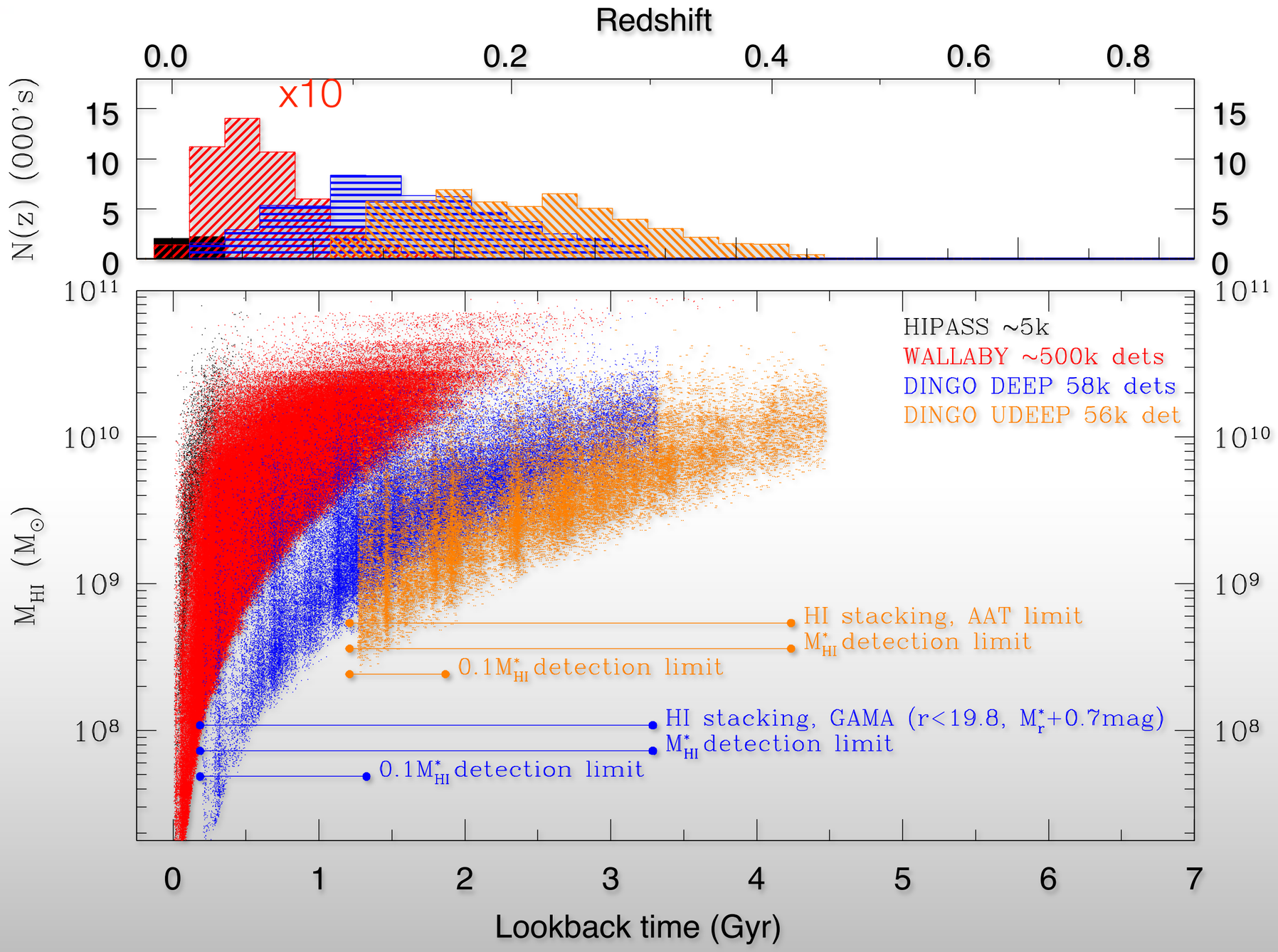
ASKAP HI Surveys



ASKAP HI Surveys

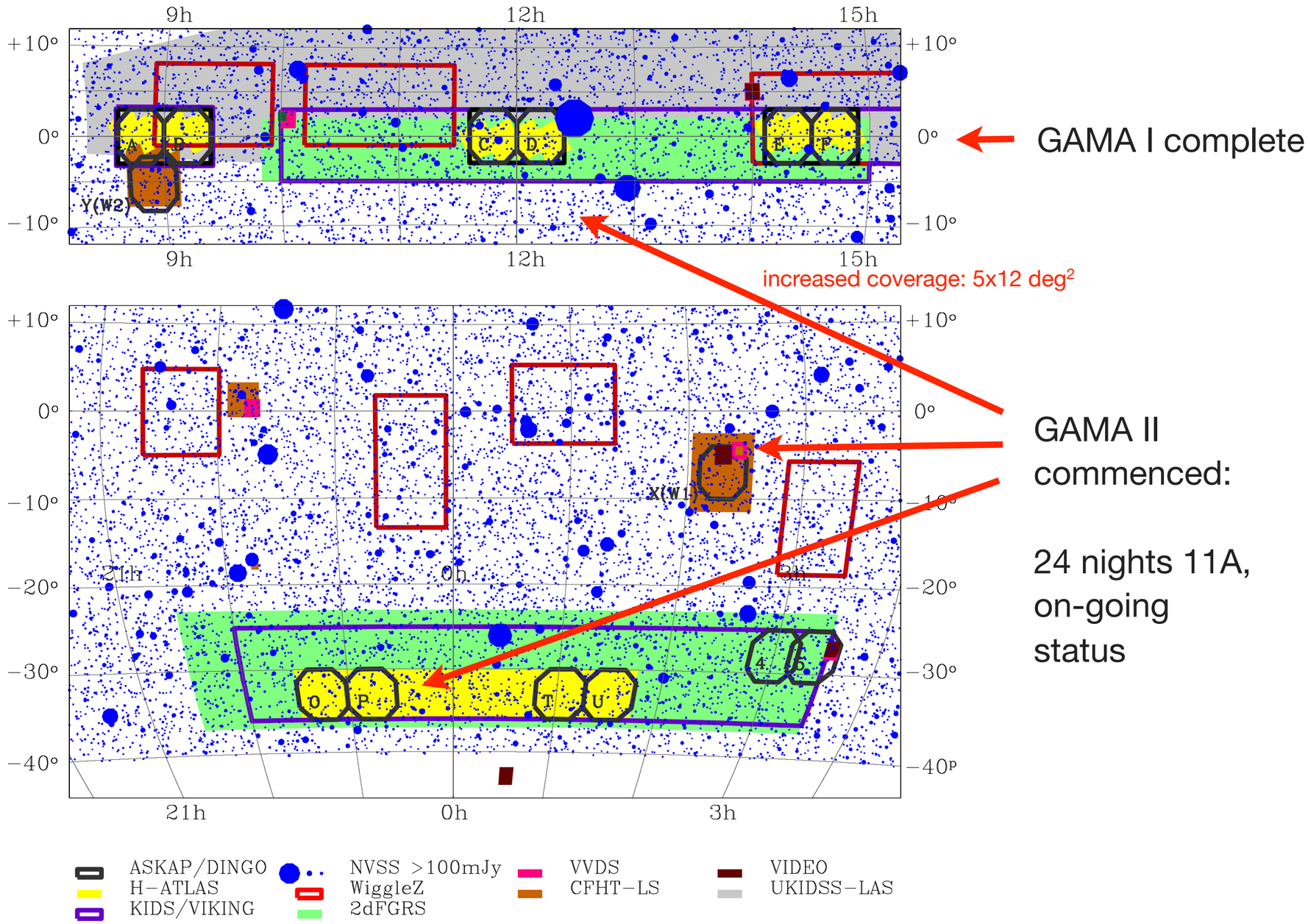


ASKAP HI Surveys



Where will DINGO look ?

Do commensal science with other surveys



GAMA I complete

increased coverage: 5x12 deg^2

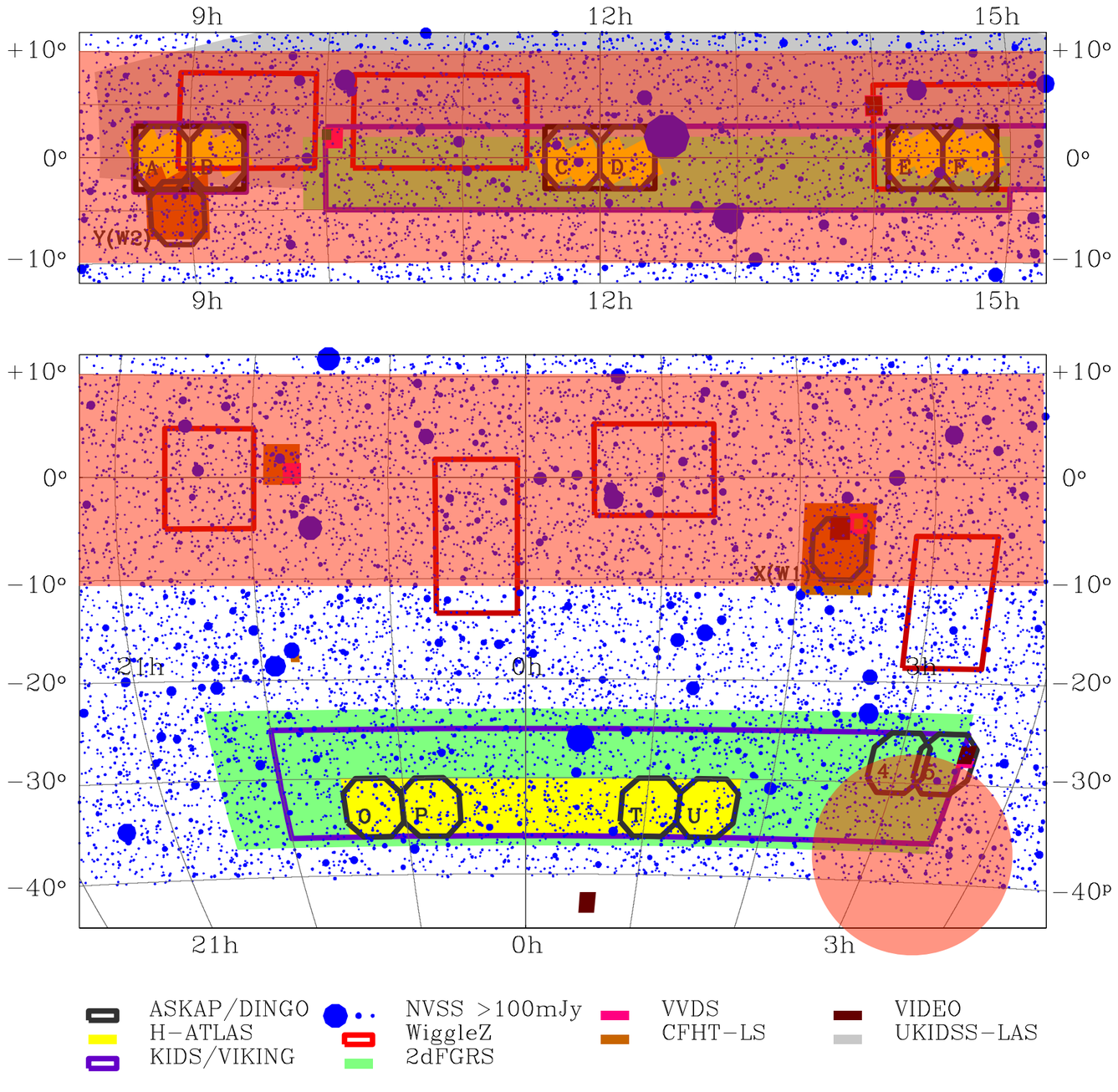
GAMA II commenced:

24 nights 11A, on-going status

Where will DINGO look ?

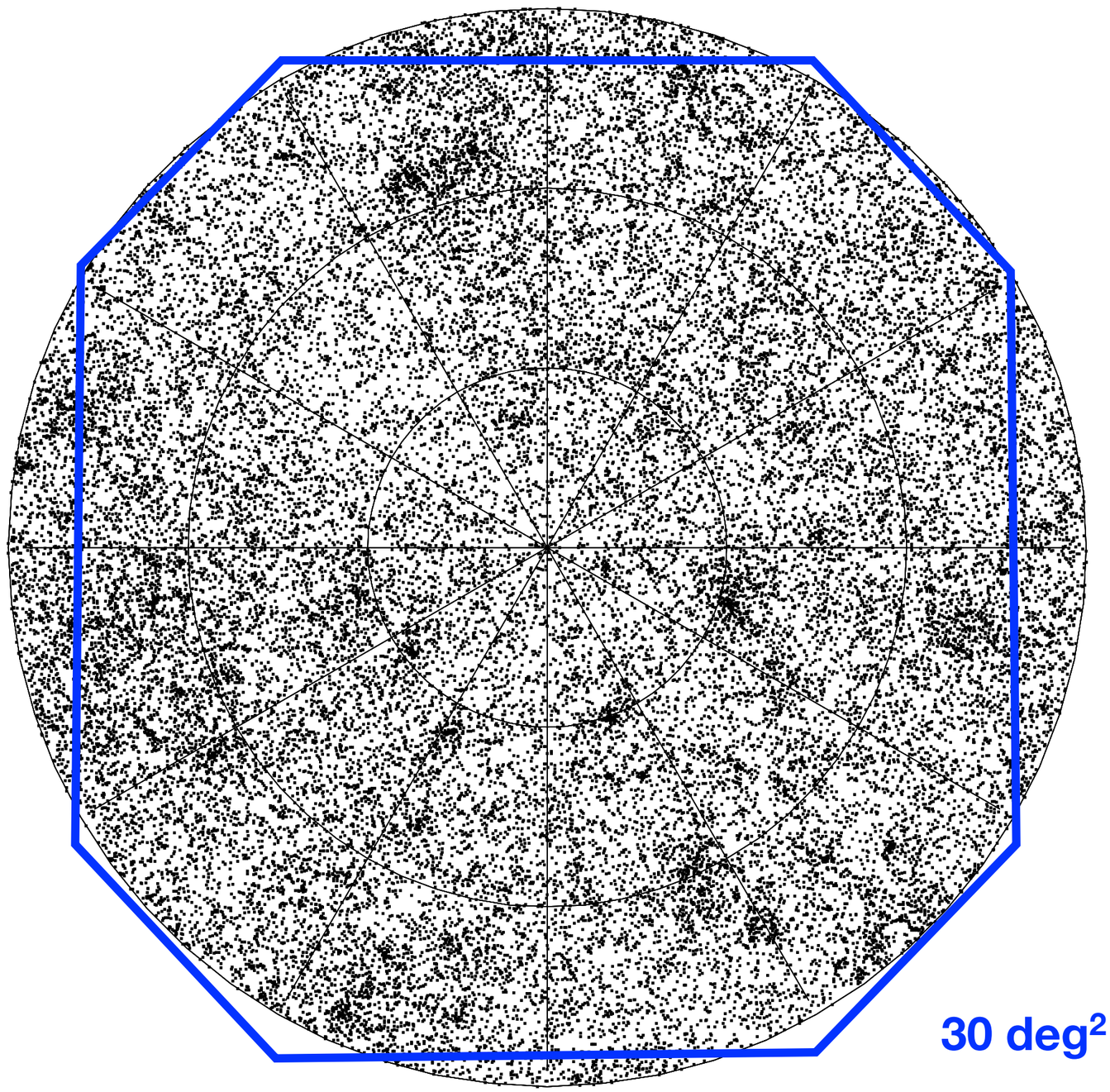
Do commensal science with other surveys

But stay away from the equator and strong continuum sources



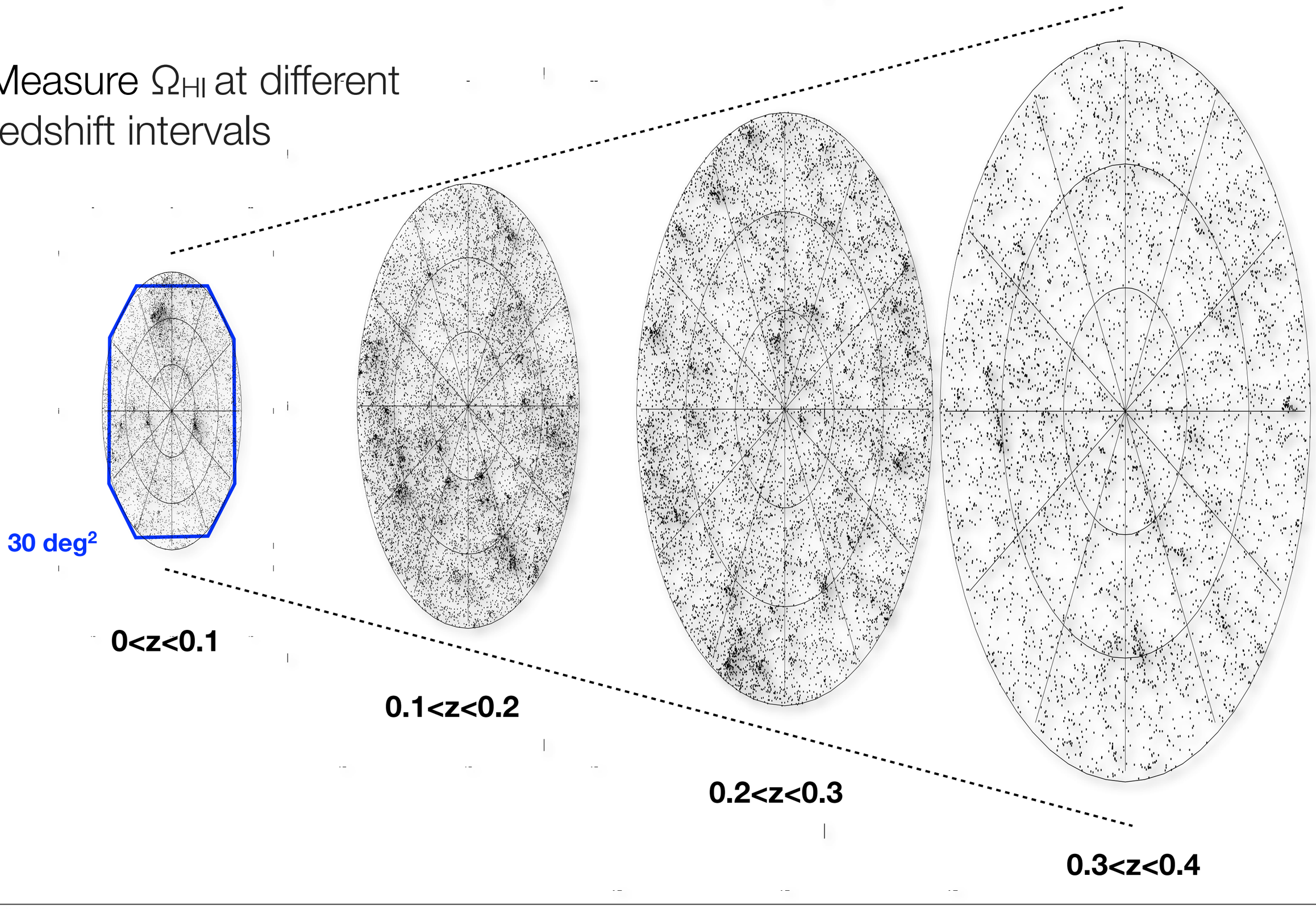
Evolution of Ω_{HI}

DINGO ultra-deep field



Evolution of Ω_{HI}

Measure Ω_{HI} at different redshift intervals



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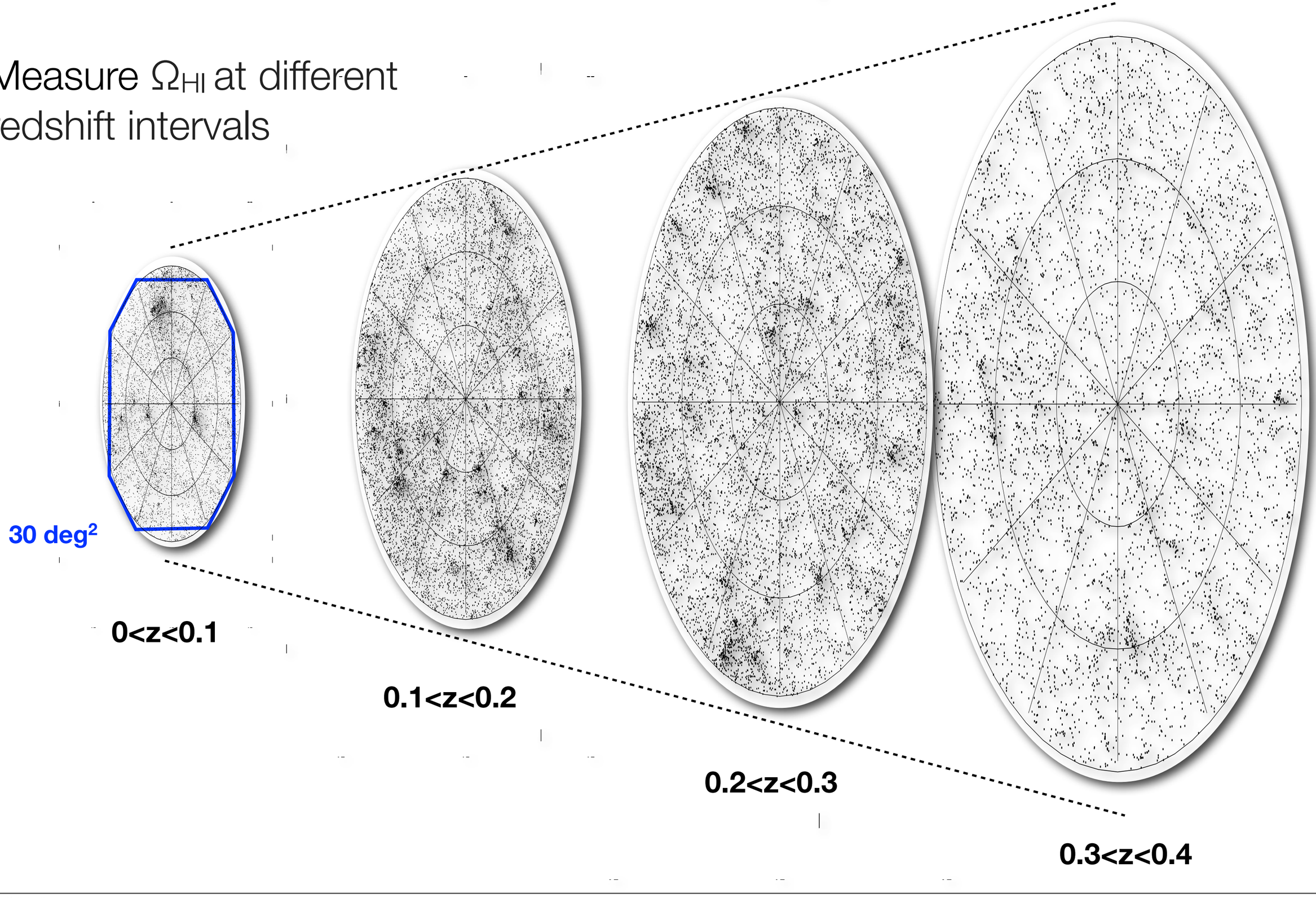
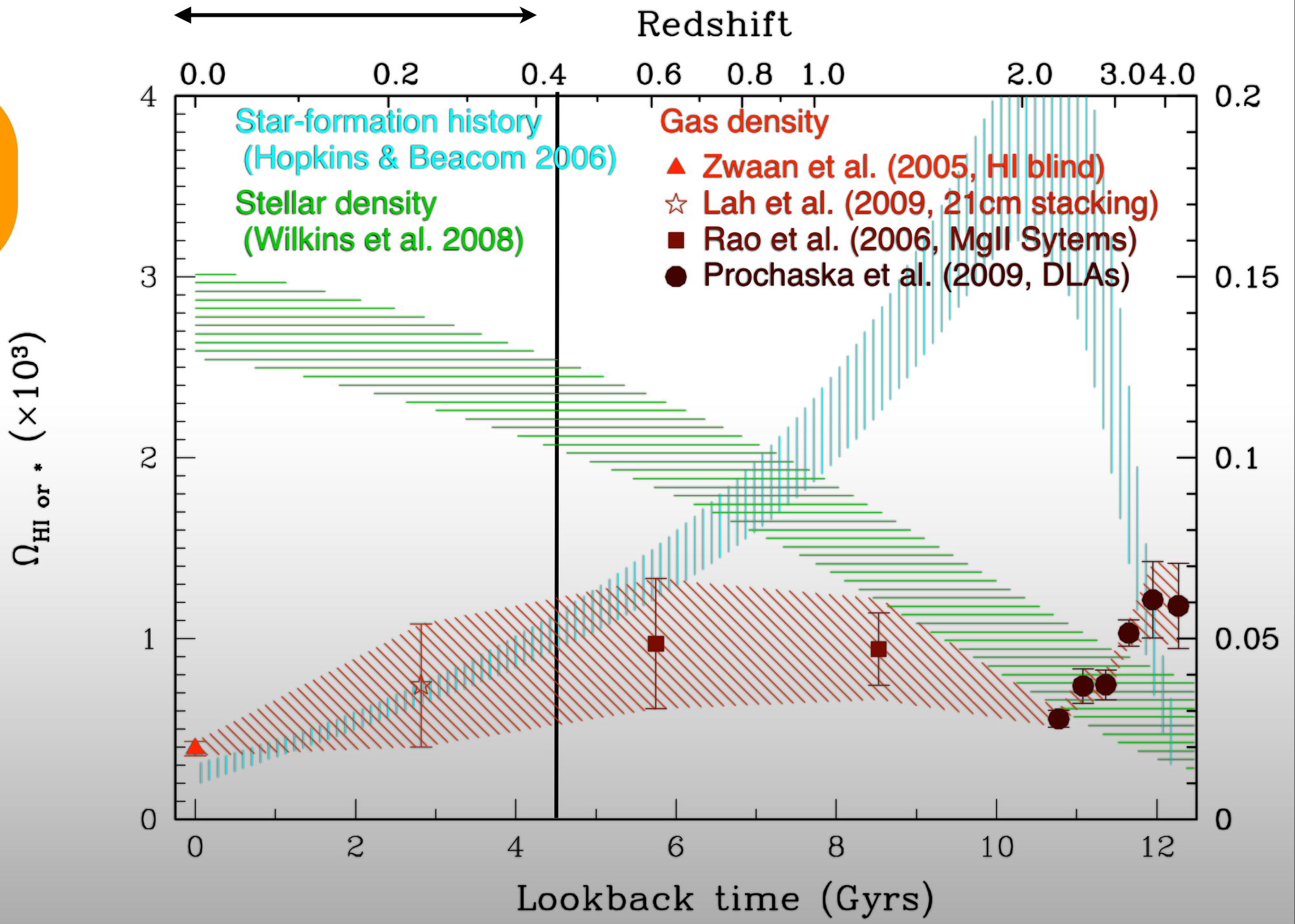


DINGO science

Evolution of Ω_{HI}

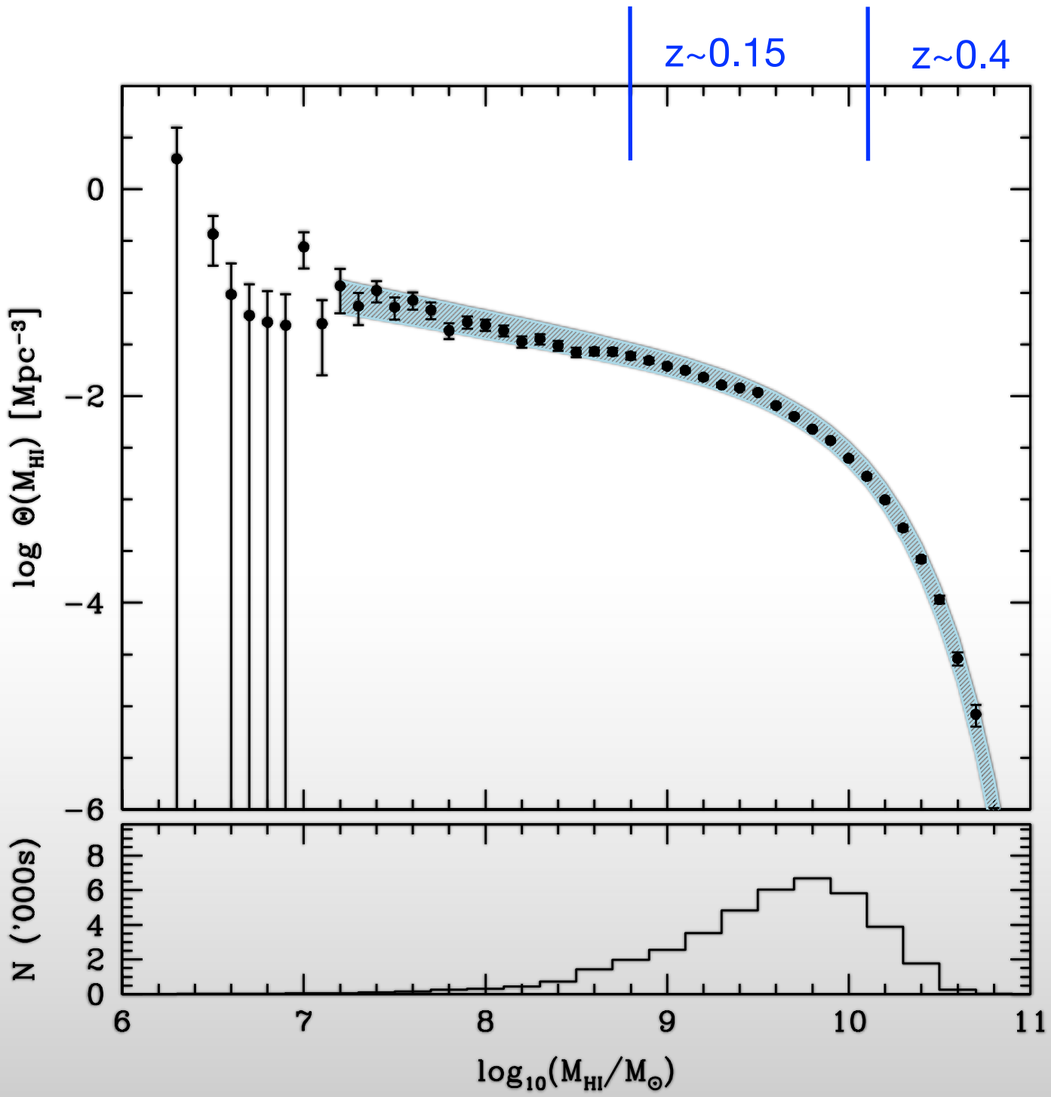
- How much HI is there in the Universe? How do we explain Ω_{HI} cf. Ω_{SFR}?

How has **cosmic mass density** of HI evolved?

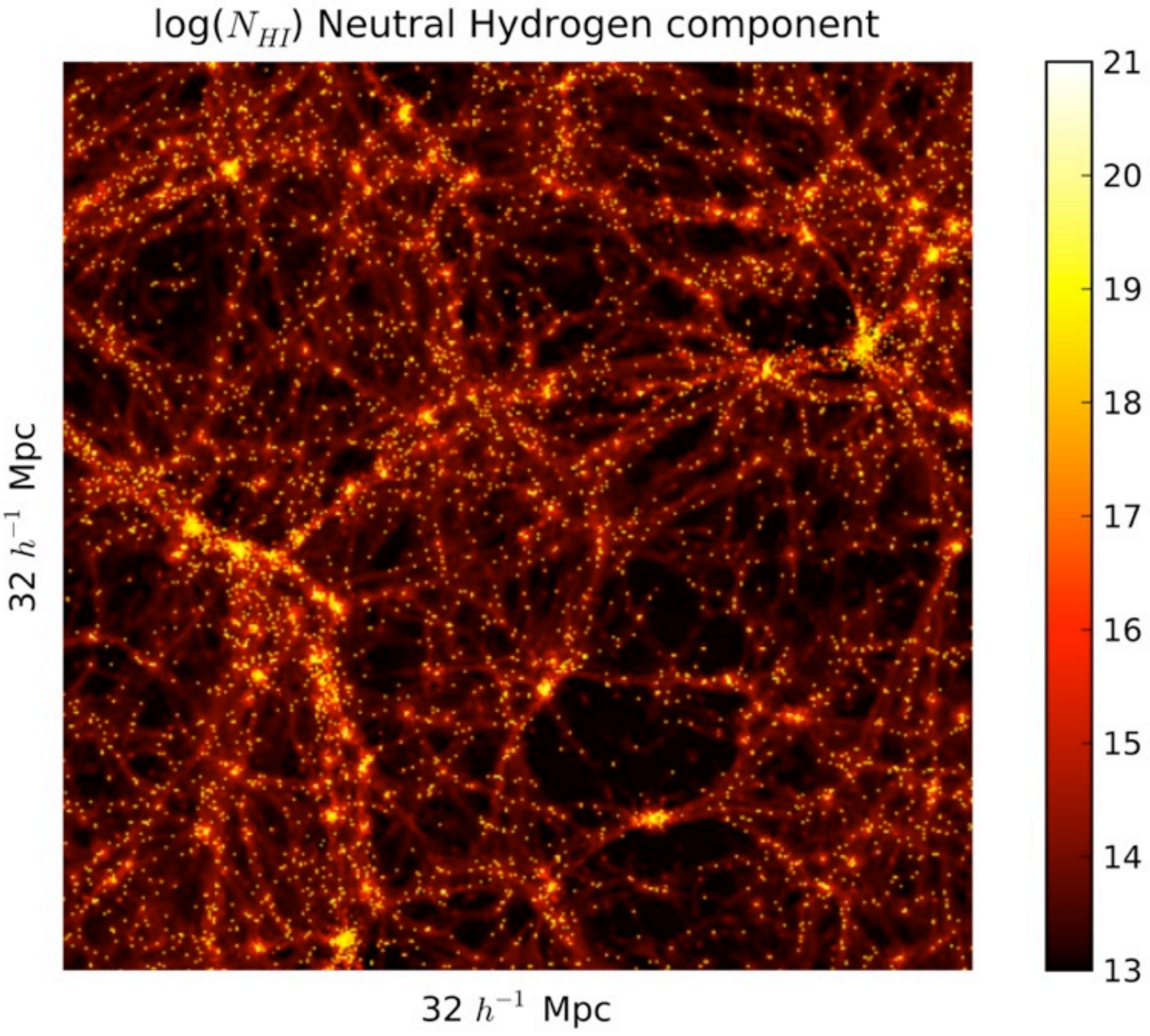


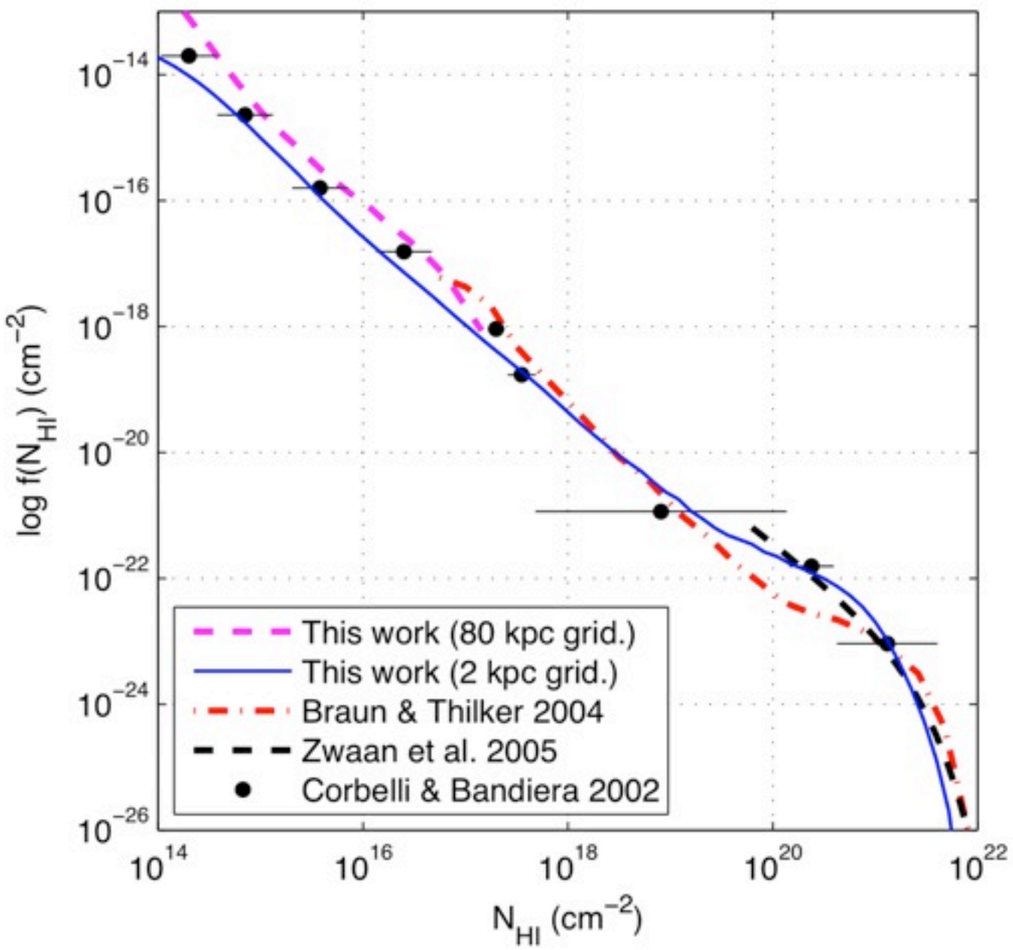
DINGO science

How has distribution of HI in the universe changed with time?



HI Cosmic Web

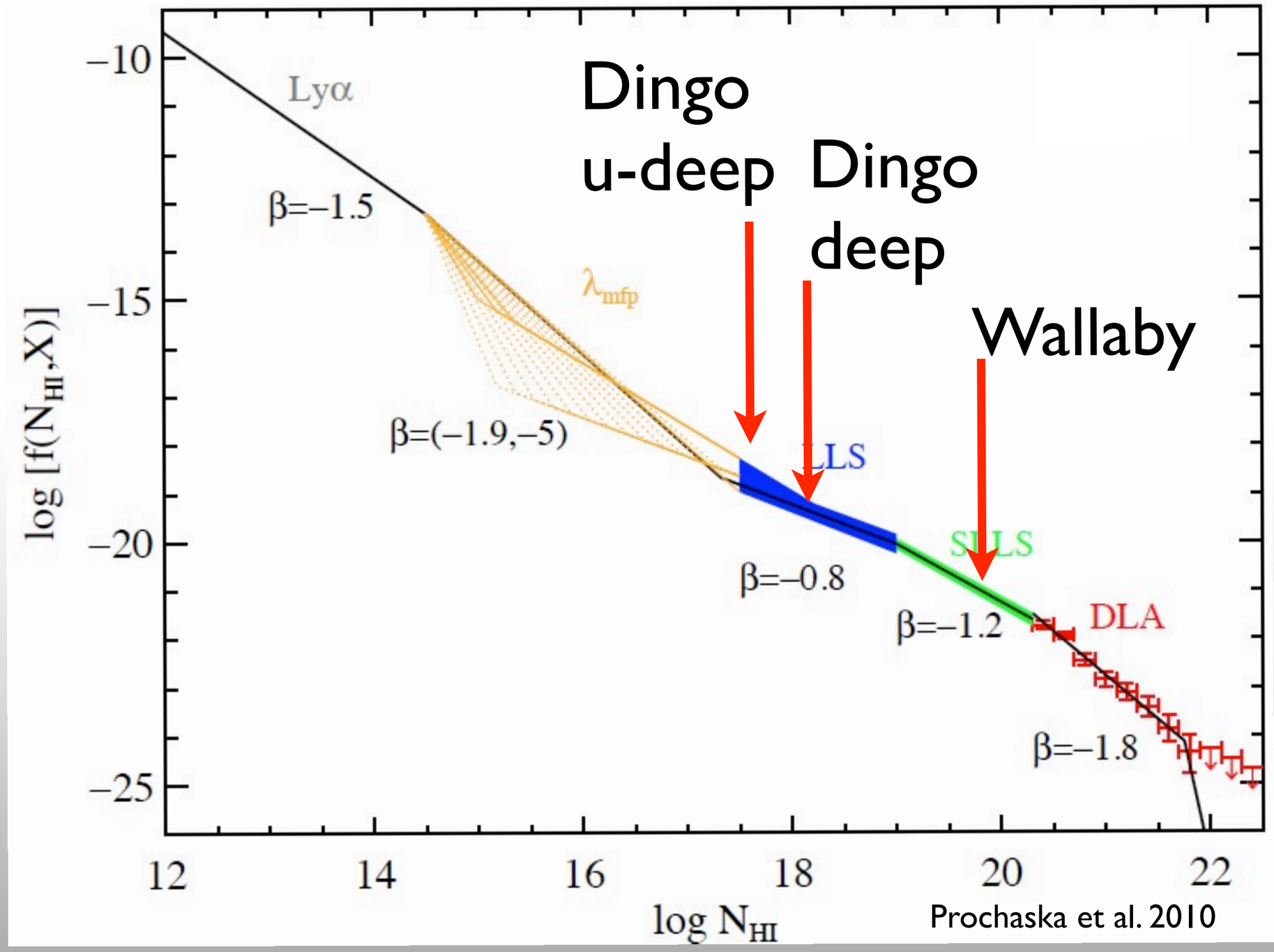




Popping et al. 2009

HI distribution function

- Get a better feeling for the HI distribution function log(NHI)<20



Prochaska et al. 2010

Headline Science

How have gas, dust and stars co-evolved over the last 4 Gyr?

What drives the evolution of HI content in **groups**?

How has the **star formation efficiency** changed with time?

What kind of dark matter halos do gas-rich galaxies reside in? Is there a **minimum host halo mass**?

How has the **accretion and loss of cool gas** in galaxies changed and what are the dominant processes?

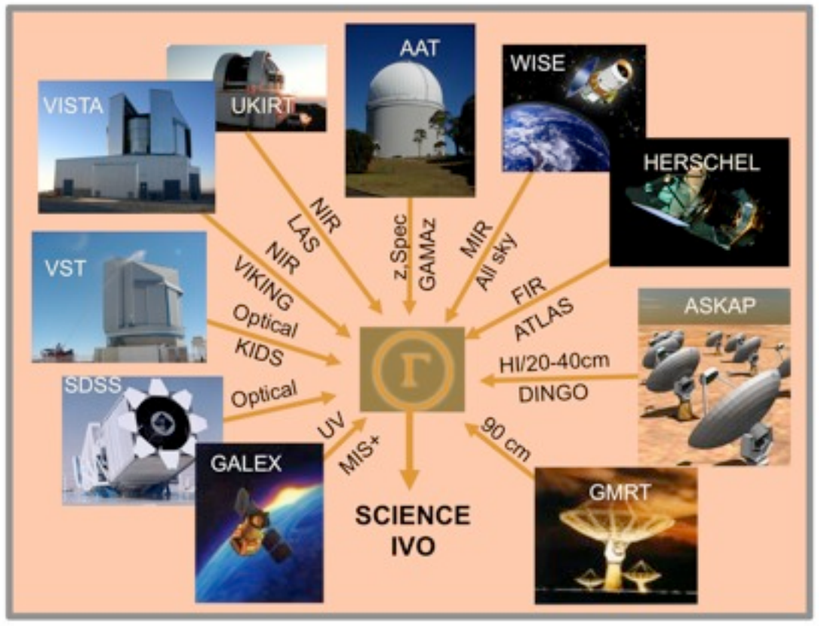
Is HI absent or suppressed within **satellites** orbiting central galaxies?

What is the build-up of stellar and cold-gas mass as a **function of halo mass**?

What is the impact of **environment**?

How has **Tully-Fisher** relation evolved 0<z<0.4?

Headline Science



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Preparation work: e.g. Source Finding

HIPASS : ~ 5000 sources
ALFALFA: ~ 30.000 sources

WALLABY : ~500.000 sources
WNSHS : ~150.000 sources
DINGO : ~ 100.000 sources
APERTIF MDS : ~ 100.000 sources
LADUMA : ~ 10.000 sources

Reliable automated Source Finders are needed !!

There are several source finders under active development;
- **What is their current state ?**
- **Which finders performs best ?**
- **Concentrate on completeness and reliability**

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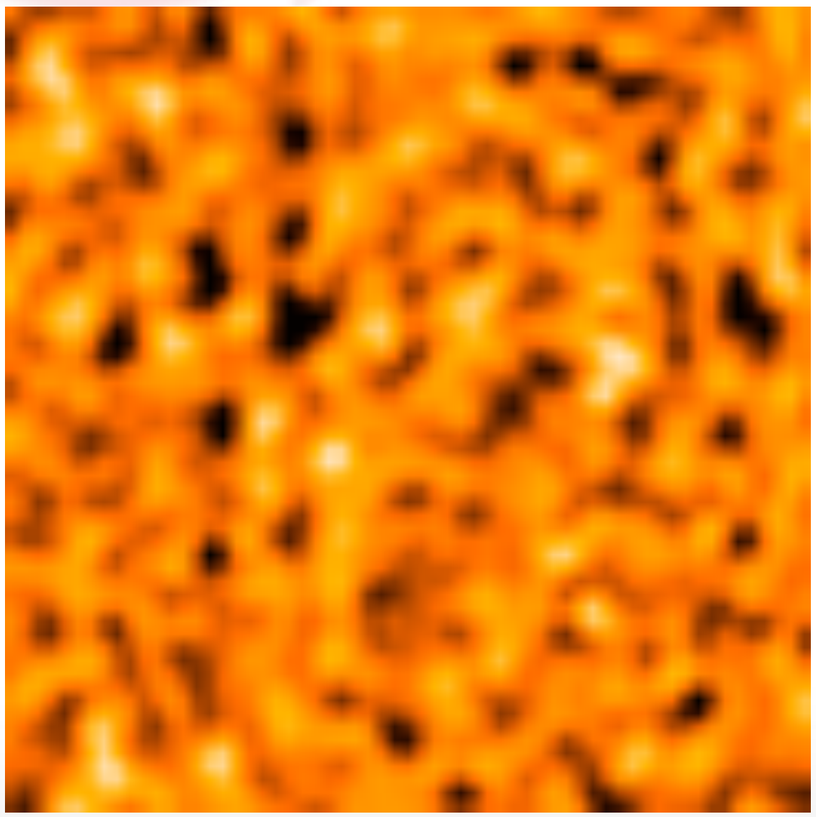
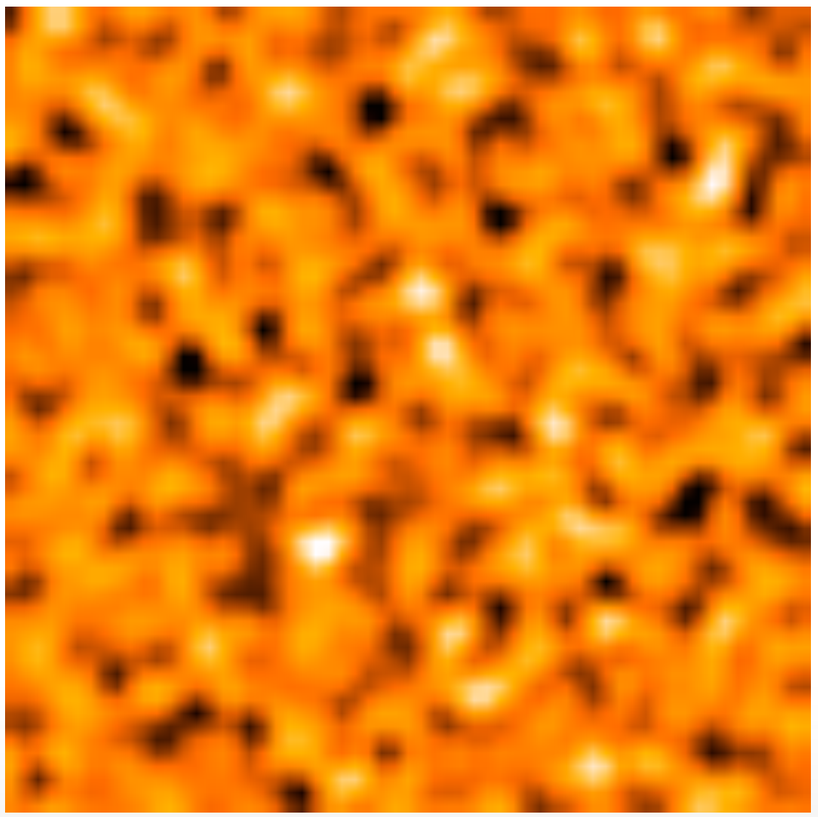
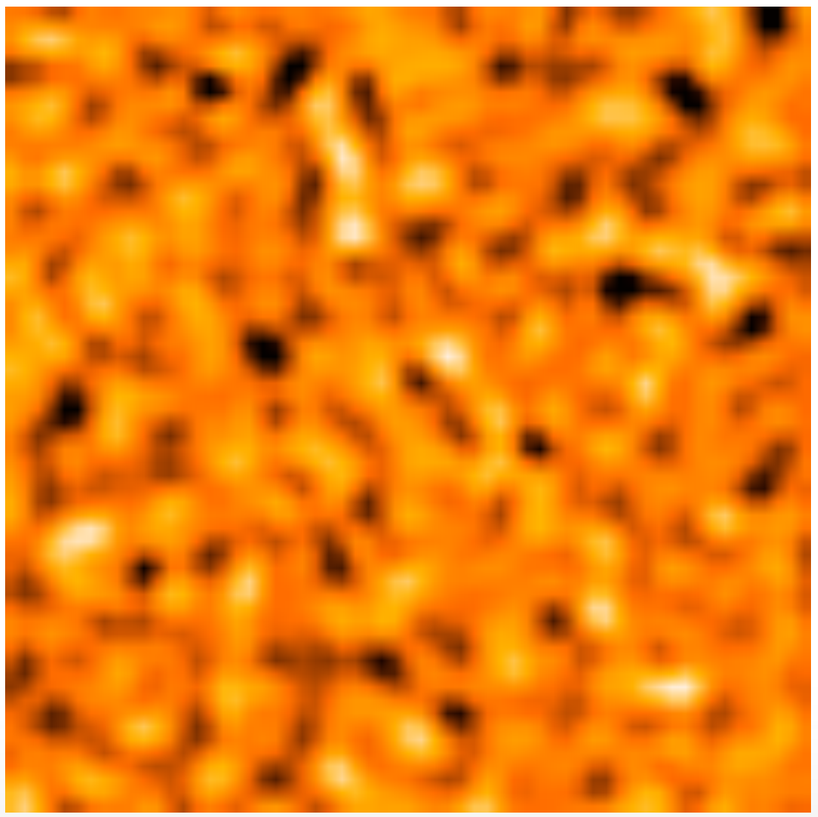
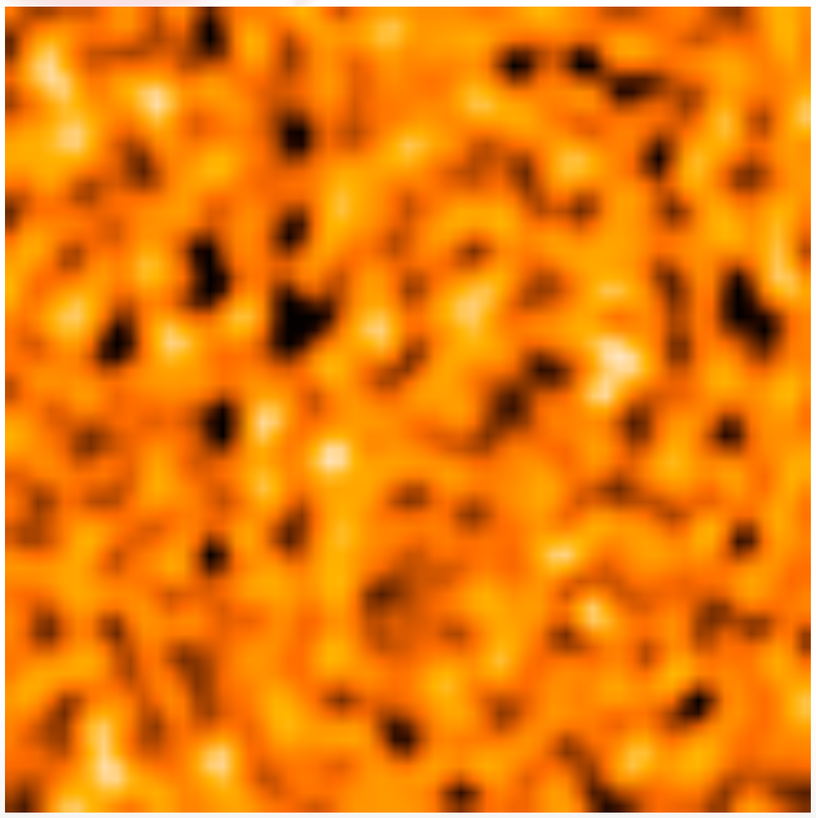
- Source finding cannot be that difficult, right ... ?
- Can you make automated source finders; the human eye is much better

Fixed integrated Signal to Noise

S/N: 1, 3 , 5, 10, 20, 50, 100 ??

Fixed integrated Signal to Noise



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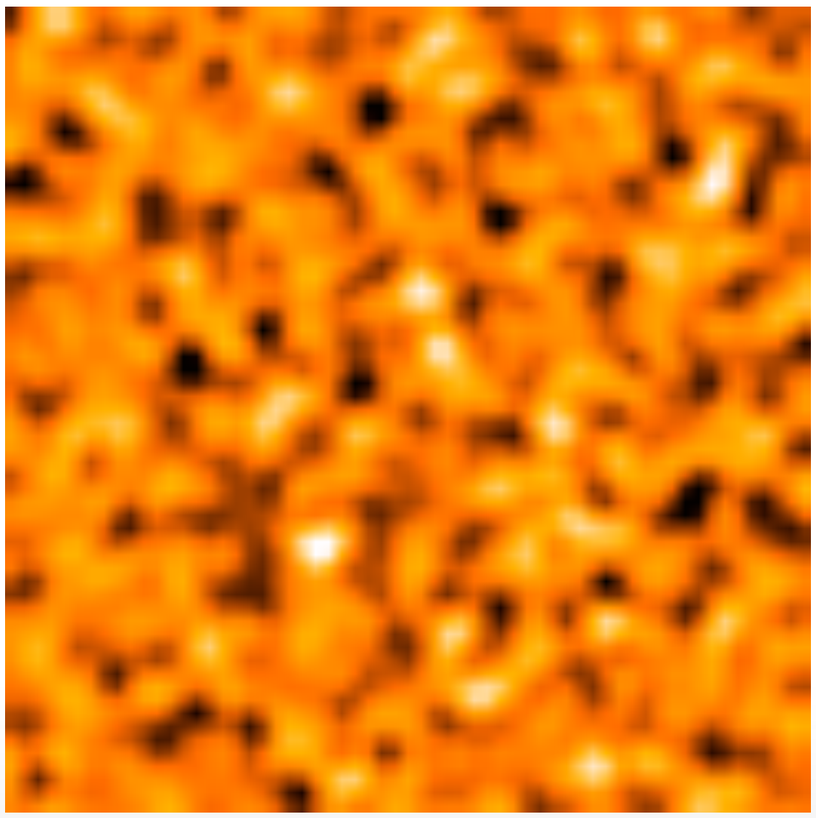

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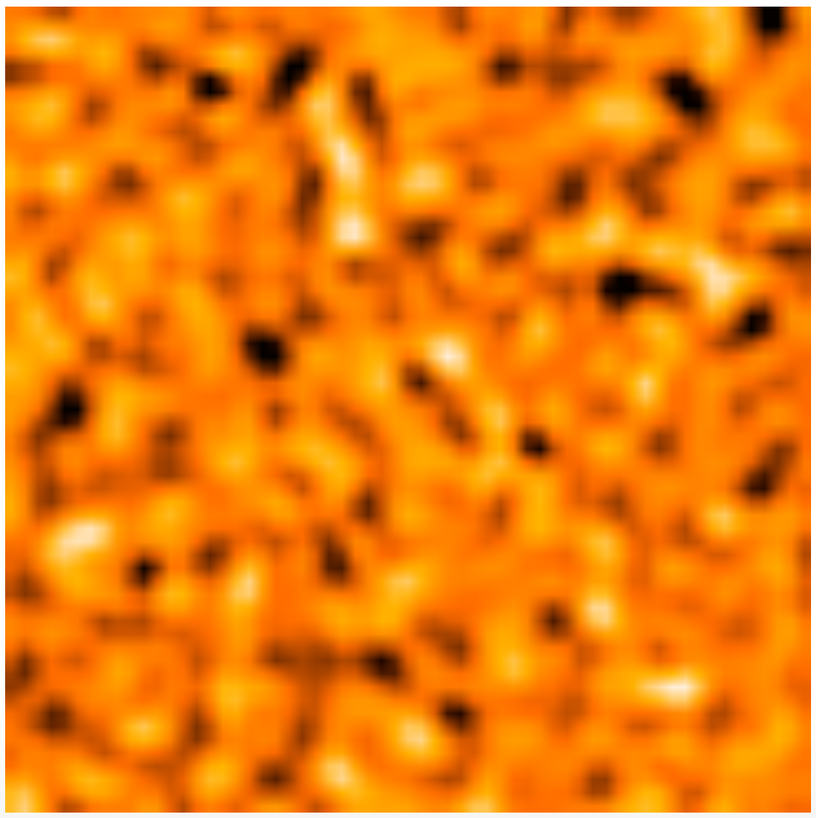
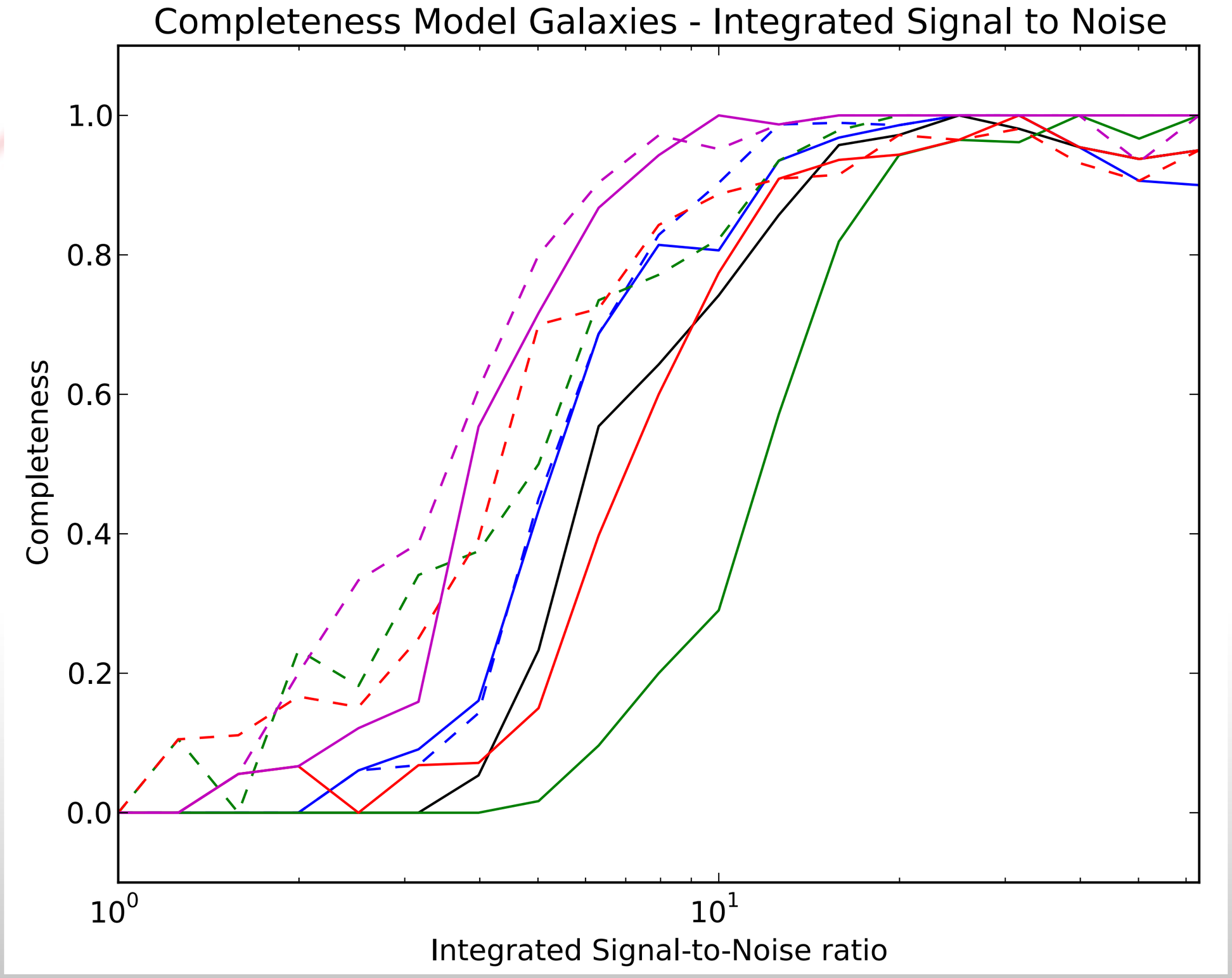


100



Popping et al. 2012

We need more help using outreach

✗

People don't always know what you are doing

We need more help using outreach

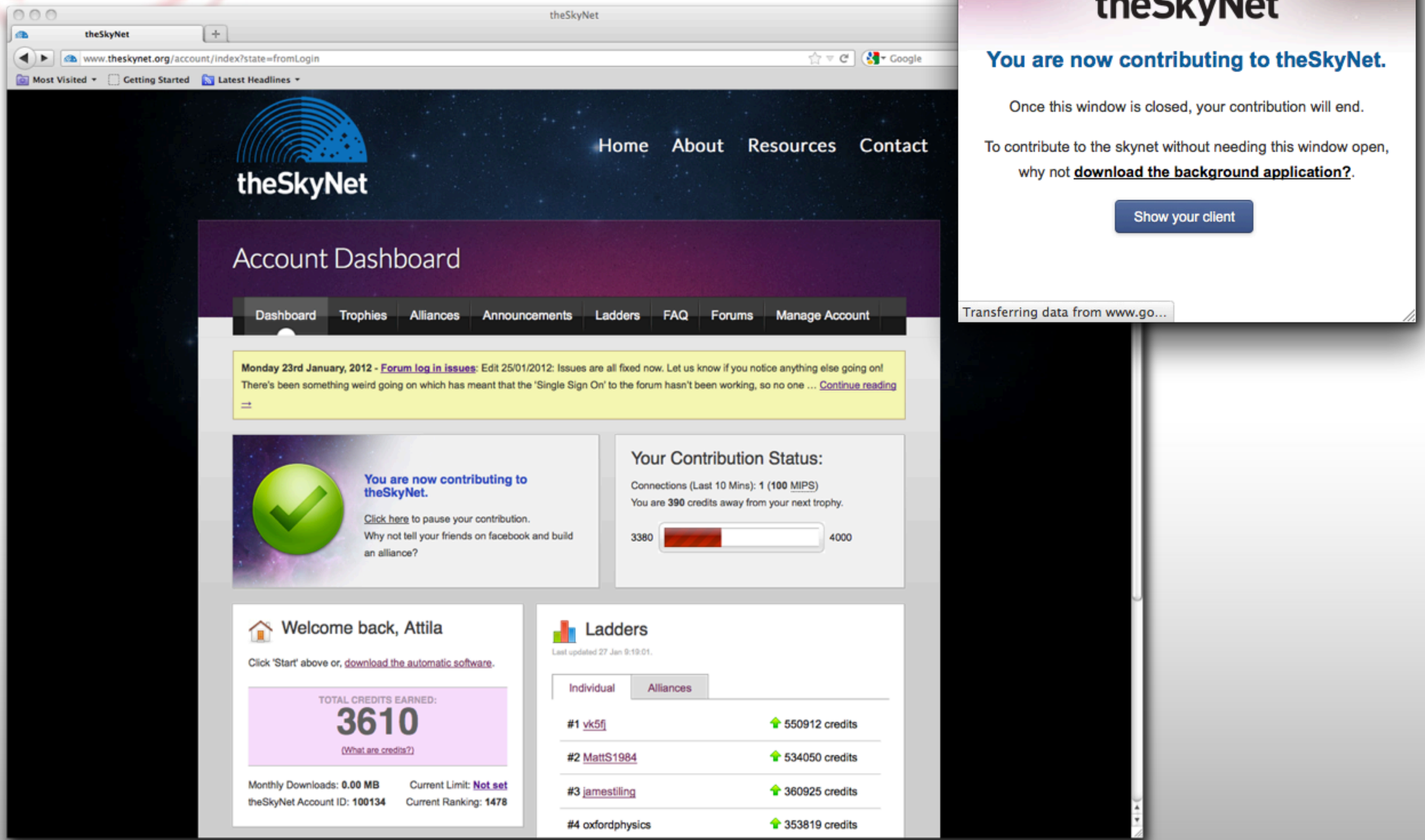
✘

People don't always know what you are doing

✔

You want them involved, and you want them to like you

theSkyNet.org



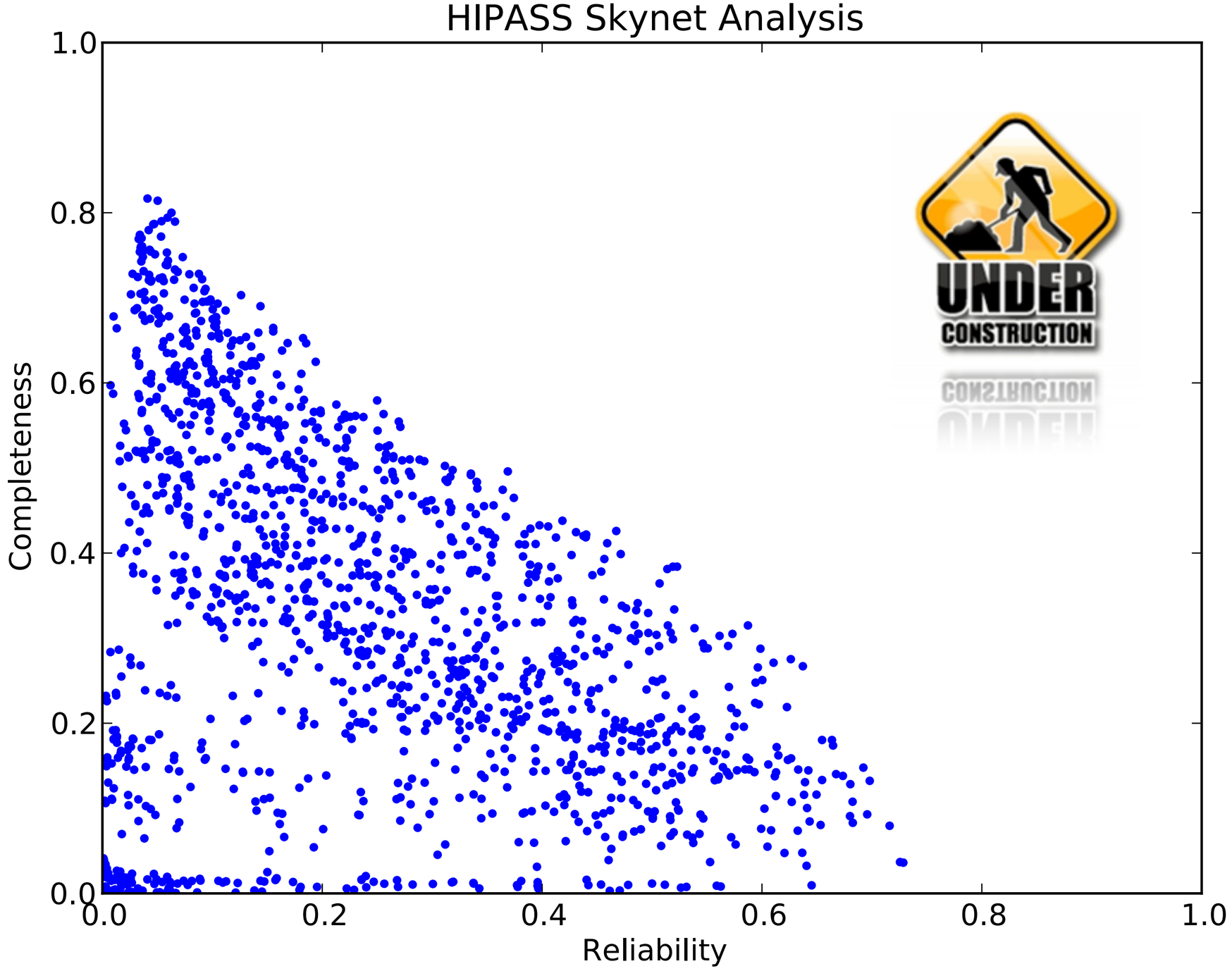
Datasets:

- HIPASS
- ASKAP simulation
- DINGO simulation

Each dataset is about 65 Gb in size, impossible to do on your own machine

- Very powerful tool; full HIPASS takes a few minutes to process
- Ideal to test many many parameters
- Currently only running Duchamp, but there are plans to implement other source finders

Show here HIPASS result with skynet



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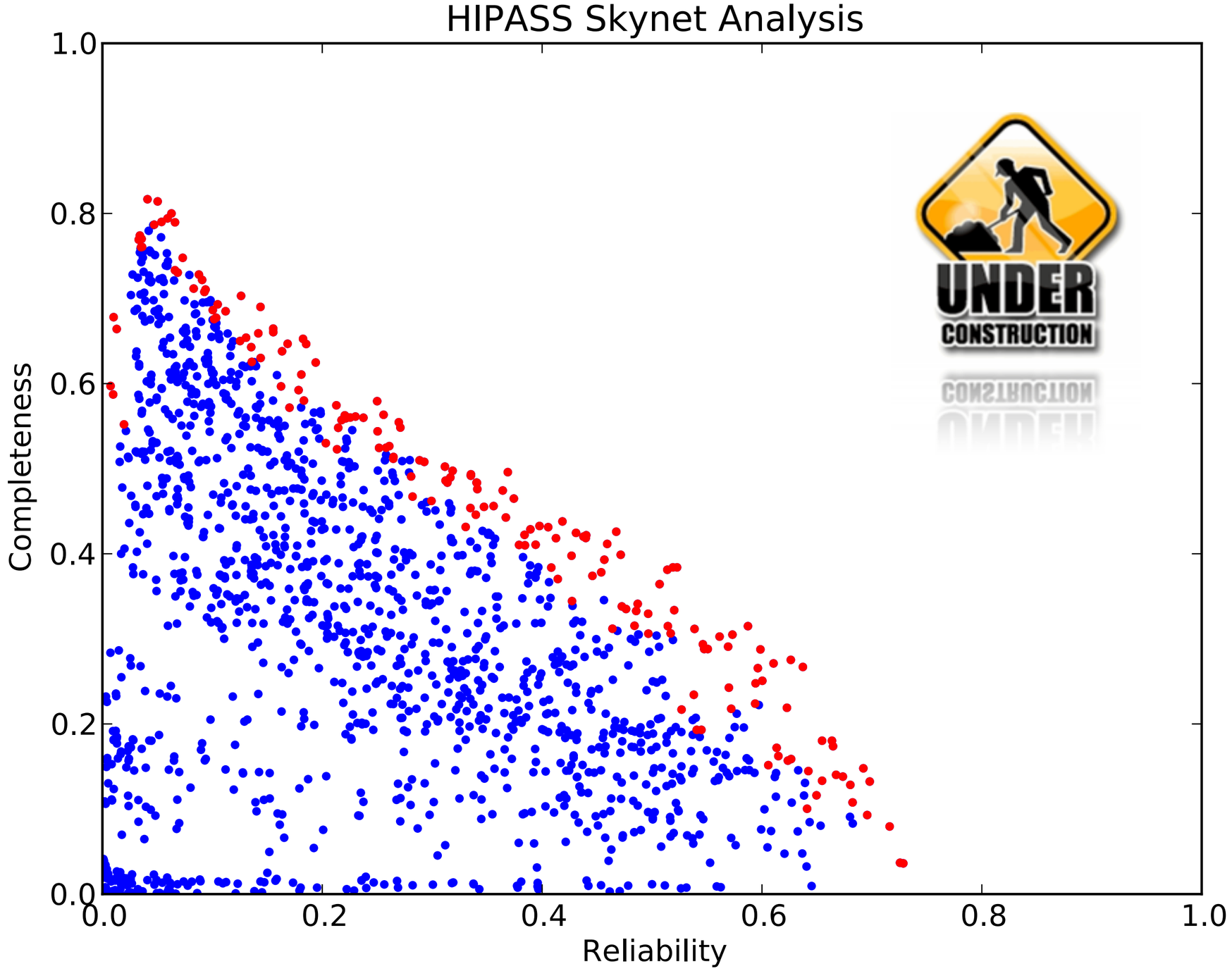
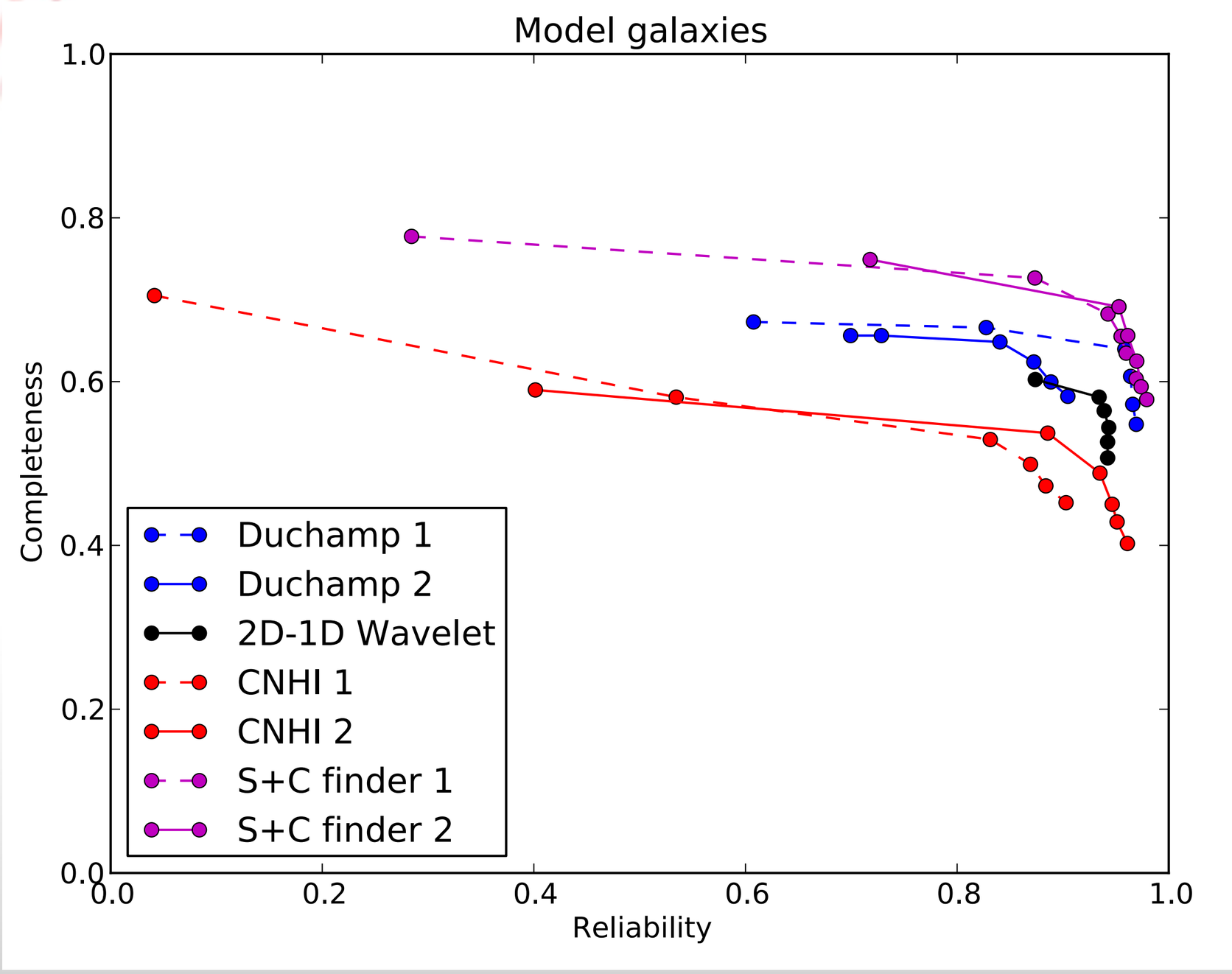


Completeness vs Reliability

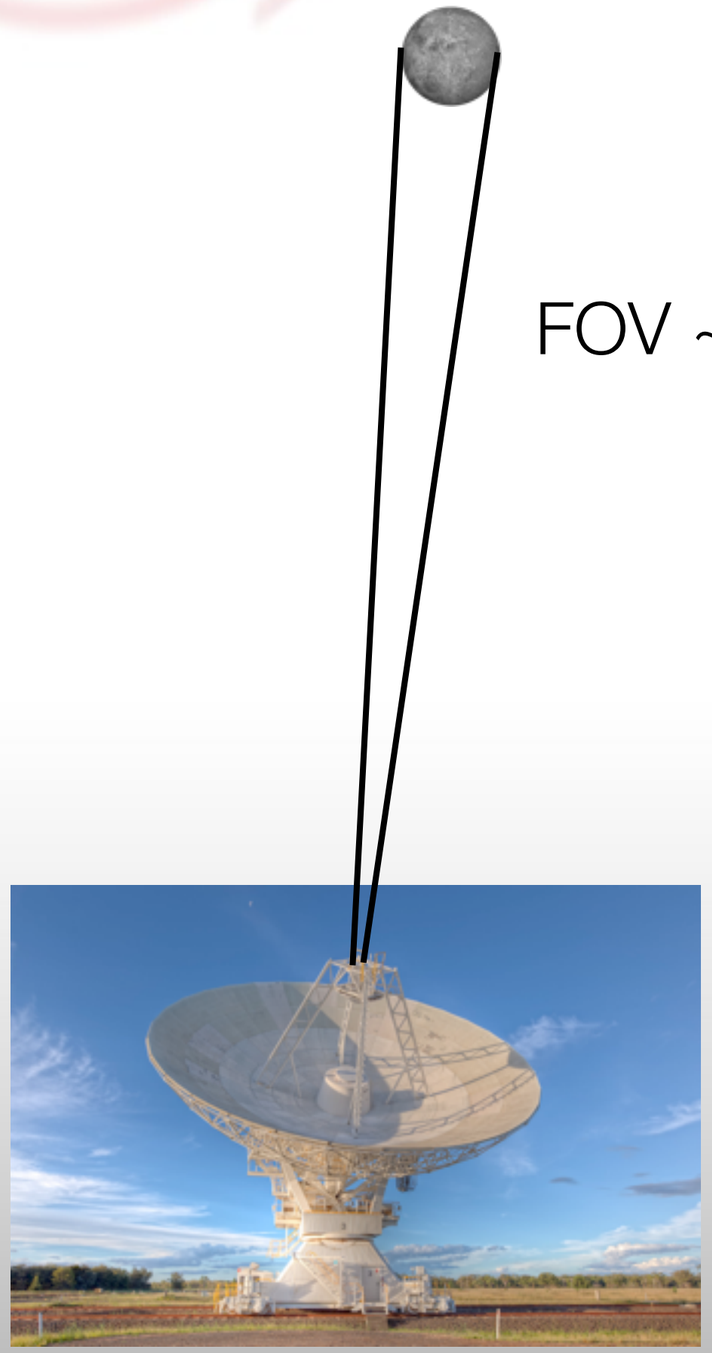


Reliability improves significantly after applying a cut on detections in integrated flux

Boolardy Engineering Test Array

BETA:
First 6 complete ASKAP dishes

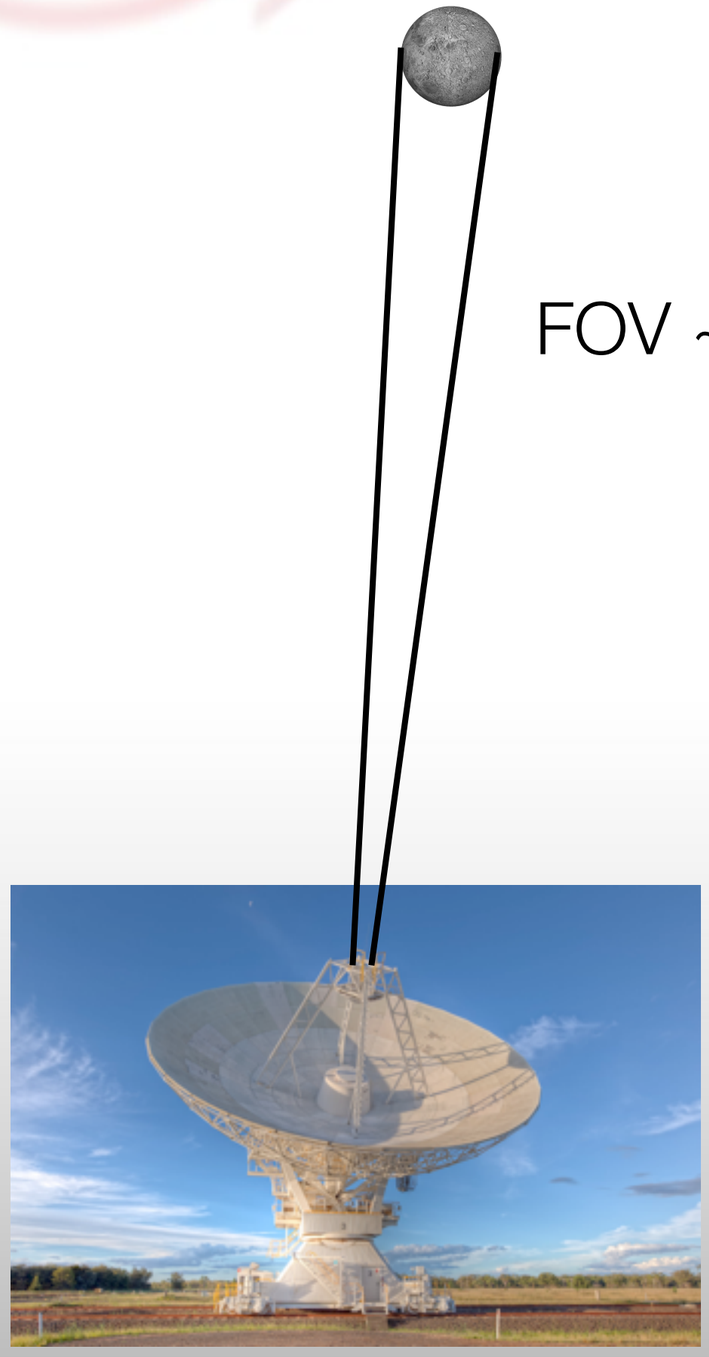
Field of View



FOV ~ 0.25 deg□

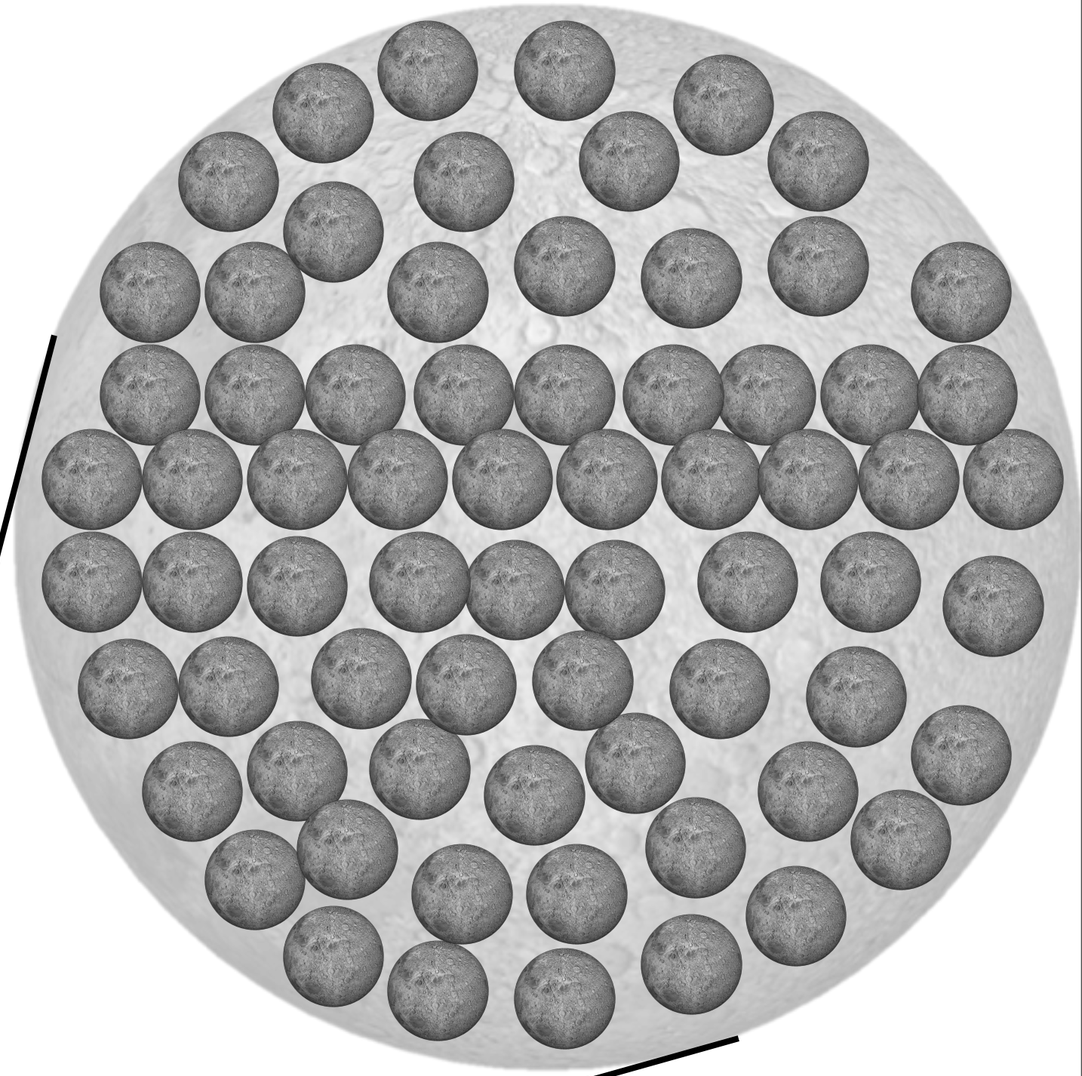
ATCA

Field of View



FOV ~ 0.25 deg□

ATCA



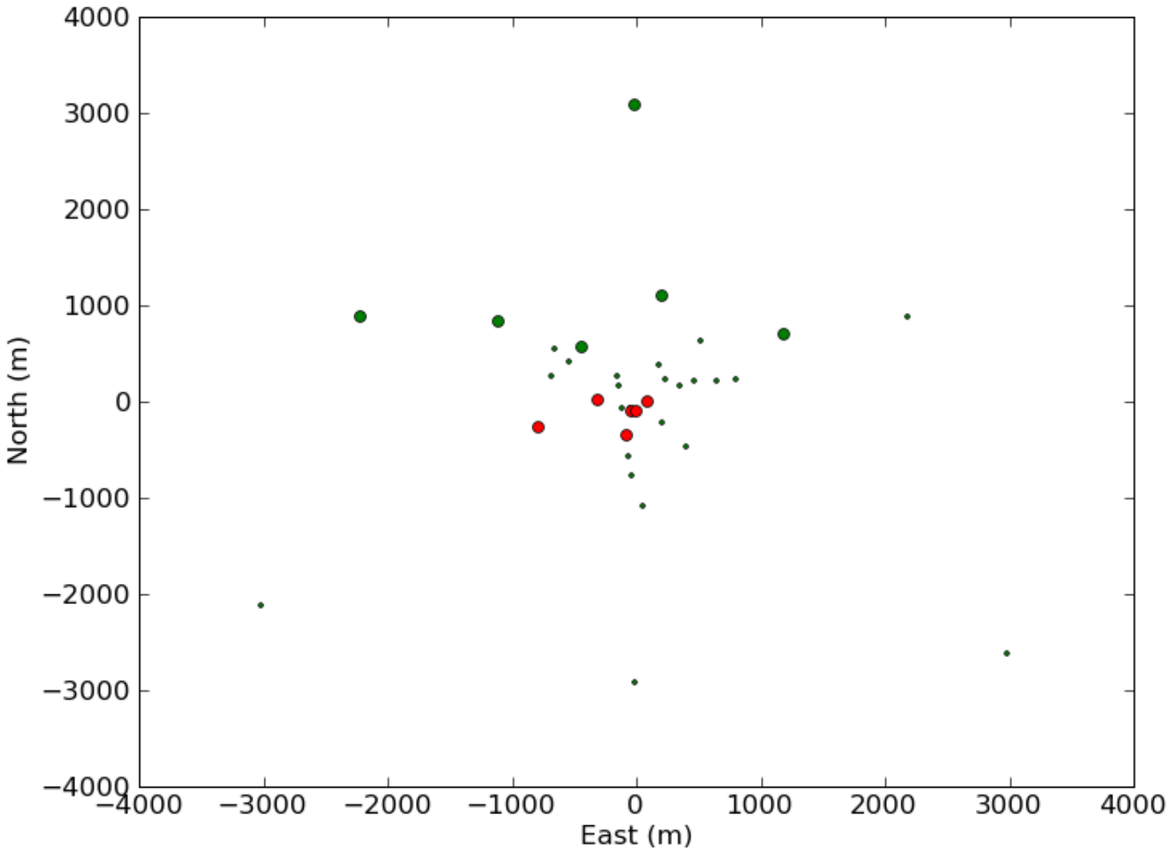
FOV ~ 30 deg□

ASKAP

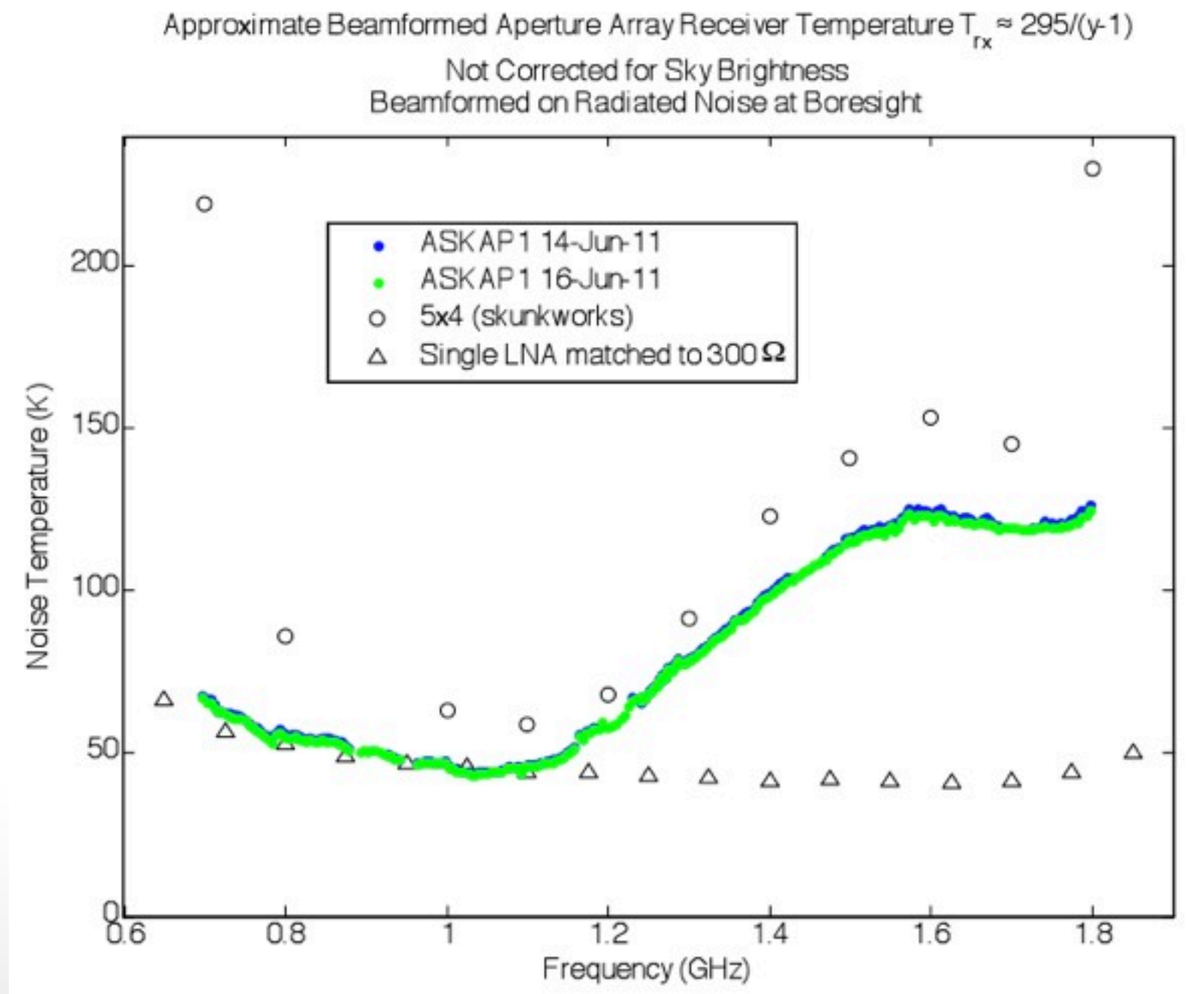
factor ~120 gain !!

BETA & ASKAP-12

ASKAP - 12



Tsys 1st PAF



ASKAP : 2014 +
ASKAP-12 : 2013
BETA : 2012

What can we do with BETA and ASKAP-12 ... ?

Crucial phase of first DINGO baby steps

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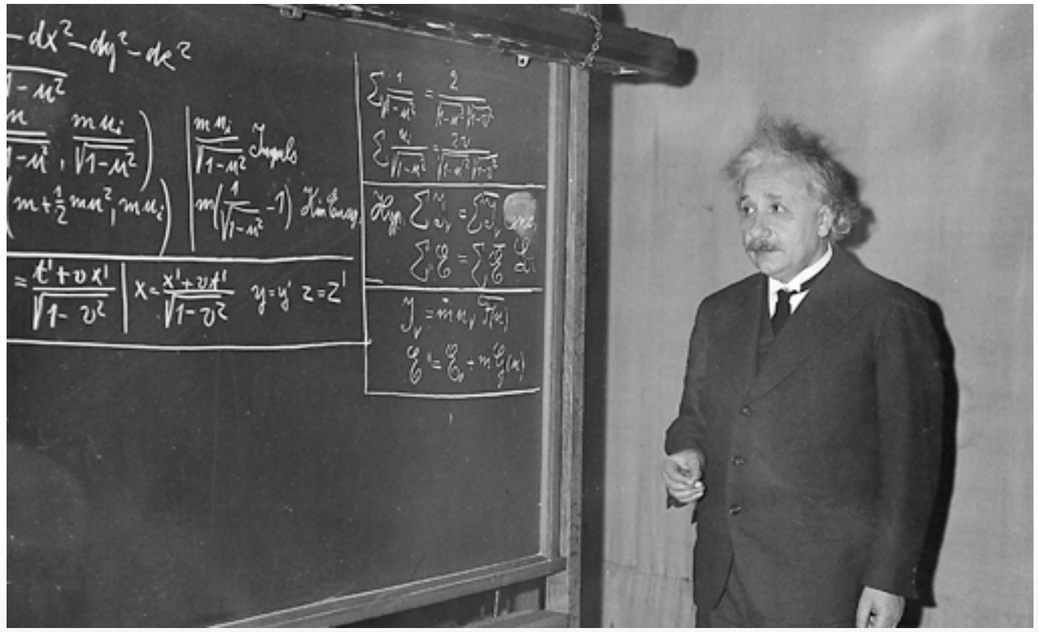
Crucial phase of first DINGO baby steps



Crucial phase of first DINGO baby steps

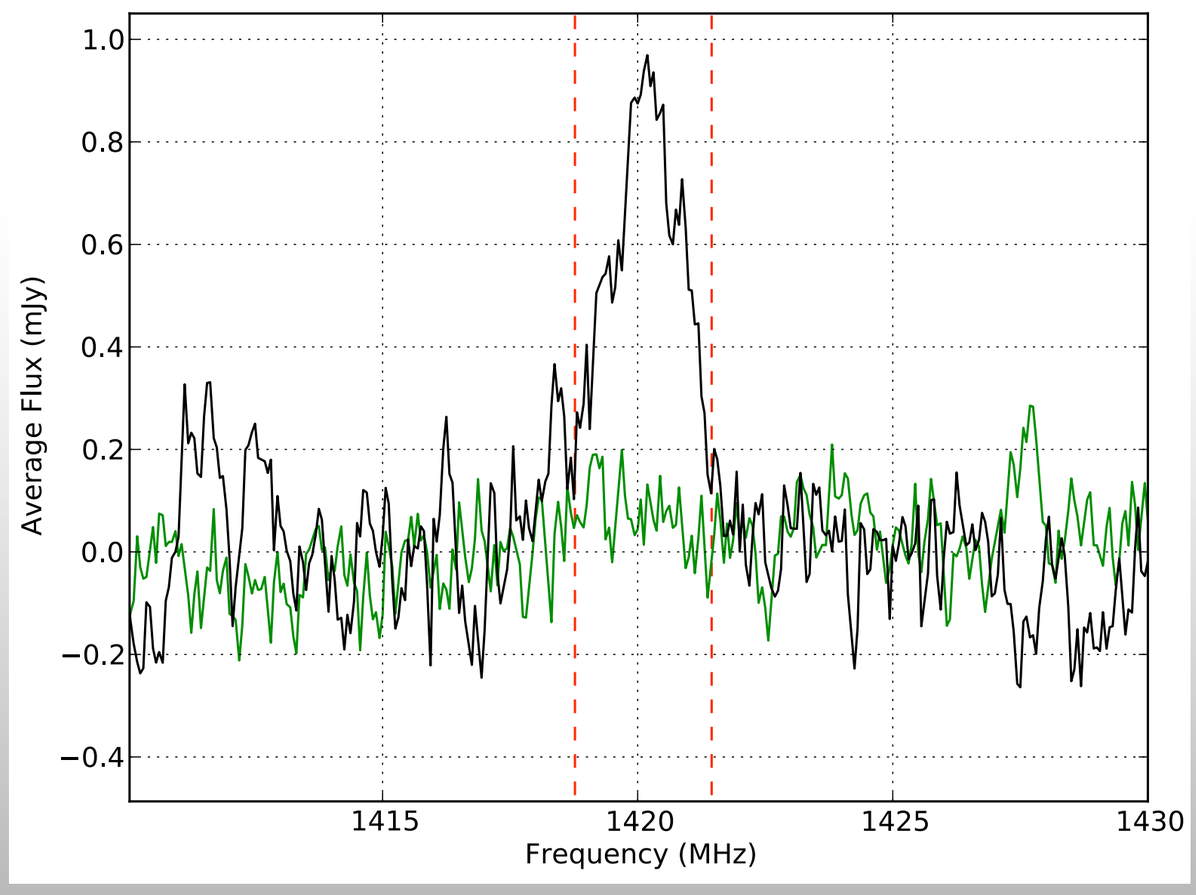
DINGO stacking experiment

DINGO stacking experiment

Extracting a statistical HI signal by co-adding the 21-cm line emission form multiple galaxies using their known positions and redshifts

DINGO: HI to z ~ 0.4

GAMA: optical spectra



J. Delhaize

GAMA 9hr field, 30 deg2 (ASKAP FOV)

Bandwidth [MHz]	z-range	nr sources	max baseline [meter]
1000 - 1100	0.42 - 0.29	5500	1950
1100 - 1200	0.29 - 0.18	9500	1780
1200 - 1300	0.18 - 0.093	5500	1650
1300 - 1400	0.093 - 0.014	2200	900

Baselines of ASKAP-12 should be no longer than 2km

BETA, 100 hours integration time

Bandwidth [MHz]	Fint (M*) [mJy km/s]	Tsys	σ (1MHz) [mJy]	S/N (200 km/s)	S/N stack
1000 - 1100	24	50	3.56	0.23	18
1100 - 1200	43	50	3.56	0.43	42
1200 - 1300	100	70	5.0	0.71	52
1300 - 1400	560	100	7.1	2.8	131

ASKAP-12, 100 hours integration time

Bandwidth [MHz]	Fint (M*) [mJy km/s]	Tsys	σ (1MHz) [mJy]	S/N (200 km/s)	S/N stack
1000 - 1100	24	50	1.8	0.47	35
1100 - 1200	43	50	1.8	0.84	82
1200 - 1300	100	70	2.1	1.68	125
1300 - 1400	560	100	2.7	7.33	344

WARNING
BEWARE OF THE
DINGO