The European SKA Consortium

SKA SQUARE KILOMETRE ARRAY

Calibration and Calibratability for AA's; a System Design Strategy

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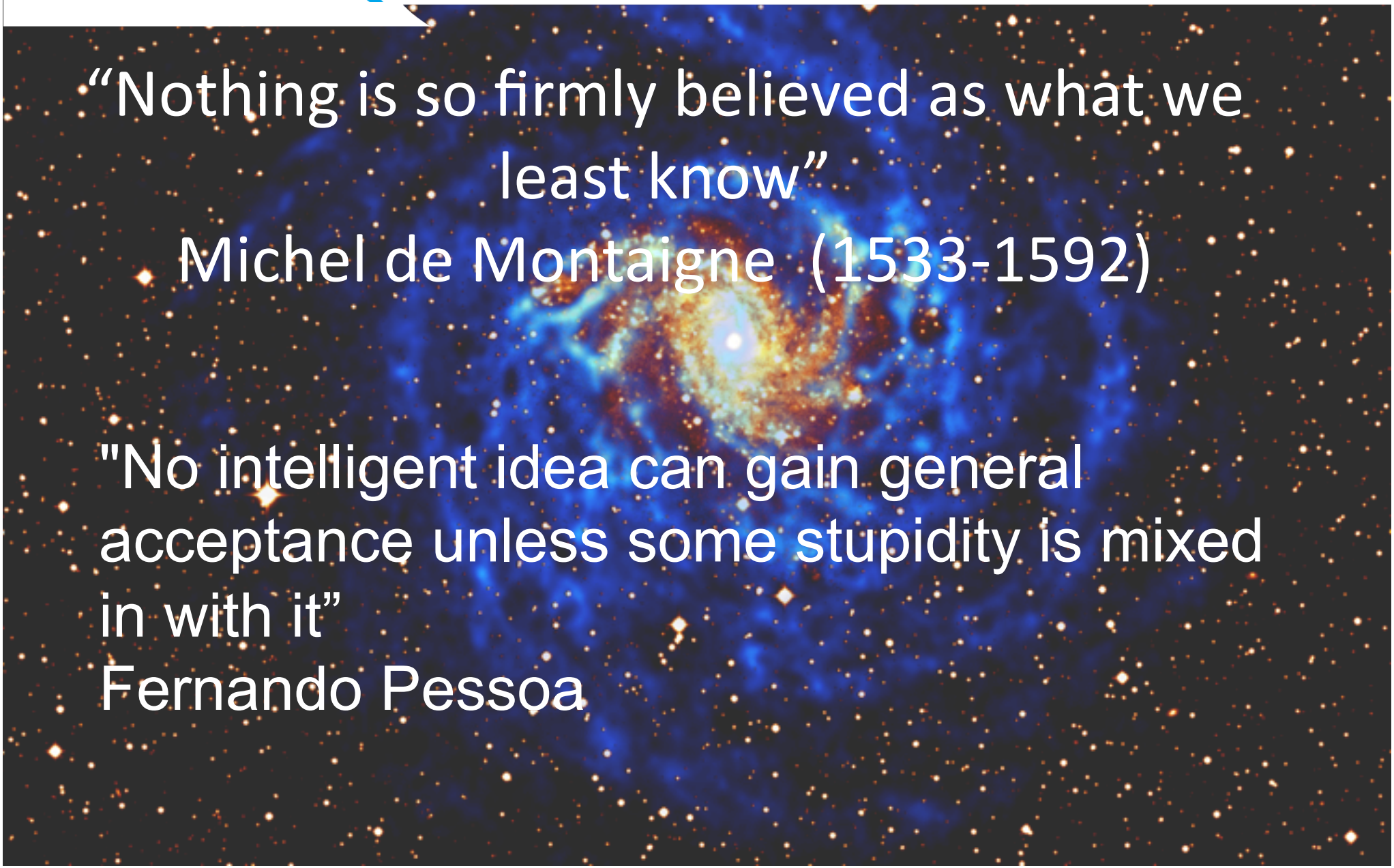


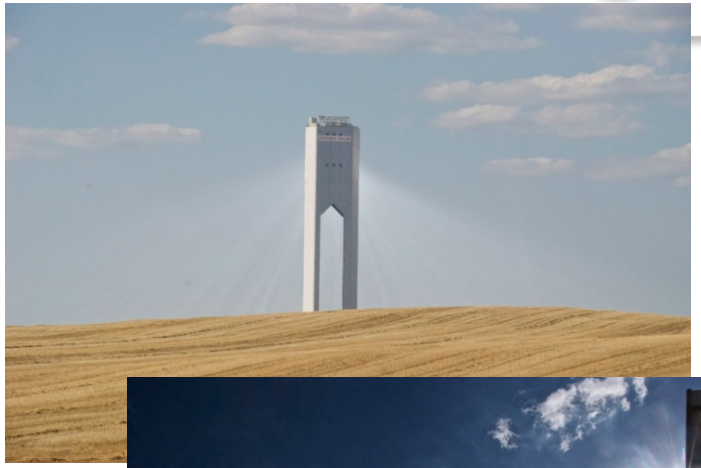
“Nothing is so firmly believed as what we least know”

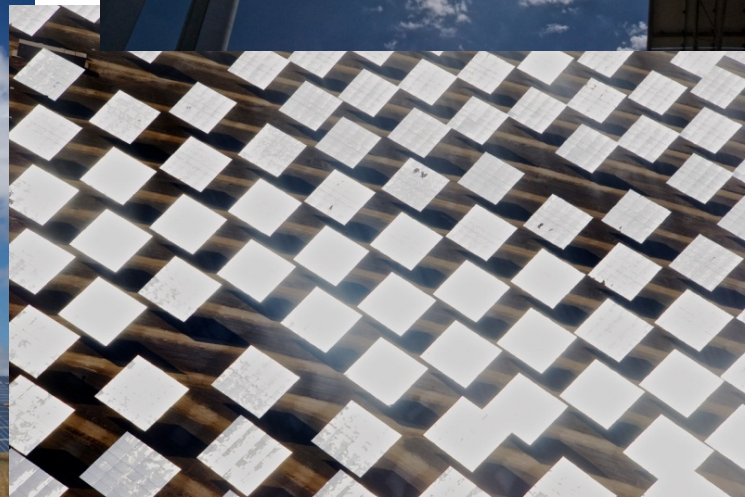
Michel de Montaigne (1533-1592)

"No intelligent idea can gain general acceptance unless some stupidity is mixed in with it”

Fernando Pessoa

Optimizing power from the SKY; Calibrating the instrument





Power for SKA

Workshop Moura/Sevilla

20-21 July 2012

SKA-AAVP

Optimizing imaging from the SKY; Calibrating the instrument

July 12 ***Chair Stefan Wijnholds***

17:00 Opening (Arnold van Ardenne)
17:20 AAs and the SKA (Andre Gunst)
17:40 Overview of SKA aperture arrays (Jan Geralt bij de Vaate)
18:00 Overview and goal of the Calibration & Imaging Working Group (Keith Grainge)

18:20 Drinks
19:00 Dinner

July 13 ***Chair: Keith Grainge***

09:00 Figures-of-merit for signal reconstructability (Tobia Carozzi)
09:30 System requirements derived from calibratability (Stefan Wijnholds)
10:00 SAGEcal and reduction of LOFAR data (Sarod Yatawatta)

10:30-11:00 Coffee break

11:00 StefCal (Stefano Salvini)
11:30 An important lesson learned from redundancy calibration (Parisa Noorishad)
12:00 OSKAR (Fred Dulwich / Ben Mort)

12:30-13:30 Lunch break

Chair: Arnold van Ardenne

13:30 Primary beams & radio interferometric imaging performance (Oleg Smirnov)
14:00 XArray (Nima Razavi-Ghods / Eloy de Lera Acedo)
14:20 Low order beam models (Christophe Craeye)
14:40 Characteristic Basis Function Patterns (Rob Maaskant / Stefan Wijnholds)

15:00-15:30 Break

15:30 Discussion: What are the open questions? What are the next steps to get to an instrument design?

Team

- Core:
  - Keith Grainge (ch.)
  - Stefan Wijnholts
  - Oleg Smirnov
  - Tobia Carozzi
  - Ronald Nijboer
  - Sarod Yarawatta

- Many others; see (e.g.) this workshop

Background

- Context: Aperture Array Verification Program
- Cal & Imaging: System level WG

  Identify and Solve AA-specific CC aspects as seen from SKA
- Focussed, succes oriented
- Previous (AA) workshops e.g. MC-SKADS
- SKA CALIM

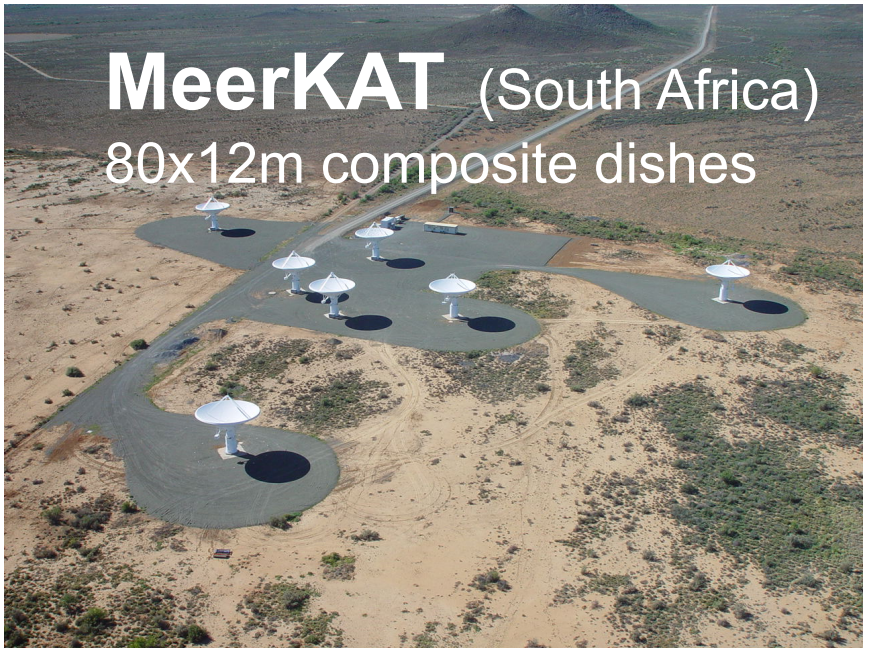
- Results (to) connect to SKA at large
  - How best to ensure? Min.: SKA memo?
  - Flow toward SKA design-at-large e.g. dish receptors

Some aspects

- Convolving the sky with a changing beam
  - How to model
  - How to measure/what is needed
  - Toward what criterium?
  - Dynamic range meaning……
  - Design issues e.g. redundancy vs. #u-v points vs. configuration
  - Required “amount” of Redundancy
  - Imaging modes vs. other modes e.g. tied arraying
  - Specifically: widefielding
    - What about twisted photons? Solved? Tobia!
    - Aspects of polarimetry etc.
    - U, v w, projections etc..
  - Quantization (BF, A/D) effects vs (effective) sidelobes?

- Iff OK for AA’s then what about
  - Consequences for dish designs ; integral feed-dish, config., etc.
  - Over what freq. range
  - Note: Easier for smaller fov’s and toward higher frequencies

Besides AA's: what dish is optimal for the job? (performance/cost)



st radio telescope

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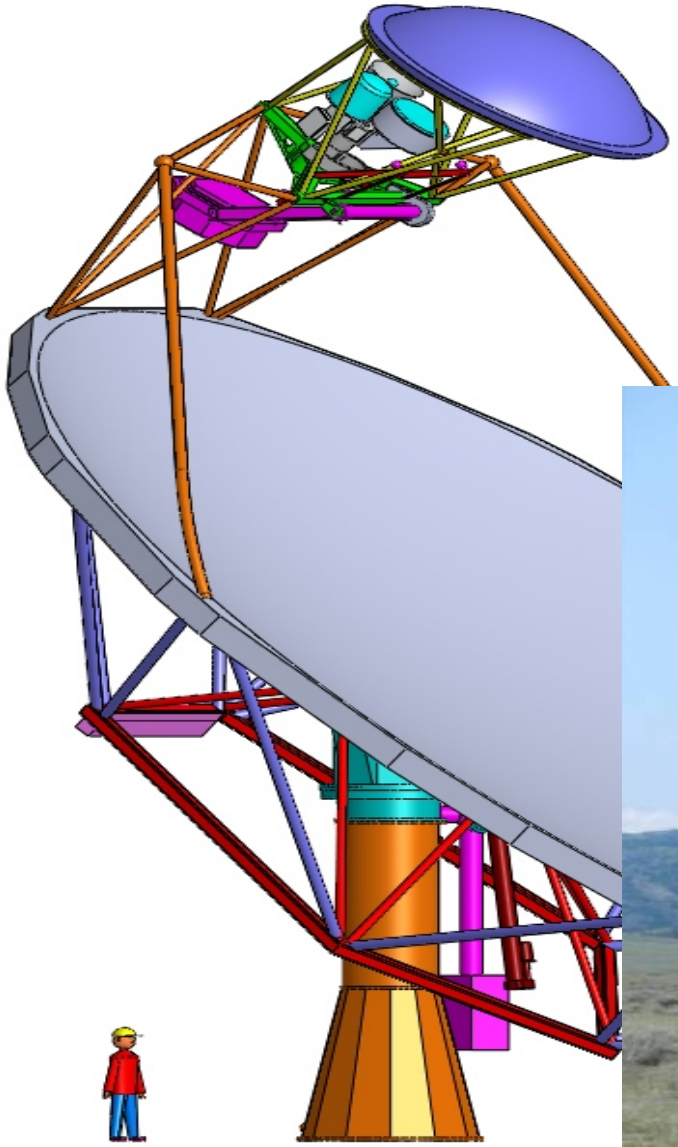
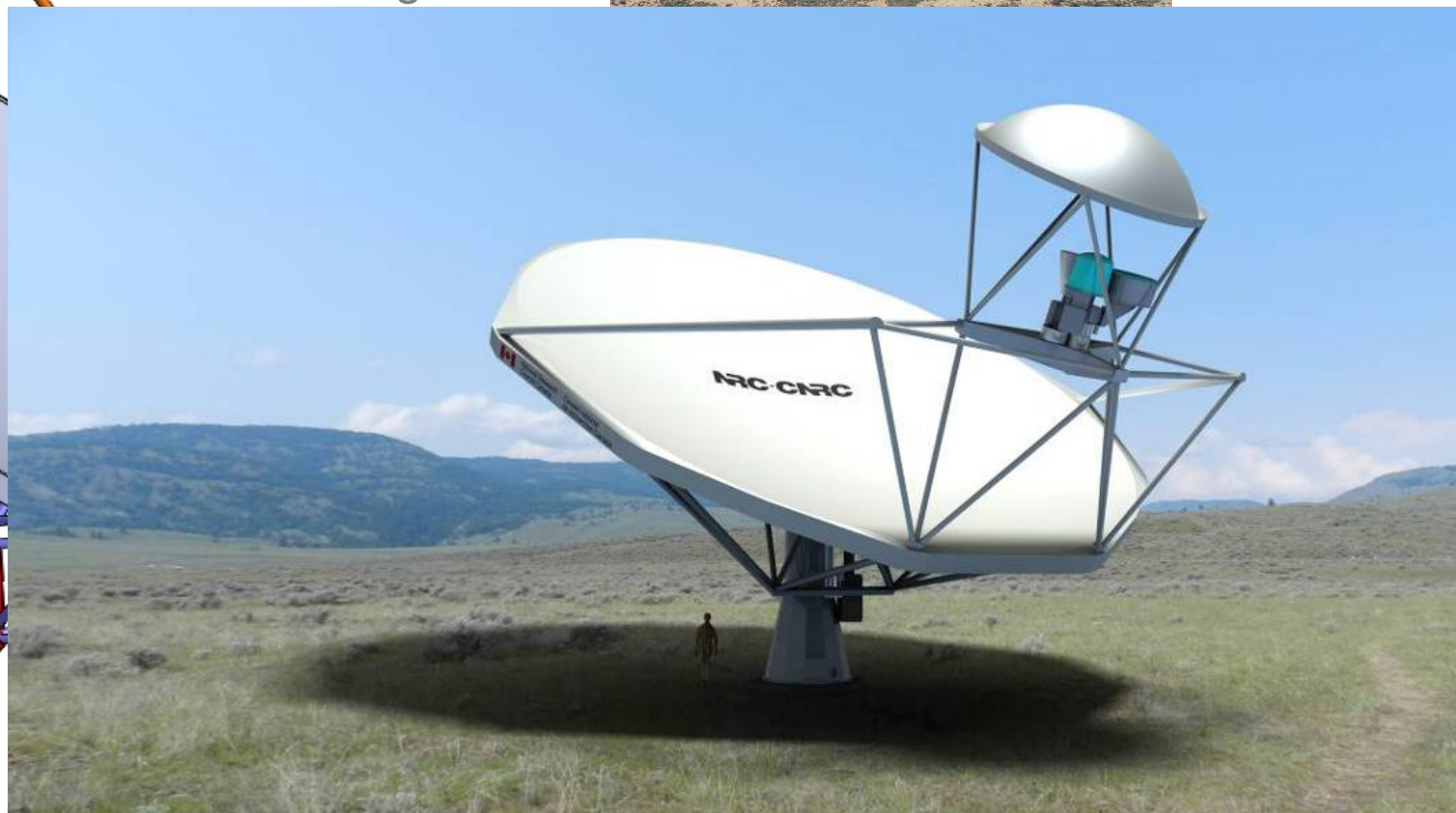


SKA Dish Verification Antenna #1

Mechanical design by Gordon Lacy & Matt Fleming



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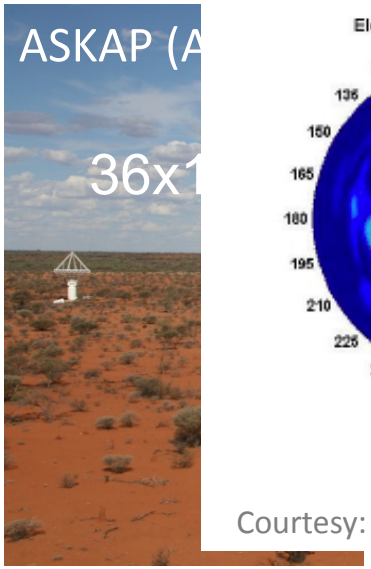
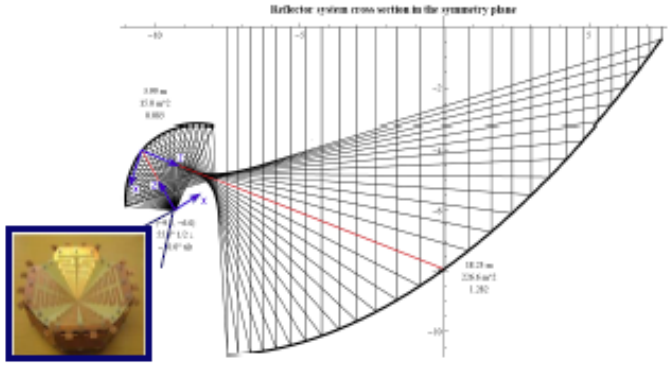
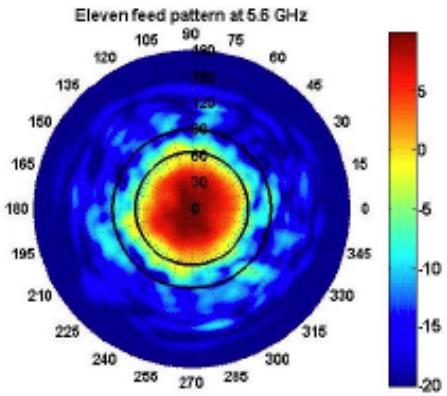


Example sidelobes from gregorian for illustration purposes only

Displaced-axis dual reflector antenna (Gregorian configuration) with Eleven feed





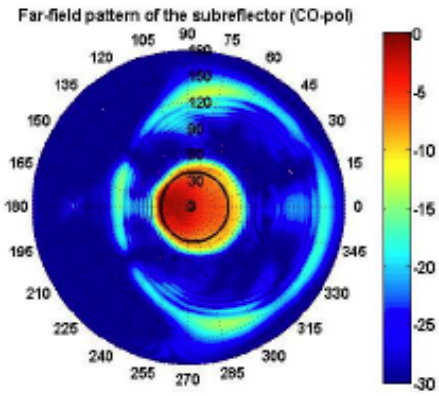
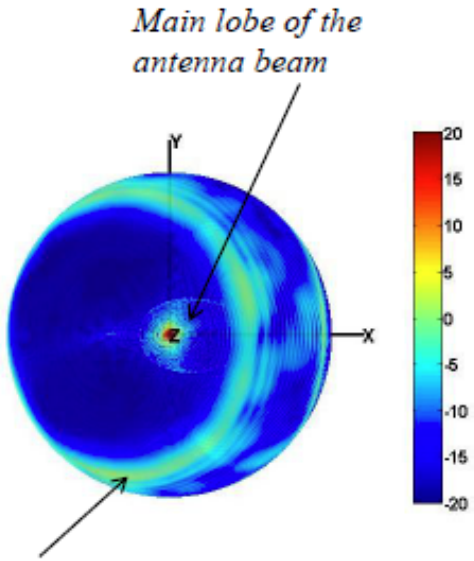
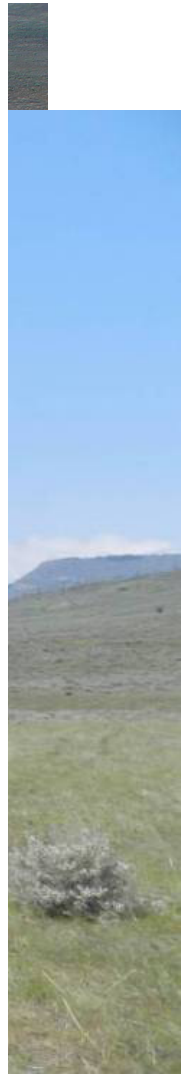


Fig. 1

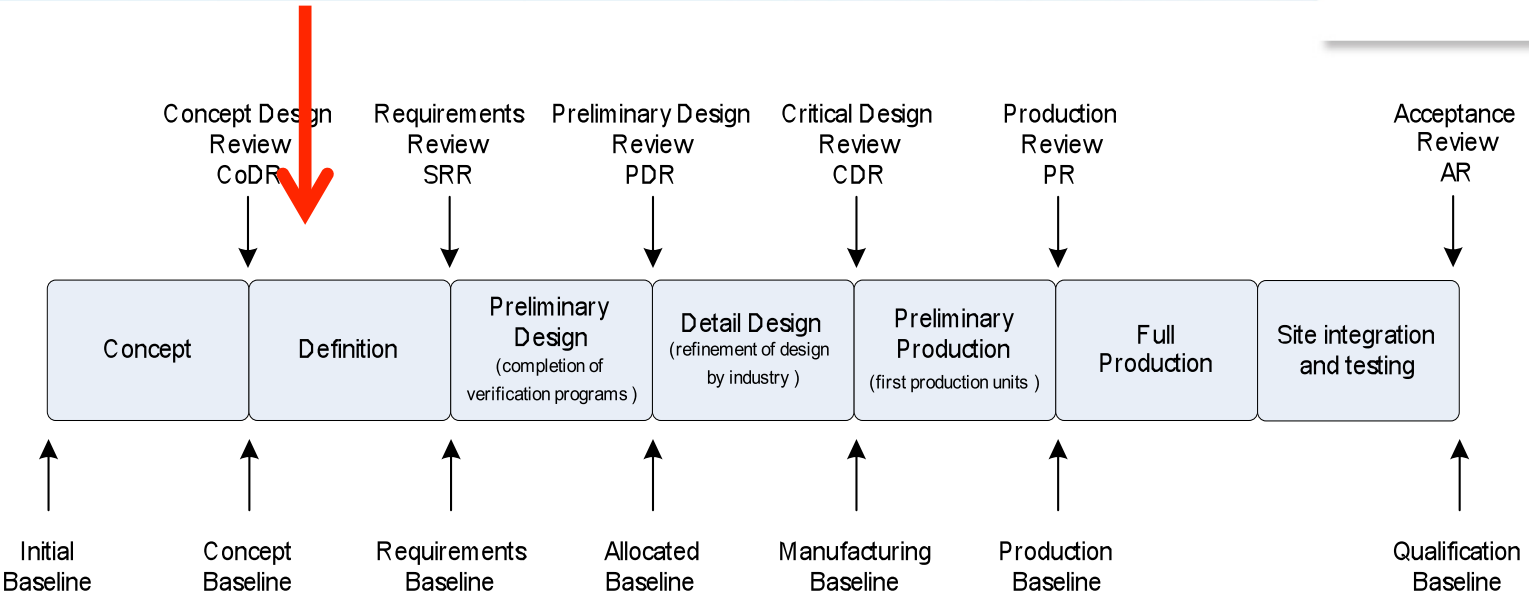


Courtesy: Marianna Ivashina et.al.

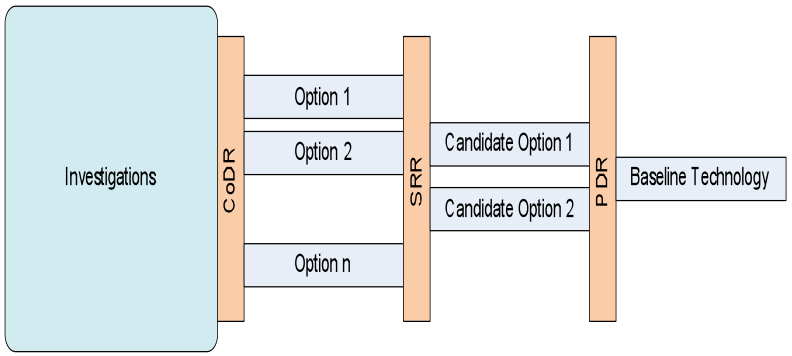


telescope

System Engineering Approach



Note: AA's passed CoDR in 2011



SKA System Engineering Management Plan

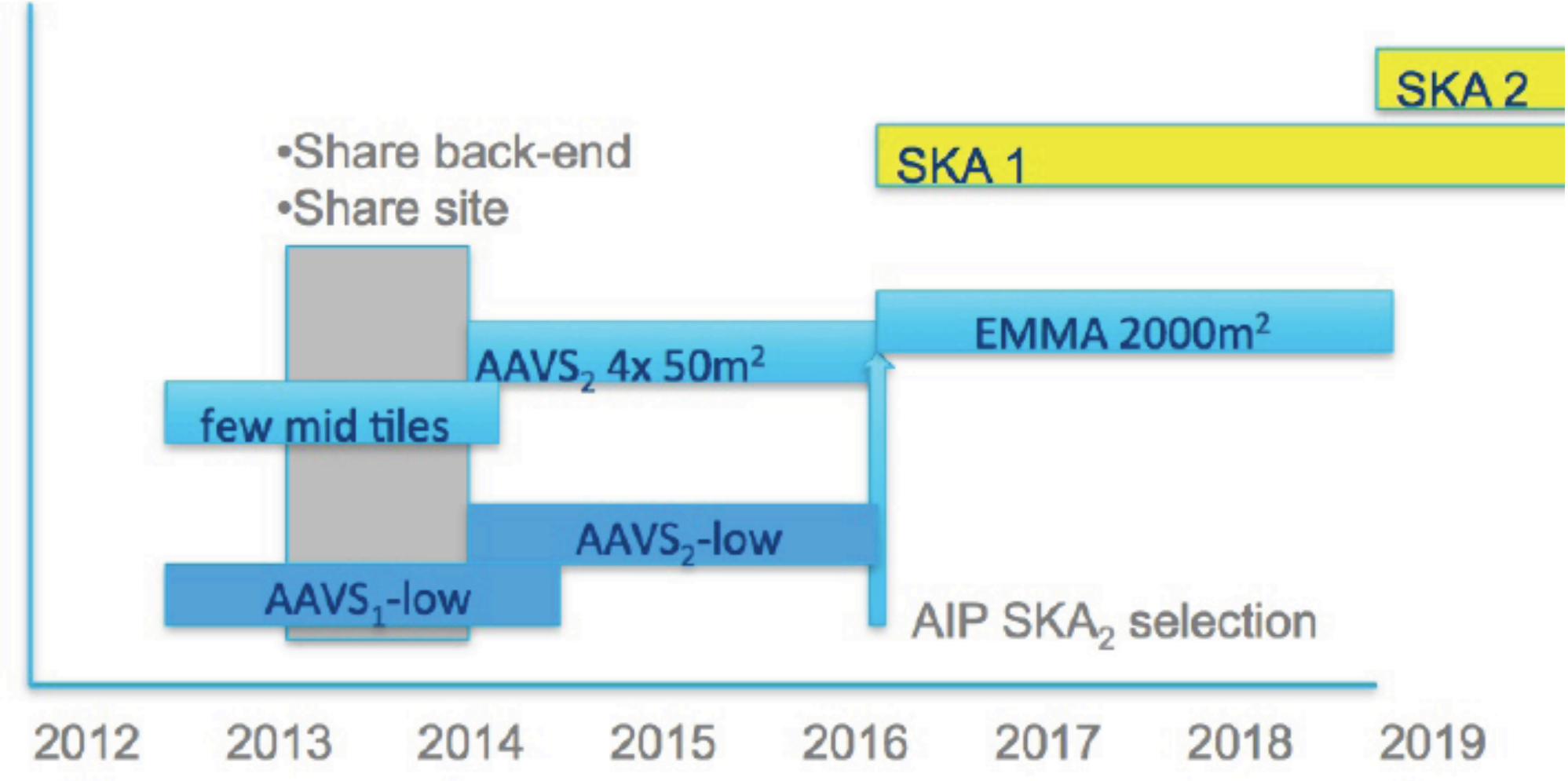
- SKA1/First Stage: Expression of Interest (EoI, done)
- SKA1/First Stage: Req. for Proposals (RfP)

Timeline

1995-00	Preliminary R&D
2000-07	Initial Concept Phase
2008-12	Preparatory Phase
	• System design, Site selection
2012-16	Pre-construction Phase
	• Costed System Design, Detailed design, Production readiness
2016-23	Construction
2020-50+	Operations

Aperture Array Demonstrators in SKA timeline

High Frequency AA pathfinder demonstrator: Emulating "***Single" SKA Station-level*** but see other Presentation (JGbdV)



Team expertise areas

- System design
  - configuration, connection astro-techno, low freq. array expertise/ LOFAR, …
- Simulation tools
- Common language; “Semantics right”
  - e.m., widefield issues, mathemathics, ME
- Calibration algorithms
- Beam modeling

Toward the agenda:

- Interest in SKA growing e.g. from Pt/Sp , Germ. and Korea; excellent positioning mechanism (Sweden joined recently)
- Major steps taken
  - SKA Organization
  - (Dual) Site
- Next steps to be defined in collaboration at SKA level

- Sound Engineering project:
  - Costed system design
  - Clear roles
  - Calibration at SKA level 2 affects choices at lower levels

- SKA Design to be done <2 yrs?