Innovation through the SKAO
The story of the MSF

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SKA, the science project of all superlatives

- **SKA**
  - The world’s largest radio telescope
  - A 2 B€ project (CAPEX + 10y OPEX)
  - A global project: 16 SKAO Member States and Observers + 8 African Partners Countries
  - 100 organisations across about 20 countries

- **The biggest ever-built scientific machine**
  - Beyond scientific goals ever reached
  - Request for mandatory technology breakthroughs to reach the objectives
France in the SKA project

- **Pros**
  - France = big astronomy player
  - Complementarity with other instruments (both optical and radio)
  - Pathfinders in France (Nenufar/Lofar)

- **Cons**
  - Limited resources for new Large Research Infrastructures
  - Competition with other astro projects
  - Other scientific priorities

**Timeline**
- 2009: AS SKA-LOFAR
- 2010: EMBRACE
- 2011: PropSKA
- 2012: SKADS
- 2013: LoFAR
- 2015: P0 for France joining SKAO
- 2016: NenuFAR

**BUT:** French withdrawal from the SKA
France in the SKA project: no choice!

- Unique solution: INNOVATION!
  1. Technology: machines needed do not exist (exascale computer, H2 energy systems, …)
  2. Business model: Big Science business
  3. Project culture: management by objective

- How?
  1. Astrophysics/astronomy = science (dragging force) + technology (means)
  2. Systemic approach: scientists, industry, PA = 3 partners equally interested and rewarded
  3. SKA = lighthouse for:
     - research (scientific objectives)
     - industry (business perspective)
     - PA (social/societal achievements)
  4. Focus on well-identified targets where France can play a leading role
  5. Proof by action: convince by demonstrating, run in front of competition.
Change of paradigm

• Situation analysis:
  1. Sequential approach will take too long
  2. Lack of means (HR and finance)
  3. Need to build a new system, aggressive (positive way) to bring results and to demonstrate the absolute necessity to be in SKA and take our « market share » in science, business and societal ROI.

• Empowerment of all stakeholders:
  1. Involvement of PA since the beginning in the progress of research projects
  2. Making scientists working in multidisciplinary teams
  3. Making researchers from academia and industry partnering in mixed teams

• Interest/added value:
  1. For industry, big science has always been attractive: technology progress, innovation, new metiers, new business, new business model (industrial rules, IP management, procurement rules)
  2. For PA, a means to find where and how to bring support (political and financial) and spend wisely public money
  3. For scientists, a guarantee to keep their independance and freedom to lead their research.
Parallel action plan (2016-2018)

• In France:
  1. Motivate and structure the scientific community towards SKA objectives
  2. Gather together scientists and technologists to identify the crucial technology gaps and define a common roadmap to answer SKA demand
  3. Introduce SKA to all PA offices concerned: research, foreign affairs, finance, etc.
  4. Prepare for the Large Research Infrastructure Roadmap

• With SKA Office:
  1. Reinforce French scientists representation in science WG
  2. Introduce French industry on targeted subjects
  3. Ensure permanent representation at Board level and scientific and technical WG

• Achievements:
  1. The French SKA White Book
  2. Industry/Science Workshops on Energy, HPC, HF feeds, etc.
The French SKA White Book

176 authors from

- 40 French research institutes
- 6 private companies
Industrial perspectives and solutions

Scientific and technology workshops:
- Energy
- Energy and Cryogeny
- HPC/Big Data
- Signal processing
- System integration (AIV, ITF)

French companies involvement:
- RFI Energy for SKA RSA: Engie
- French industry meets with SKAO: Airbus, Callisto, Air Liquide, Bull Atos, Thalès, Kalray, Fedd, CNIM, Bertin
SKA France factsheet in 2017

French contribution to the SKA:
- Observer at SKA Board and Strategy Committee
- Chair of AENEAS GA & 1/3 Members of Ext. Adv. Board
- Invitees to all SKA scientific and technological conferences
- 55 scientific experts in SWG (including 2 co-chair)
- French ILO in SKA Industry Liaison Group and member of PSOW
- Contributor to SKA tech. consortia: LFAA, MFAA, WSBF, DISH, SDP

SKA France actions in 2 years:
- 2 French industry days ( > 50 organisations)
- 2 presentations to HC TGIR
- SKA France visits at SKA Office
- SKAO visits in French companies
- 10 scientific and technology workshops: SP, Energy, HPC/Big data

French SKA community:
- 176 contributors to the French White Book
- > 250 scientists involved today, 400 by the end of 2017
- > 40 French labs involved
- > 50 experts from the industry
- 6 LE, 3 SMEs involved in RfI & collaborative projects for SKA

→ Ready to move forward to the next step :
  « Maison SKA France »
Maison SKA France

- A 3y 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
Maison SKA France

Objective: make France joining SKAO

- A common vision
- An adaptive strategy
- Short & mid-term goals clearly defined
- HR and financial means engaged
- MoU opened to new partners

MSF : the « couteau suisse » tool

- Interface with SKA Office, to prepare for the future position of France
- Interface with French PA to permanently show the reality of SKA in France and its growing dimension
- Host for all research institutes to invite scientists of all necessary domains (Astro, Big Data, Energy…) starting from France (CNRS, CEA, INRIA, Obs,…)
- Host for all new comers from industry
Building this fantastic machine: technological developments in France

SKA1-MID

SKA1-LOW

8.8 Tbps

7.2 Tbps

~2 Pb/s

5 Tbps

8.8 Tbps

7.2 Tbps

50 PFLOPS

100 PFLOPS
Industrial perspectives and solutions

- System engineering
- Data science for monitoring
- Hardware and application integration
- Energy production and storage
- Data storage, distribution, preservation

- Cryogenics systems
- Telecommunications
- Receiving technologies
- Antenna design

Industrial perspectives and solutions
Industry contributions: baseline & innovations

<table>
<thead>
<tr>
<th>Description</th>
<th>Acteurs</th>
<th>Ligne budgétaire</th>
<th>Lot de construction</th>
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</thead>
<tbody>
<tr>
<td>Centres de calcul scientifique SPC (supercalculateurs HPC) Offre intégrée, optimisée globalement Codesign HW/SW</td>
<td>Atos BULL</td>
<td>• Lots de construction</td>
<td>Mid/Low SPC</td>
</tr>
<tr>
<td>Récepteur de la bande 5 de SKA-Mid</td>
<td>FEDD - Lab</td>
<td>• Lots de construction</td>
<td>Mid digitization</td>
</tr>
<tr>
<td>Antennes hydrogène SKA-Mid (Refroidissement des détecteurs par hydrogène liquide et alimentation électrique des antennes)</td>
<td>CNIM Air Liquide</td>
<td>• Lots de construction</td>
<td>DISH</td>
</tr>
<tr>
<td>Approvisionnement en énergie - Centrale photovoltaïque, système de stockage (éventuellement production / distribution d’hydrogène liquide pour SKA1-Mid)</td>
<td>IPP français Equipementiers français (Air Liquide)</td>
<td>• Opérations</td>
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Maximisation du retour vers les industriels français en allant chercher des revenus sur les deux lignes budgétaires:
• Capital cost of construction (lots de construction)
• Coûts opérationnels

Certaines de ces innovations (antenne hydrogène) ne peuvent être acceptées que démonstration faite (niveau de TRL atteint permettant de déclencher une « Engineering Change Proposal »)
And finally it happened!

From:
- 2016: SKA France Coordination
- 2018:
  - Maison SKA France
  - SKA on French LRI Roadmap
  - CNRS member of SKAO
- 2019: SKA in INSU/AA prospective
- 2021: France’s accession to the SKA Observatory

To:
- 2022: signature of the accession agreement with the SKAO

Closing of the MSF, long life to SKA France 2.0!
- End of the 3y MoU
- Mission accomplished.
Thank you!

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