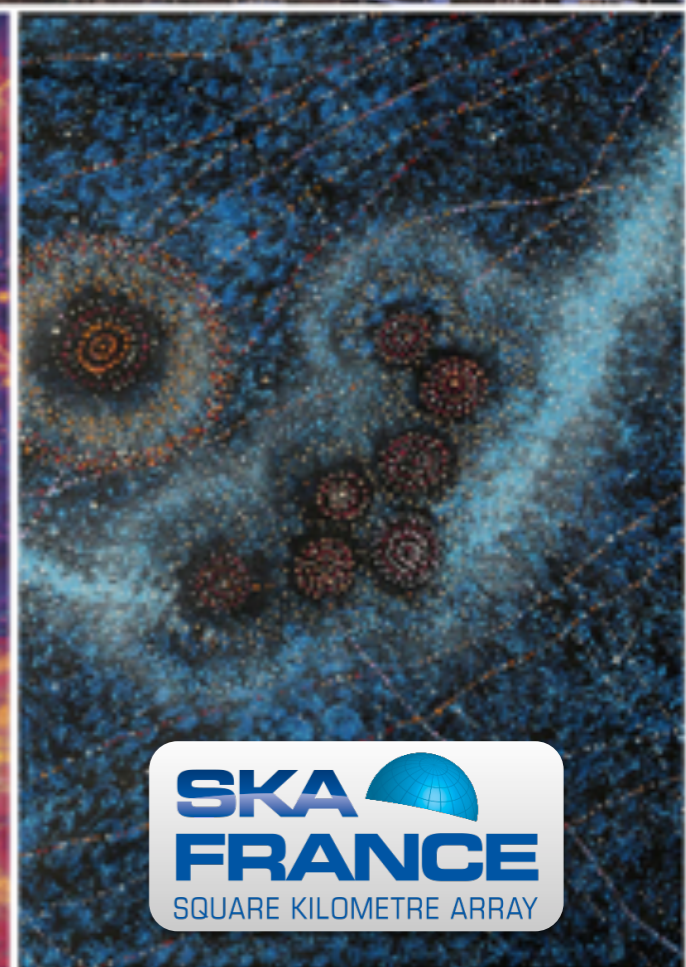
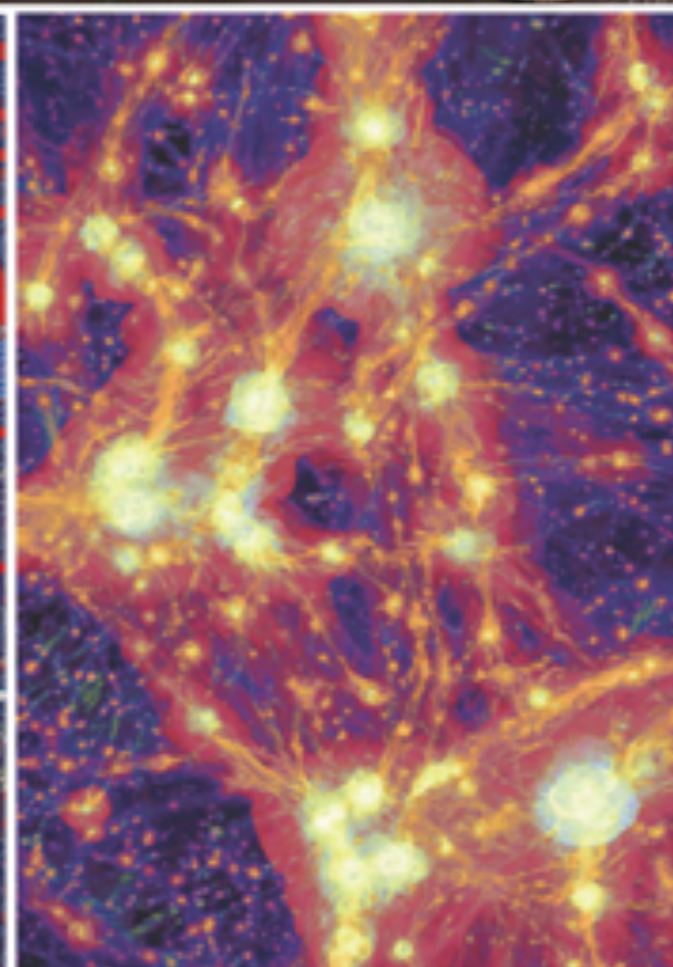
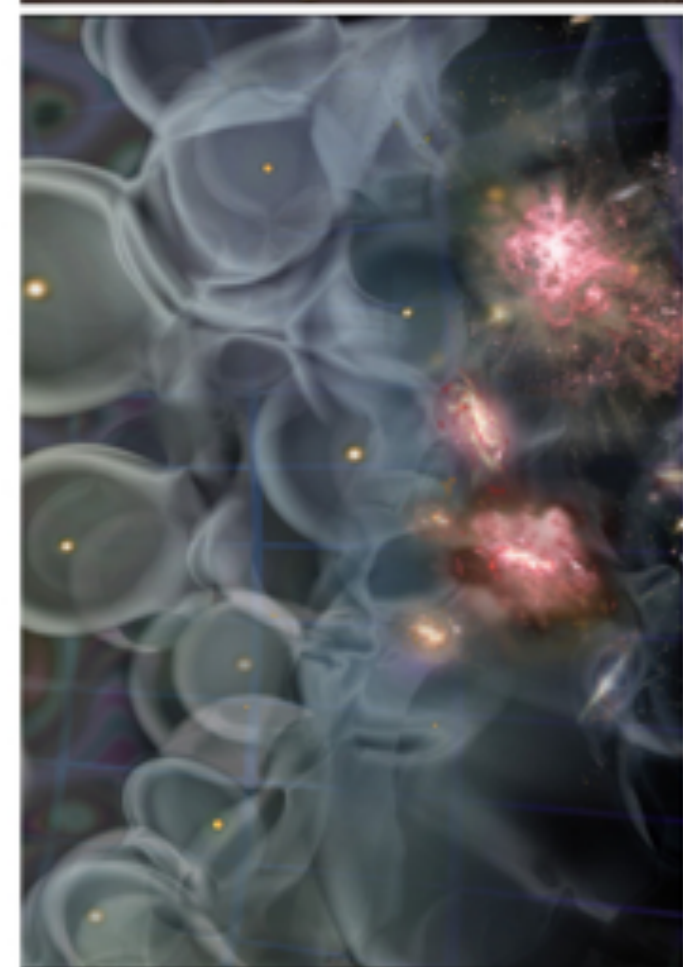




# SKA France - TANGO meeting

ESRF

April 5, 2018

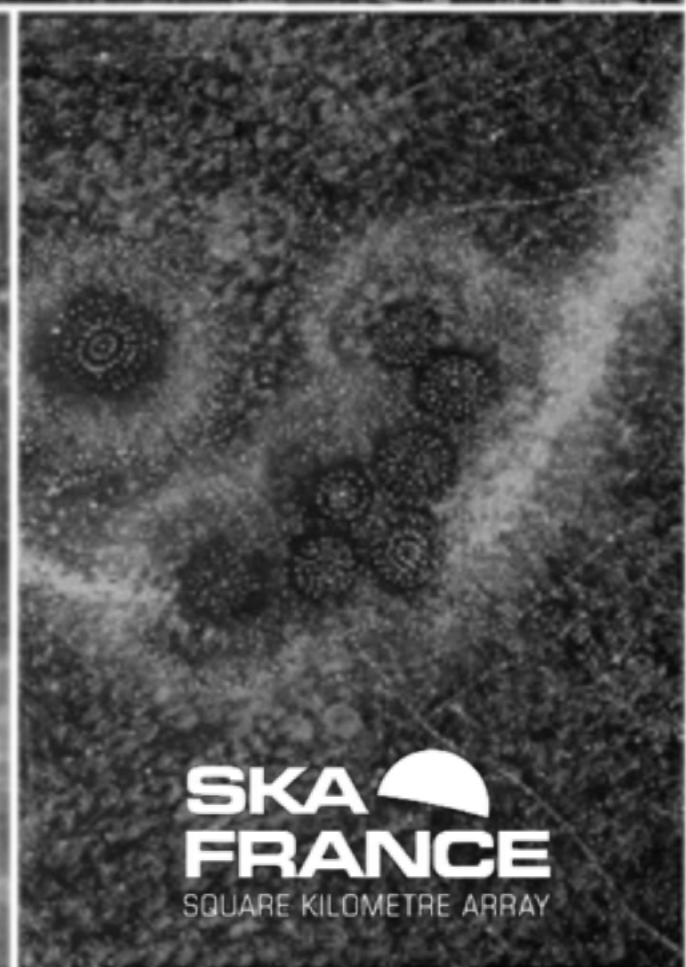
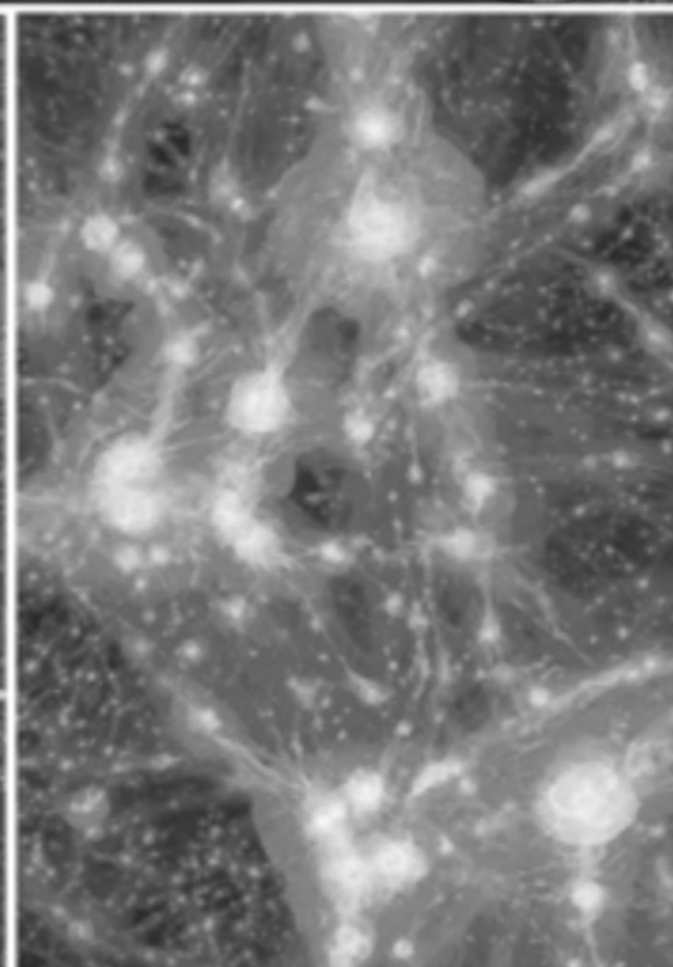
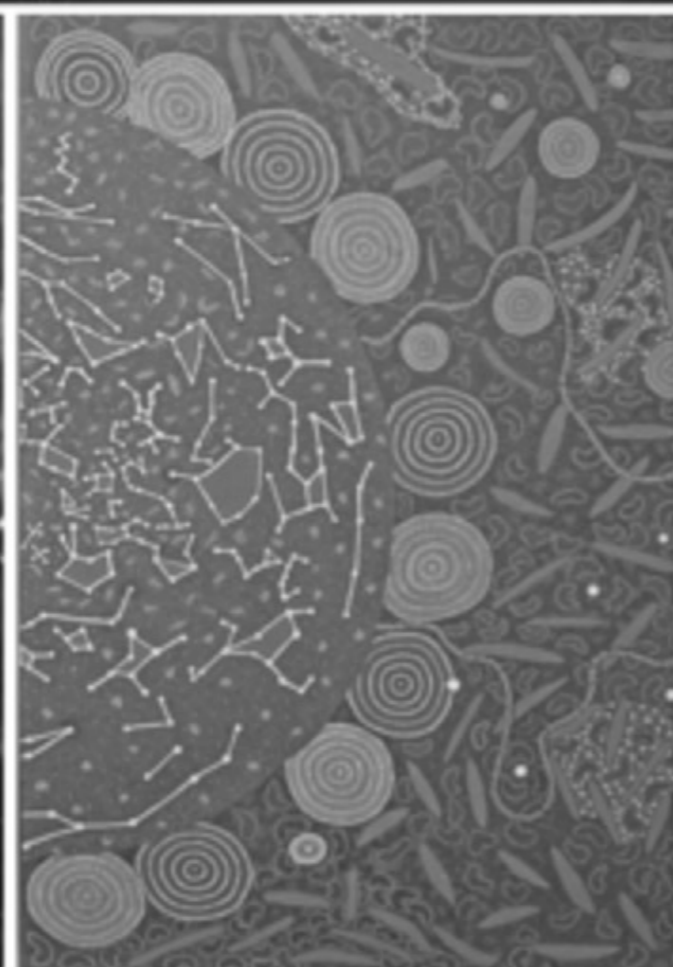
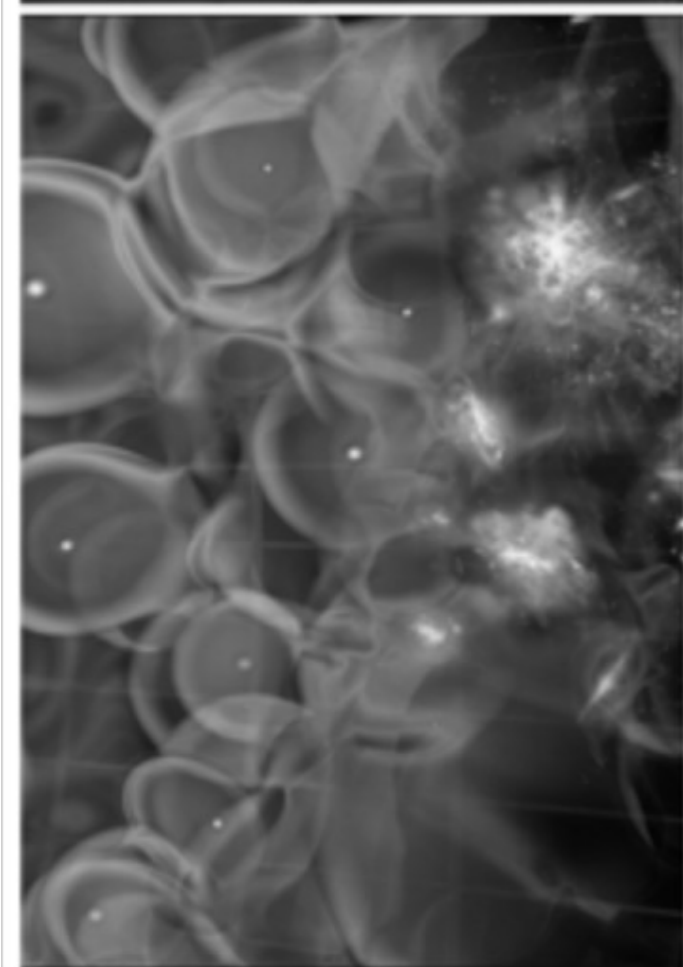




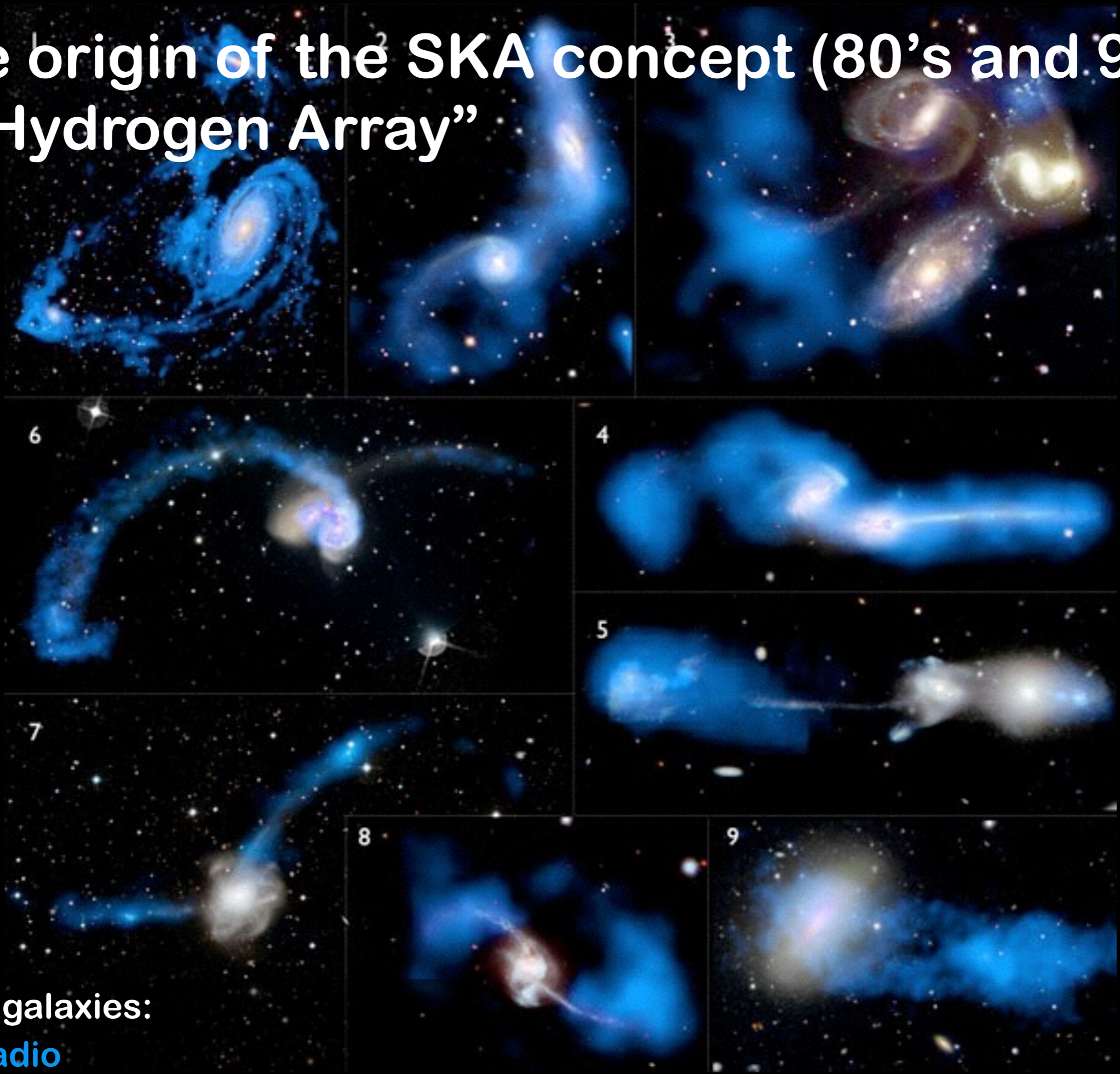
# SKA and SKA France

Chiara Ferrari

Director of “Maison SKA France”



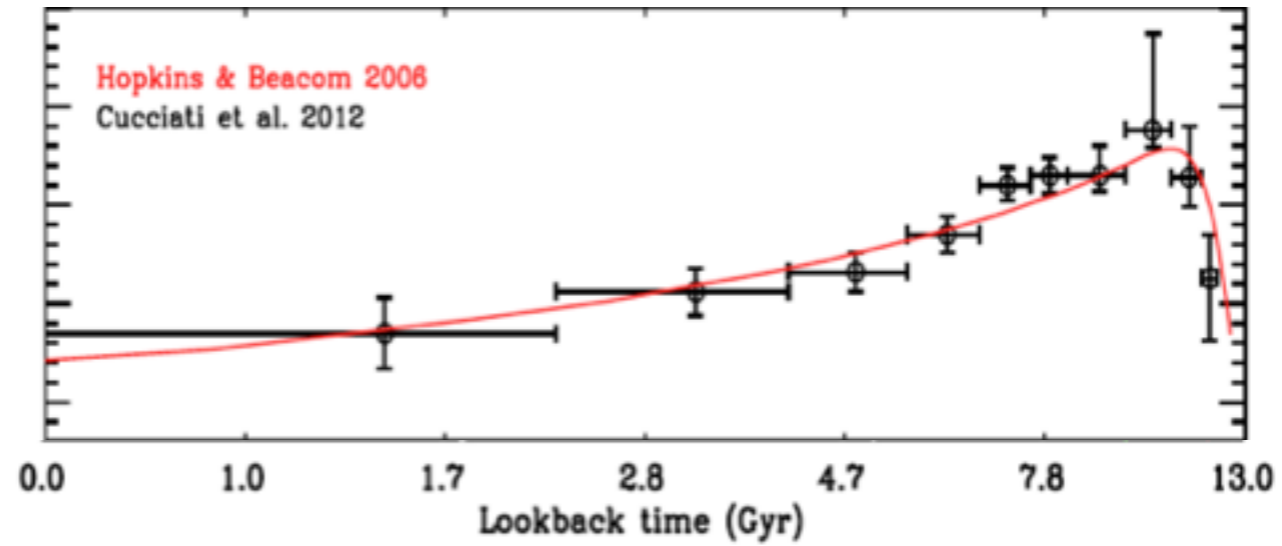
# At the origin of the SKA concept (80's and 90's) The "Hydrogen Array"



Light from galaxies:  
visible & radio

# Changing our understanding of the Universe with the SKA

Star formation rate



Galaxy evolution

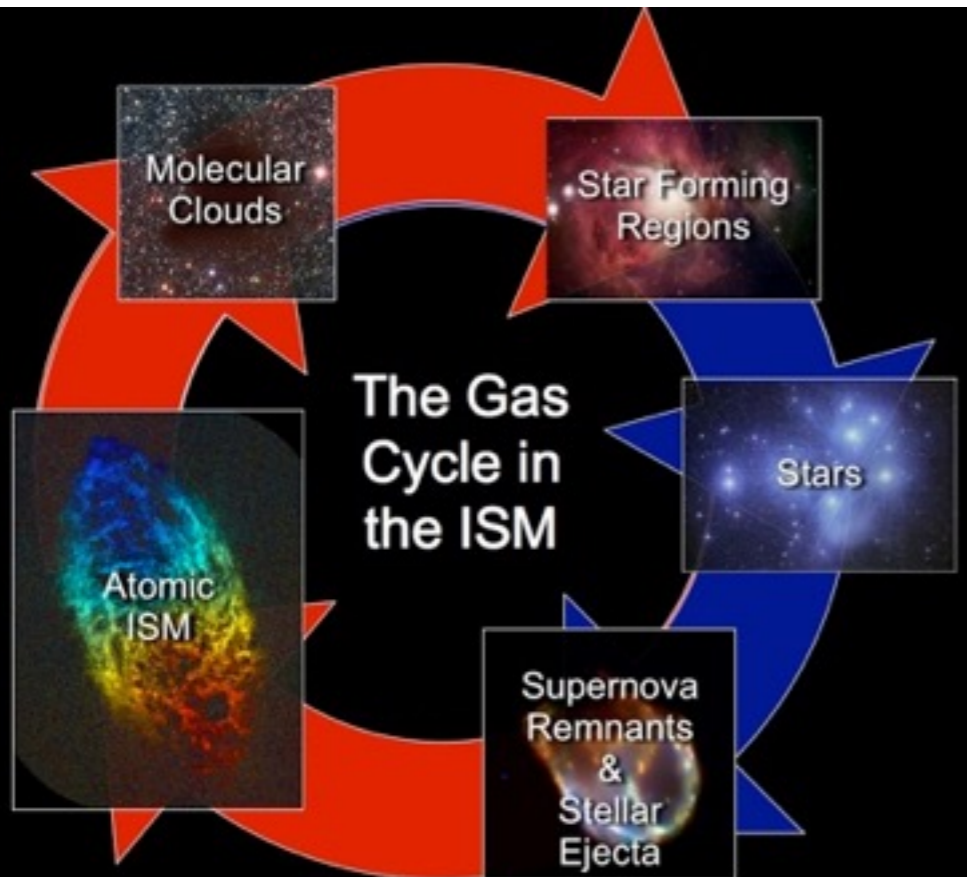
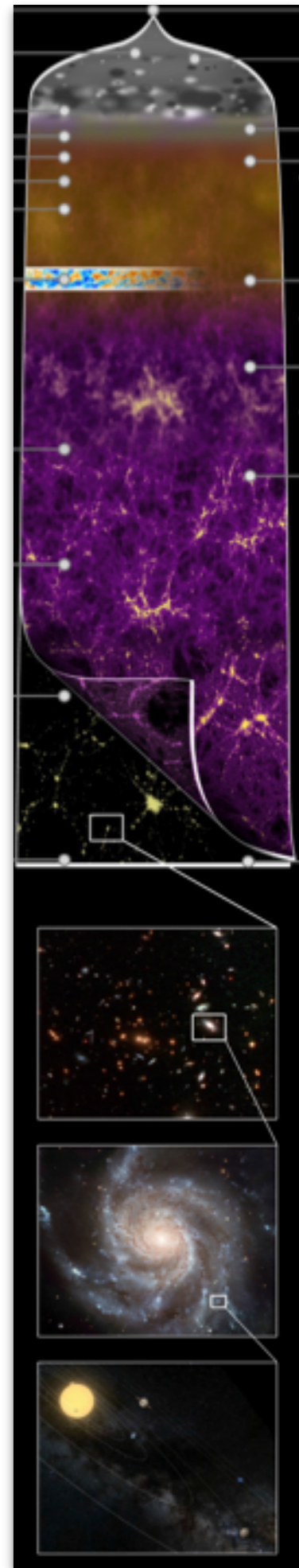
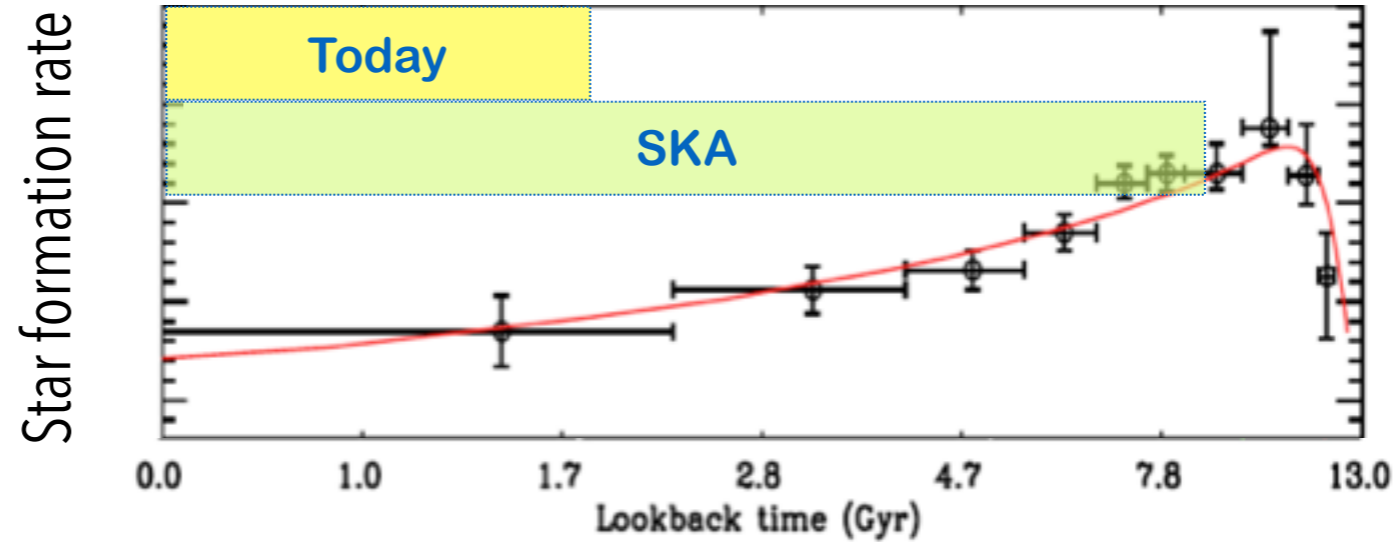


Photo Credits: R. Gendler, the FORS Team, D. Malin, SAO/Chandra, D. Thilker

# Changing our understanding of the Universe with the SKA



Galaxy evolution

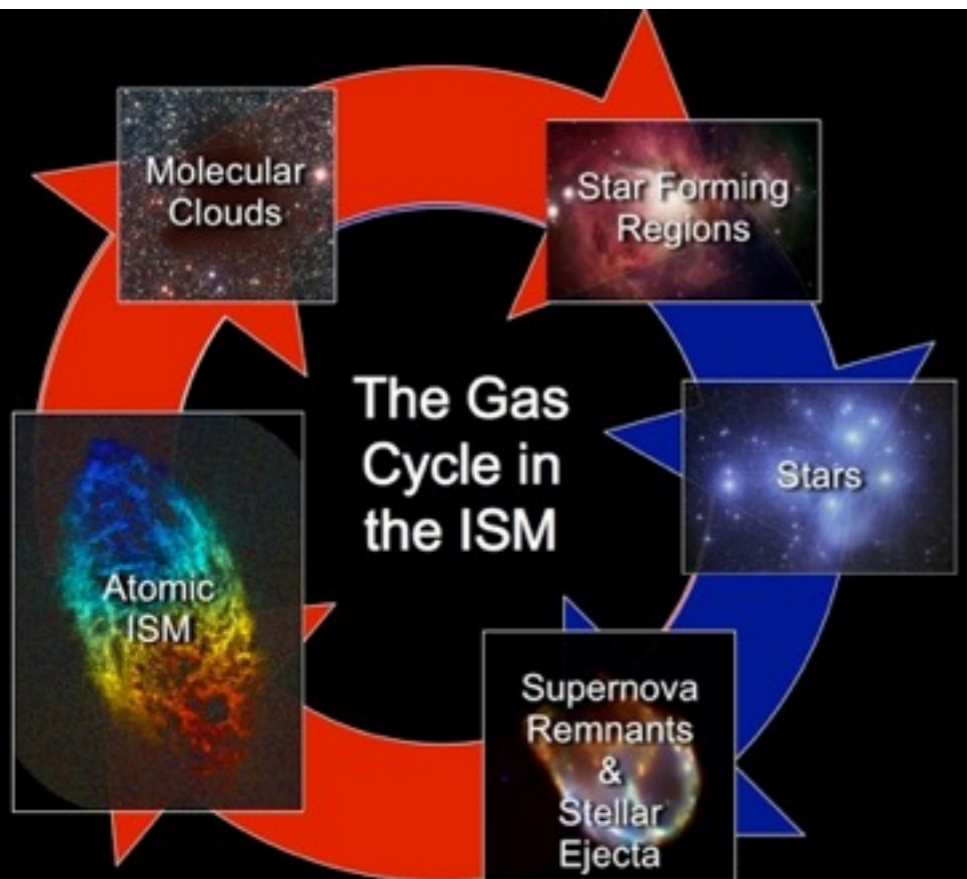
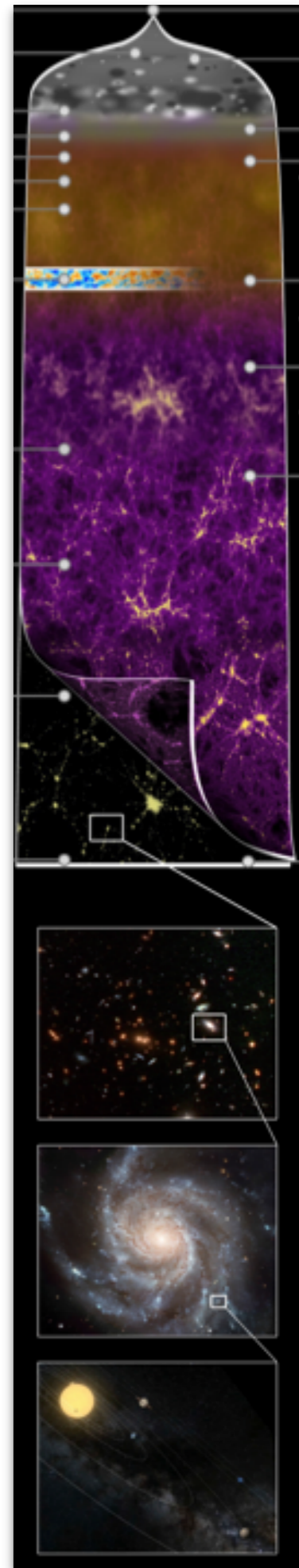
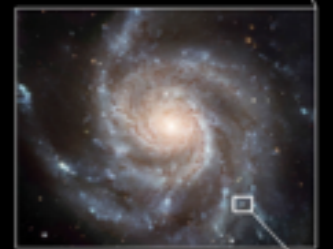
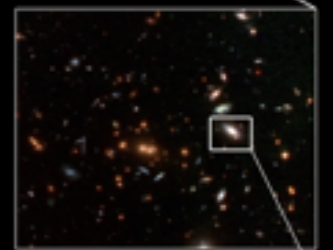
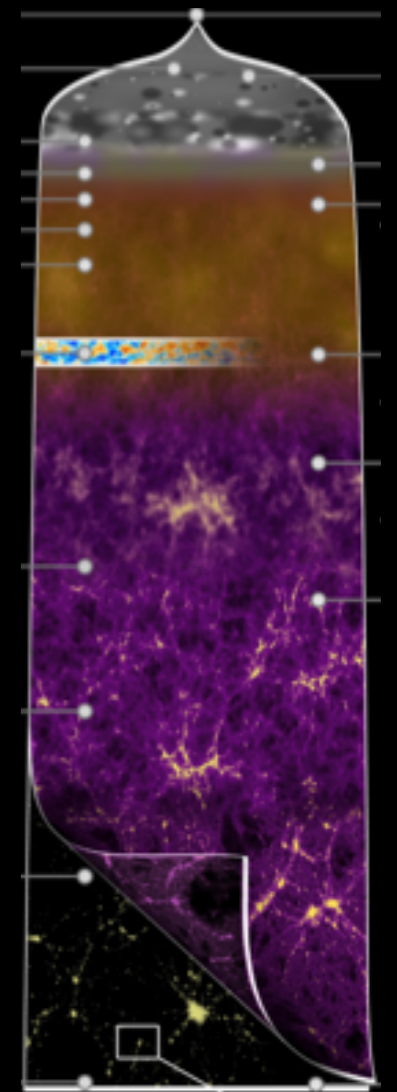
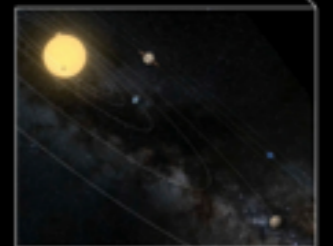
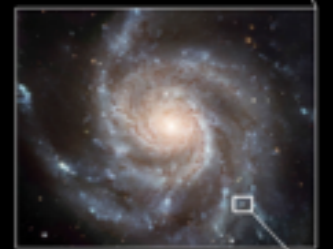
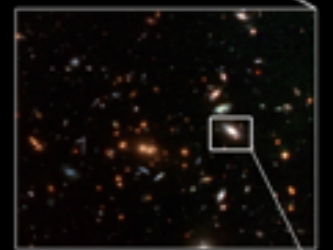
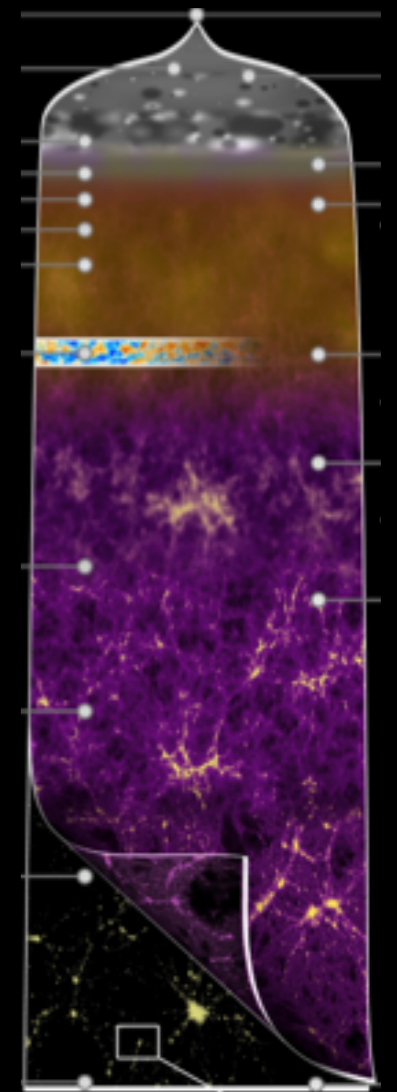
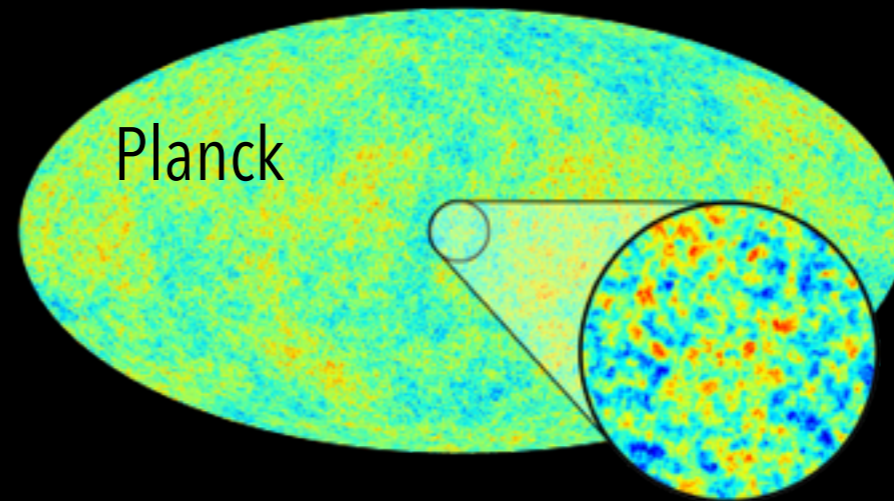


Photo Credits: R. Gendler, the FORS Team, D. Malin, SAO/Chandra, D. Thilker

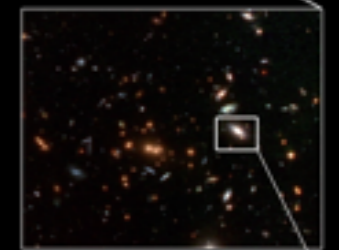
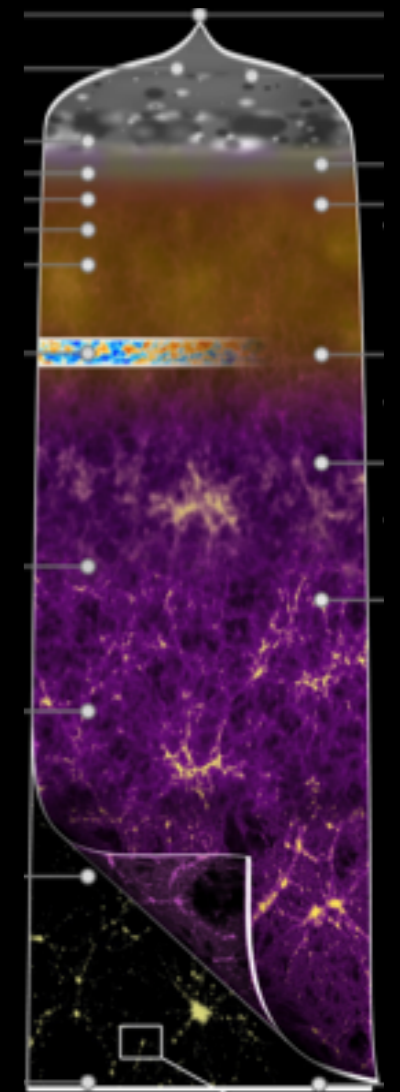
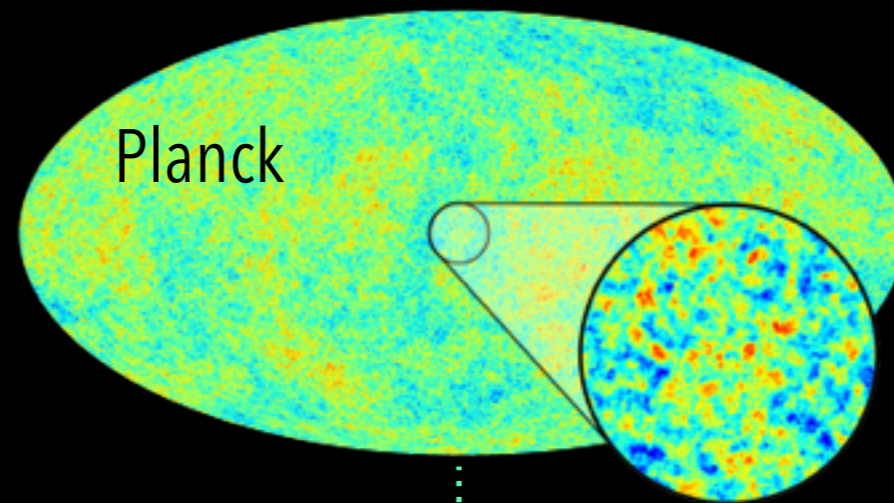
# Changing our understanding of the Universe with the SKA



# Changing our understanding of the Universe with the SKA

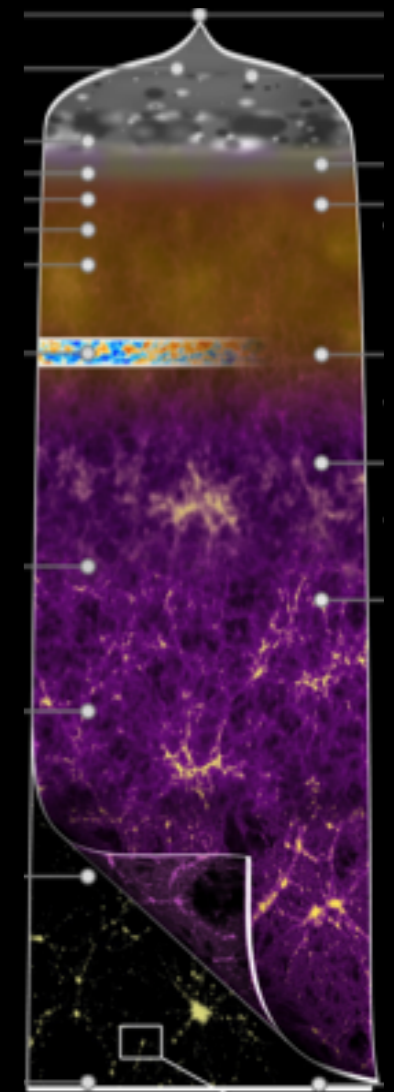
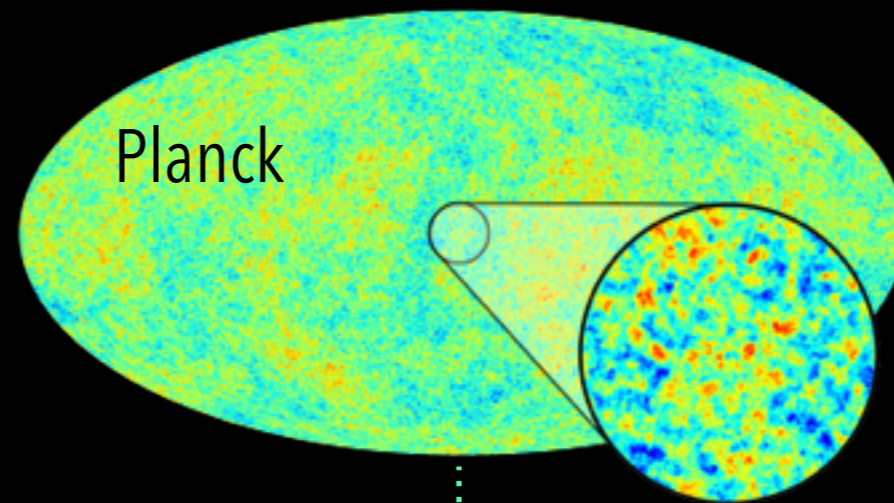
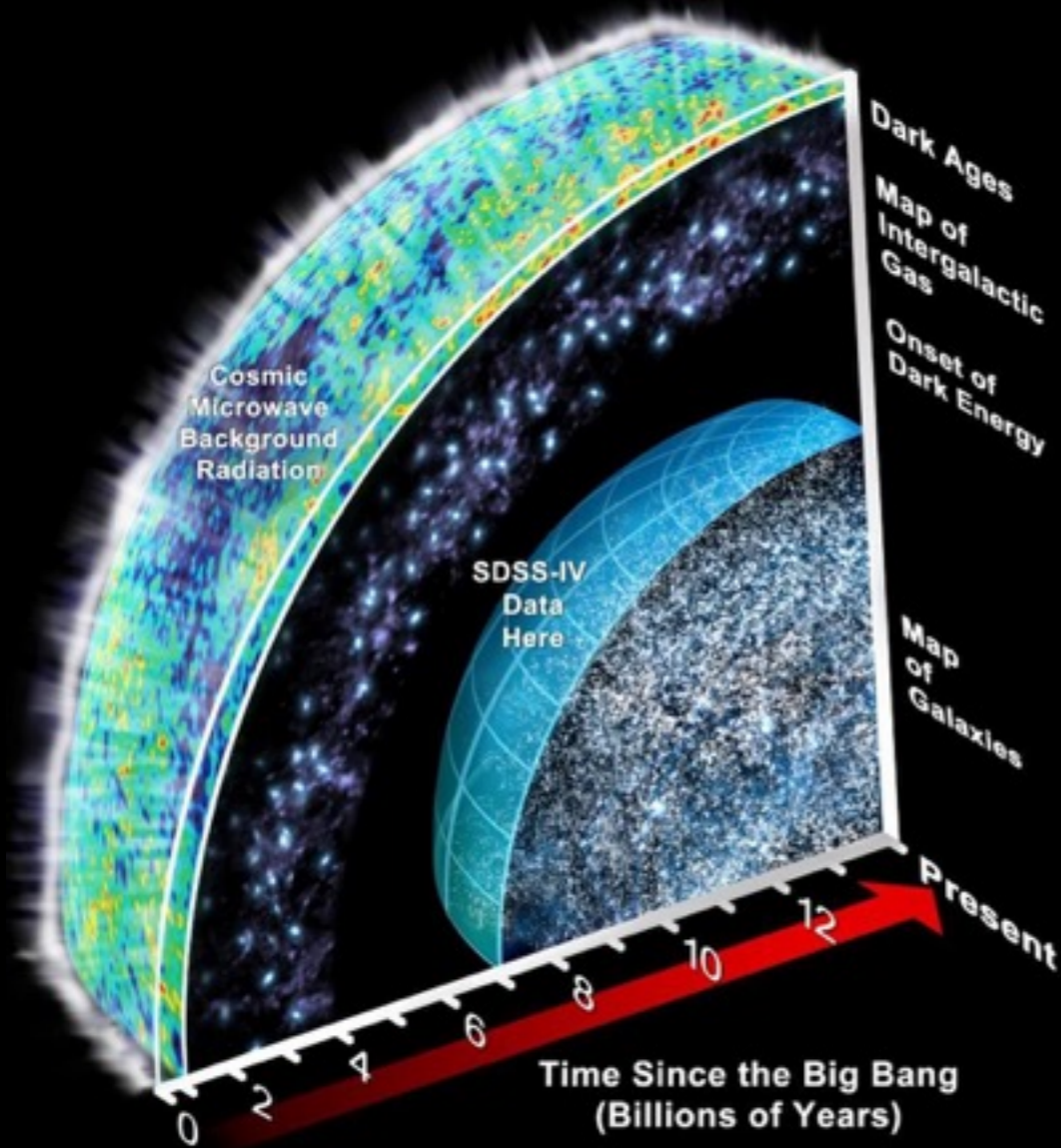


# Changing our understanding of the Universe with the SKA

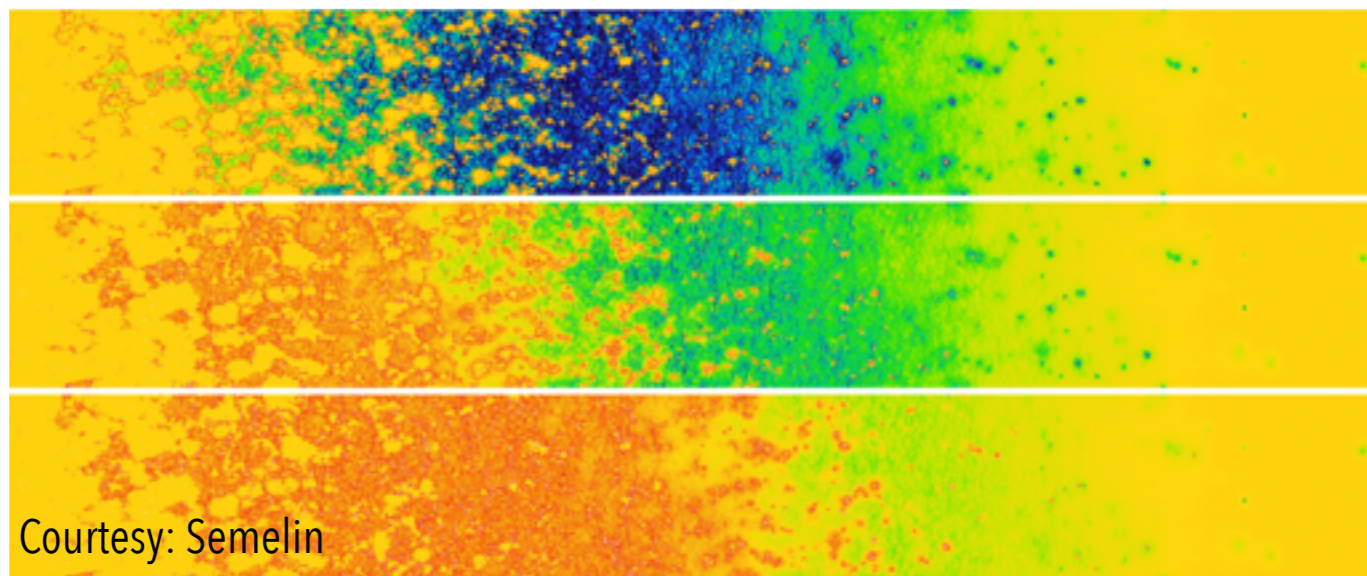
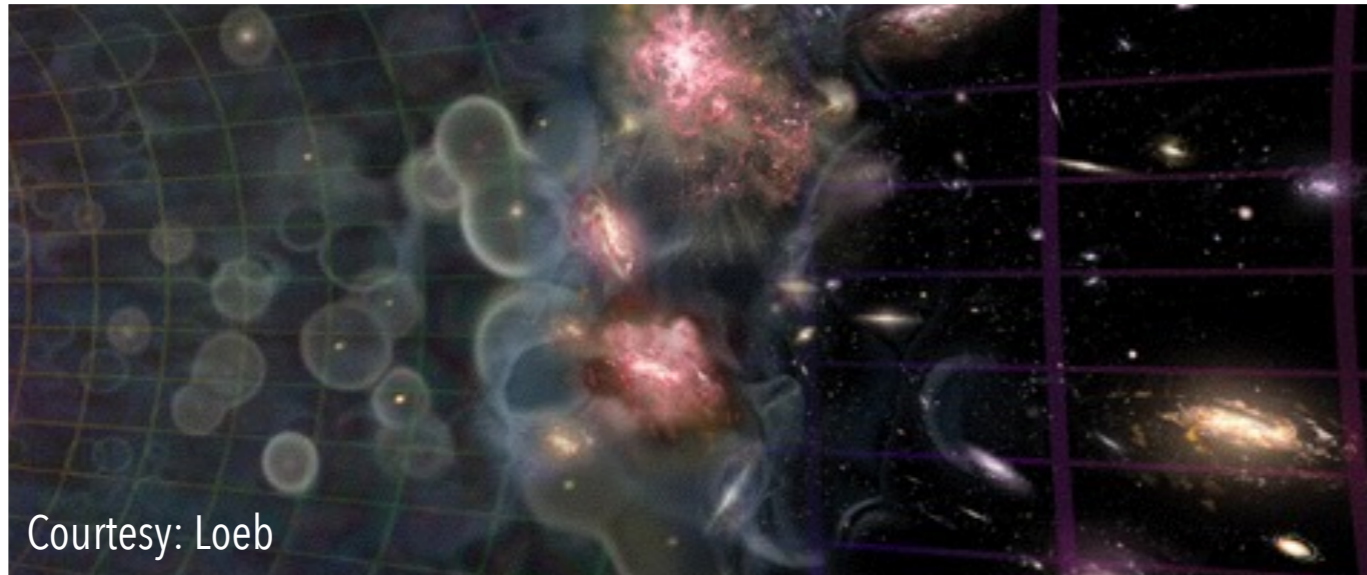




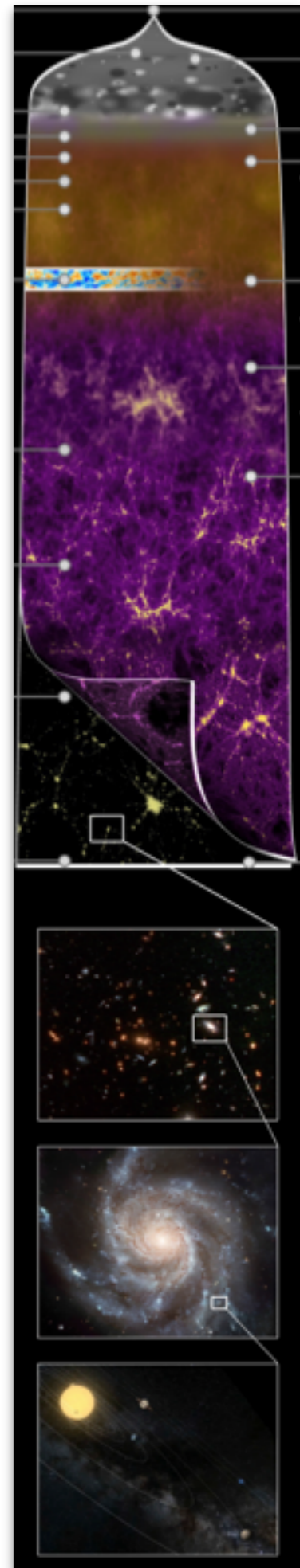
# Changing our understanding of the Universe with the SKA



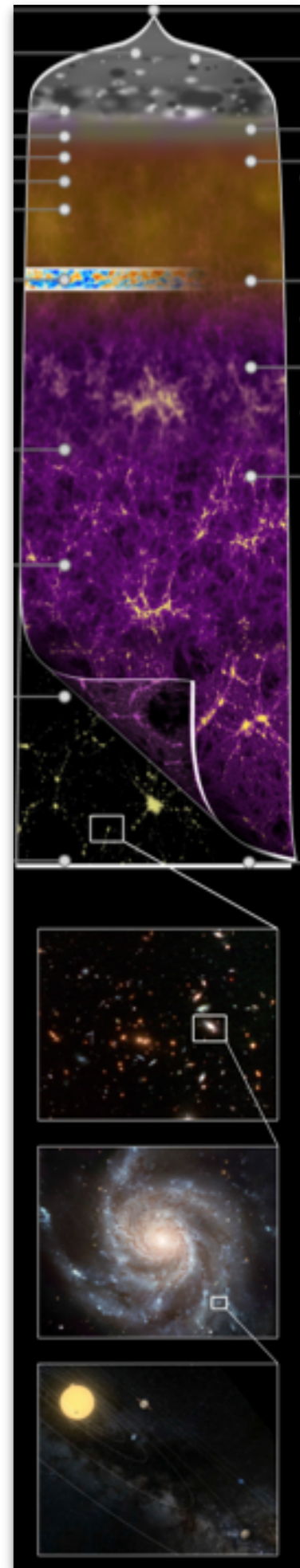
# Changing our understanding of the Universe with the SKA



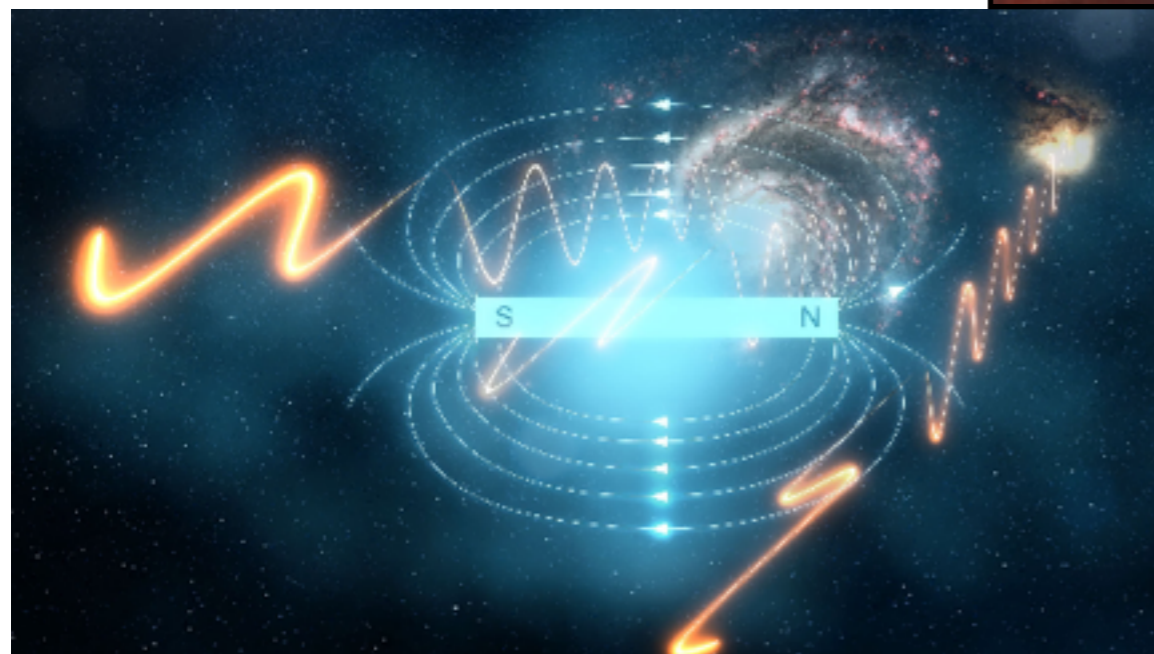
Cosmic dawn &  
Epoch of Reionisation



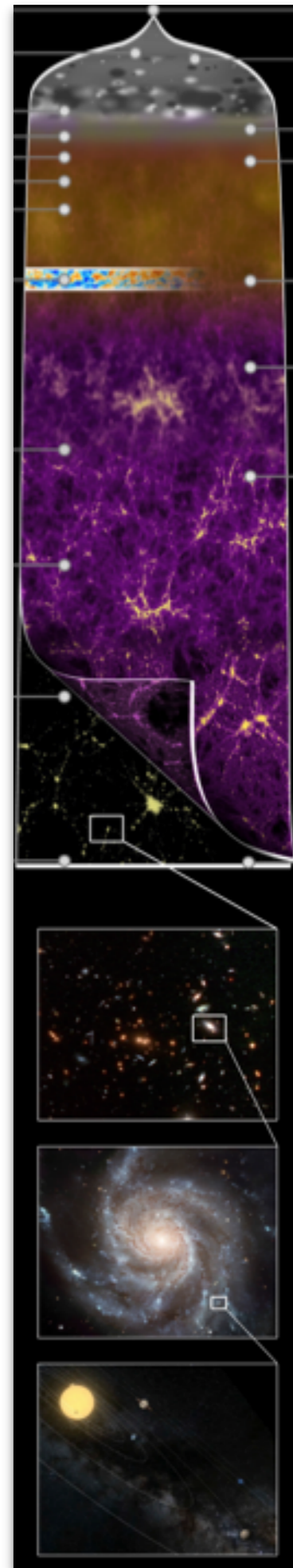
# Changing our understanding of the Universe with the SKA



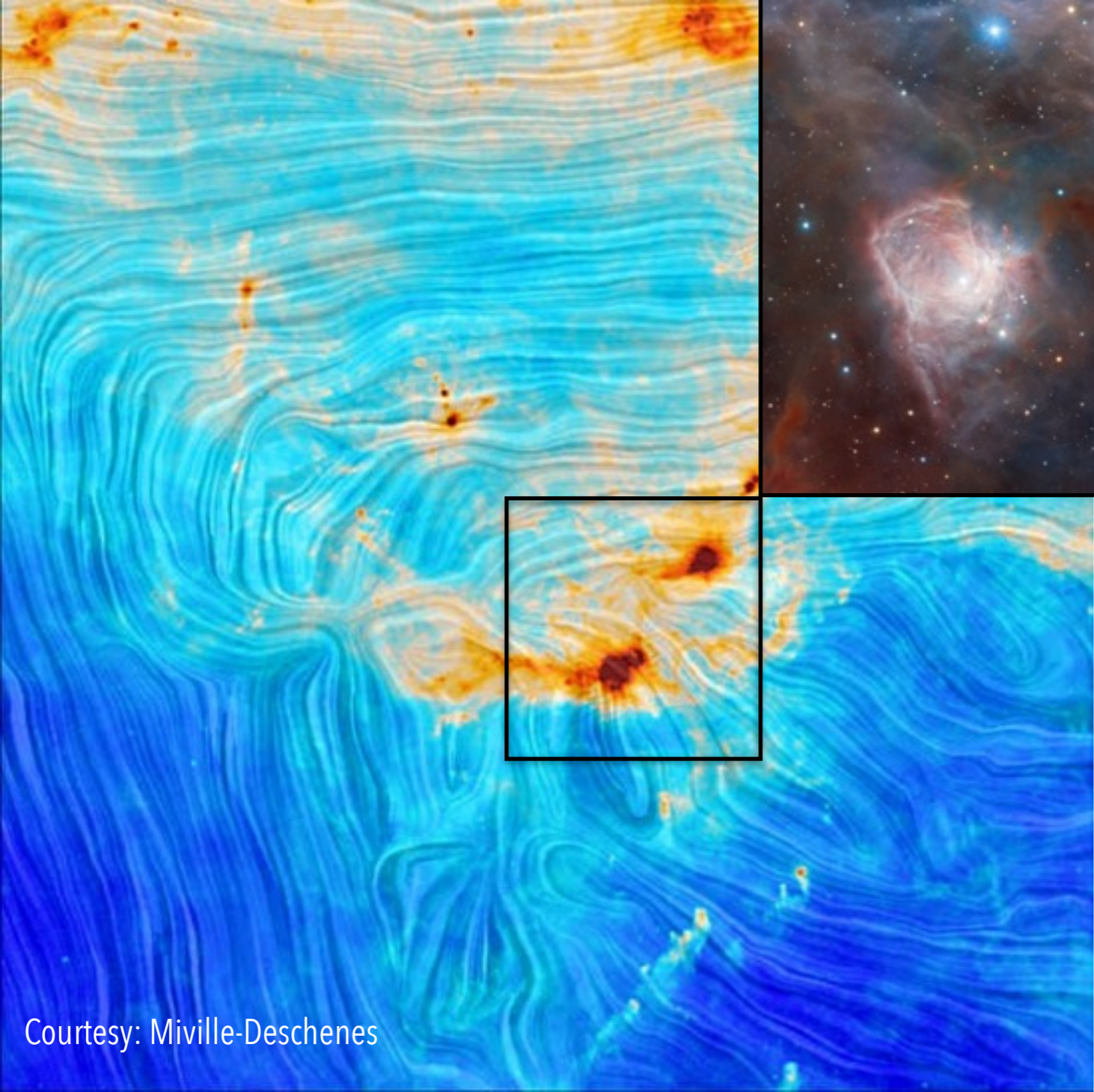
# Changing our understanding of the Universe with the SKA



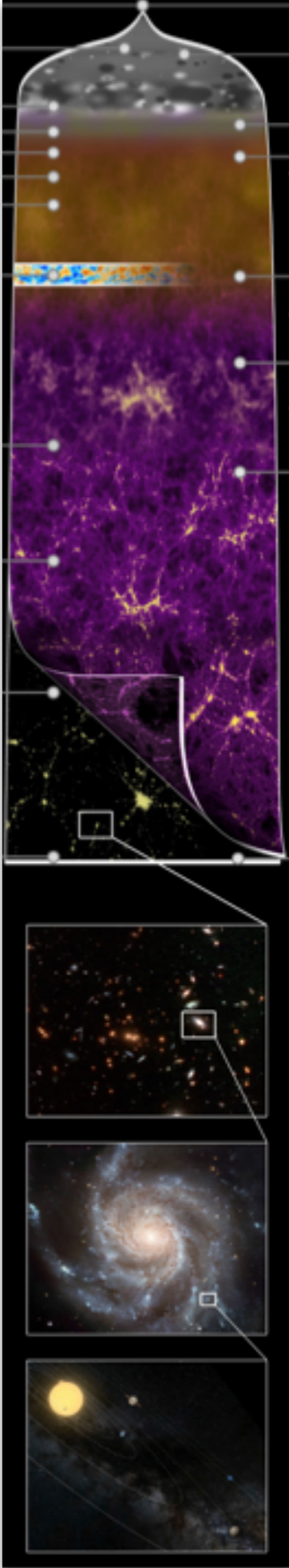
Cosmic magnetism



# Changing our understanding of the Universe with the SKA



Cosmic magnetism



# Changing our understanding of the Universe with the SKA

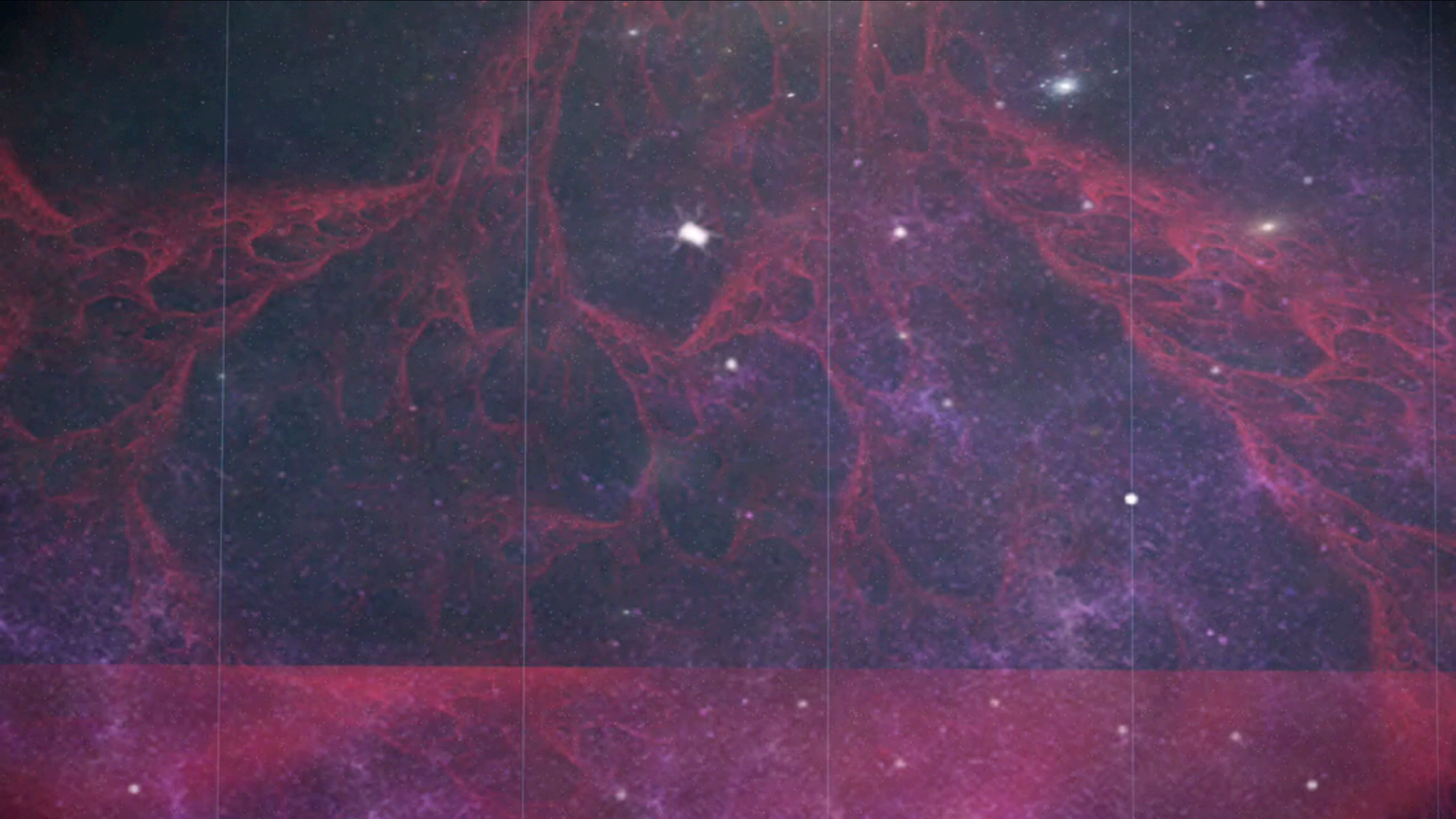


Courtesy: SKAO

# Changing our understanding of the Universe with the SKA

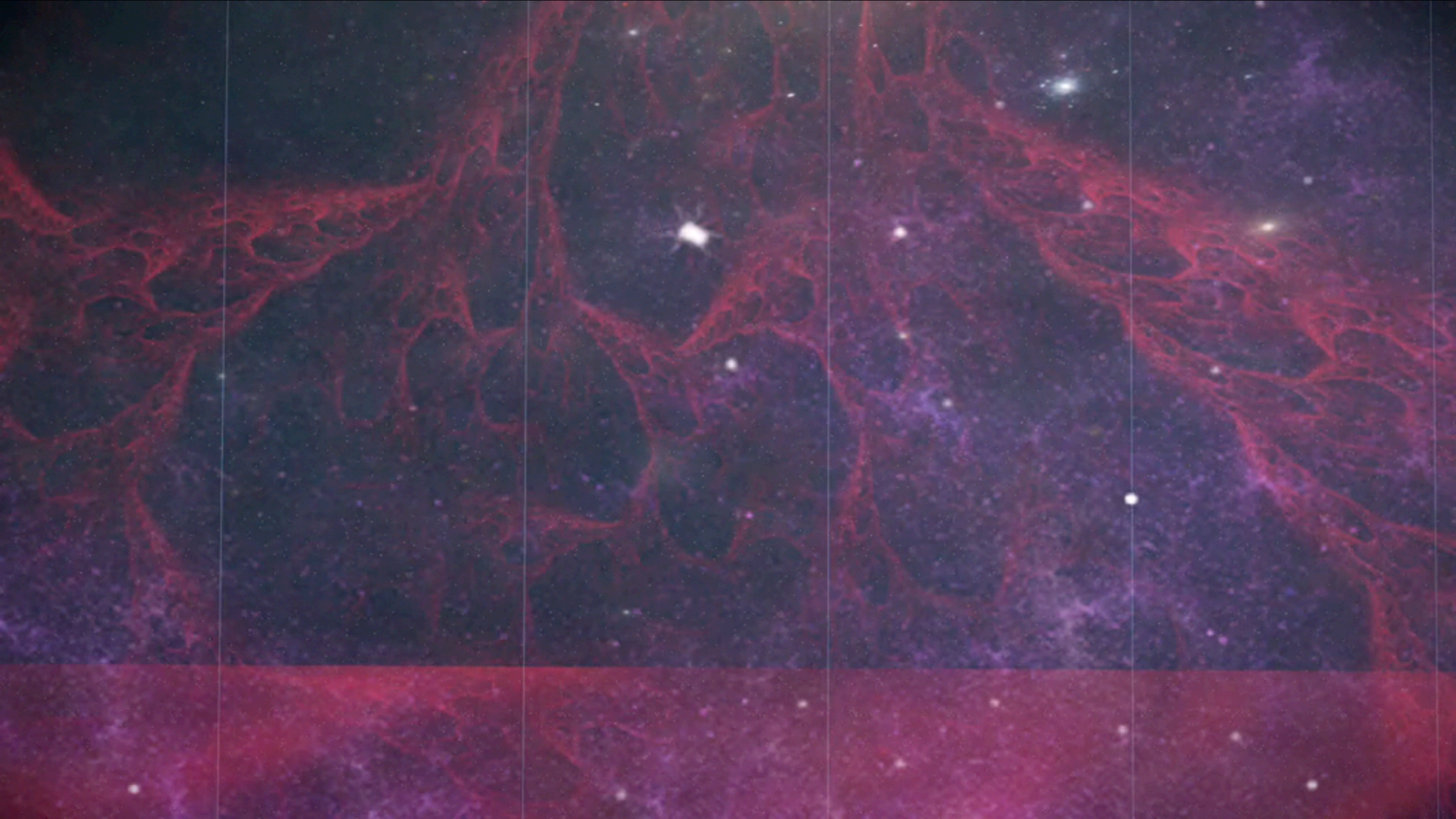


Courtesy: SKAO



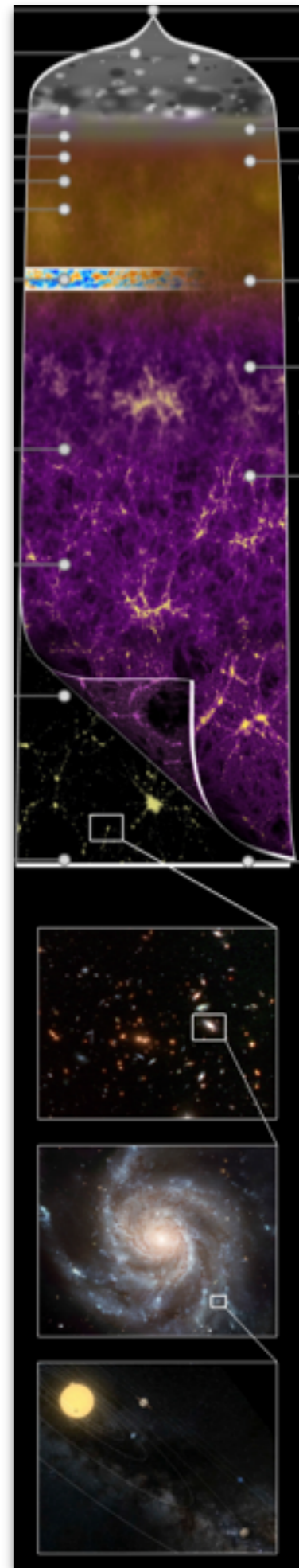
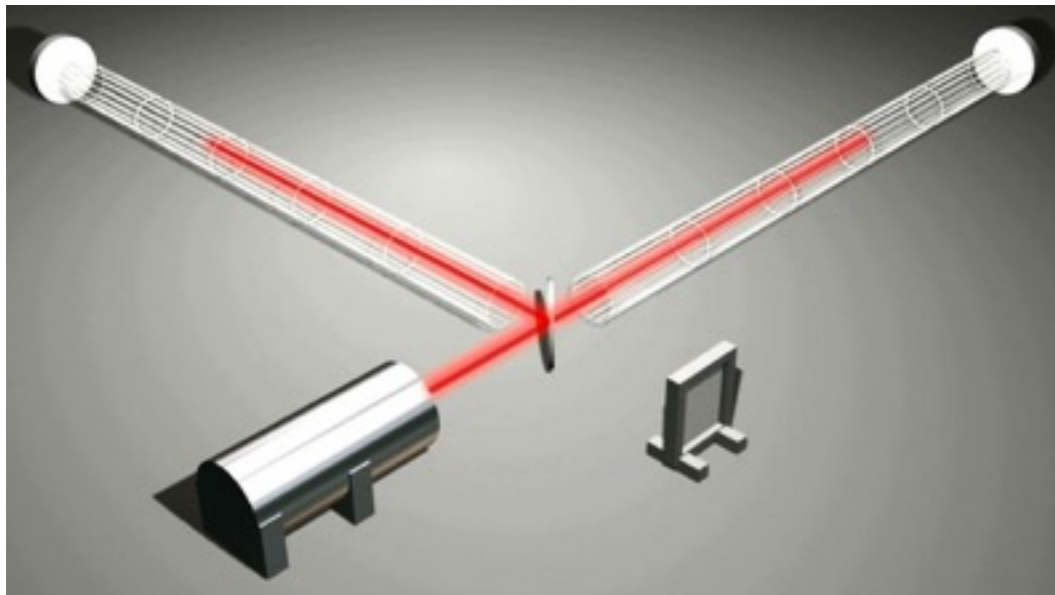
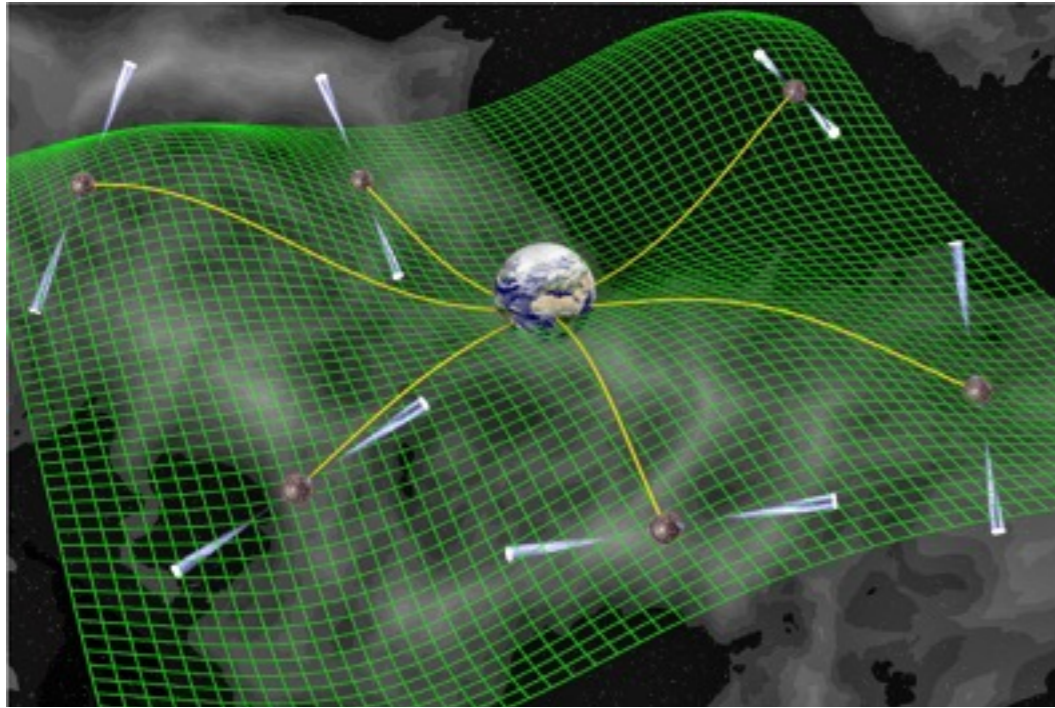
Courtesy: SKAO





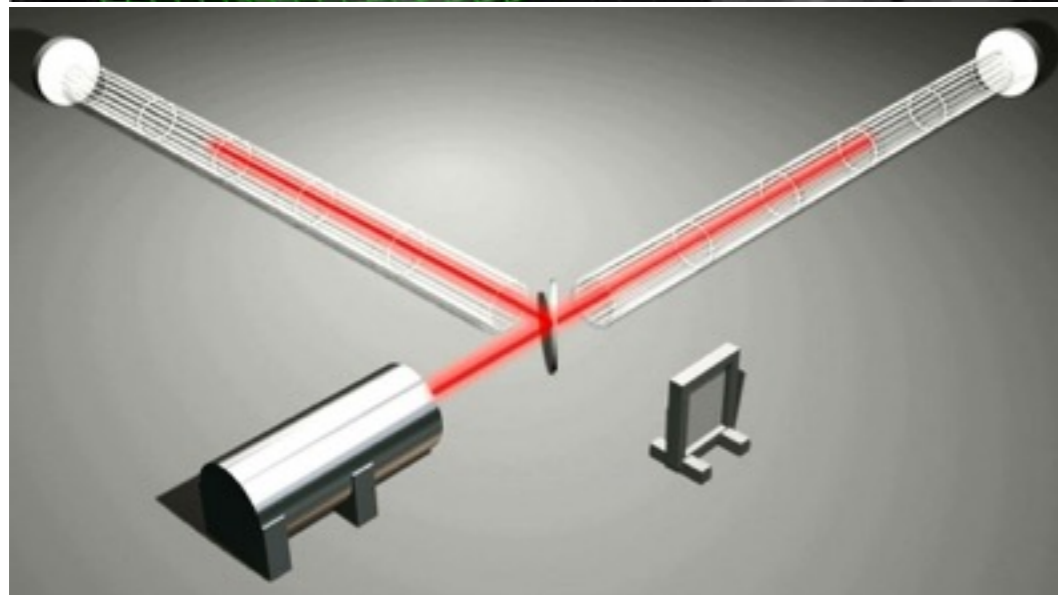
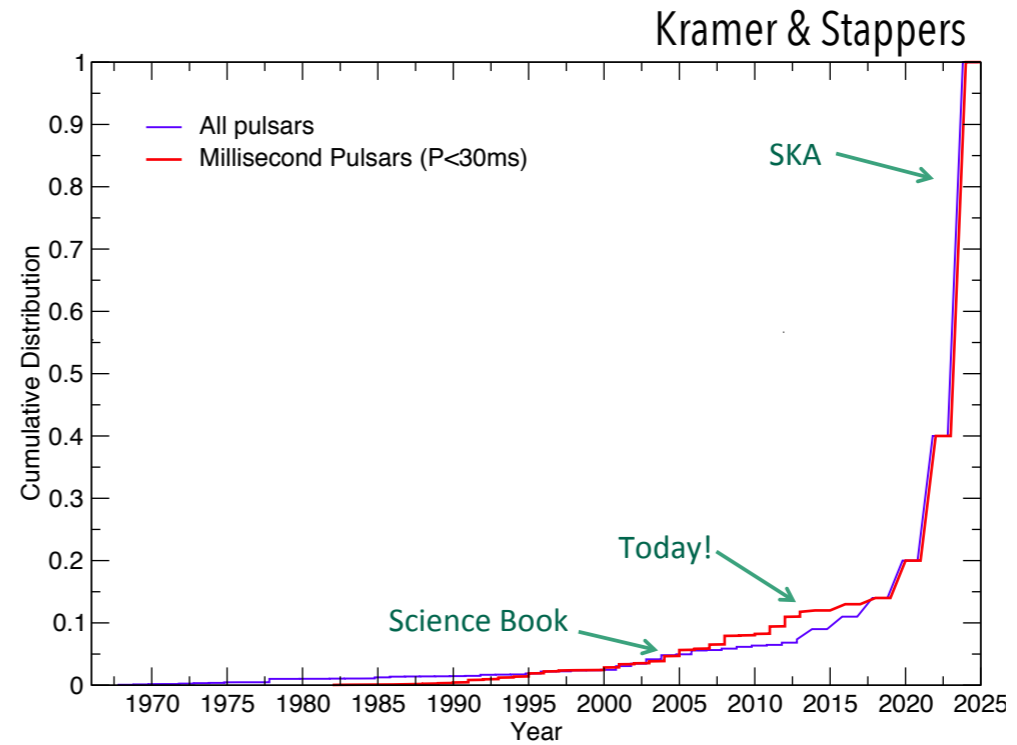
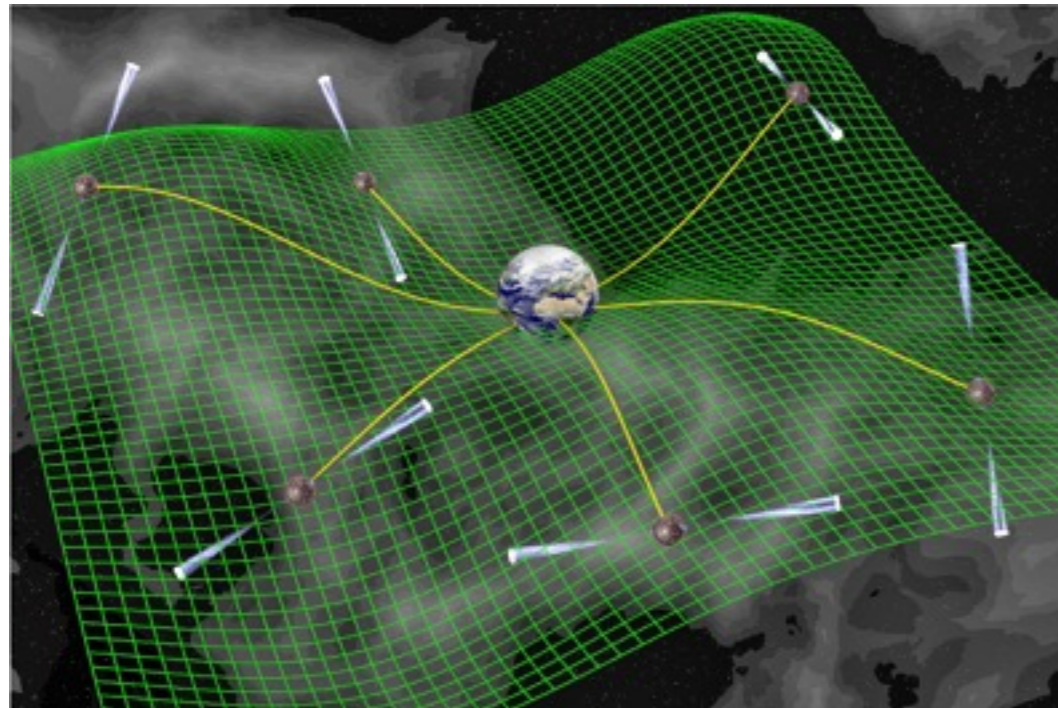
Courtesy: SKAO

# Changing our understanding of the Universe with the SKA

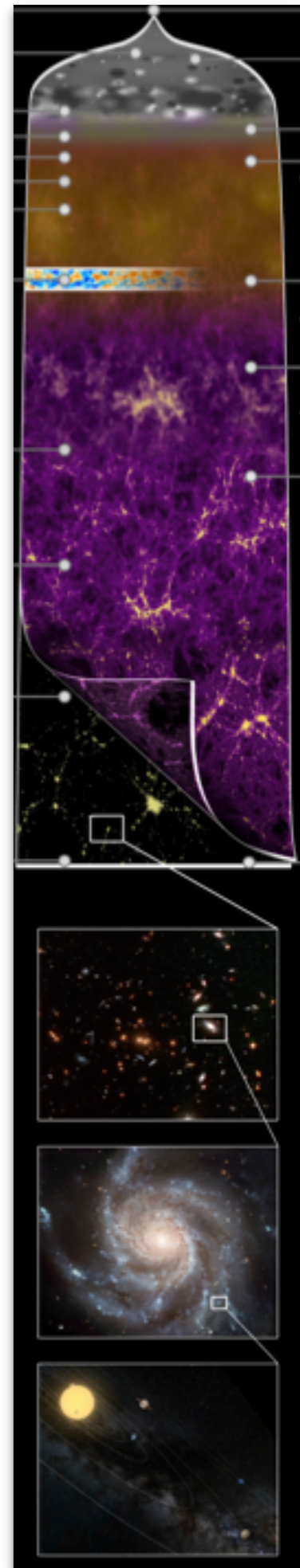


Fundamental physics

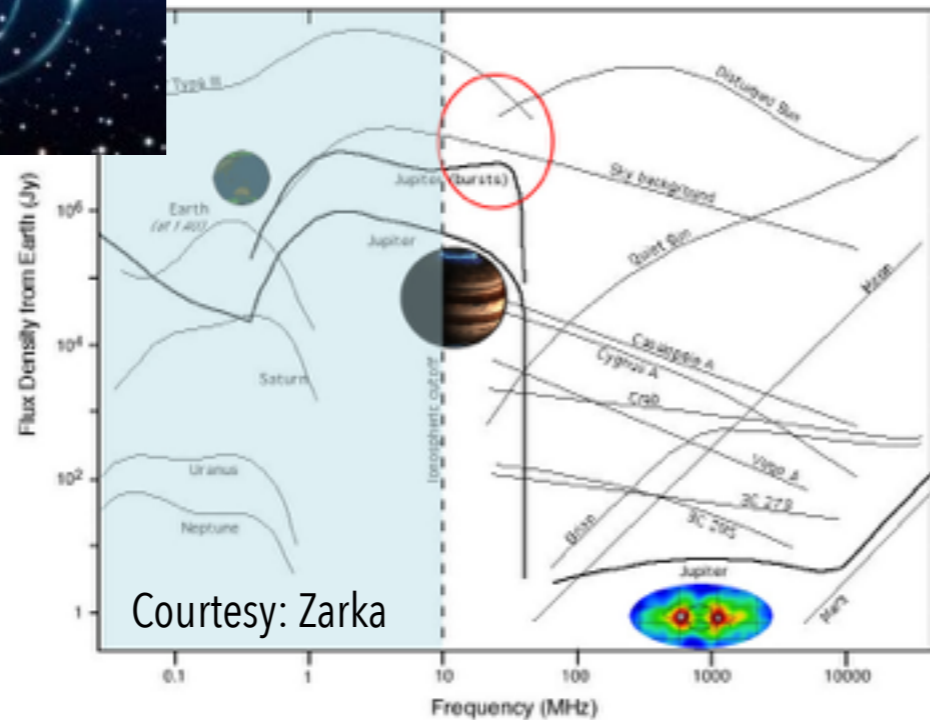
# Changing our understanding of the Universe with the SKA



Fundamental physics



# Changing our understanding of the Universe with the SKA



Cosmic dawn & Epoch of Reionisation

Cosmology

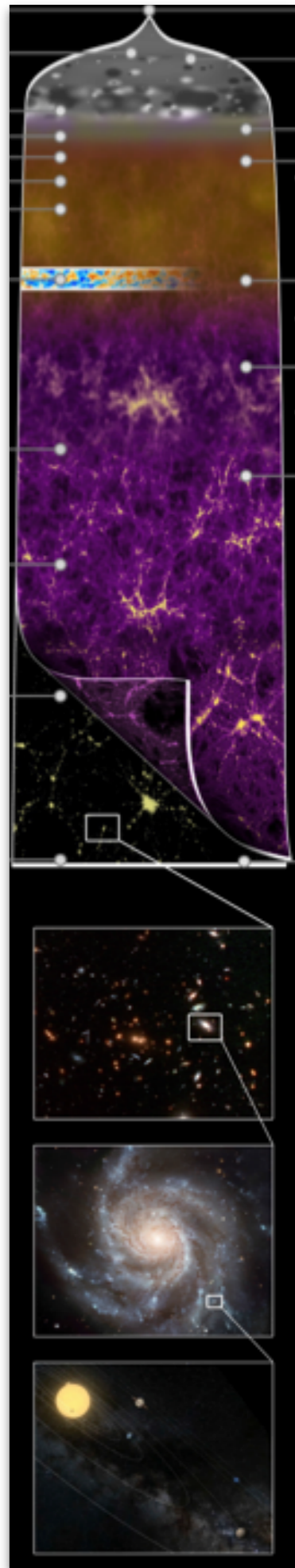
Galaxy evolution

Cosmic magnetism

Fundamental physics

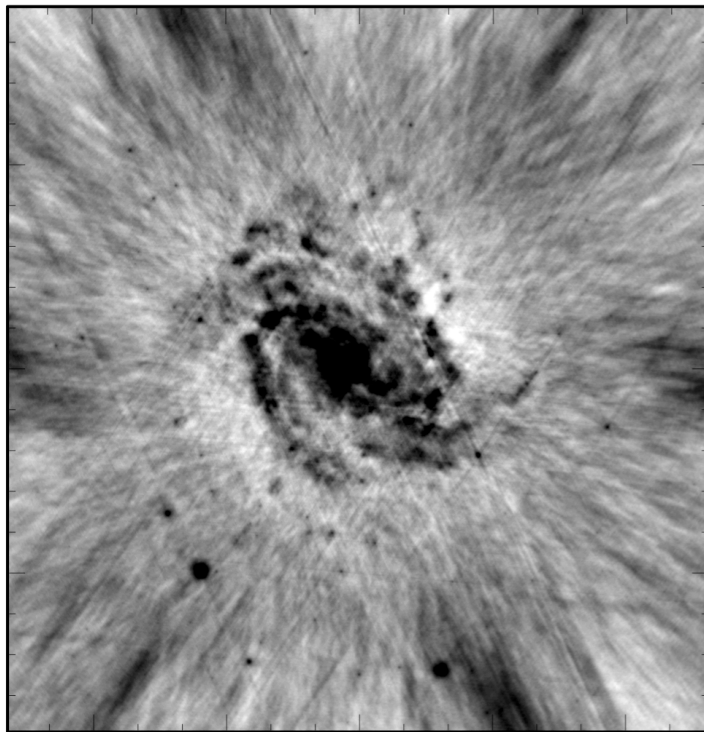
Transient sky

Cradle of life

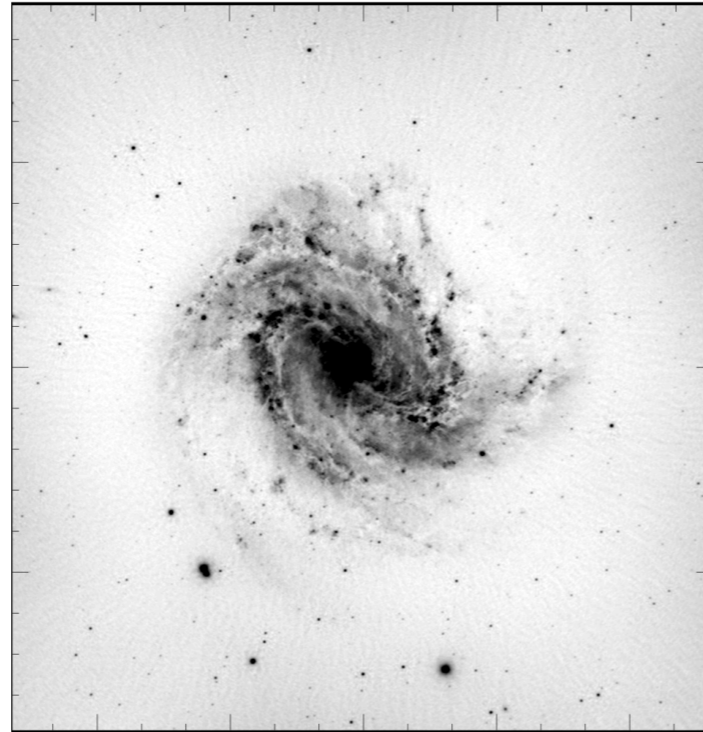


# Why with the SKA?

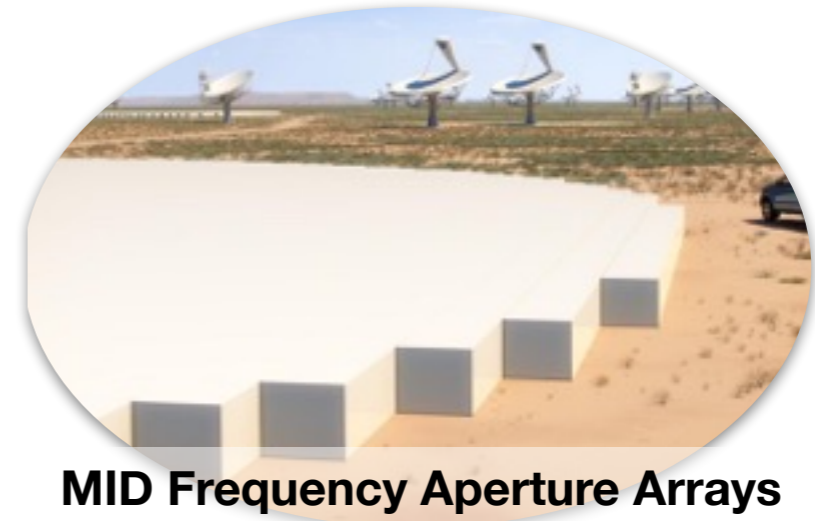
Today with JVLA



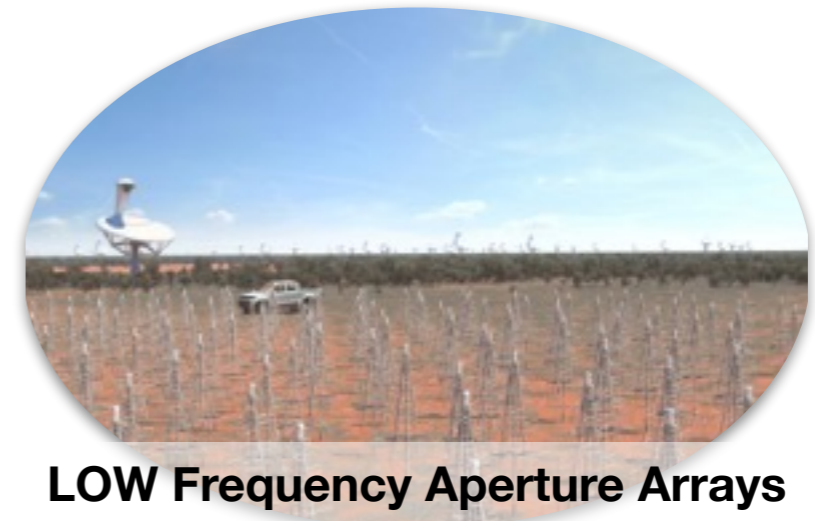
Tomorrow with SKA1



Dishes



MID Frequency Aperture Arrays



LOW Frequency Aperture Arrays

↑  
>15 GHz

50 MHz

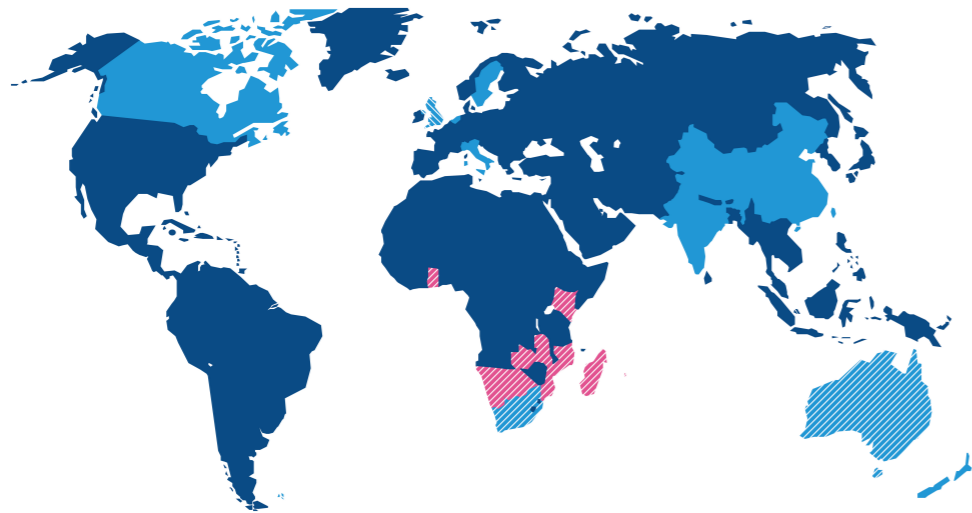
# Timeline of the SKA project

2012

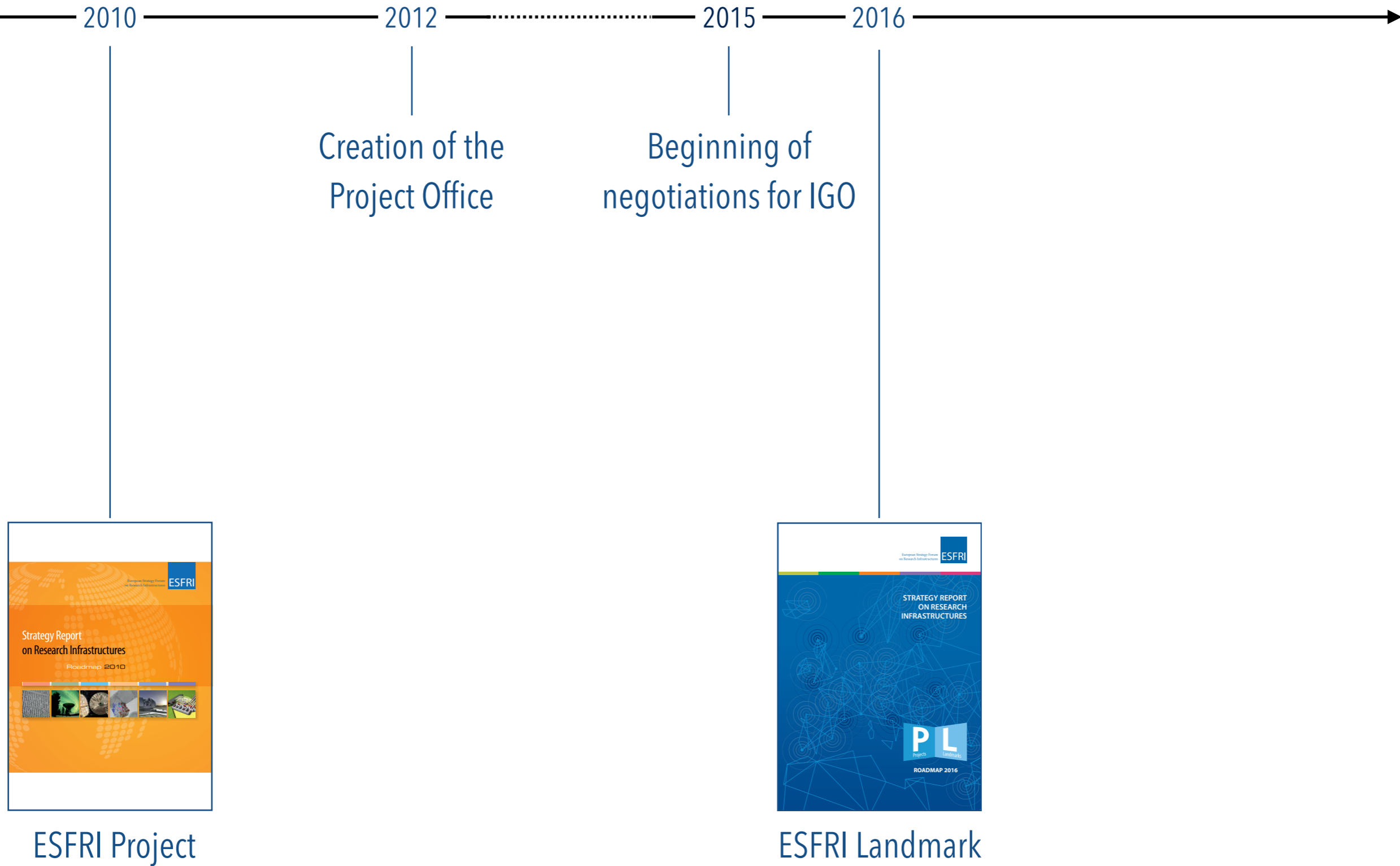
2015

Creation of the  
Project Office

Beginning of  
negotiations for IGO



# Timeline of the SKA project



# Timeline of the SKA project



## Technical consortia



## Science Book Published





# SKA Phase 1 (SKA1)



## SKA1-LOW (AUS)

130,000 log periodic antennas



## SKA1-MID (SA)

197 dishes (15m)

— 50 MHz ————— 350 MHz ————— 15 GHz —>



# SKA Phase 1 (SKA1)



## SKA1-LOW (AUS)

130,000 log periodic antennas



## SKA1-MID (SA)

197 dishes (15m)

— 50 MHz ————— 350 MHz ————— 15 GHz —>



# SKA Phase 1 (SKA1)



## SKA1-LOW (AUS)

130,000 log periodic antennas



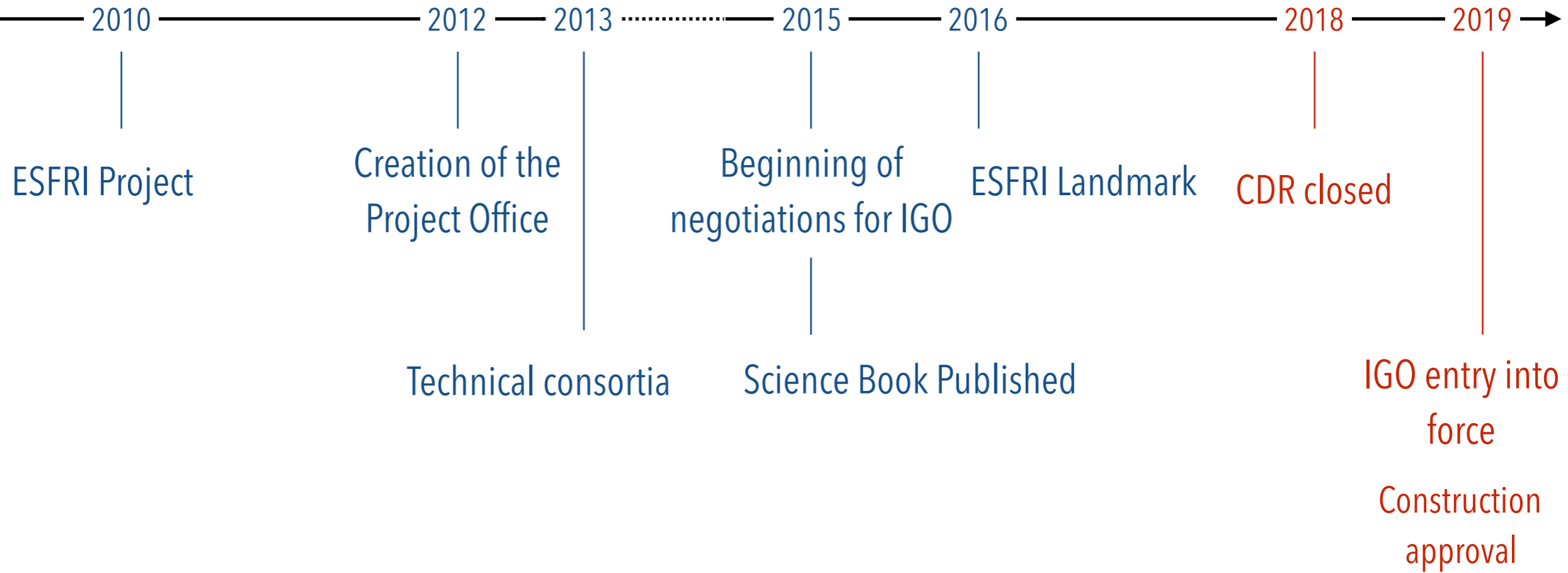
## SKA1-MID (SA)

197 dishes (15m)

— 50 MHz ————— 350 MHz ————— 15 GHz —>



# Timeline of the SKA project



# Timeline of the SKA project

2010

2012

2015

2016

2017

2018

2019



# Timeline of the SKA project

..... 2009 — 2010 — 2011 — 2012 — ..... 2015 — 2016 — 2017 — 2018 — 2019 →

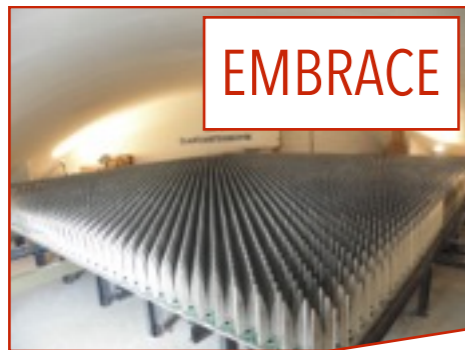
AS SKA-LOFAR



# Timeline of the SKA project

..... 2009 — 2010 — 2011 — 2012 — ..... 2015 — 2016 — 2017 — 2018 — 2019 →

AS SKA-LOFAR



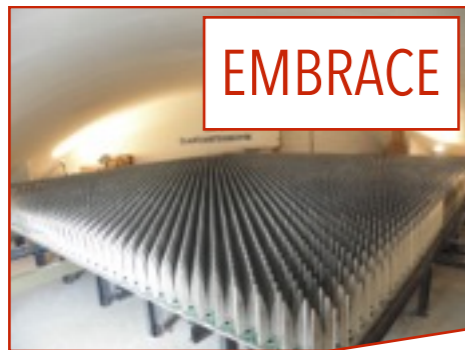
BUT: French withdrawal from the SKA



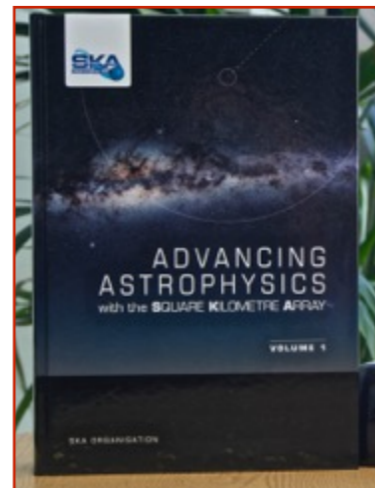
# Timeline of the SKA project

..... 2009 — 2010 — 2011 — 2012 — ..... 2015 — 2016 — 2017 — 2018 — 2019 →

AS SKA-LOFAR



BUT: French withdrawal from the SKA





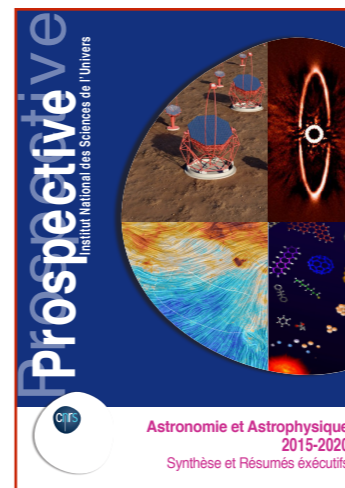
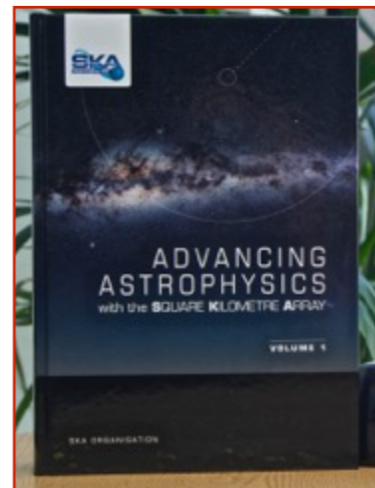
# Timeline of the SKA project

..... 2009 — 2010 — 2011 — 2012 — ..... 2015 — 2016 — 2017 — 2018 — 2019 →

AS SKA-LOFAR



BUT: French withdrawal from the SKA



PO for France joining SKAO



NenuFAR



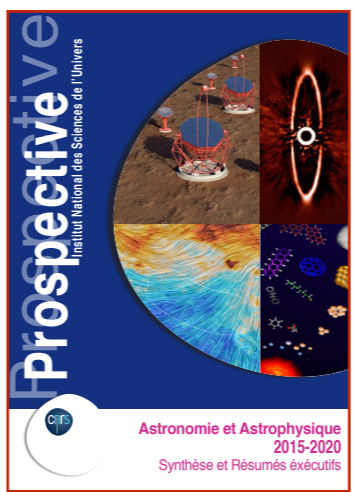
# Timeline of the SKA project

..... 2009 — 2010 — 2011 — 2012 — ..... 2015 — 2016 — 2017 — 2018 — 2019 —>

AS SKA-LOFAR



BUT: French withdrawal from the SKA

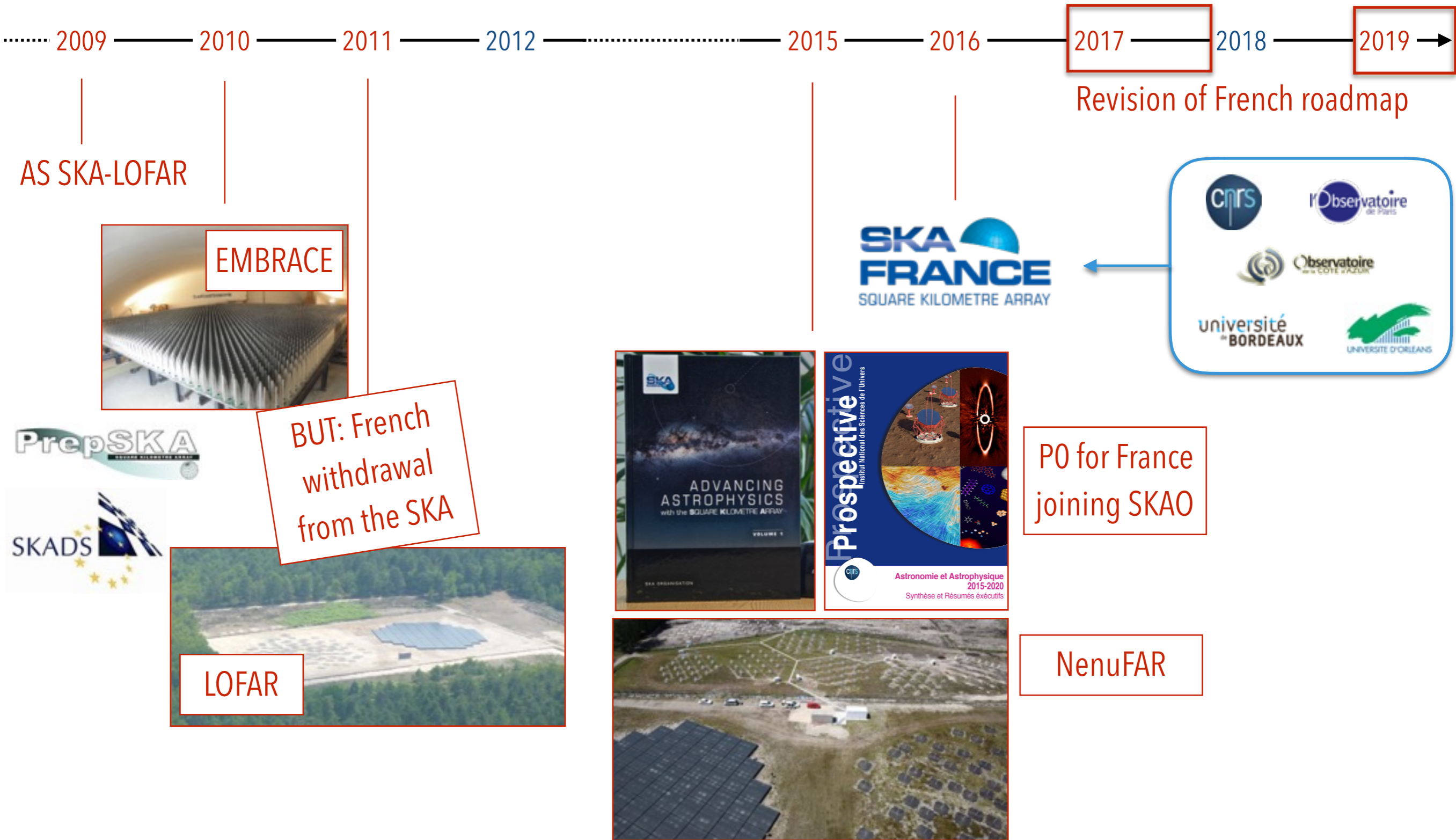


PO for France joining SKAO



NenuFAR

# Timeline of the SKA project



# The SKA France coordination



Workshops



Web page



Big events



Seminars

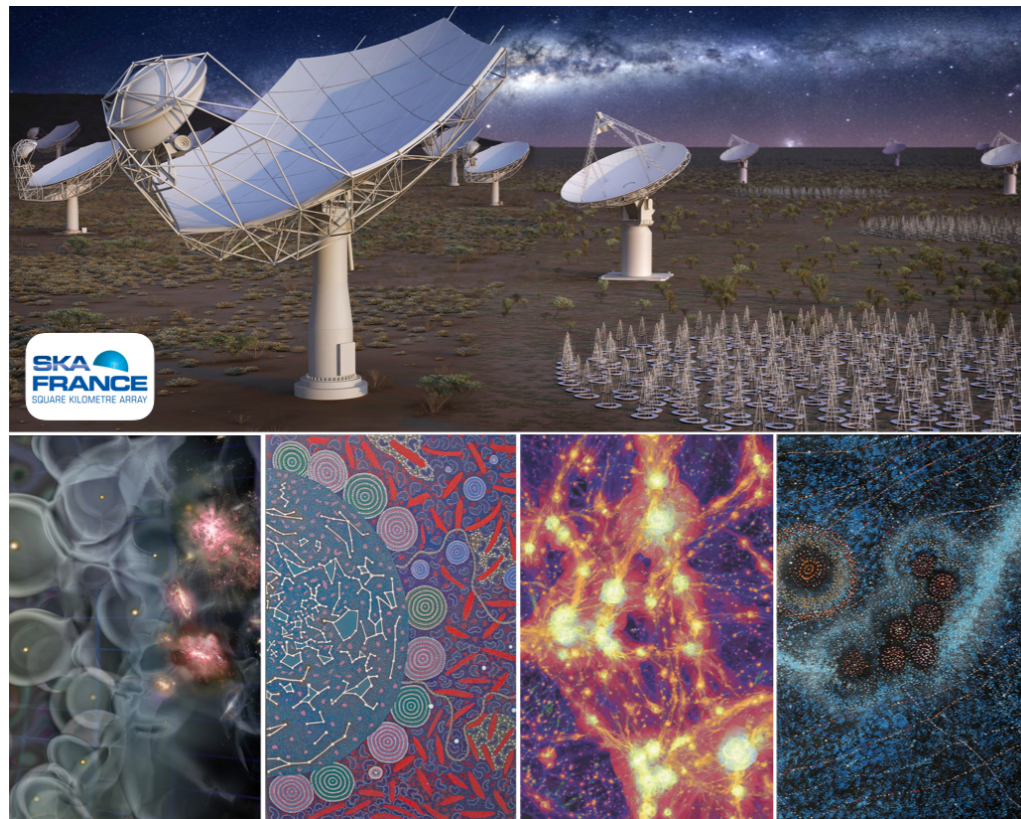
Monthly bulletins



# The French SKA White Book

## French SKA White Book

The French community towards the Square Kilometre Array



### Editor in Chief:

C. Ferrari

### Editors:

G. Lagache, J.-M. Martin, B. Semelin — [Cosmology and Extra-galactic astronomy](#)  
 M. Alves, K. Ferrière, M.-A. Miville-Deschenes, L. Montier — [Galactic Astronomy](#)  
 E. Josselin, N. Vilmer, P. Zarka — [Planets, Sun, Stars and Civilizations](#)  
 S. Corbel, S. Vergani — [Transient Universe](#)  
 S. Lambert, G. Theureau — [Fundamental Physics](#)  
 S. Bosse, A. Ferrari, S. Gauffre — [Technological Developments](#)  
 G. Marquette — [Industrial Perspectives and Solutions](#)

176 authors from

\* 40 French research institutes



\* 6 private companies



# A wider and wider community and strong interdisciplinary incentives



# A wider and wider community and strong interdisciplinary incentives



- The richest synergy chapter ever published about SKA vs. other projects, including:

- instruments covering the whole electromagnetic spectrum
- gravitational wave detectors

# A wider and wider community and strong interdisciplinary incentives



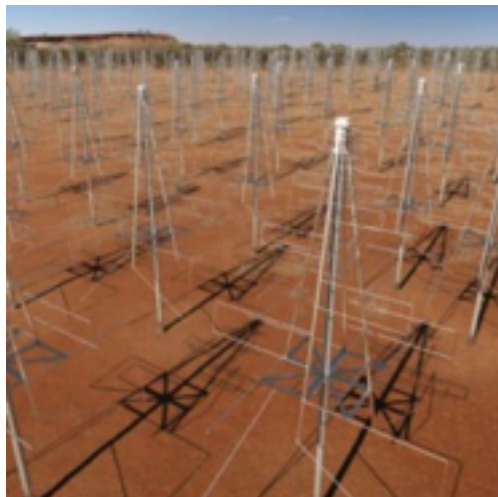
- The richest synergy chapter ever published about SKA vs. other projects, including:
  - instruments covering the whole electromagnetic spectrum
  - gravitational wave detectors
- A wide variety of technical challenges



# Building this fantastic machine



**SKA1-MID**

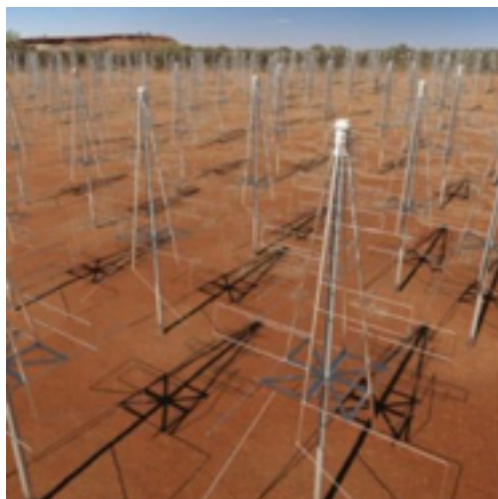


**SKA1-LOW**

# Building this fantastic machine

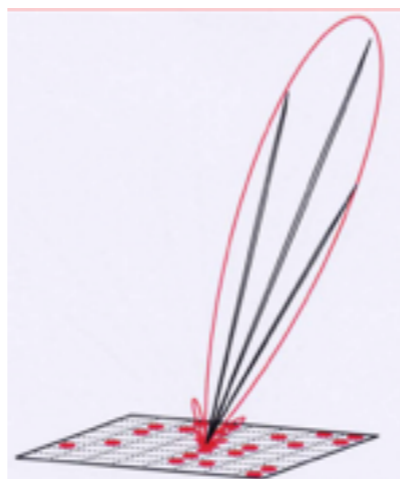


SKA1-MID



SKA1-LOW

~2 Pb/s



# Building this fantastic machine



SKA1-MID

8.8 Tb/s

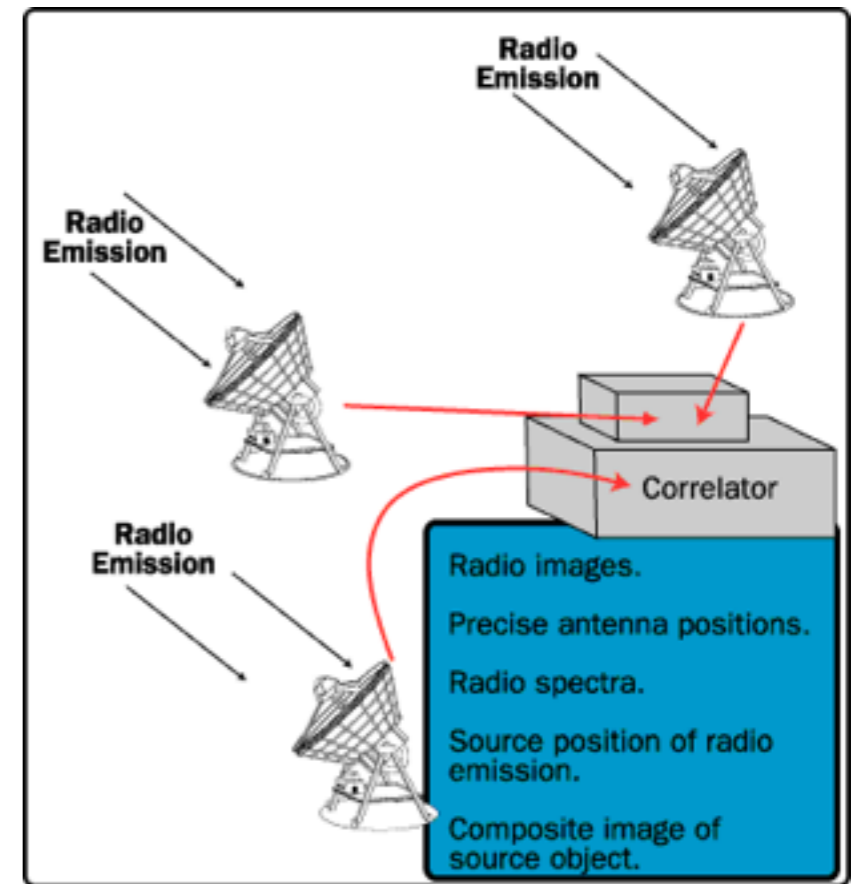
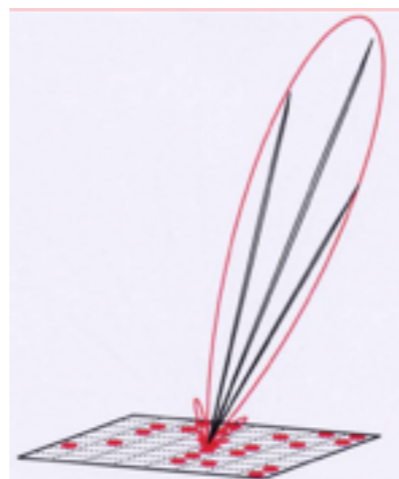


SKA1-LOW

~2 Pb/s



7.2 Tb/s



# Building this fantastic machine



SKA1-MID

8.8 Tb/s



5 Tb/s



SKA1-LOW

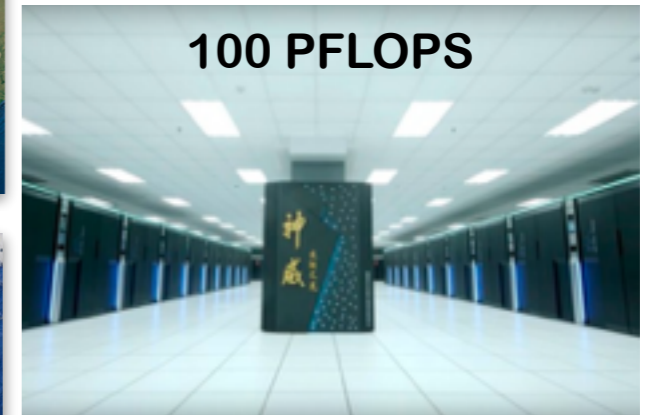
~2 Pb/s



7.2 Tb/s



100 PFLOPS



# Building this fantastic machine



SKA1-MID

8.8 Tb/s



5 Tb/s



SKA1-LOW

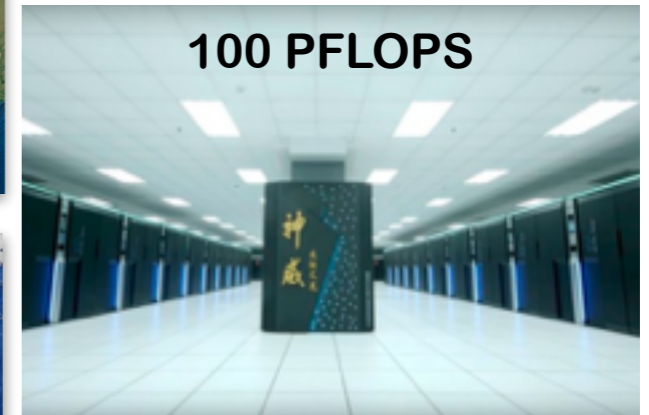
~2 Pb/s



7.2 Tb/s



100 PFLOPS



# Building this fantastic machine



SKA1-MID

8.8 Tb/s



7.2 Tb/s



50 PFLOPS

5 Tb/s

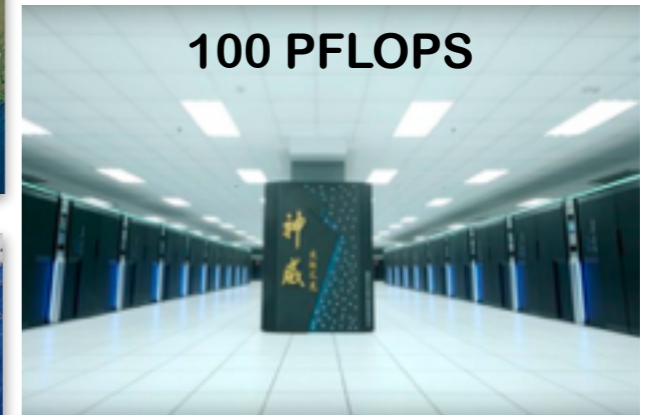


SKA1-LOW

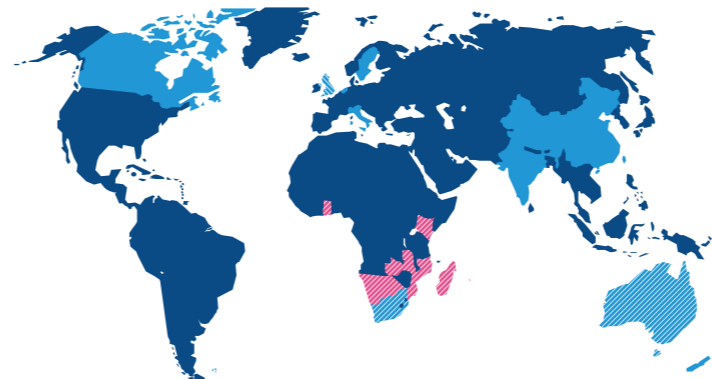
~2 Pb/s



100 PFLOPS

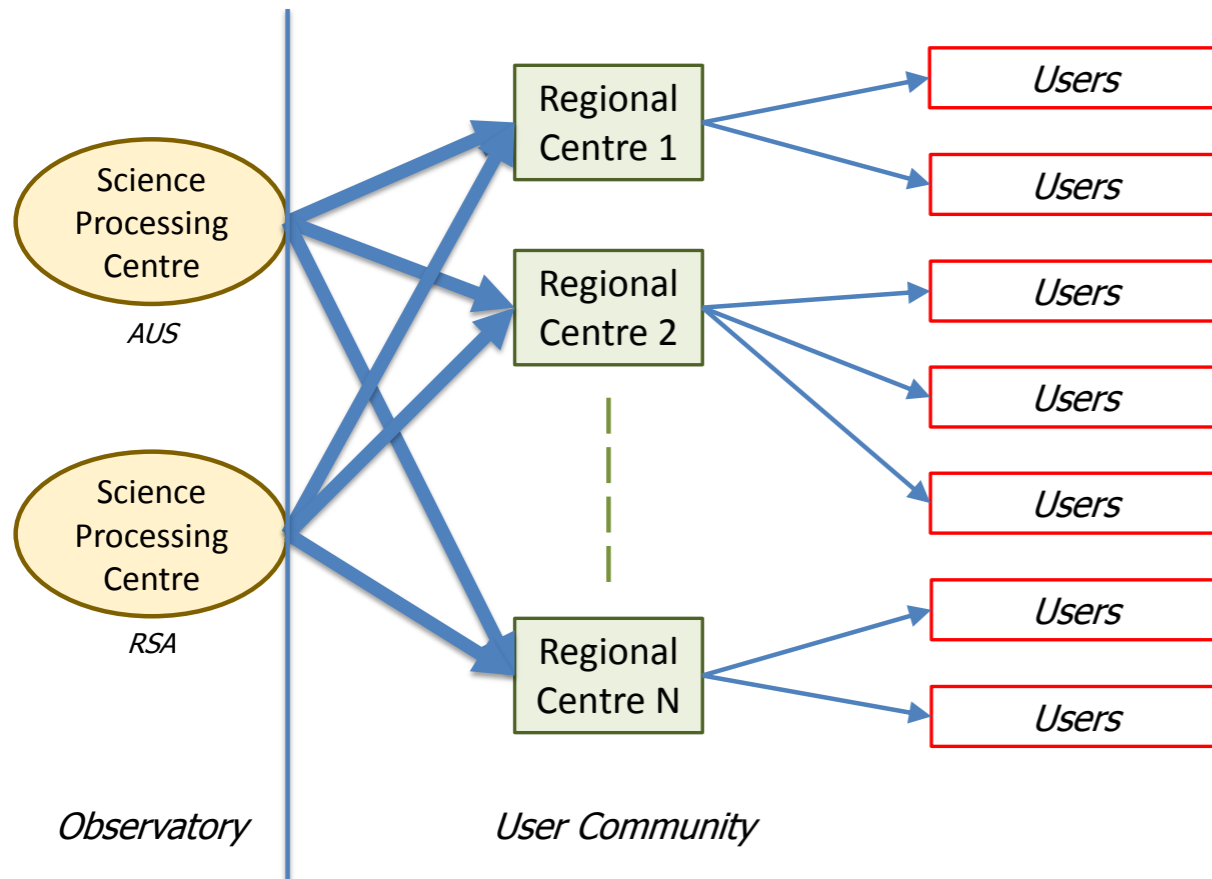


~300 PB/yr

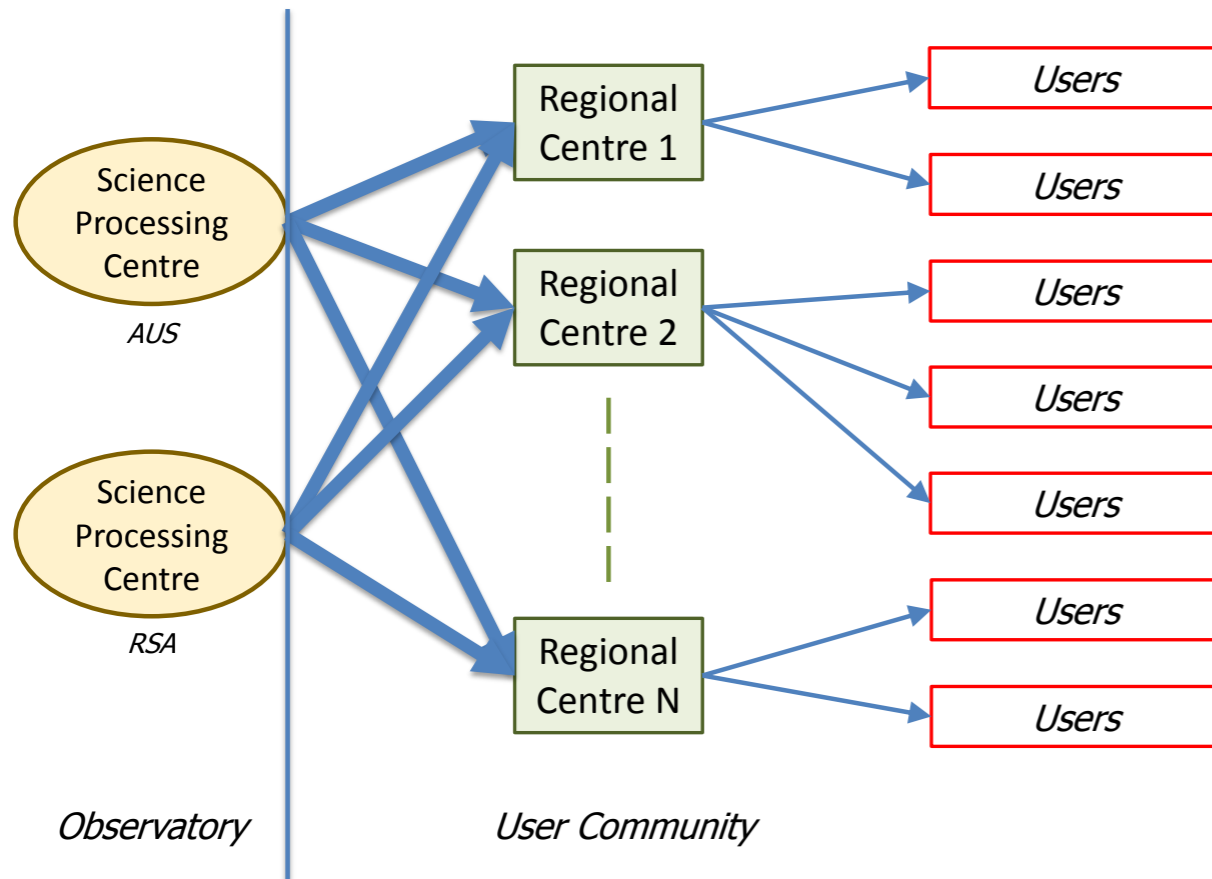


Users

# France within the organisation of the SKA European Regional Data Centre



# France within the organisation of the SKA European Regional Data Centre



- **J.-P. Vilotte (CNRS):** member of the External Advisory Board (with I. Bird @ CERN & M. Zwaan @ ESO)
- **C. Ferrari (OCA):** chair of the General Assembly





# Industrial perspectives and solutions



THALES

AIRBUS SAFRAN  
LAUNCHERS

IBM

FABRICANT DE CARTES  
ET PRODUITS  
ÉLECTRONIQUES PROFESSIONNELS

ENGIE NOKIA

Callisto

KALRAY

Alcatel-Lucent

ST life.augmented DDN STORAGE

Schneider Electric

AEG

EDF

TOTAL

SAFT

NVIDIA

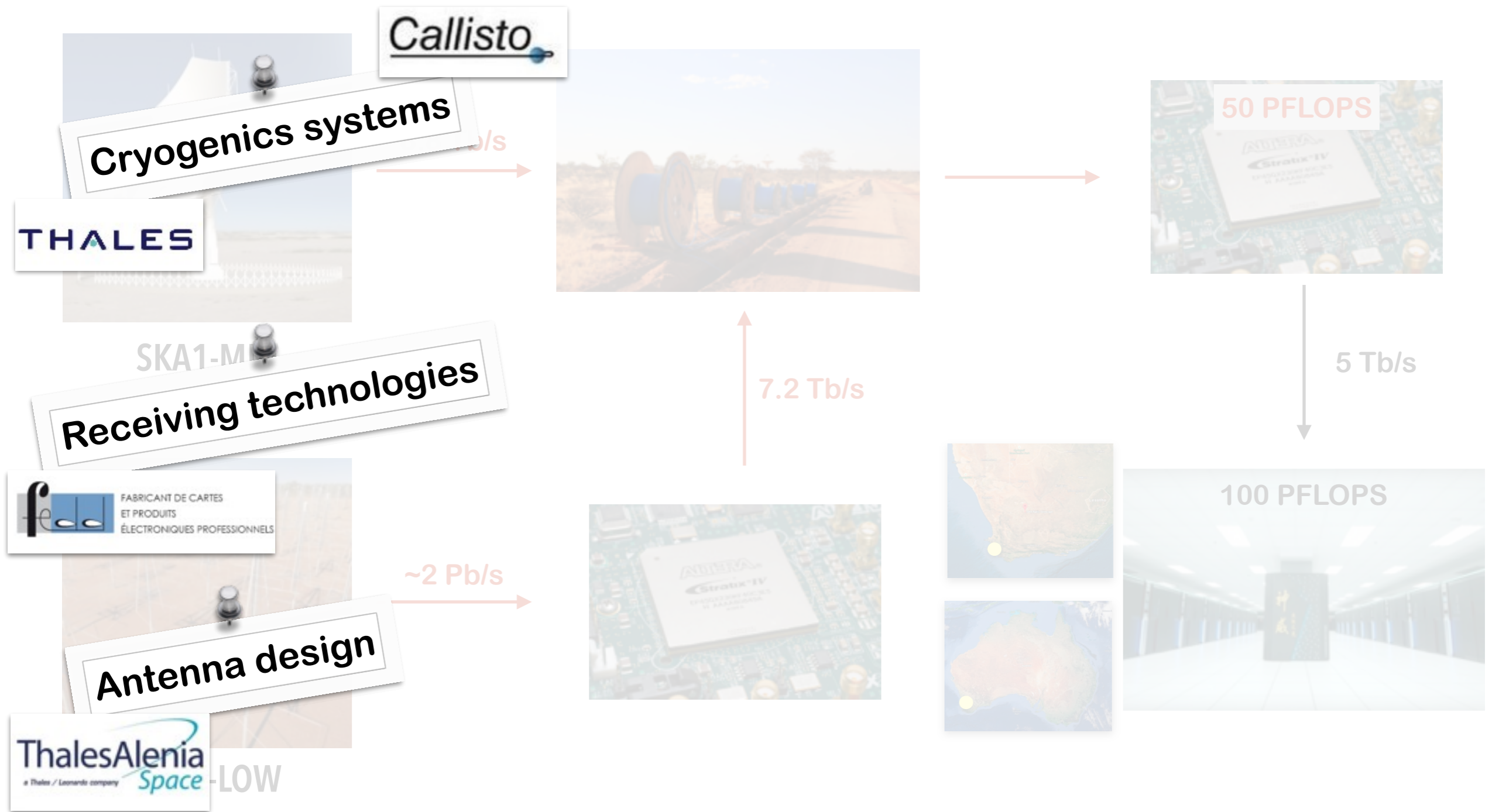
intel

Alcatel-Lucent

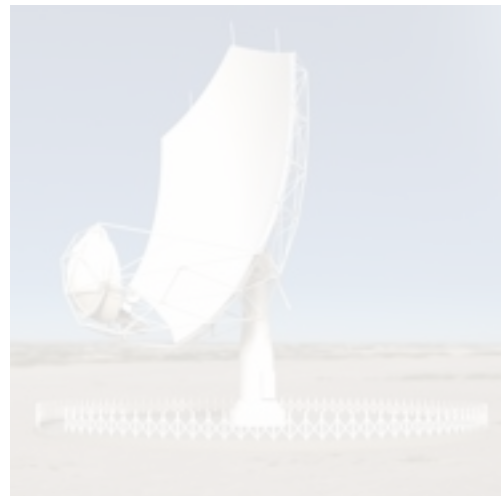
Air Liquide  
creative oxygen

Bull  
atos technologies

# Industrial perspectives and solutions



# Industrial perspectives and solutions



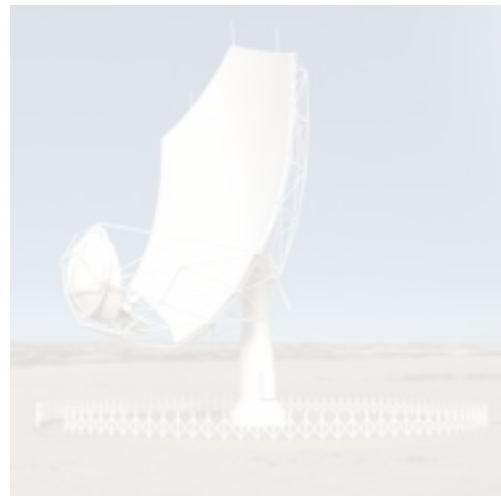
SKA1-MID



SKA1-LOW



# Industrial perspectives and solutions



SKA1-MID

8.8 Tb/s



Data science for monitoring



Hardware and application integration

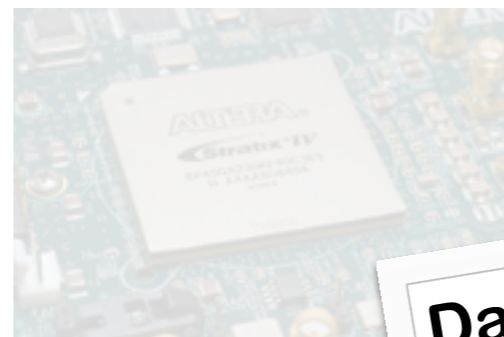


7.2 Tb/s



SKA1-LOW

~2 Pb/s



Data storage, distribution, preservation

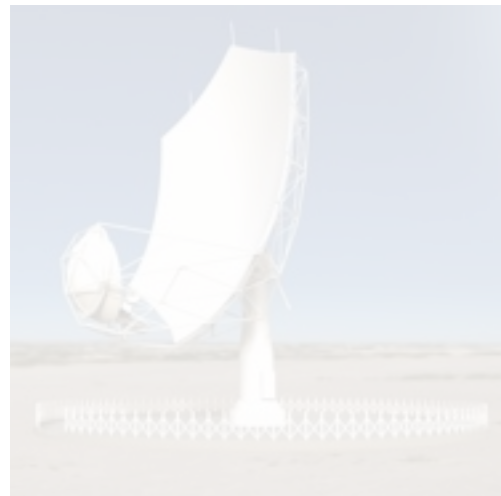
100 PFLOPS



# Industrial perspectives and solutions



System engineering



SKA1-MID

8.8 Tb/s

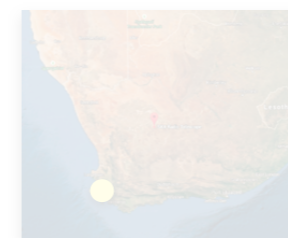


5 Tb/s

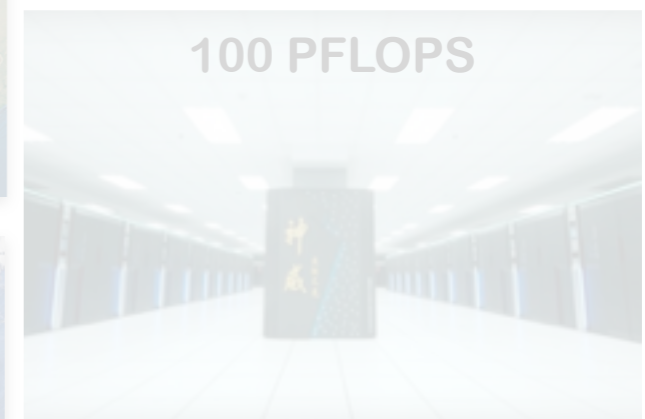


SKA1-LOW

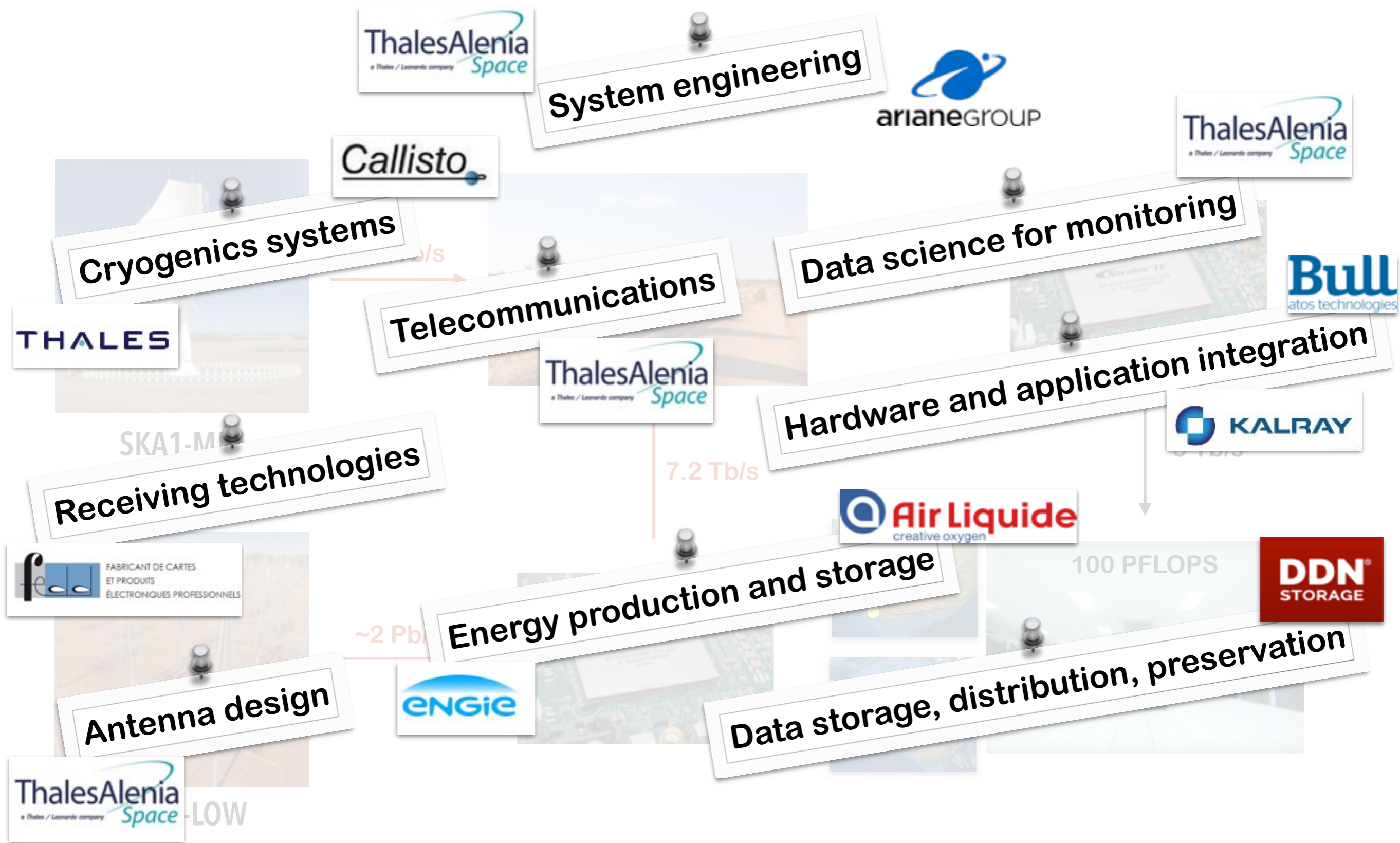
~2 Pb/s



100 PFLOPS



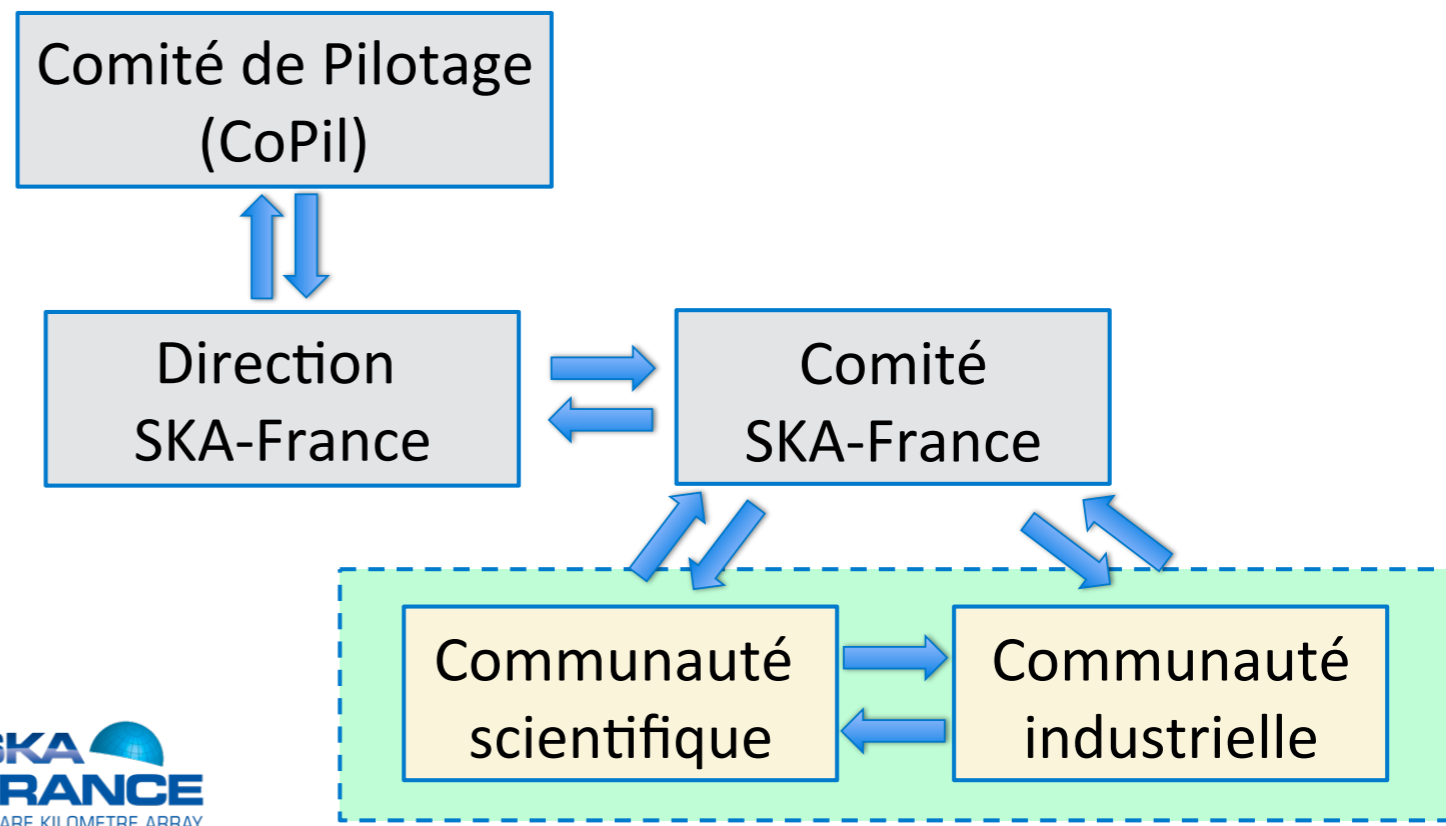
# Industrial perspectives and solutions



# Maison SKA France



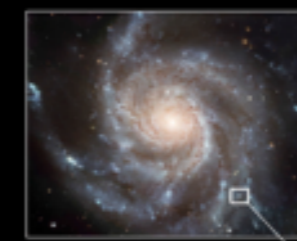
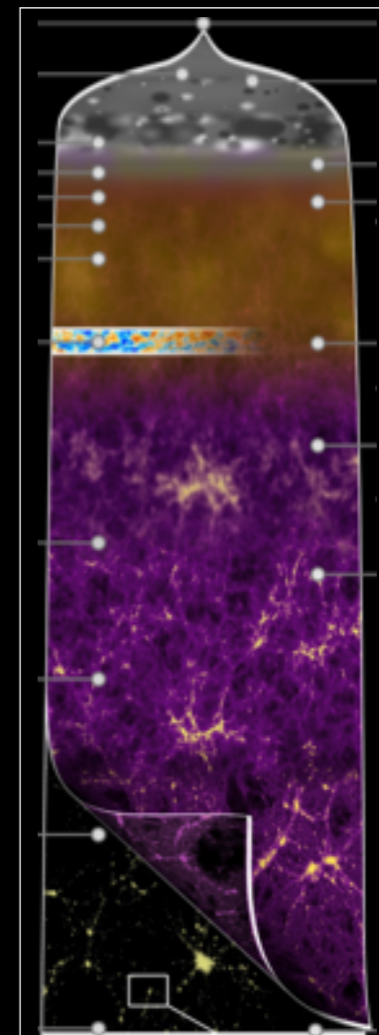
- A MoU, strong real equilibrated PPP, between research organisations and their industry partners
- A science and technology roadmap
- A forum to develop fundamental research and R&D projects
- A precursor of a new business model for Large Research Infrastructures



# Conclusions

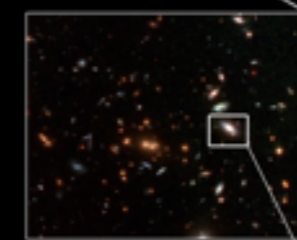
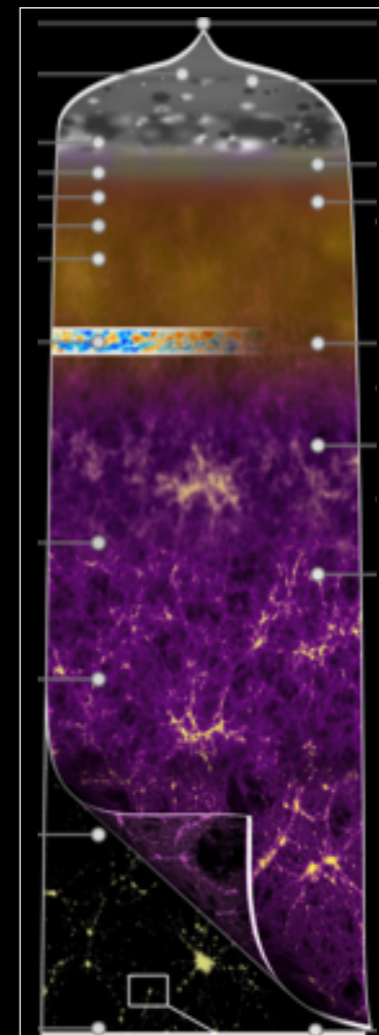
- The SKA will push the whole community to major breakthroughs in a wide variety of scientific and technological fields
- The French astronomical community has intensified its efforts in preparing a national contribution to the SKA project
  - About 180 authors from 40 research institutes and 6 private companies involved in the French SKA White Book
- Multi-usage, transversal domain dimension of the SKA
  - A conservative estimate of at least 400 future users of SKA1 in France
  - Ongoing discussions with public research institutes & infrastructures
  - More potential partners identified within private companies and research institutes
  - A scientific project with a big expected impact on society
- Evolution towards a new structure : « Maison SKA France »
  - Create an instrument in response to the necessity of an innovative financial approach
  - Enable France to participate to major scientific breakthroughs over the next 50 years





THANKS!

**SKA**   
**FRANCE**  
SQUARE KILOMETRE ARRAY



THANKS!

**SKA**  
**FRANCE**  
SQUARE KILOMETRE ARRAY