Towards the construction of the SKA Observatory

Dr. Chiara Ferrari
(SKA-France Director, Chair of European SKA Forum, OCA)

SKA at a glance

- A global collaboration to design, build and operate the next generation radio astronomy observatory
- A new Inter-Governmental Organisation for astronomy and fundamental physics with 50+ year lifetime
- It will consist of:
  - An array of ~200 dishes in ZA
  - An array of ~131000 antennas in AU
  - A global HQ in UK
  - Two data computing centres in ZA & AU + A world-wide network of SKA regional centres (SRC)
- SKA is now:
  - February 3-4, 2021: First SKA Observatory Council
  - Q2/2021: construction activity begins

Courtesy: SKAO, H2020 AENEAS

SKA at a glance

- A global collaboration to design, build and operate the next generation radio astronomy observatory
- A new Inter-Governmental Organisation for astronomy and fundamental physics with 50+ year lifetime
- It will consist of:
  - An array of ~200 dishes in ZA
  - An array of ~131000 antennas in AU
  - A global HQ in UK
  - Two data computing centres in ZA & AU + A world-wide network of SKA regional centres (SRC)
- SKA is now:
  - February 3-4, 2021: First SKA Observatory Council
  - Q2/2021: construction activity begins

Courtesy: SKAO, H2020 AENEAS

SKA at a glance

- A global collaboration to design, build and operate the next generation radio astronomy observatory
- A new Inter-Governmental Organisation for astronomy and fundamental physics with 50+ year lifetime
- It will consist of:
  - An array of ~200 dishes in ZA
  - An array of ~131000 antennas in AU
  - A global HQ in UK
  - Two data computing centres in ZA & AU + A world-wide network of SKA regional centres (SRC)
- SKA is now:
  - February 3-4, 2021: First SKA Observatory Council
  - Q2/2021: construction activity begins

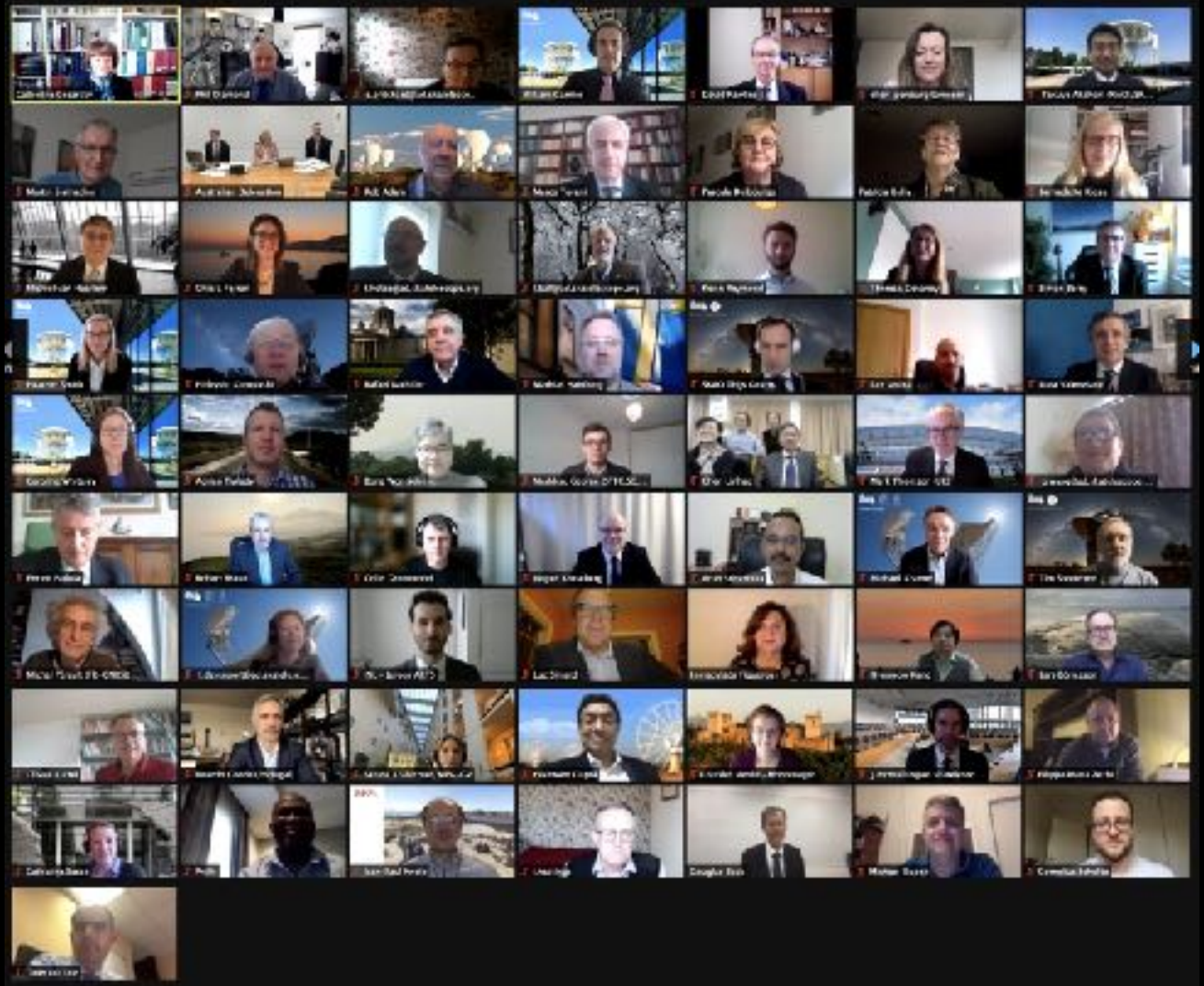
"This is the culmination of many years of work by hundreds of people, whose talents and dedication are the driving force behind the SKA. That collective effort, guided with skill and efficiency by the safe hands of the SKA Office, has brought us to this point."

Dr Catherine Cesarsky
Chair of the SKA Board of Directors

Courtesy: SKAO, H2020 AENEAS

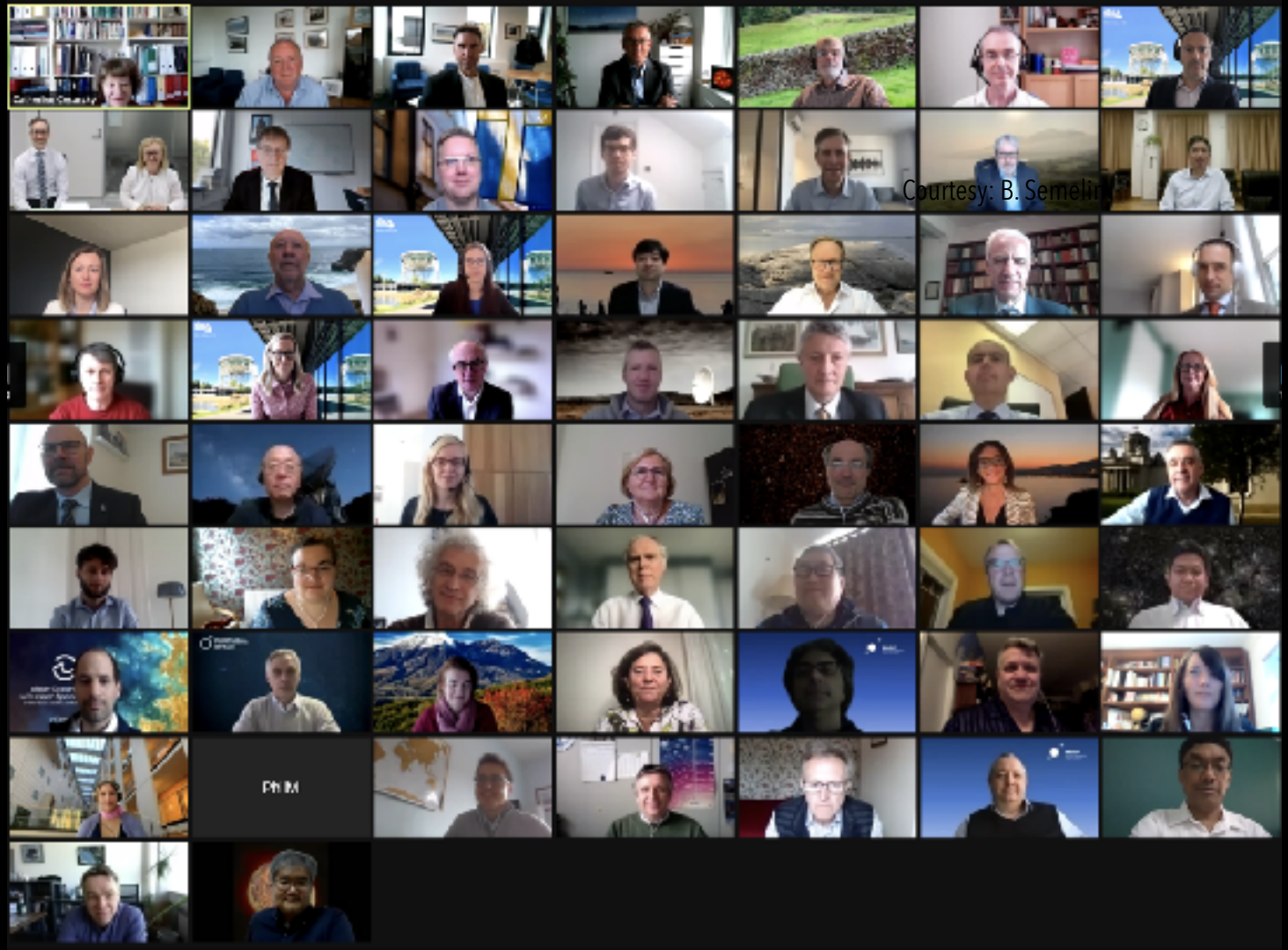
First SKAO Council

(Feb. 3-4, 2021)



Second SKAO Council

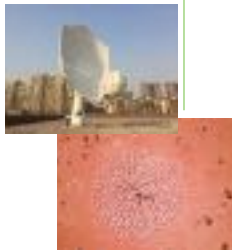
(Apr. 27-28, 2021)

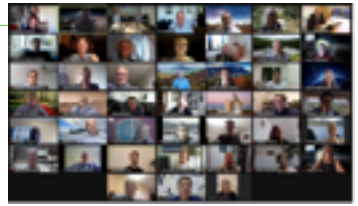


Development of the SKA project

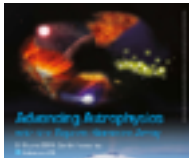
2012 — 2016 — 2019 — 2020 — 2021

2013 — 2018 — 2019 — 2020 — 2021 — 2029





2014 — 2015



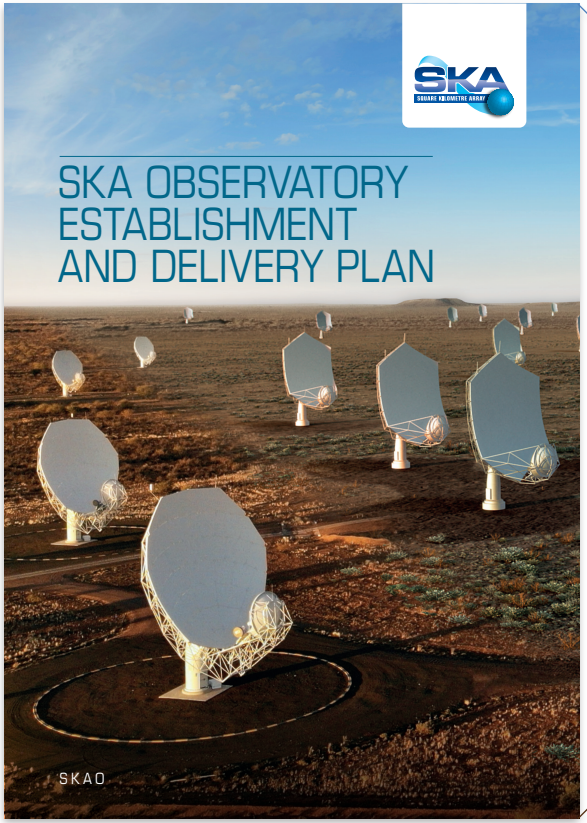
SKA Phase 1

SKA1-LOW (AUS)
130,000 log periodic antennas

SKA1-MID (SA)
197 dishes (15m)

50 MHz ——— 350 MHz ——— 15 GHz →

Three SKA key documents



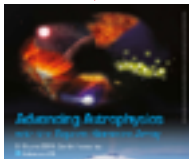
https://www.skatelescope.org/news/skao-publishes-construction-proposal/

Development of the SKA project

2012

2013

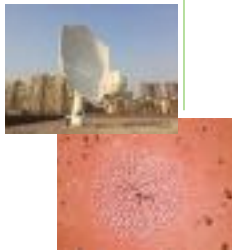
2014



2015

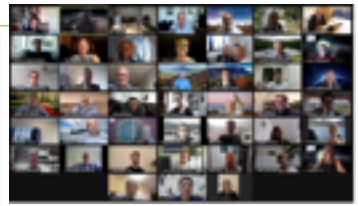
2016

2018



2019

2020

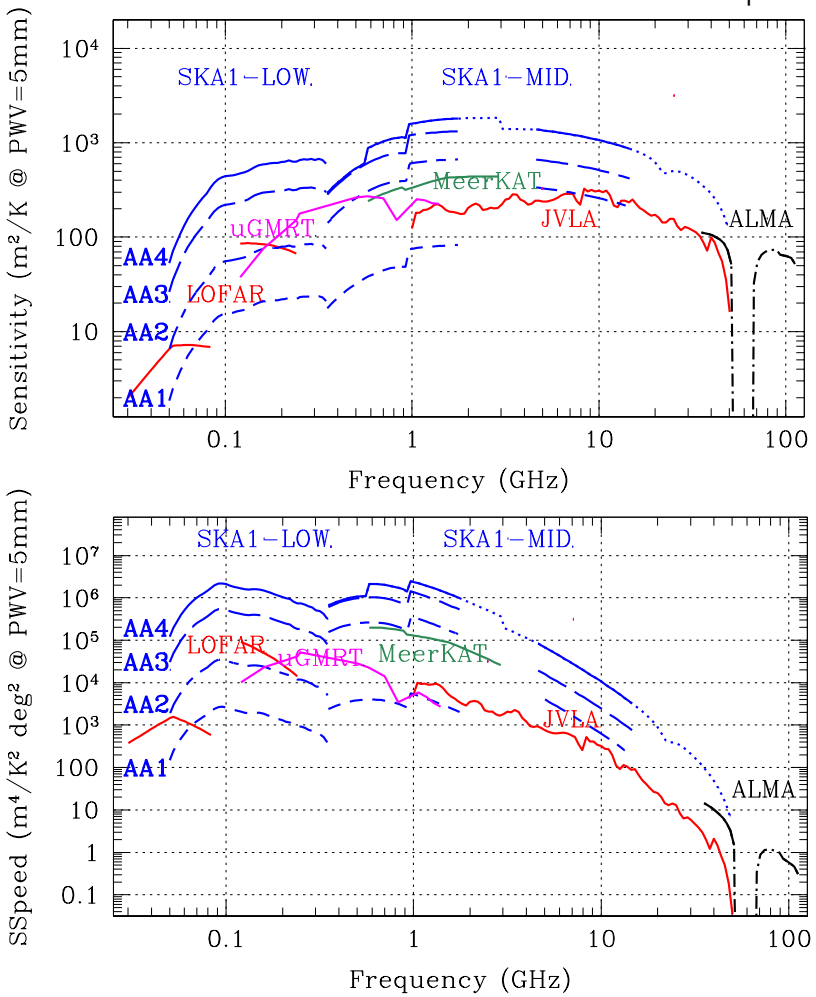


2021

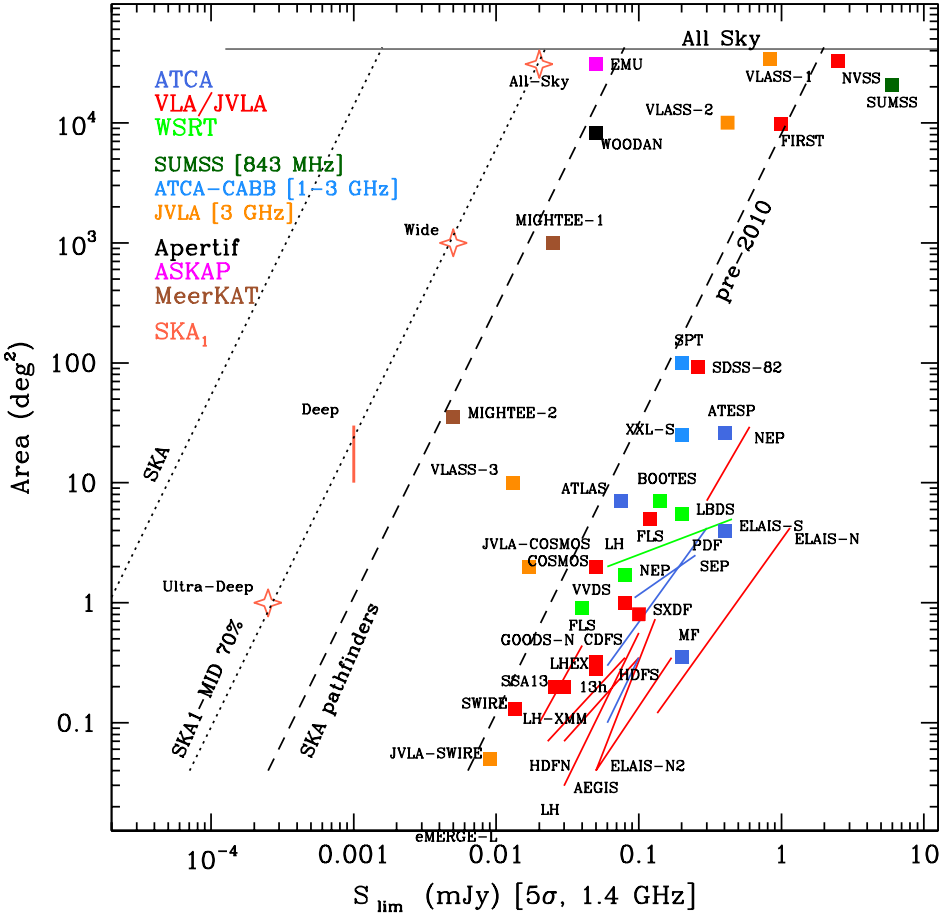
2029

	SKA-Low	SKA-Mid
Start of construction (T0)	1st July 2021	1st July 2021
Earliest start of major contracts (C0)	August 2021	August 2021
Array Assembly 0.5 finish (AA0.5) SKA-Low = 6-station array SKA-Mid = 4 stations	February 2024	March 2024
Array Assembly 1 finish (AA1) SKA-Low = 18-station array SKA-Mid = 8 stations	February 2025	February 2025
Array Assembly 2 finish (AA2) SKA-Low = 64 stations SKA-Mid = 64 stations, baselines mostly <20km	February 2026	December 2025
Array Assembly 3 finish (AA3) SKA-Low = 256-station array, including long baselines SKA-Mid = 128-station array, including long baselines	January 2027	September 2026
Array Assembly 4 finish (AA4) SKA-Low = full Low array SKA-Mid = full Mid array, including MeerKAT dishes	November 2027	June 2027
Operational Readiness Review (ORR)	January 2028	December 2027
End of construction	July 2029	July 2029

SKA Phase 1 Construction Proposal



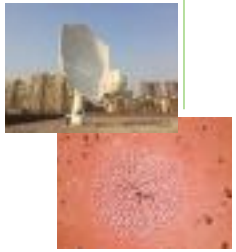
Prandoni & Seymour 2015

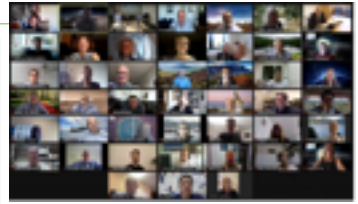


Development of the SKA project

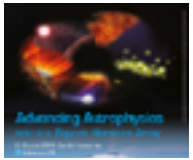
2012 — 2016 — 2019 — 2020 — 2021

2013 — 2018 — 2019 — 2020 — 2021 — 2029





2014 — 2015 — 2020 — 2024 — 2025 — 2026 — 2028



Science Commissioning

Data Challenges

Early Science | Shared Risk | PI Proposals

KSP Workshops | KSP Proposals

Major Science Meetings

A Golden Age for Radio Astronomy

Some of the SKA Pathfinders

NenuFAR

France

10-85 MHz

LOFAR

Europe

30-80 MHz + 110-240 MHz

CHIME

Canada

400-800 MHz

APERTIF

The Netherlands

1 – 1.750 GHz

JVLA

US

1- 50 GHz

SKA Precursors

MWA

Australia

80 - 300 MHz

ASKAP

Australia

700 - 1800 MHz

HERA

South Africa

50 - 250 MHz

MeerKAT

South Africa

0.580 – 14 GHz

SKA

SKA1-LOW

Australia

50 MHz - 350 MHz

SKA1-MID

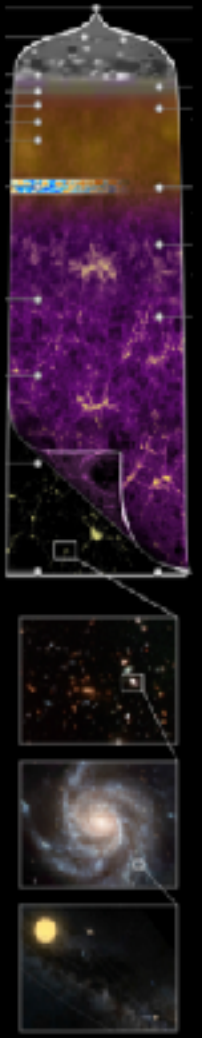
South Africa

350 MHz – 15.4 GHz

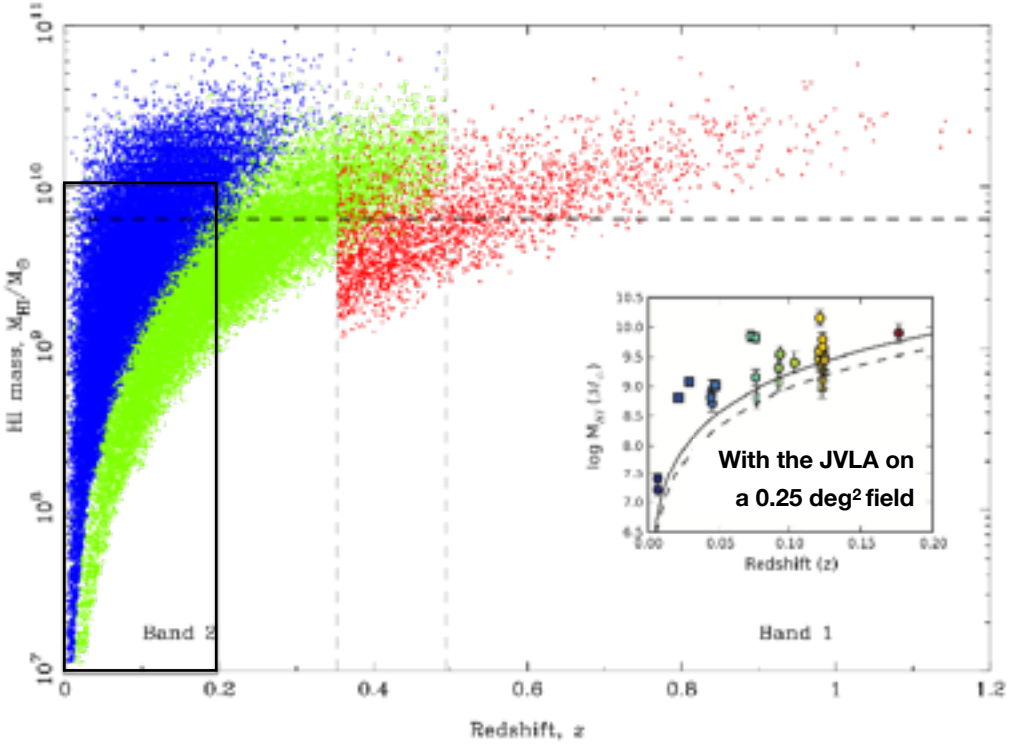
Exploring the cosmos with the SKA

Braun et al. 2015

- Cosmic dawn & Epoch of Reionisation
- Cosmology
- Galaxy evolution
- Cosmic magnetism
- Fundamental physics
- Transient sky
- Cradle of life
- Solar, Heliospheric and Ionospheric Physics



Galaxy evolution

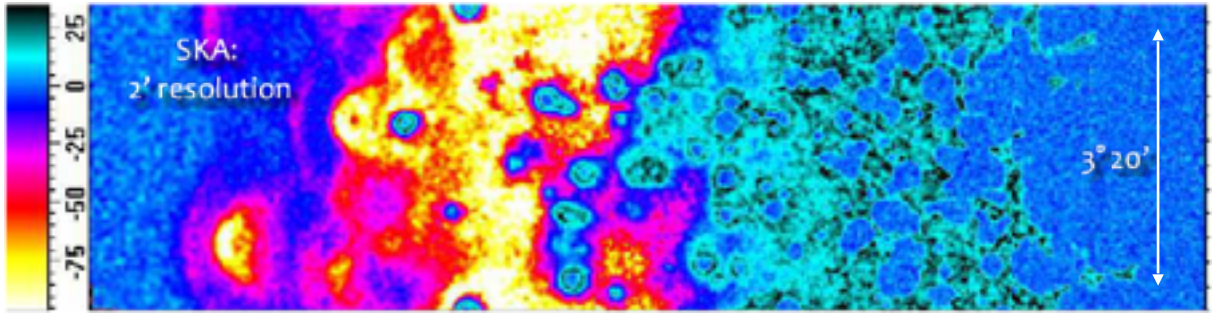


Survey	Ω deg²	Frequency[1] MHz	Resolution[2]	N	<z> (z_{max})	N_{HI} 10^{20} cm^{-2}
Galaxy/MS (absorption)	400	1418-1422	5″	4,000		
Extragalactic (absorption)	1000 1000	350-1050 200-350[3]	2″ 10″	5,000 ?	1(3) 4(6)	
Galaxy/MS	600	1418-1422	10″-1′			2
Medium wide	400	950-1420	10″	34,000	0.1 (0.3)	2
Medium deep	20	950-1420	5″	25,000	0.2 (0.5)	0.6
Deep	1	600-1050	2″	2,600	0.5 (1)	0.4
Targeted	–	1400-1420	7″-1′	50	0.002 (0.01)	0.5

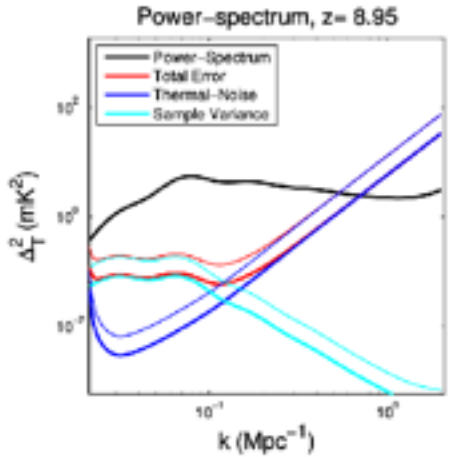
Staveley-Smith & Oosterloo 2015

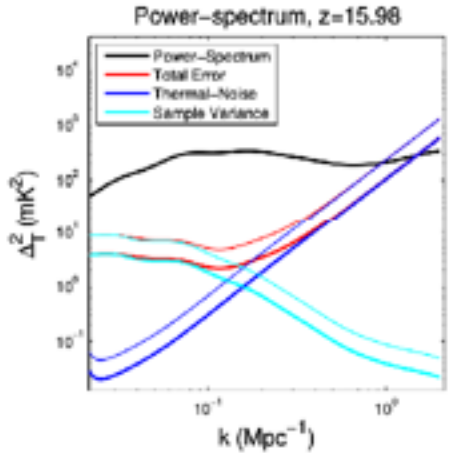
With SKA1
400 deg²
20 deg²
1 deg²

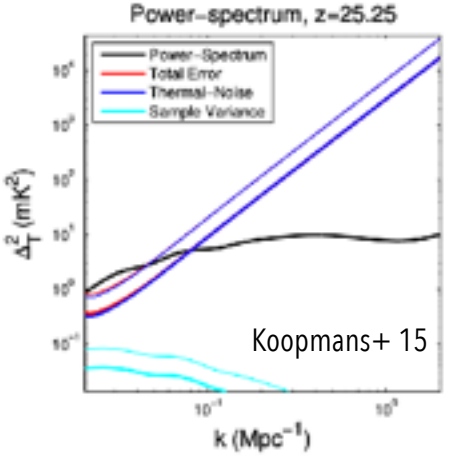
Epoch of Reionisation and Cosmic Dawn



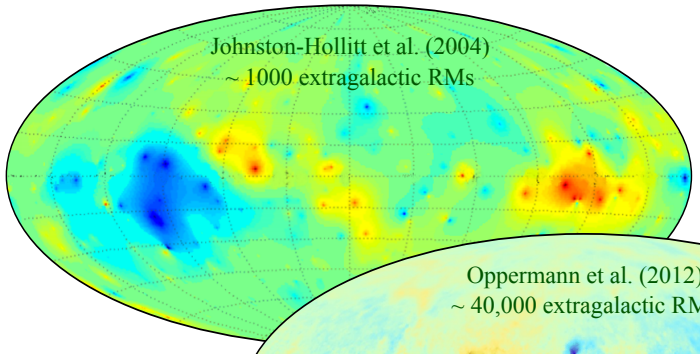
Courtesy: B. Semelin

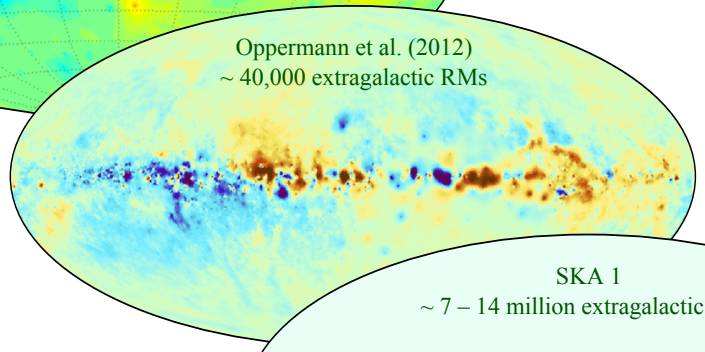


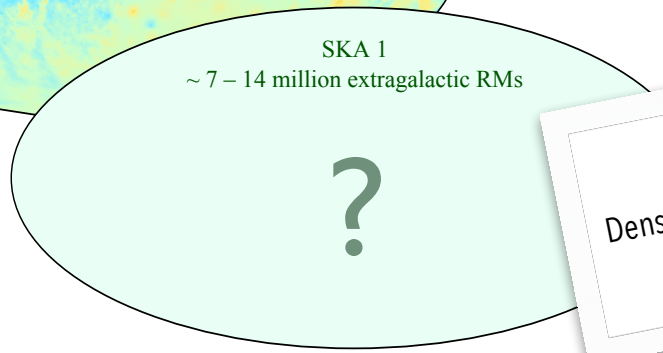




Cosmic magnetism







SKA1

Density of background sources for Faraday Rotation Measures:

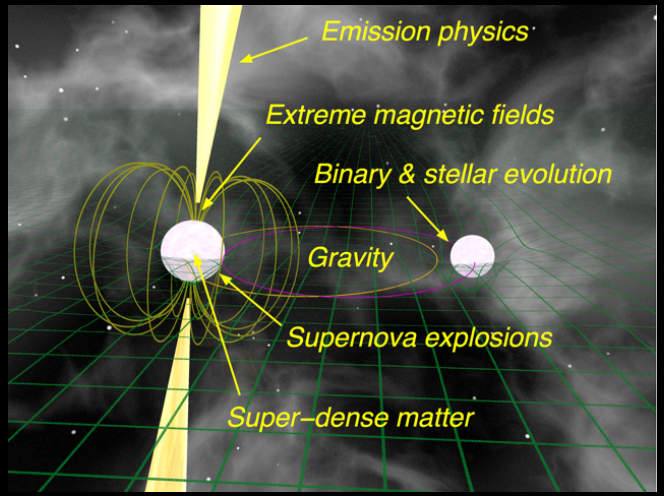
~300x higher!

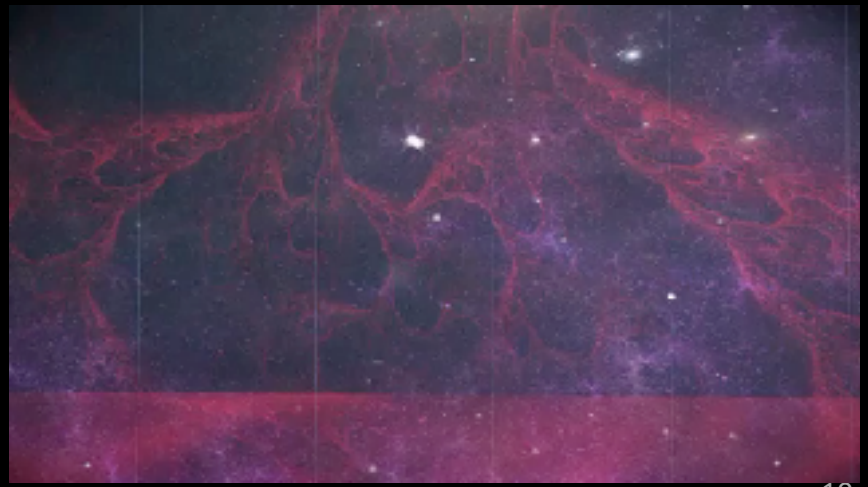
Pulsars

- Strongly self-gravitating compact bodies
- Very stable clocks

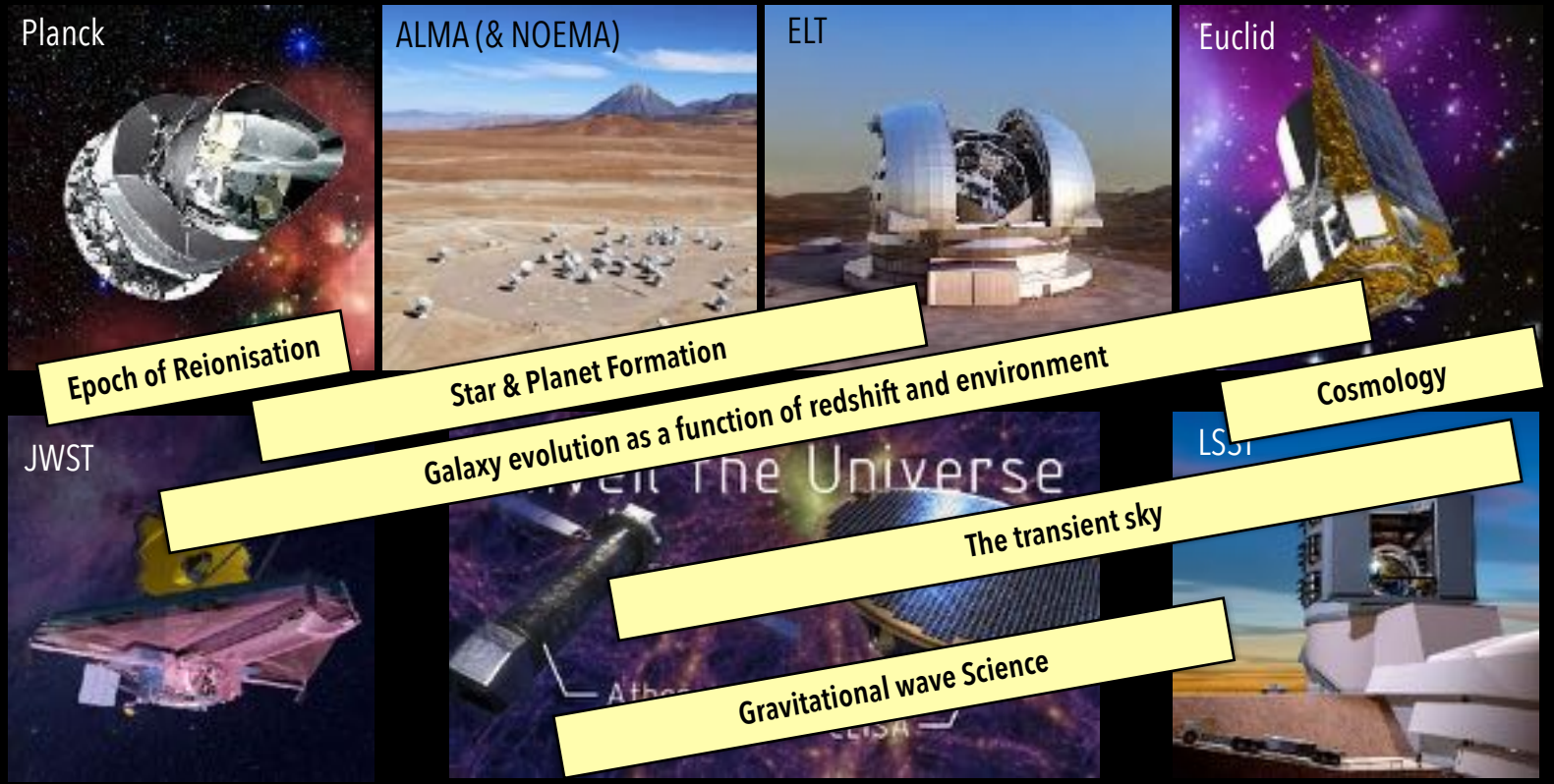
Test of gravitation theories

Astrophysics





Synergies


Planck
ALMA (& NOEMA)
ELT
Euclid
JWST
LSST
Epoch of Reionisation
Star & Planet Formation
Galaxy evolution as a function of redshift and environment
Cosmology
The transient sky
Gravitational wave Science

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

arXiv:1712.06950

178 co-authors from

- 40 research institutes
- 6 private companies

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

- instruments covering the whole electromagnetic spectrum
- gravitational wave detectors

SKA-France milestones

October 16, 2017

First SKA-France Day

July 1st, 2016

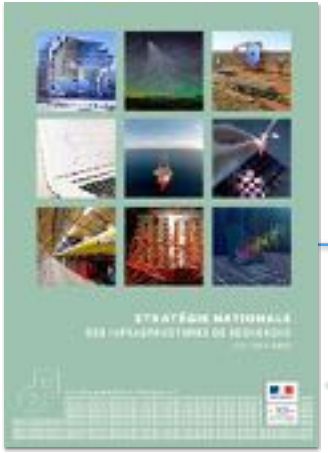
SKA-France Coordination

SKA-France milestones

February 1st, 2018

Kick-off meeting of
Maison SKA-France

SKA-France milestones



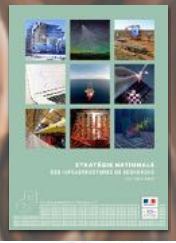
Mai 17, 2018

MESRI publishes the French Large Research Infrastructure Roadmap

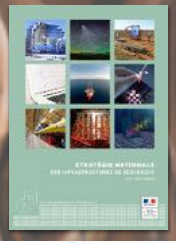
SKA-France milestones

July 12, 2018

CNRS approved as new member of SKAO by the SKA Board of Directors



SKA-France milestones



November 15, 2019

Two new academic partners of Maison SKA-France

The French Ministry of Higher Education, Research and Innovation has announced that France is now engaged in the process of applying for membership in SKA Observatory

MINISTÈRE
DE L'ENSEIGNEMENT
SUPÉRIEUR,
DE LA RECHERCHE
ET DE L'INNOVATION

MINISTÈRE | STRATÉGIE | ENSEIGNEMENT SUPÉRIEUR | RECHERCHE | INNOVATION | EUROPE ET INTERNATIONAL | RESSOURCES HUMAINES

Accueil > Recherche > Domaines de la recherche > Environnement planète, univers

ENVIRONNEMENT, PLANÈTE, UNIVERS

La France exprime le souhait de devenir membre de SKA Observatory (SKAO)

infrastructure de recherche

A l'occasion de la première réunion du Conseil de SKA Observatory (SKAO) qui s'est déroulée les 3 et 4 février 2021, la France a exprimé le souhait de devenir membre de cette organisation intergouvernementale qui assurera la construction puis l'exploitation de ce qui sera le plus grand instrument de radioastronomie jamais réalisé.

ACTUALITÉ

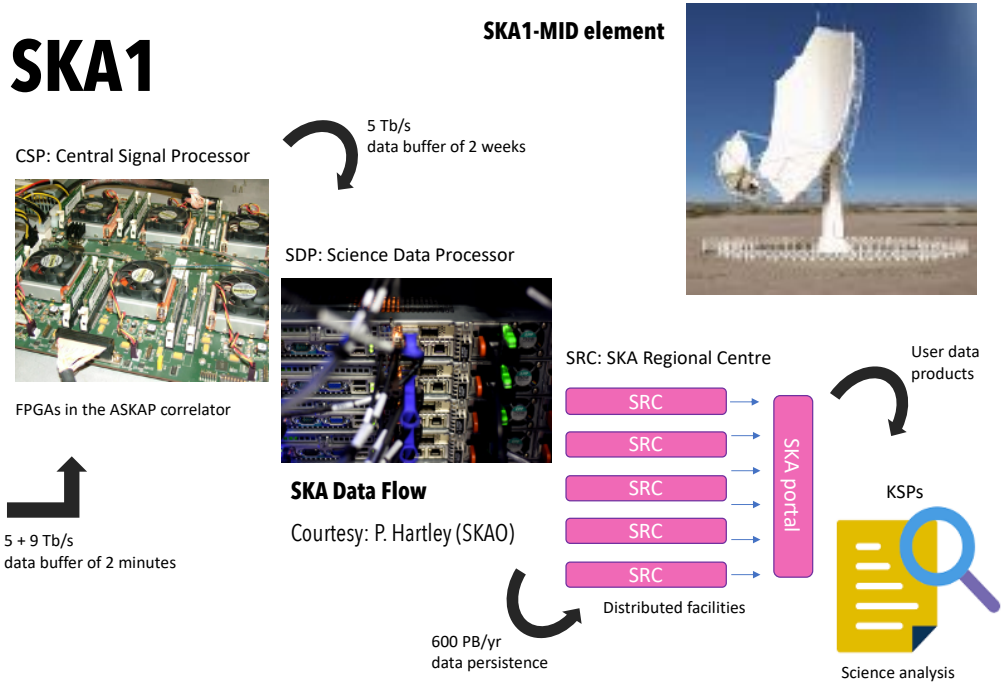
› Infrastructures de recherche : tous les événements

CONTACT PRESSE

Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation
06 65 65 84 34

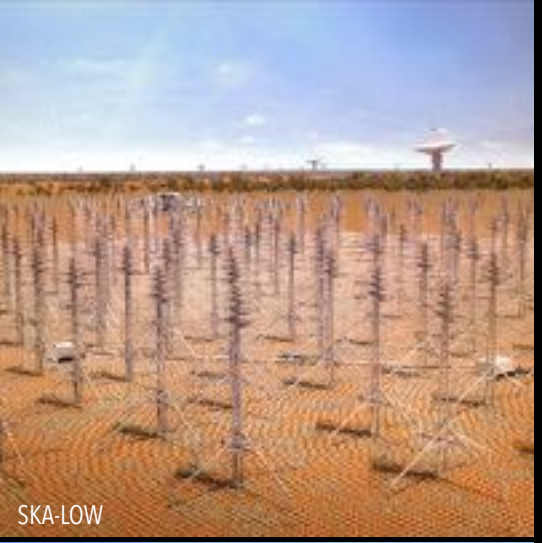
Main French involvements in SKA1

- Construction:
  - provision of high bandwidth digital electronics for SKA1-MID
  - provision of the SKAO Science Data Processor Hardware
- SKA challenge and opportunities in terms of energy needs:
  - innovative solutions for the generation, storage and management of energy with minimal environmental impact
  - energy efficient code and exascale data centres
- SRCs:
  - conception of the worldwide network of SRCs
  - French (co-)leadership in 1/ definition of software federated computing and data software services, 2/ identification of users' needs, 3/ collaborative efforts at European level



SKAO/CERN/PRACE/GÉANT
Collaboration Agreement

Courtesy: SKAO/CERN/PRACE/GÉANT


SKA-LOW


SKA-MID

SKA is now! How to be involved /prepared?

- Make the best use of pathfinders and precursors
- Subscribe to SWGs: this allows
  - ✓ To be constantly informed about developments and possibilities opened by SKA in your research field(s)
  - ✓ To bring forward new ideas, collaborations and synergies
  - ✓ To be present when Key Science Projects will start to grow
- SRC activities: different possibilities
  - ✓ Definition of scientific requirements
  - ✓ Participation to SRC specific Data Challenges
  - ✓ Technical contribution and expertise in conceiving the SRC network
- SKA-France related activities: again, different possibilities
  - ✓ Work in close relation with AS SKA-LOFAR too to develop the community of users of low-frequency radio facilities
  - ✓ Active involvement in the SWG/SRC discussions to animate national workshops, project developments, multi-disciplinary collaborations
  - ✓ Involvement in the software/hardware co-design in collaboration with SKA-France partners