Lessons from the SKA

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Summary

- Challenges for global Megascience projects
- Governance and Megascience projects
- The SKA
- Development of the SKA Governance structure
- Lessons

Global Megascience projects are complex

- Multiple nations
- Research organisations
  - large and small, institutes and universities
- industrial organisations
  - large and small
- Government funding
- Inter-disciplinary research

Challenges for a global science project

- different
  - funding cycles
  - prior investment histories
  - scientific interests
  - levels of technology development
  - decision-making cultures
- regional funding may be contingent on “juste retour”
  - eg industrial spin-off, location
- technical and political considerations may link decisions on concept and location

Economic Context

- Single countries are less likely to fund Megascience projects unilaterally
  - To make them happen requires multi-national/global collaborations
- Large science projects need to contribute to wealth creation in the funding countries
  - Innovation
  - International linkages
  - Training scientists and engineers
- Participation is often by ‘in-kind’ contributions – minimal or no exchange of cash, no central funding

Governance

- Good governance
  - optimizing the collaborative advantage for all parties
- A lasting collaboration is based on mutual advantage
  - need to understand the agendas of the people you deal with before you start
- Scientific questions are borderless, but funding and legal frameworks are not borderless

Governance frameworks must address:

- Management of the collaboration
  - resourcing, schedule, deliverables, risk assignment…
- Control of decision making process
- Representation of partners
- Communication protocols
- Funding
  - Initial approval, political backing, continued funding assurance
- IP ownership, licence rights, commercialisation
- Procurement
- Conflicts of interest
- Disputes

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I have always found that plans are useless, but planning is indepensable

Dwight D. Eisenhower

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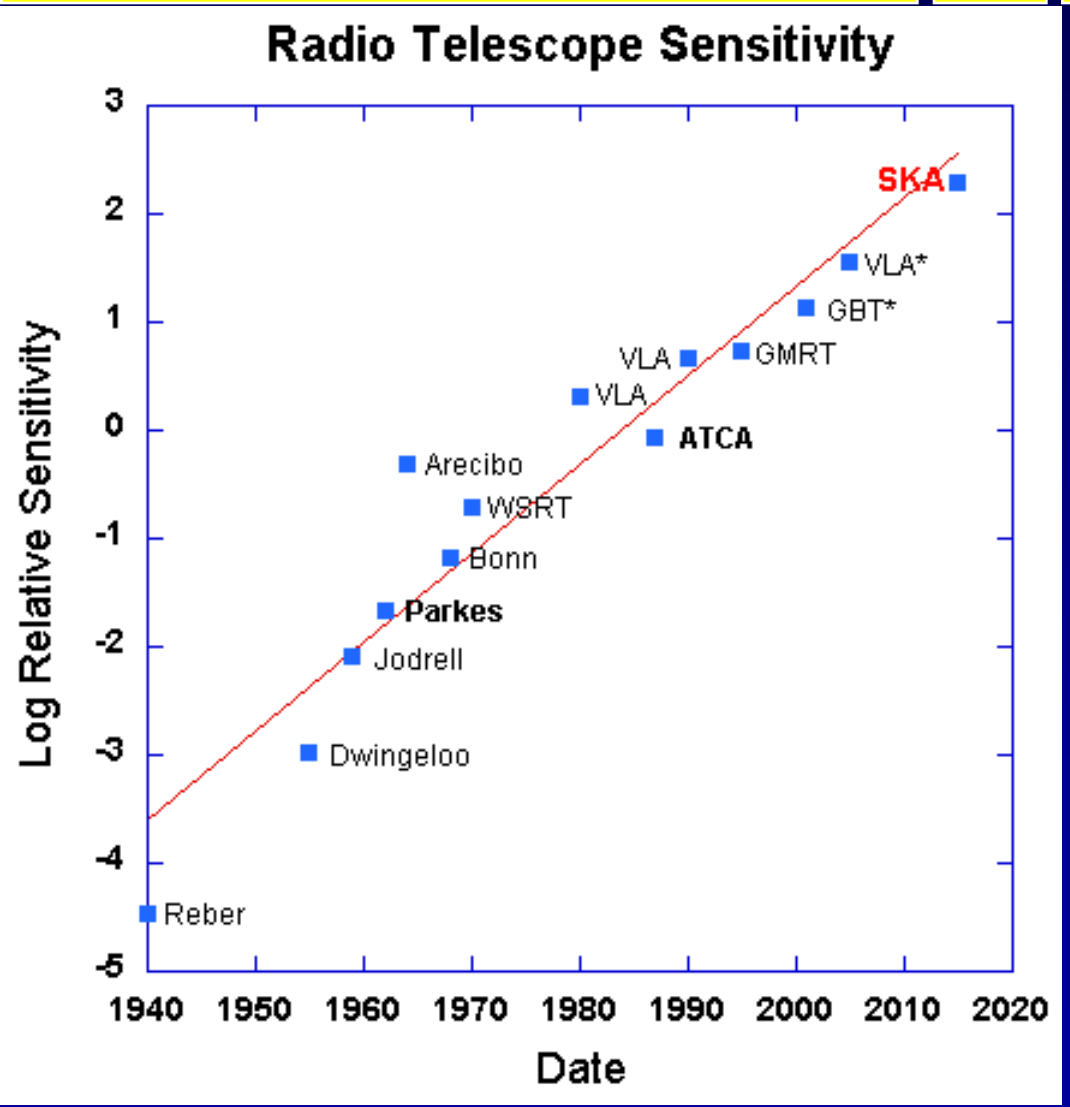
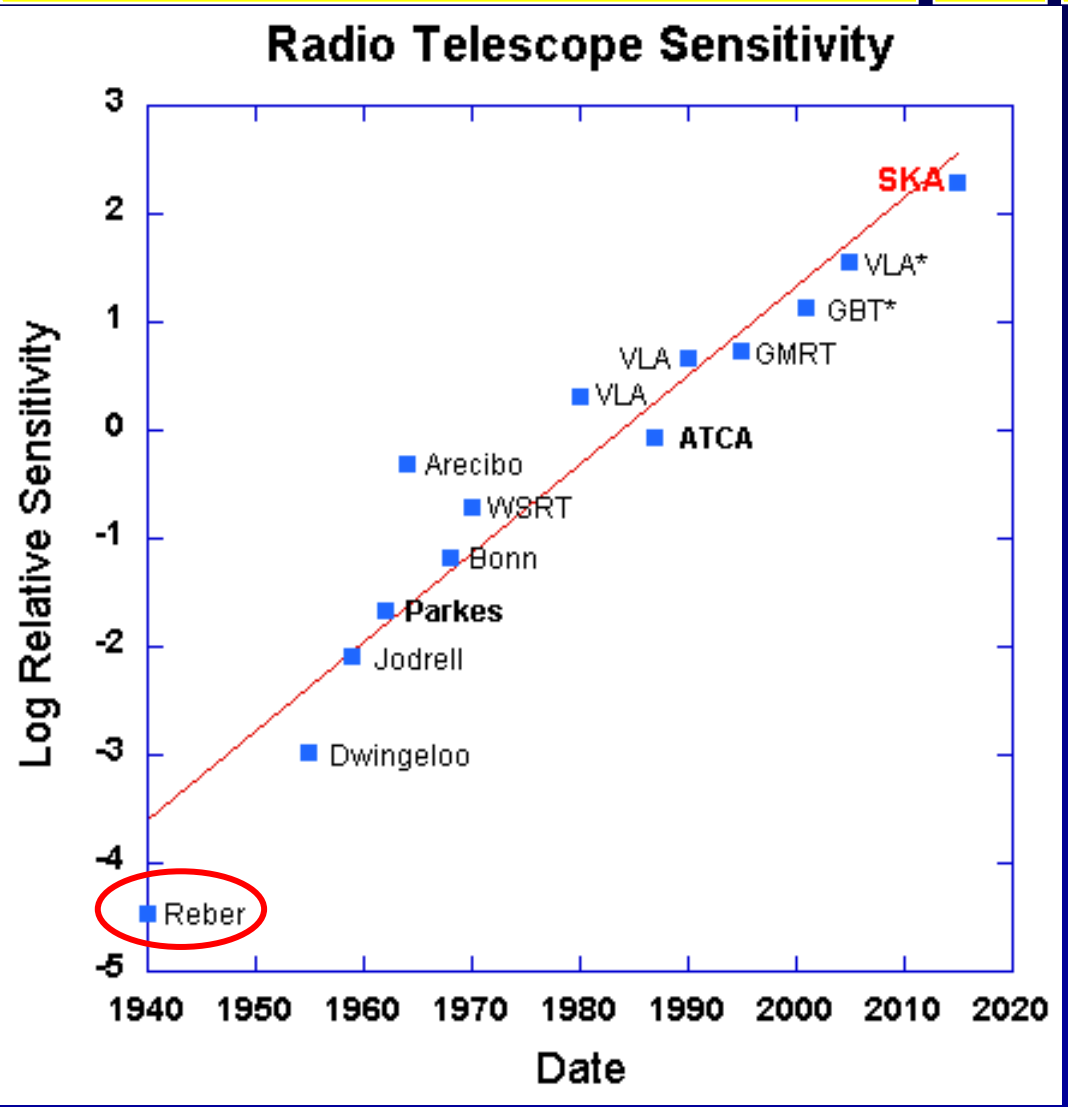
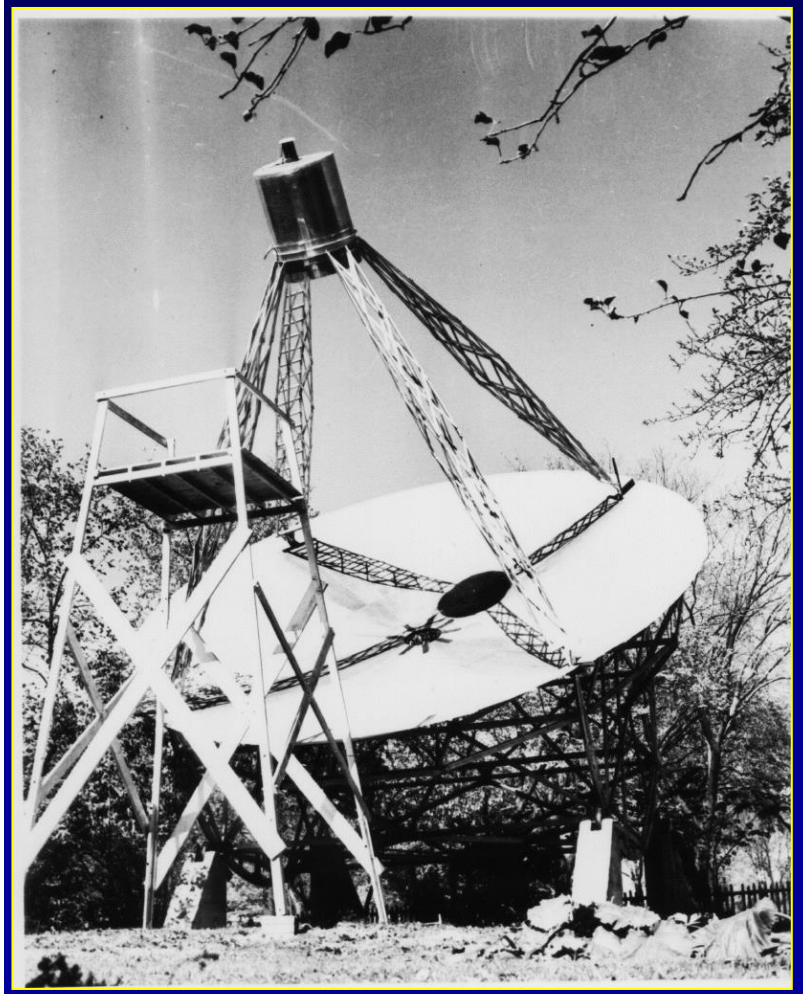
Radio Telescope Sensitivity



- 1990
- Ron Ekers, URSI General Lecture Prague
  - exponential growth and discovery arguments
- Yuri Parijski, IAU colloq 131
  - need to maintain exponential growth and to beat the RFI threat

Radio Telescope Sensitivity





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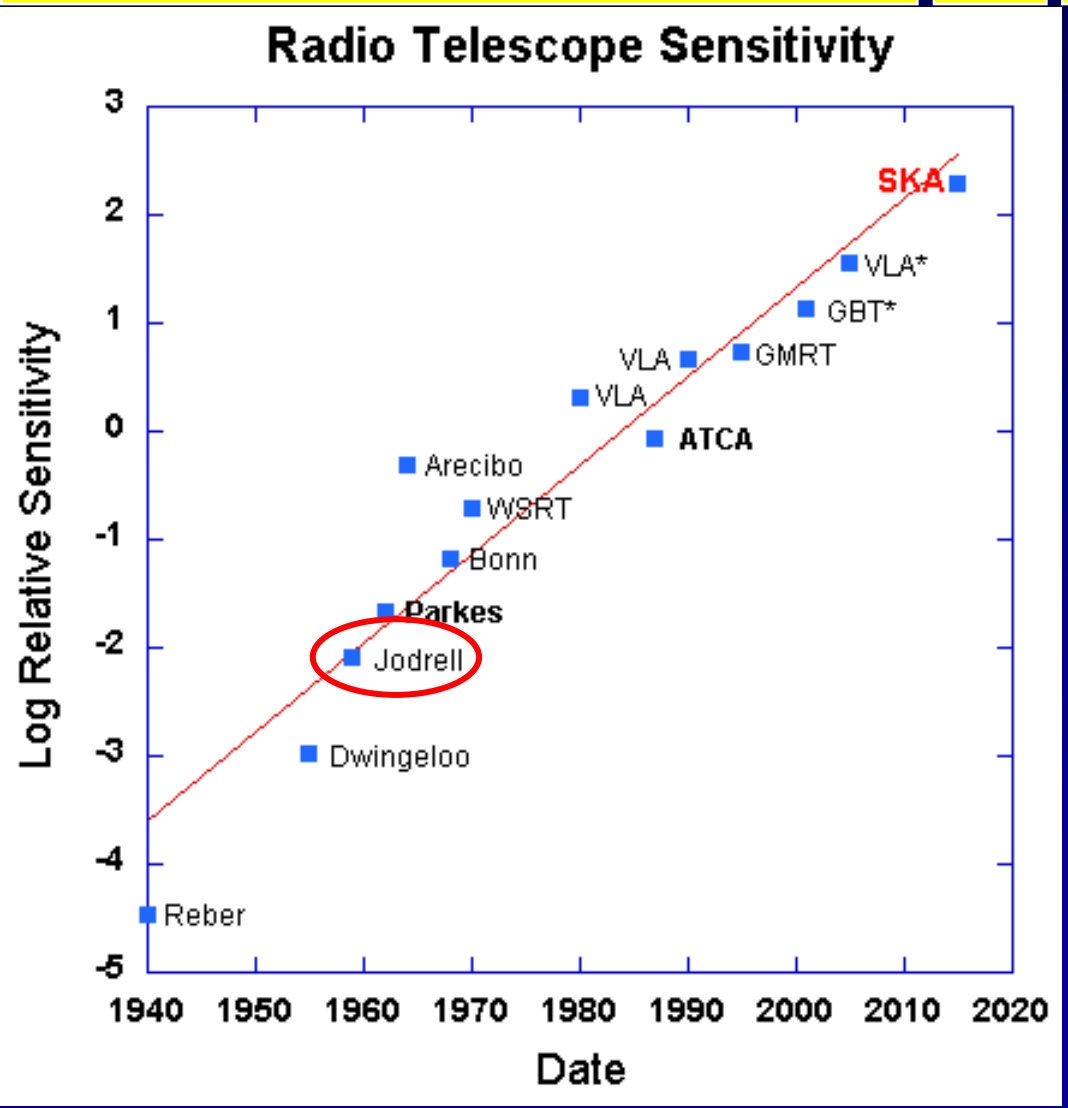

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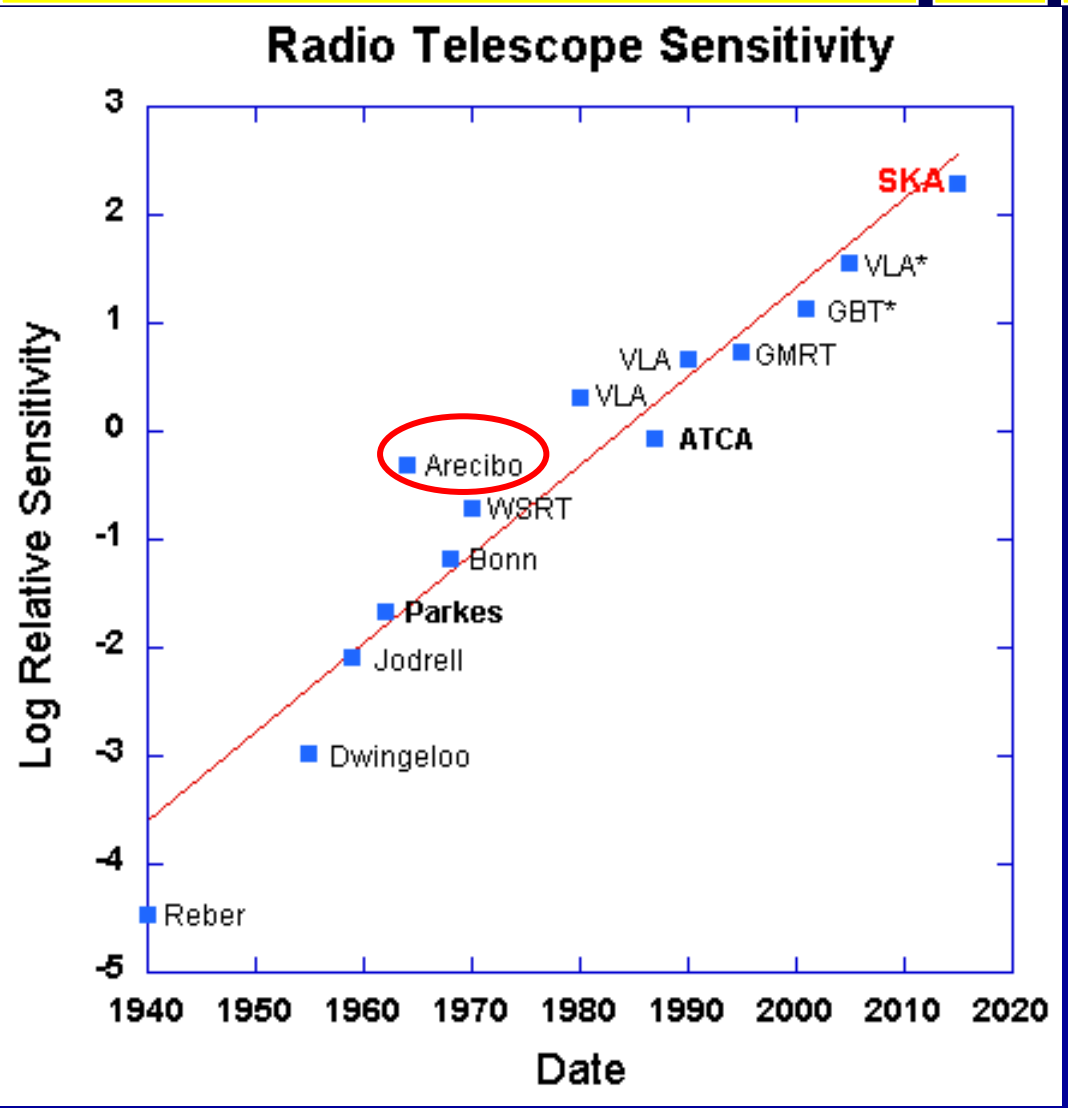

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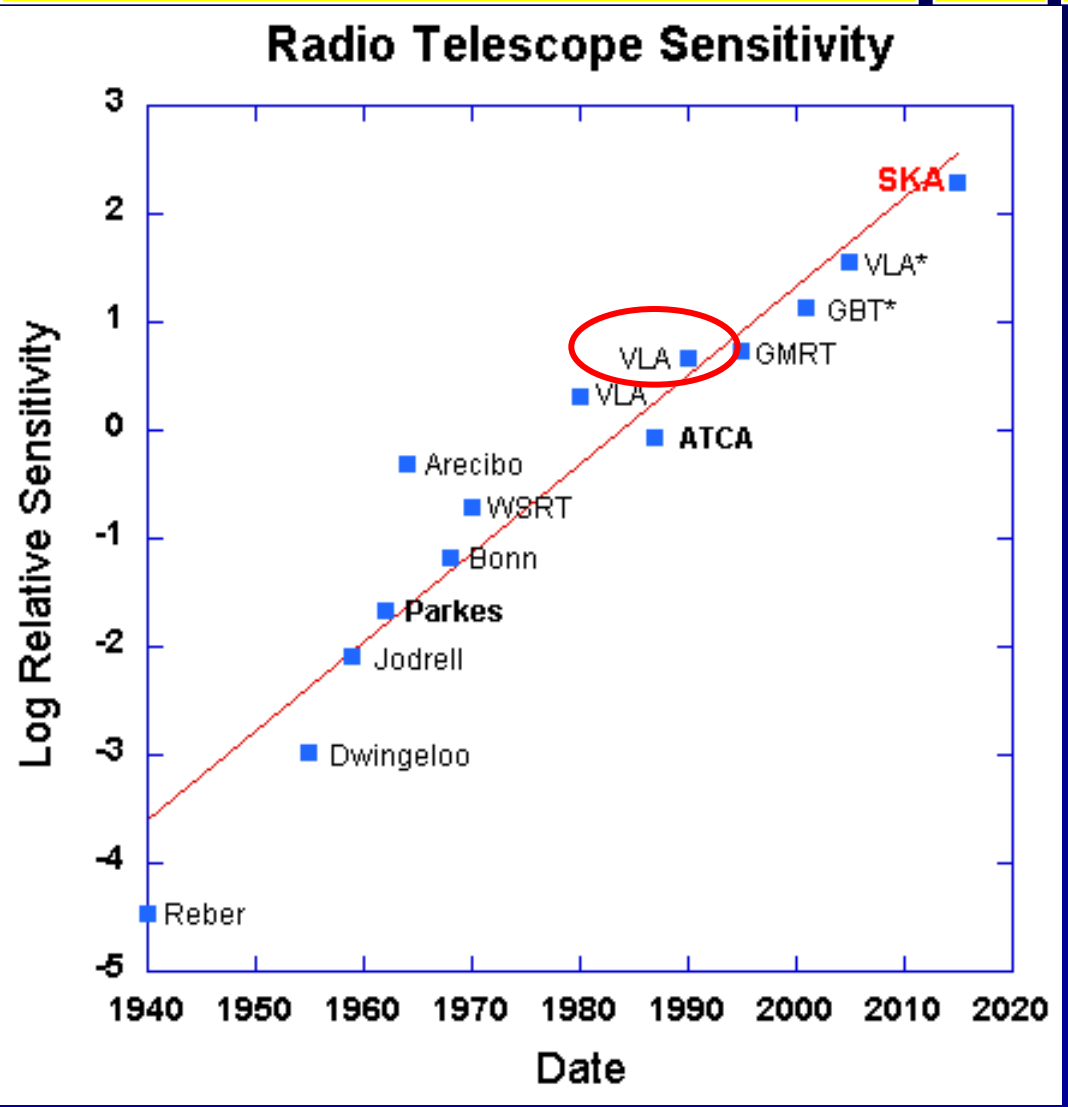

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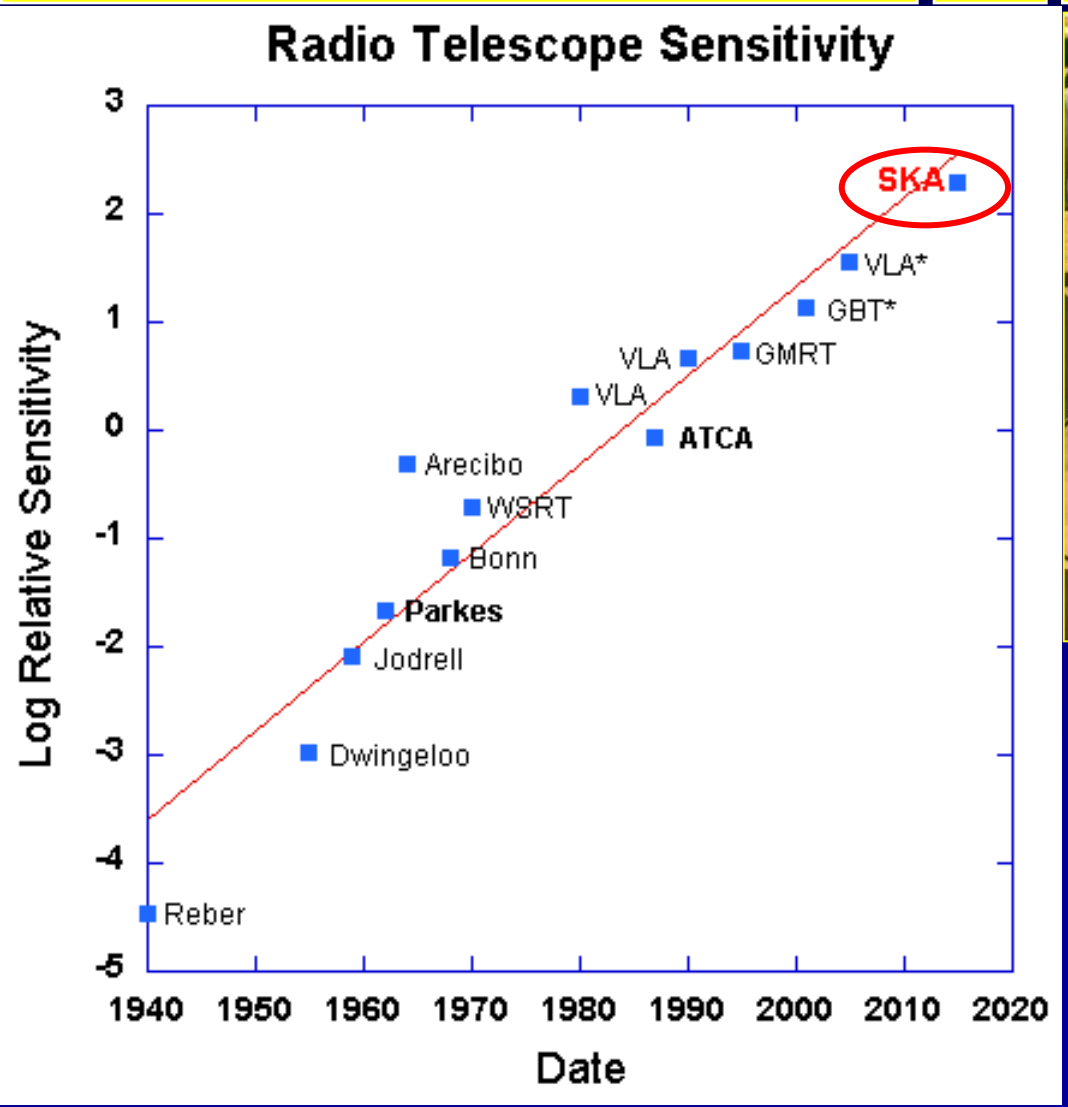

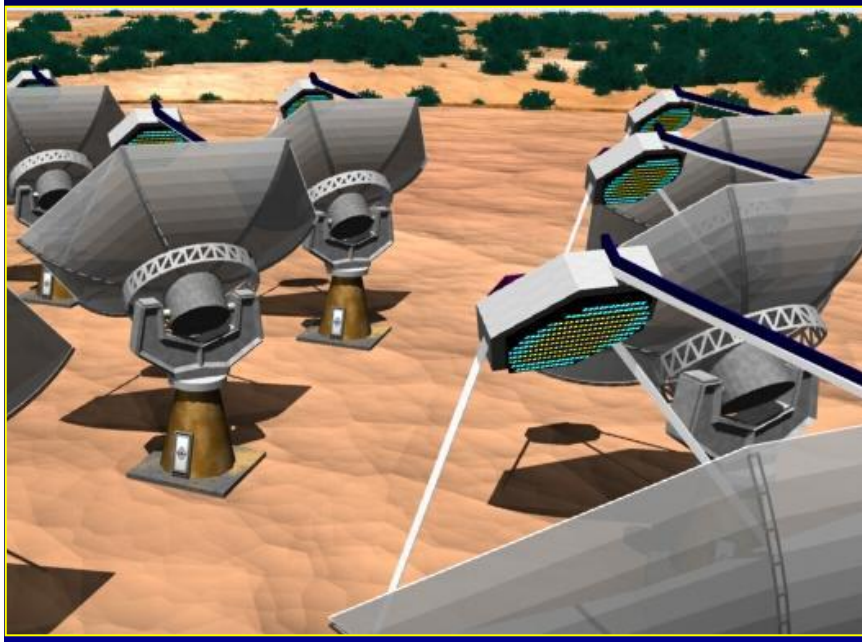

VLA 10th anniversary 8 Oct 1990

- Jan Noordam discusses the NFRA large HI telescope with Peter Wilkinson
- Peter Wilkinson includes the case for 1sqkm collecting area for extragalactic HI in his talk
  - *The Hydrogen Array*
- Govind Swarup (India)
  - International Radio Astronomy telescope (ITRA)
  - 160 75m dishes, centrally concentrated and baselines to 200km

And so the SKA was born...

- From the beginning SKA was conceived as an international/global project
- The scientists and engineers involved were accustomed to working together
  - A shared radio Astronomy culture
- Open Sky policy
- Links were made to existing International organizations
  - URSI, IAU, OECD, EC

The first 10 years of the SKA

- 1988 Independent suggestions for a Large Radio Telescope
- 1990 10th anniversary of VLA – the visions merge
- 1993 URSI GA Kyoto resolution
- 1994 IAU forms the Future Large Telescope WG
- 1996 MoA on technology studies
- 1996 OECD Global Science Forum activities start
- 1998 "SKA" name adopted (1kT, SKAI, …

Union Radio Science International Sep 1993 – Born Global

Large Telescope Working Group
URSI Commission J,

Considering,

a) The strong scientific case for a new, internationally accessible radio telescope with one or two orders of magnitude greater sensitivity than that of any existing or planned facility;

b) The need for innovative technical developments to realize such a facility at an affordable price;

c) The likely need for international collaboration to allow realization of this facility,

resolves to appoint a Working Group with the following terms of reference:

1. to explore the range of scientific problems to be addressed by the instrument.
2. to discuss the technical specifications and general design considerations needed to maximize the scientific return of such a facility.
3. to identify and, in so far as possible, resolve the major technical challenges to realization of an affordable radio telescope with the required sensitivity.

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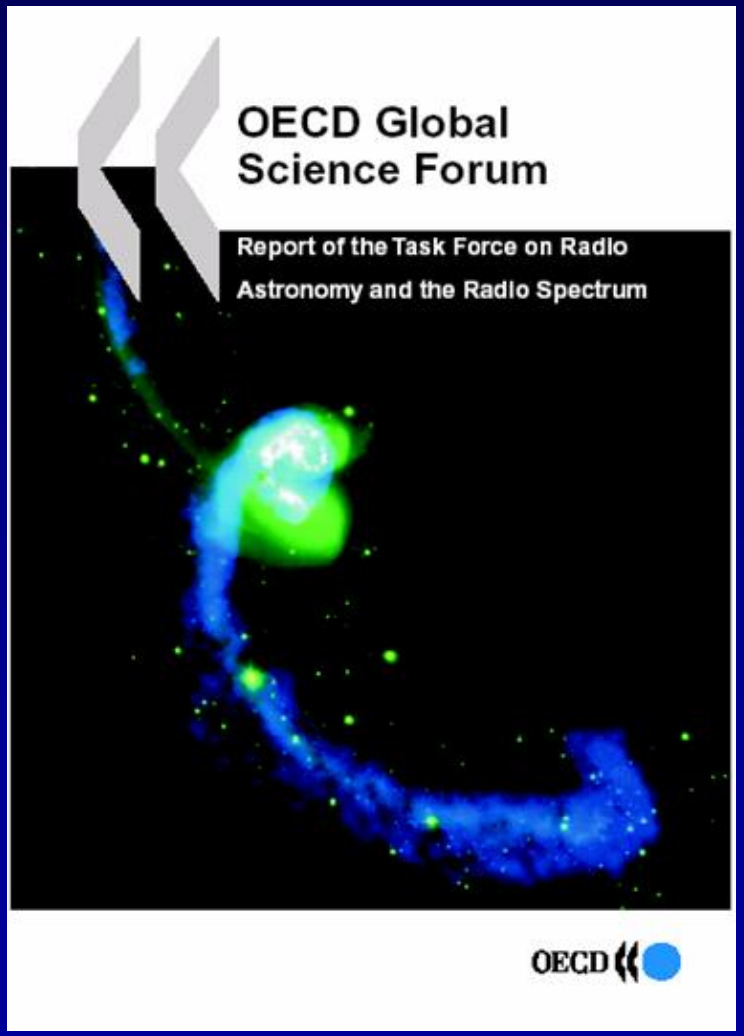
OECD Global Science Forum



- 1996 Mega Science Forum
  - Looked at big science models
- 1998 Task Force on Radio Astronomy
  - International protection from Satellite communications
- 2003 GSF on Astronomy
  - Global collaboration on funding processes – failed
- 2005-6 OECD is "banker" for the SKA project

The next 8 years

- 1999 International SKA Steering Committee (ISSC) met for the first time
- 2000 ISSC formalised by MoU
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- 2005 Technology down-select
- 2006 Site down select to Australia and Southern Africa
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  - Funding agencies + Government Departments in some countries
- 2007 Competition for location of the SKA Program Development Office SPDO

International SKA Steering Committee - 1999

It is in everyone's interests to create and fund a Steering Committee. Since the SKA is a truly international project that does not have a single sponsoring agency, the only way to create such a committee is to "self-appoint" an ad hoc group consisting of active project scientists and engineers from each participating country.

ISSC-1 minutes

This led to the creation of the International SKA Steering Committee at the IAU GA in Manchester in August 2000.

SKA International Steering Committee

- 18 members representing 11 countries
  - 6 European (UK, Germany, Netherlands, Sweden, Italy, Poland)
  - 6 United States
  - 2 Canada
  - 2 Australia
  - 1 China
  - 1 India
  - 2 at large members

- MOU signed IAU Manchester August 2000
  - appointed an Executive Secretary (Russ Taylor) partially supported by $2000 per ISSC member

SKA MoU 2000

...hereby agree to establish an International Square Kilometre Array Steering Committee to:

1. promote the SKA as an international project,
2. to provide oversight and to act as a coordinating body to establish agreed goals and timelines for the project,
3. to develop a joint international technical and scientific proposal for the SKA, including an implementation and cost plan, and
4. to establish and oversee working groups as necessary.

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SKA Management Structure 2004

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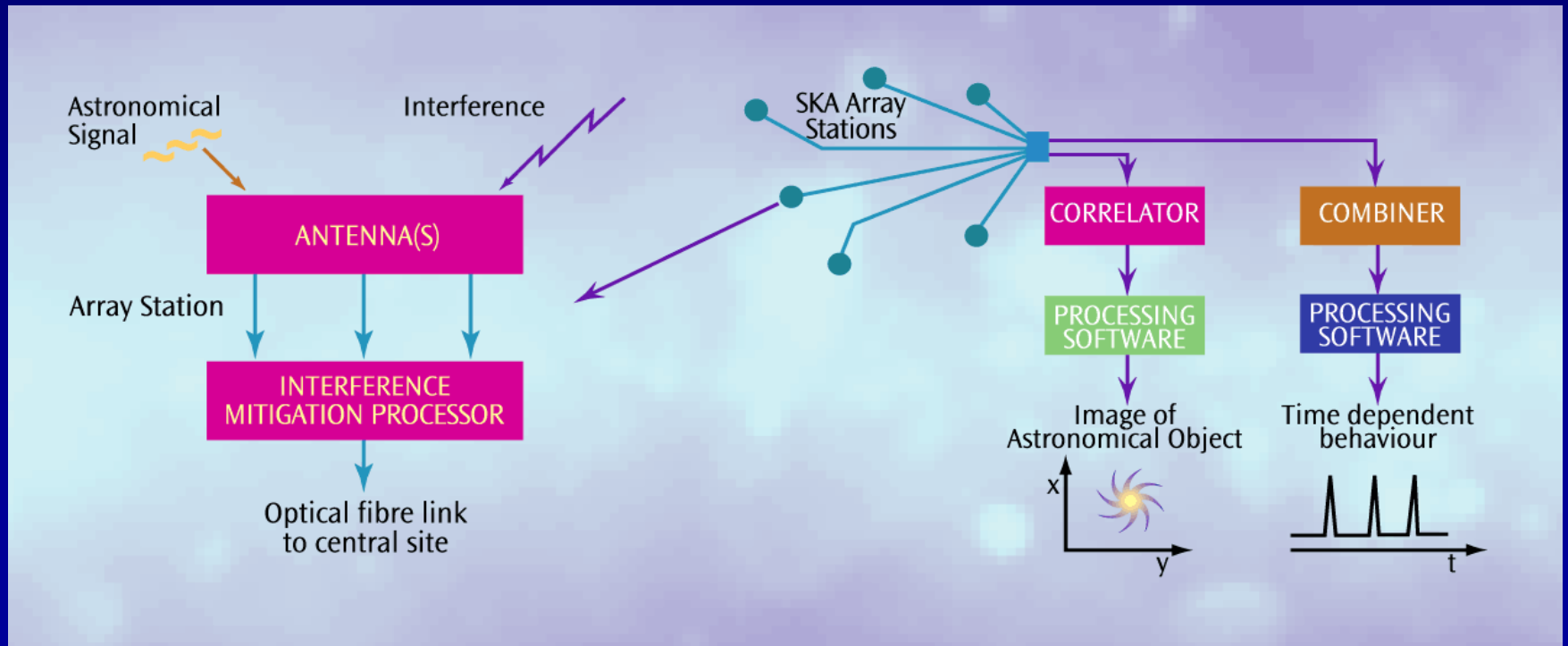

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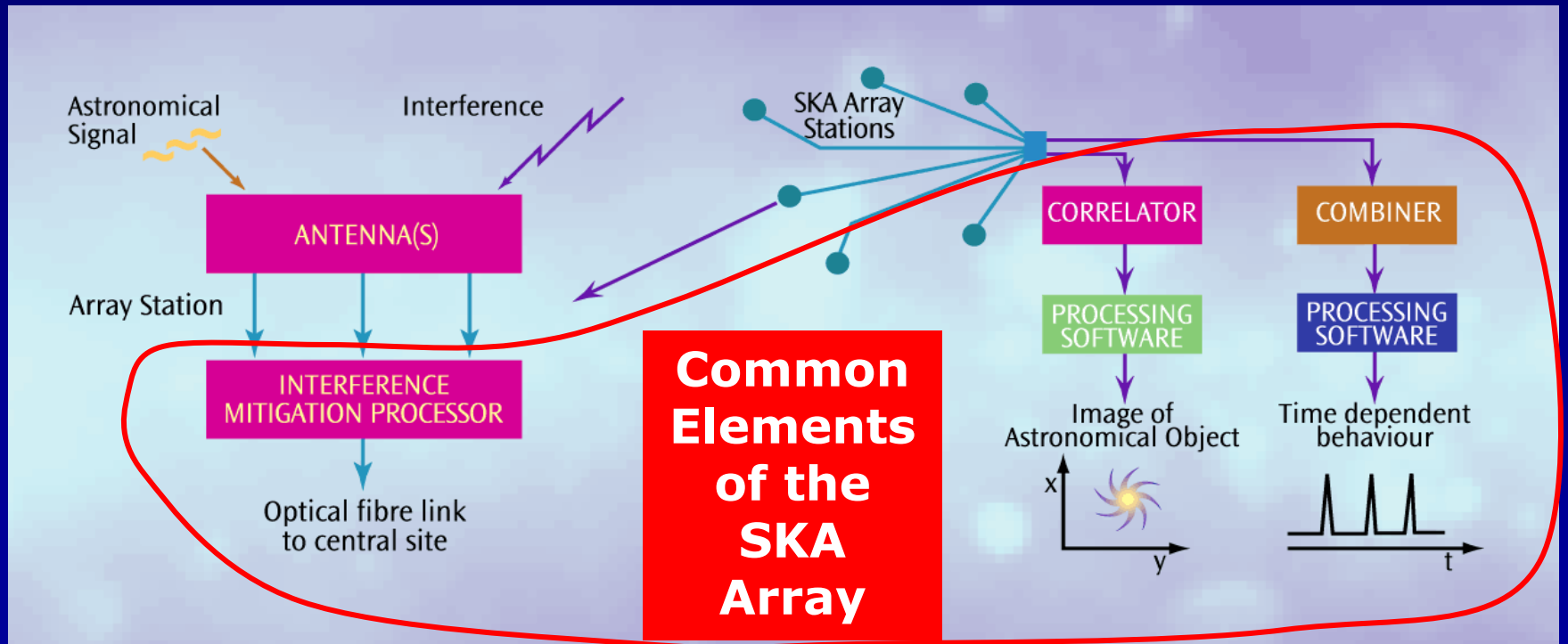

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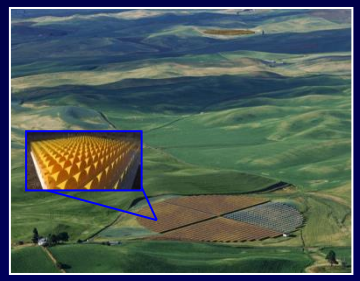
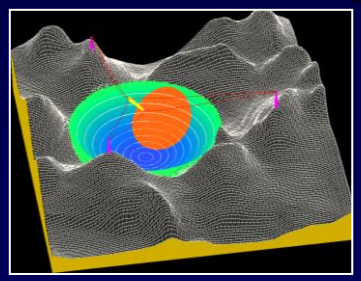
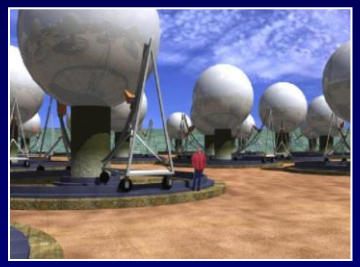
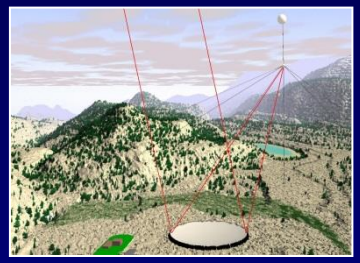
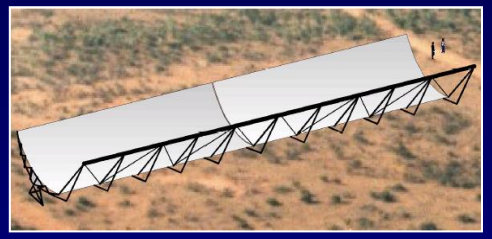
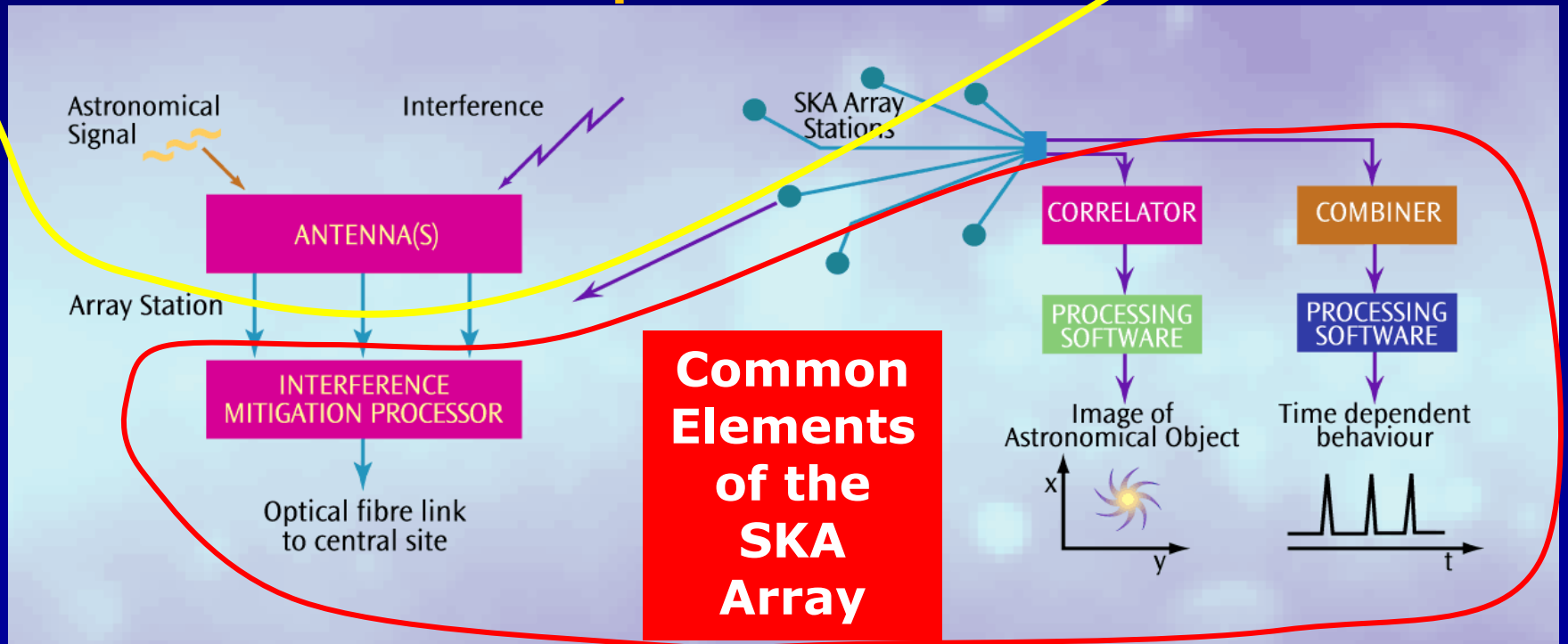



Antenna Concepts



Common Elements of the SKA Array

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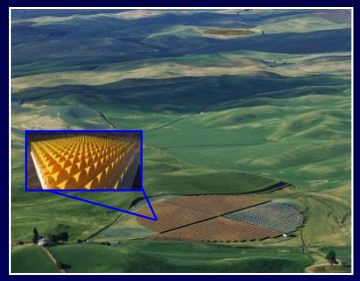
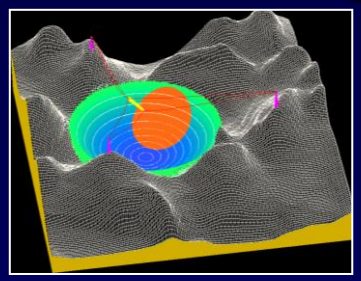


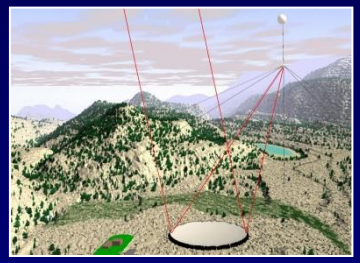
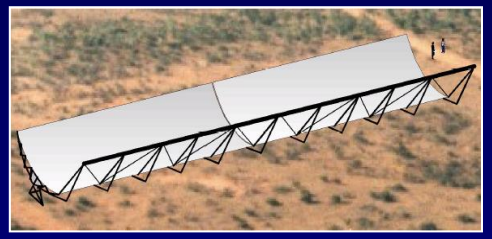

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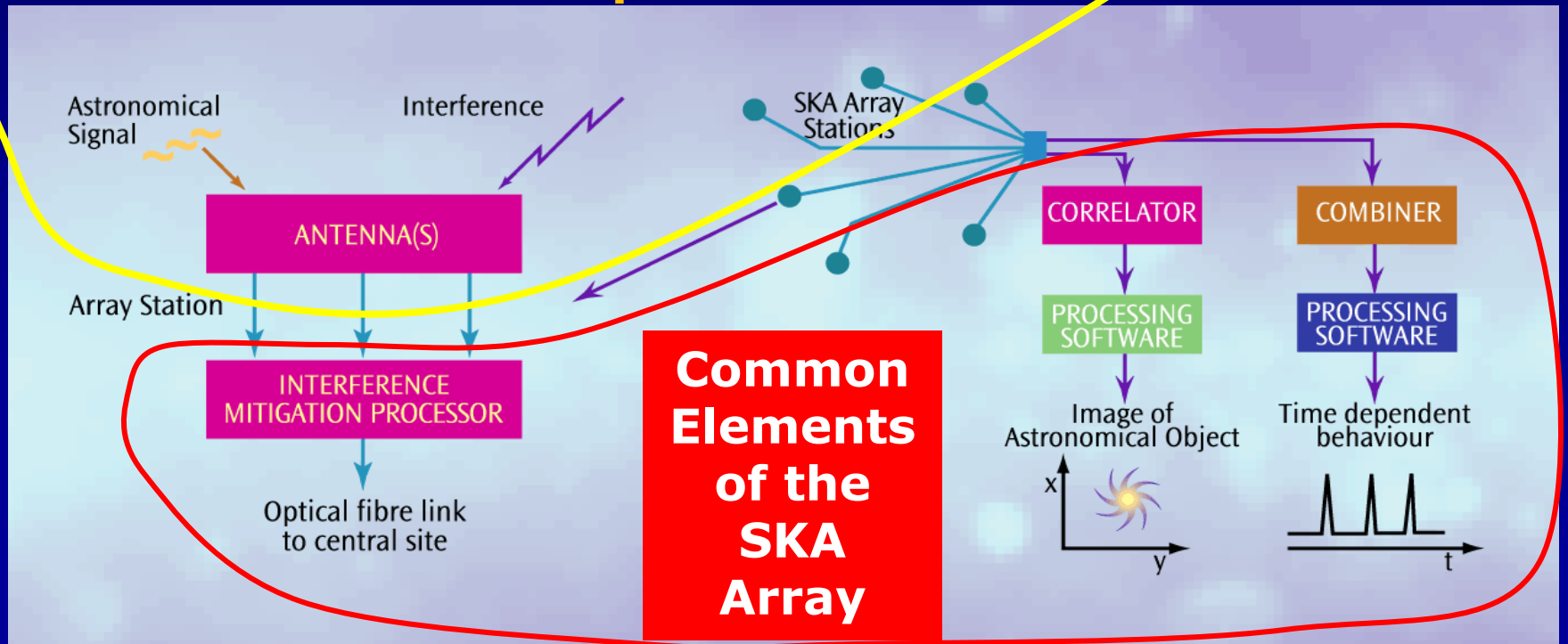

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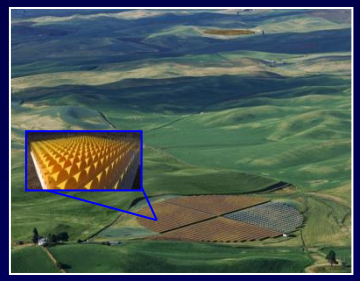
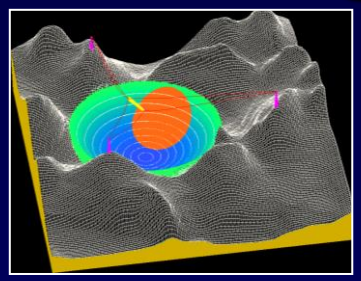



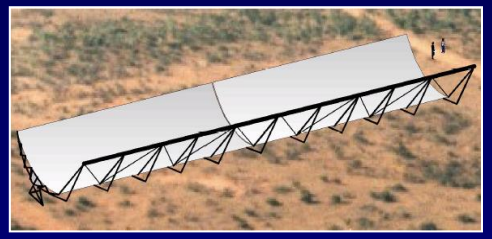

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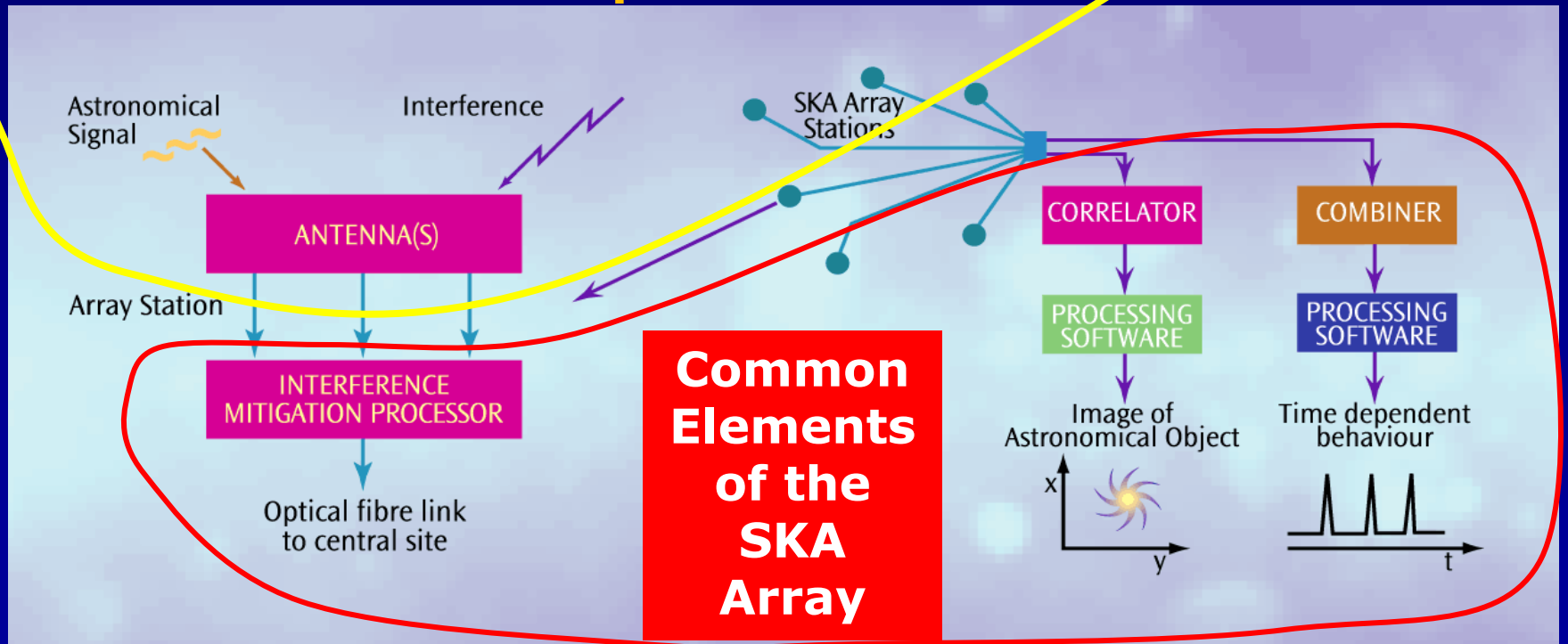

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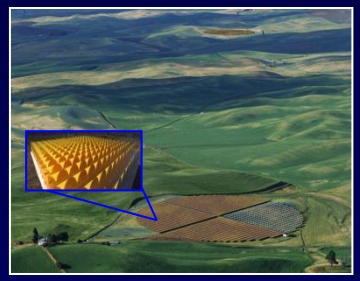
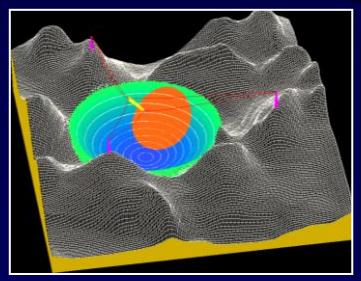



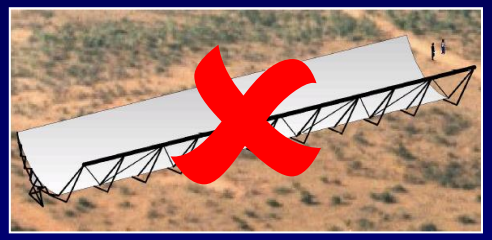

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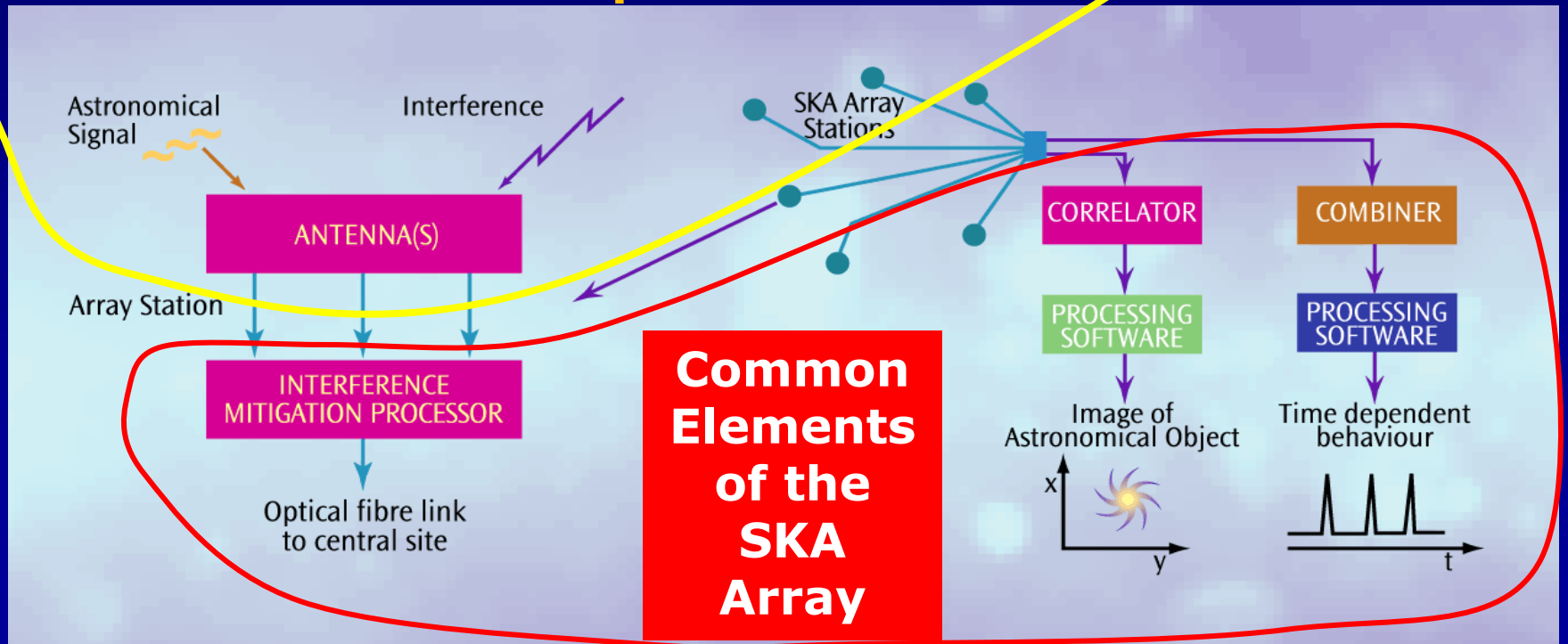

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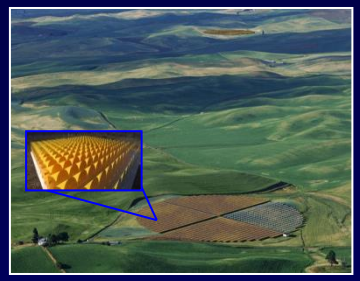
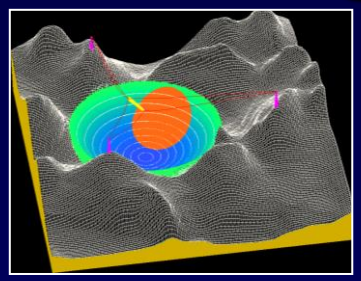



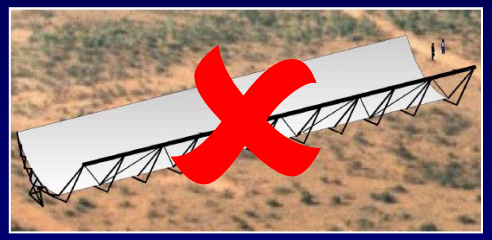

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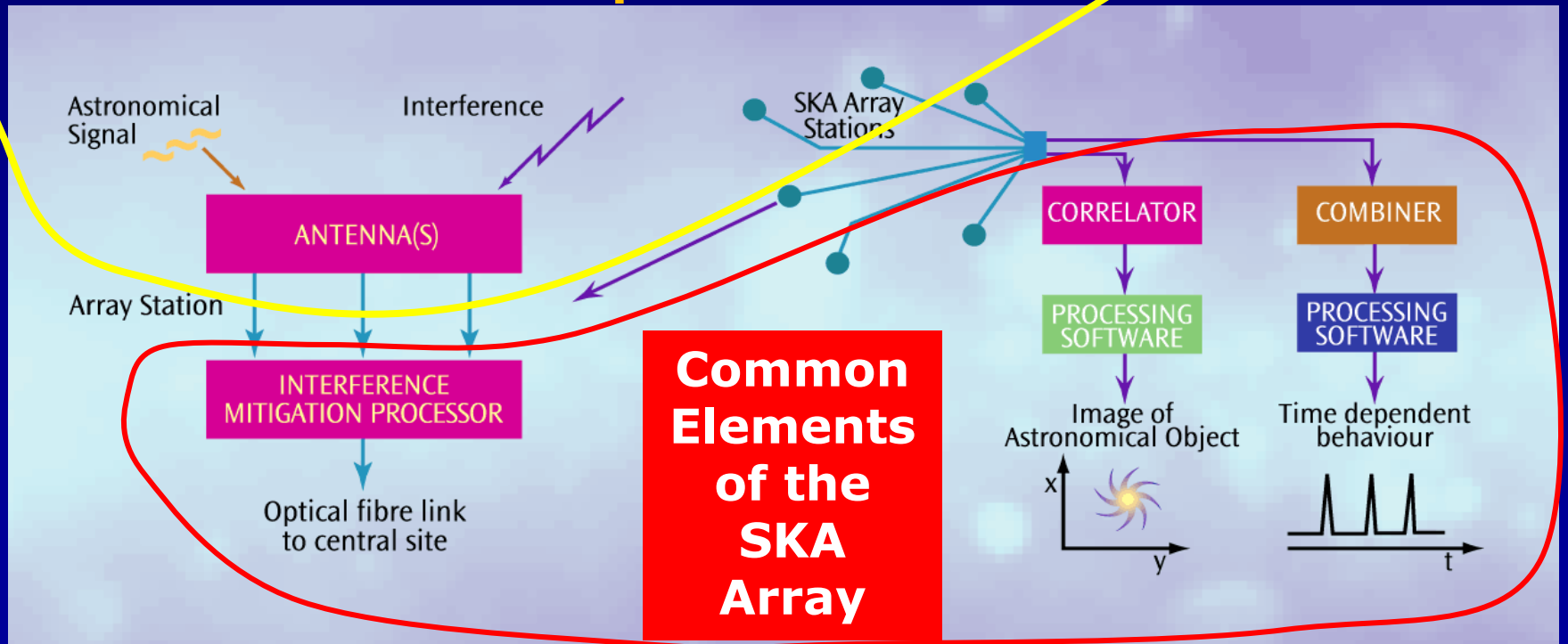

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Radio Noise Levels

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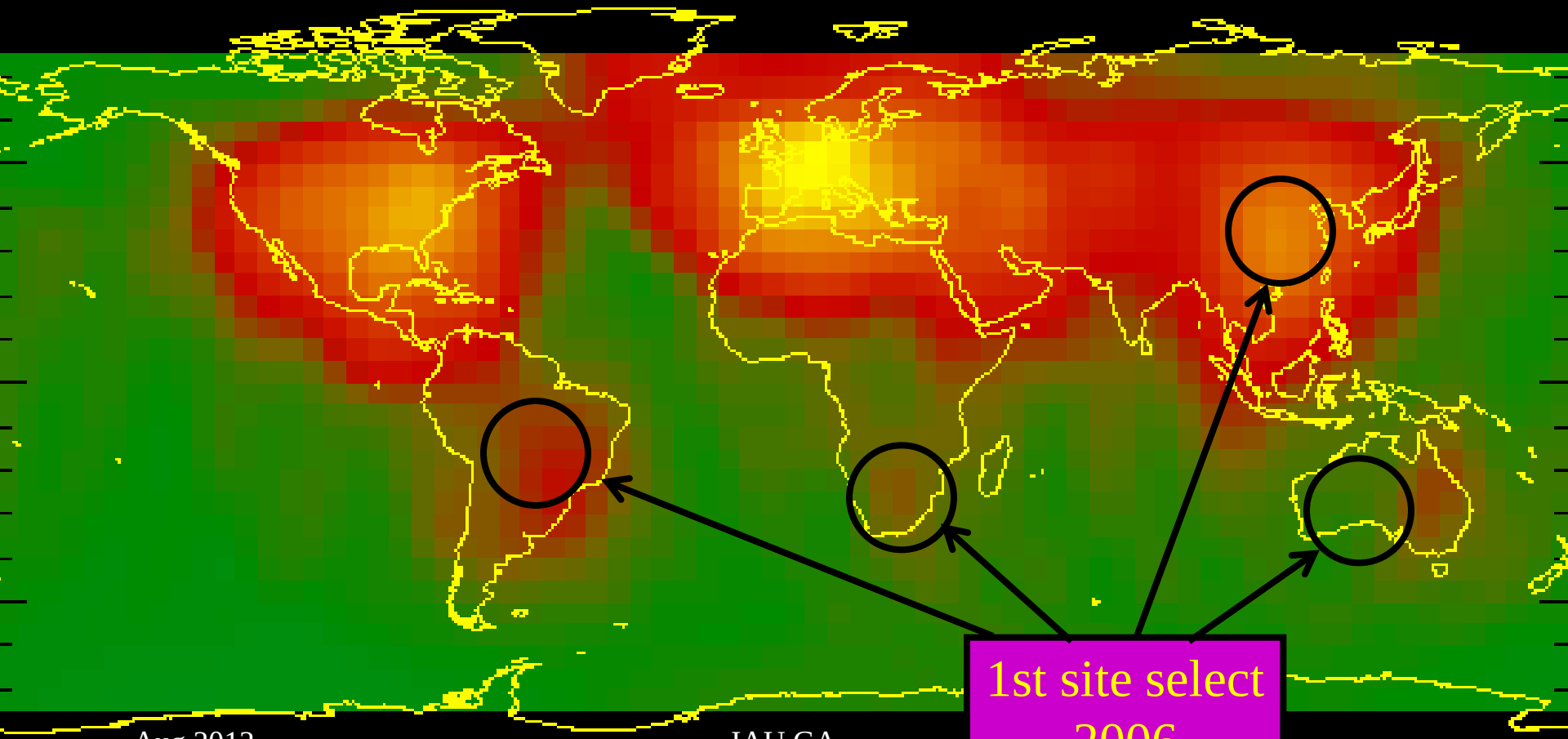

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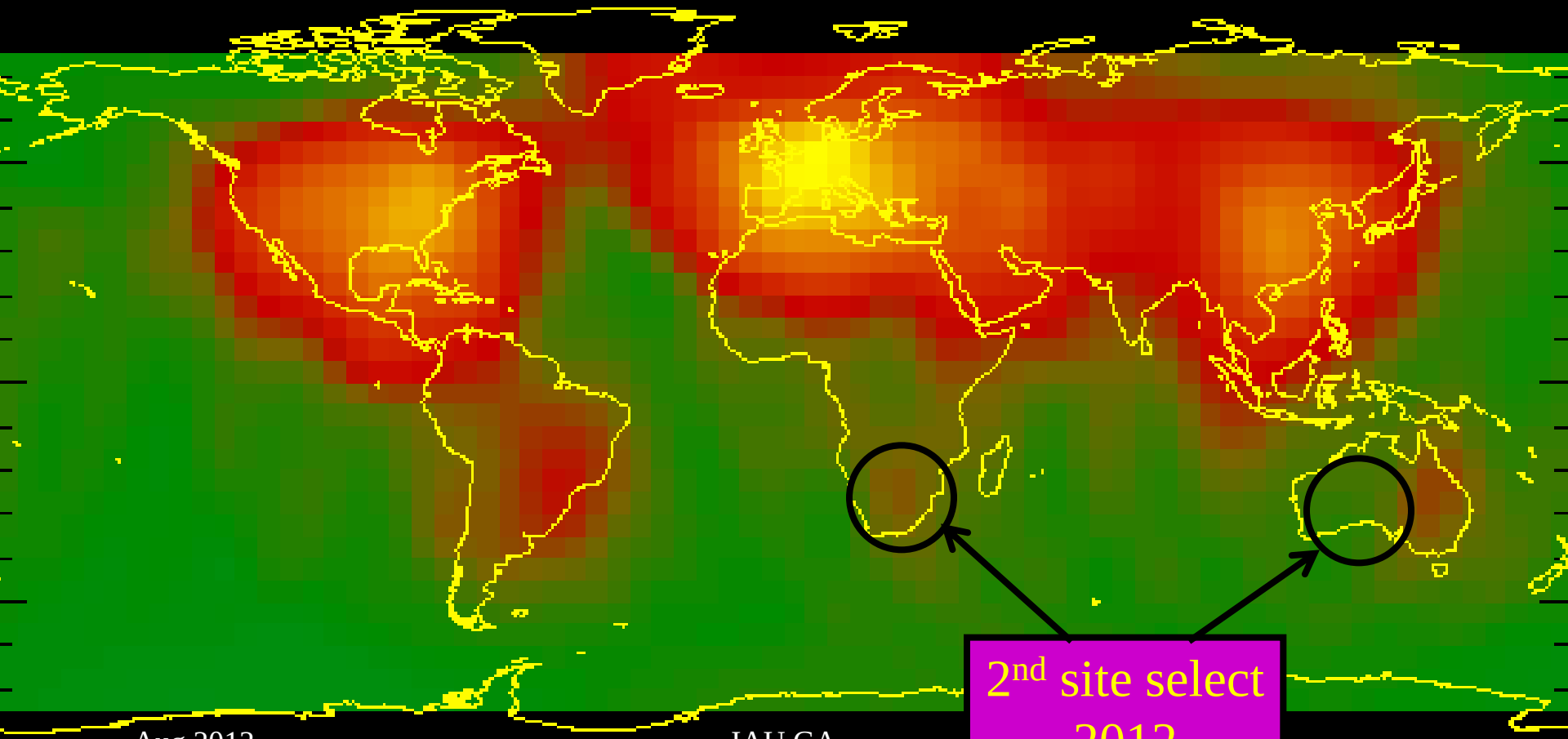


ISSC site shortlisting 2006

- ISSC established a multi-layered decision process with agreed protocols
- ISSC made the decision based on recommendations from
  - International SKA Site Advisory Committee
  - Expert Panels
- ISSC was instructed by the Funding Agencies Working group to produce a short-list of “acceptable” sites, and not to make a site decision
- Decision was ratified by informal Funding Agencies Working Group
- Short-listing decision was accepted by the non-selected sites

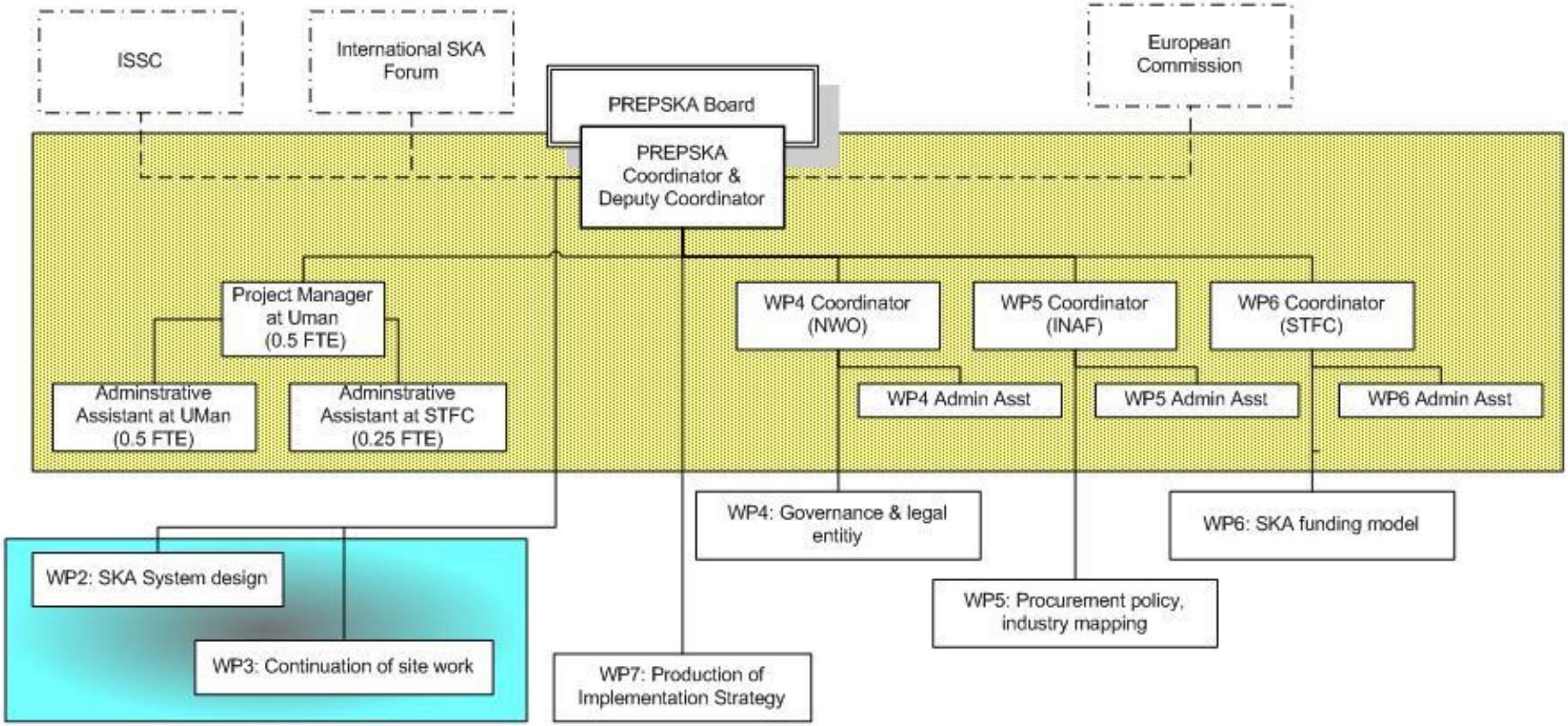
The last 4.5 years: the Preparatory Phase

- **2008 SKA Science and Engineering Committee (SSEC) replaces ISSC**
- **2008 SPDO replaces ISPO**
- 2008 EC-FP7 Preparatory Phase for SKA (PrepSKA) begins
  - engineering design, site characterisation, governance, industry engagement and procurement, construction funding
- **2009 Agencies SKA Group (ASG) formed**
- 2010 COST Workshop on Benefits of Research Infrastructures beyond Science: the Example of the SKA
- 2010 SKA Siting Group (SSG) formed to oversee site decision process
  - representation from ASG, SSEC, SPDO Director
- **2011 Founding Board replaces ASG**
- 2011 Competition for the location of the SKA Project Office in the Pre-Construction Phase
- **2011 SKA Organisation established as a Company Limited by Guarantee in the UK to start on 1-1-12**
- **2012 SKA Board replaces Founding Board, SSEC and PrepSKA Board**
- 2012 SKA Observatory/dual-site decision by SKA Board
- 2012 Formation of Pre-Construction Work Package consortia

3 Key MoA's in 2008

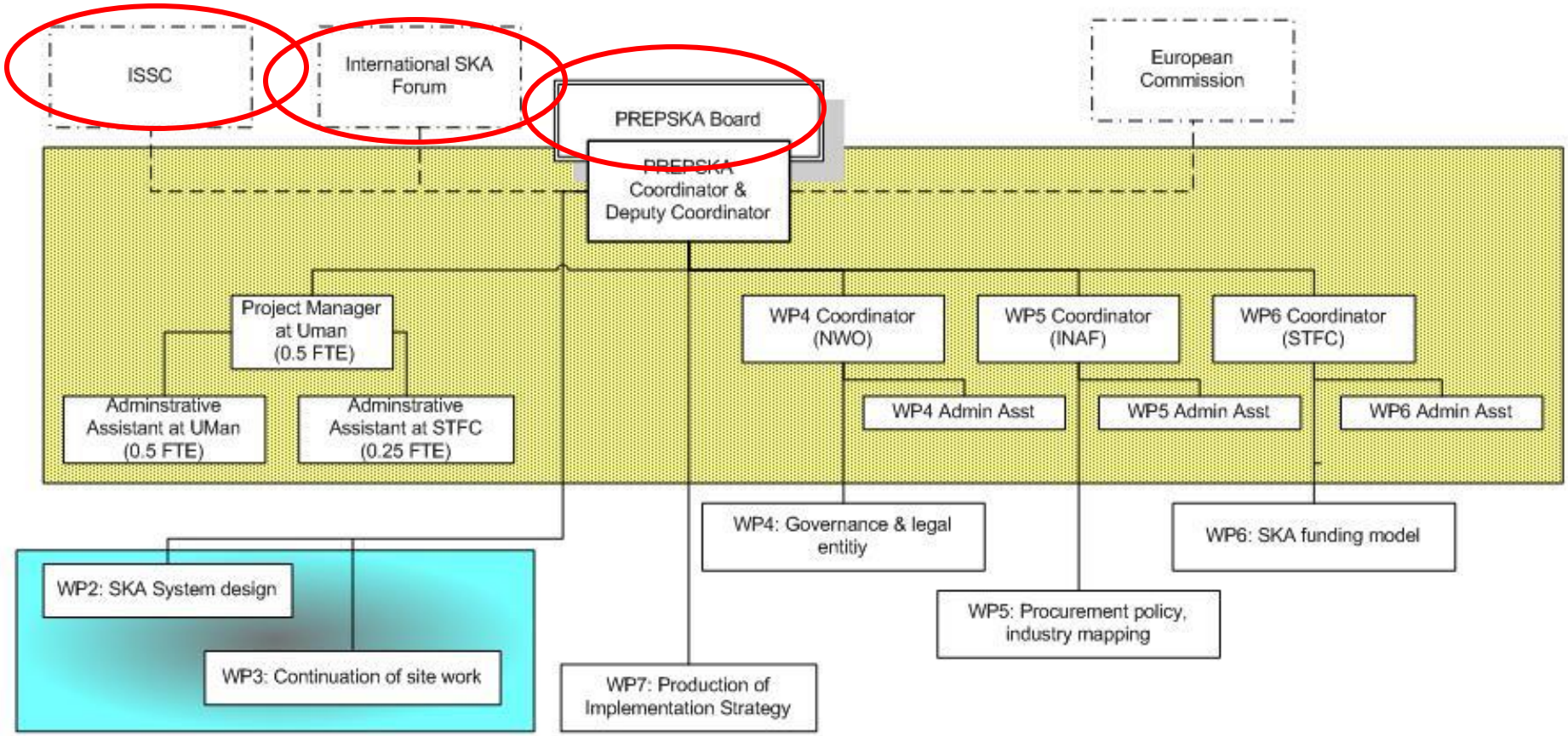
- SKA Science and Engineering Committee (SSEC)
- SKA Program Development Office (SPDO)
  - Contributions: 225k€ (Europe, US), 45k€ (Australia, Canada, South Africa) . Total 585k € p.a. indexed at 3% p.a.
- Hosting the International SKA Project Office
  - University of Manchester

PrepSKA Governance (from PrepSKA proposal in 2007)



Tri-partite governance already visible 1) ISSC → SSEC, 2) International SKA Forum → Agencies SKA Group → Founding Board, 3) PrepSKA Board

PrepSKA Governance (from PrepSKA proposal in 2007)



Tri-partite governance already visible 1) ISSC → SSEC, 2) International SKA Forum → Agencies SKA Group → Founding Board, 3) PrepSKA Board

The SKA Organisation

- Company Limited by Guarantee in the UK
- Headquarters in the UK, Jodrell Bank
- Created 23 Nov, 2011

UK, Italy, Netherlands
Sweden
Canada
China
Australia
South Africa
New Zealand
India (associate)
Germany (Oct 6 2012)

Site selection: 2008-2012

- SKA Site Advisory Committee (SSAC) formed in 2011 by Founding Board and SSEC
  - independent body of experts
  - evaluated information
  - interviewed host site representatives
  - made motivated recommendation via SSG to SKA Board (Feb2012)
- SKA Board received recommendation and provided advice to the Members of the SKA Organization on final decision (May 2012)

Longer term governance models under consideration

1) Treaty

advantages:

- robust structure
- large degree of autonomy compared to other legal models
- flexibility wrt procurement procedures, immigration of staff and users, and tax exemptions
- provides best guarantee for long-term funding for operations and further development

Disadvantages

- Lengthy ratification process by governments, may not be a good match to SKA timeline
- Robust structure means a treaty is difficult to revise

Longer term governance models

2) National Legal Entity

Advantage

- Fast to set up

Disadvantages

- Less autonomy. Procedures and regulations subject to national legal system
- Vulnerable on long-term as it is subject to domestic legislation

Longer term governance models

3) Convention with national legal entity

Advantages

- Flexible organisation
- Guaranteed long-term commitment

Disadvantage

- Start-up process is still lengthy

Longer term governance models

3) Convention with national legal entity

Advantages

- Flexible organisation
- Guaranteed long-term commitment

Recommended Option

Disadvantage

- Start-up process is still lengthy

Longer term governance models

4) **Agreement or MoU**

Advantage

- Quick start-up time

Disadvantage

- Lack of a legal personality is not well-suited to guaranteeing the sustainability of the SKA Organisation

Lessons from SKA

- It takes a long time (22 + years)
- Radio astronomy culture played a critical role
  - Open policies: science, engineering, sky
  - Strong engineering – science link
- Openness now under pressure from site, implementation and national competition
  - An earlier site decision???
- Specific current science should not be driving the specifications
  - Science case may evolve faster than the technology

Lessons from SKA: International

- Global structures can be created
- Achieved broad community involvement
  - But that also resulted in a failure to control scope until recently
- Links with existing International organizations
  - URSI – technology exchange forum
    - » recognition
  - IAU – beginning of the WGFLSF
    - » Sharing ideas on global megascience projects
    - » Communicating ideas to the astronomy community
  - OECD
    - » Examples of other big projects
    - » “Lessons learned” don’t always translate

Lessons from SKA: Governance

- Governance issue were considered from the beginning
- 2000 to 2008
  - activity was largely coordination and communication and not too much joint engineering work

  But
  - we did manage a technology down select and a site short-listing
- Once PrepSKA began in 2008, life became more serious as the funding involved grew larger, the resource conflicts became sharper, and governments and funding agencies took an increasingly active role in the governance and site decision process

Lessons from SKA: bad governance

- 2008-2011, there was effectively a tri-partite governance in operation:
  - Funding Agencies via Agencies SKA Group and Founding Board
  - SSEC
  - PrepSKA Board
- This led to overlap in responsibilities and considerable extra reporting work for the SPDO
- Establishment of the SKA Board on 1 Jan12 has simplified the structure, and there are now clear lines of responsibility

Lessons from SKA the Pathfinders

- Scale of pathfinders has been an issue
  - for South Africa and Australia, scale was large to provide a fallback for non-selection as the SKA site
- Astronomers want useful steps hence big projects
- Technology development needs small diverse R&D activity
- National interests may not be aligned with the International vision
- SKA triggered pathfinders have been a huge success
  - LOFAR, MWA, MeerKAT, ASKAP, FAST