Agenda

Session		Presenter	Starting Time	Time Allocated
	Tuesday, 19 April 2011			
	Panel members arrive at Schiphol			
	Lunch		**12:00 – 13:00**	**1 hour**
1	Review Panel (closed meeting)	Reviewers	13:00 – 13:30	30 minutes
	Welcome and General Overview of SKA	RTS	13:30 – 13:50	
	General Overview of AA	AvA	13:50 -14:05	15 minutes
	Purpose and Context of the AA CoDR	KC	14:05 – 14:20	15 minutes
	AA Science Case	SR	14:20 – 14:50	30 minutes
	AA System Requirements	AG	14:50 – 15:20	30 minutes
	Coffee Break		**15:20 – 15:40**	**30 minutes**
2	High Level System Description	AF	15:40 – 16:25	45 minutes
	Engineering: Technical AA Concepts	JGbdV	16:25 – 17:15	50 minutes
	AA Risks and Risk Management	AvE	17:15 – 17:30	15 minutes
	Review Panel (closed meeting)	Reviewers	17:30 – 18:00	30 minutes
	Drinks and Dinner		**19:00**	
	Wednesday, 20 April 2011			
3	Deployment and Operations	AF	09:00 – 09:45	45 minutes
	Strategy to proceed to Next Phase	AF/ AvE	09:45 – 10:15	30 minutes
	Coffee Break		**10:15 – 10:45**	**30 minutes**
	Summary of AA for SKA	AvA	10:45 – 11:15	30 minutes
	Review Panel (closed meeting)	Reviewers	11:15 – 12:30	75 minutes
	Lunch		**12:30 – 13:30**	**60 minutes**
4	Initial feedback to AA Team	Reviewers	13:30 – 14:30	60 minutes
	Summary and closing of the review	AvA/KC	14:30 – 14:45	15 minutes

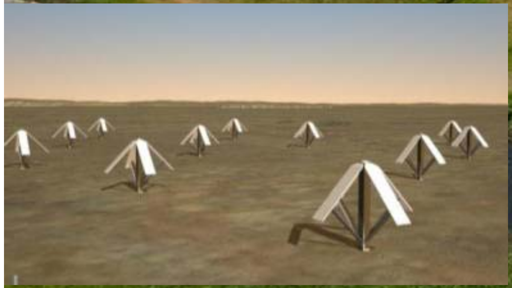
General overview

; Organizing AA's for the SKA

Arnold van Ardenne

AAVP-Coordinator

ardenne@astron.nl



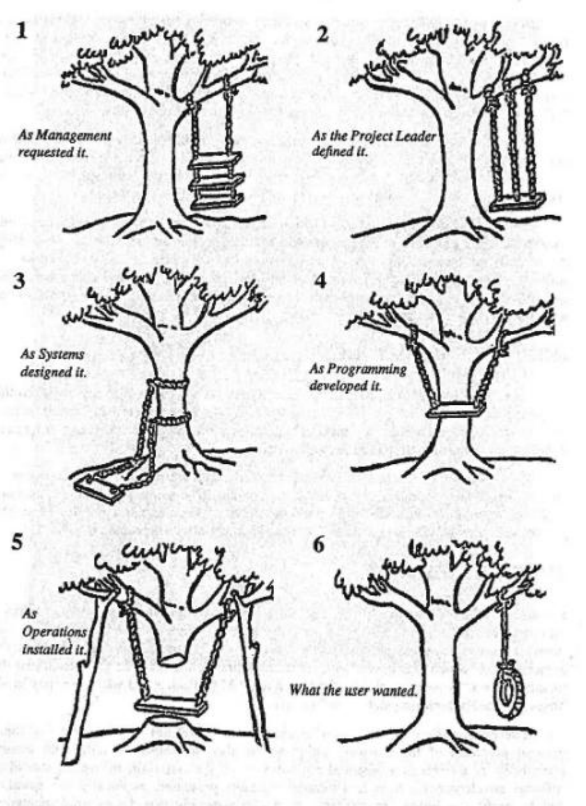
Courtesy: Lofar & SKADS/AAVP teams

SKA AA System Design 2005-2012

- (Early R&D 1995- 2004)
- SKADS - EC funded SKA design Study 2005-2009
  - EC FP6 funding 2005-2009 (€ 10.0M) plus additional for Marie Curie
- AAVP 2010- 2012
  - nationally funded (Eur/Aus) supplemented by PrepSKA
  - Context provided by SKA/SPDO
  - Activities based on System design approach
- AA-Relevant Pathfinders & Demonstrators
  - LOFAR-ILT, MWA, LWA, EMBRACE , APERTIF
  - Others for e.g. SP/network purposes e.g. JIVE/UniBoard

Continuation:

AAVP after 2012 (“Pre-Construction incl. detailed design) part of next SKA funding based on PEP



IMPEDANCE MISMATCHES
(Pre-1970 cartoon; origin unknown)

AA-low, following SKA1 BL specs

Table 3: Phase 1 Sparse Aperture Arrays			
Sparse Aperture Array			50, 180-m diameter stations
Lower Frequency		70 MHz	Dual polarization (2 orthogonal)
Upper Frequency		450 MHz	Single element covering full range
Number of antennas		11,200	Per station
Total physical aperture		$1.3 \times 10^6\ m^2$	50 Stations
Area per antenna		$2.27\ m^2$	180 m diameter station
Dense/Sparse Transition λ*		2.6 m (115 MHz)	A_e per element is equal to packing density.
Array Configuration		50 stations	
Core (radius <0.5 km)		~50% (25 stations)	Fractional total number of AA stations.
Inner (1< radius<2.5 km)		~20% (10 stations)	″
Mid (2.5<radius<180 km)		~30% (15 stations)	In clusters of 5 stations (Total of 15 clusters)
Core filling factor		0.81	$A_{core} = 7.9 \times 10^5\ m^2$; $A_{ant} = 6.4 \times 10^5\ m^2$
Number of beams		480	
Instantaneous bandwidth per beam		380 MHz	Assumes full bandwidth is available (70-450 MHz)
Digital Outputs			
Sample streams		960	Max - sub-bands
bits per sample		4	

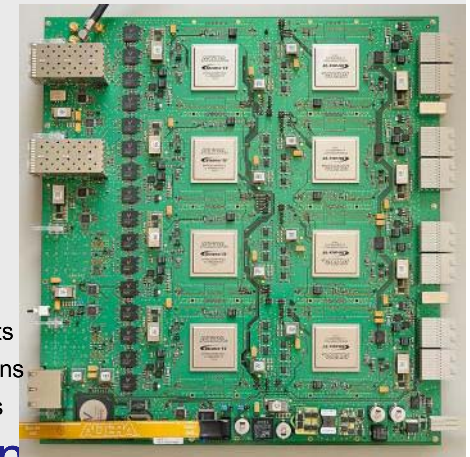
Science reference : DRM version 1.3

Next steps: detailed technical requirements/design explorations

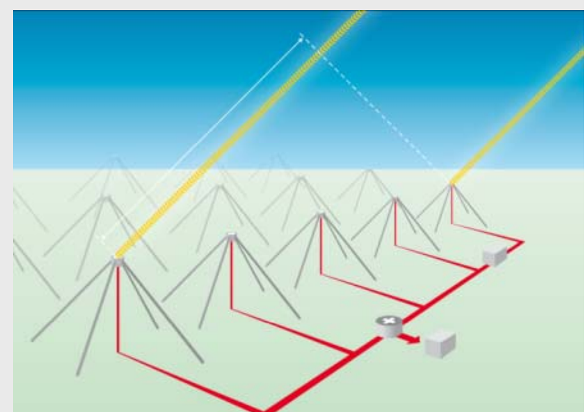
AAVS1: AA-low

- Demonstrate electromagnetic and front end performance
  - Sufficient collecting area (250-500m^2?), possibly two versions
  - Focus on **broadband** antenna and front-end design
  - Evaluation using existing processing
    - UNIBOARD, ROACH or LOFAR / MWA

- 14 Layers
- 340x366mm
- 7304 components
- 25798 connections
- 271 meter traces



  - Goal: establish antenna, tile and station configuration
    - Extensive station simulations required



  - Concept Des. Review 19/20-04-2011
  - Prel. Design Review 31-12-2011
  - Commissioning 31-12-2012
  - Reporting 30-6-2013

Int. Murchison Widefield Array

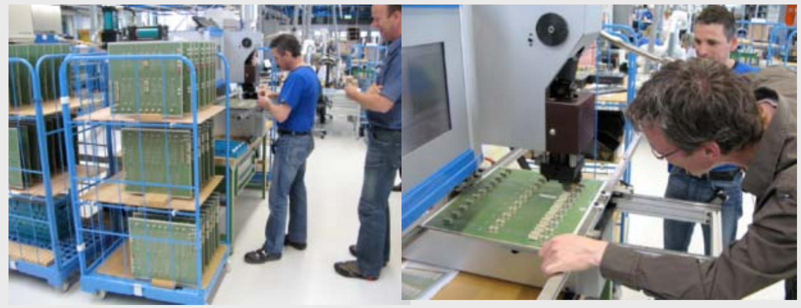
Key players

- AUS/ICRAR, CSIRO
- US/MIT-Hayst,, e.o.
- India/RRI

LOFAR Lessons learned Areas vs industrial participation

Courtesy: M. van Haarlem

- Procurement Rounds



- Supervising Mass Production

- Producing High Band Antenna

- Station Construction

and in parallel

The Advanced Instrumentation Program

- Further development of innovative wide-field *"radio camera"* technologies with the potential to enhance Phase 1 and be a major part of Phase 2:
  - dense aperture array (FoV ~ 200 deg^2)
  - phased array feeds (PAFs) on the dishes (FoV ~ 30 deg^2)
- Development of ultrawideband feeds
- Enhancing SKA_1 and being a major part of SKA_2 ; tbd 2014

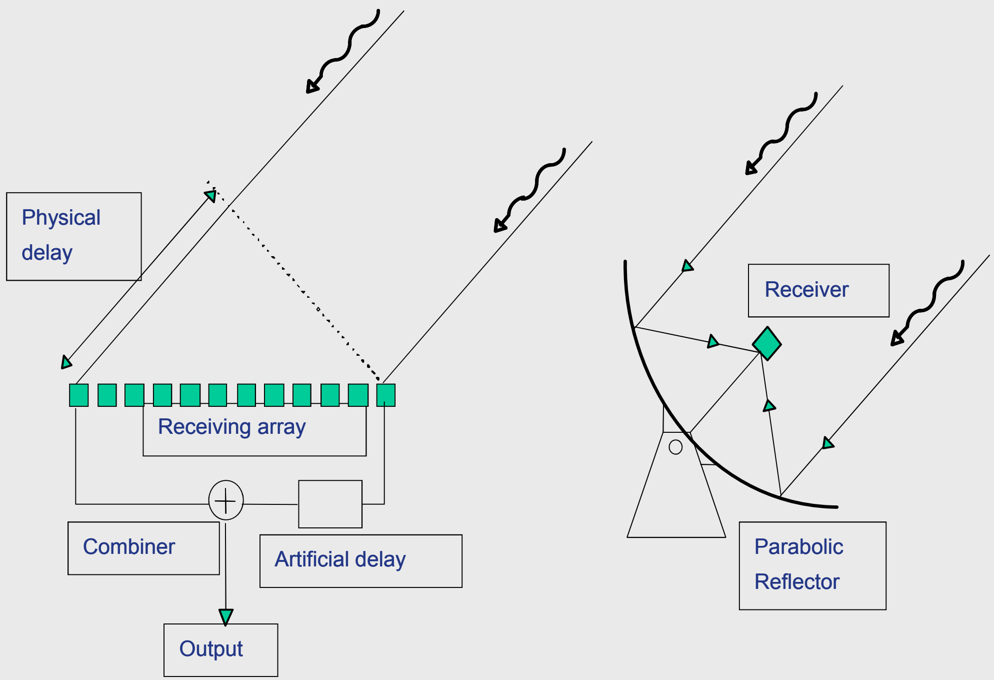
Decision in 2016

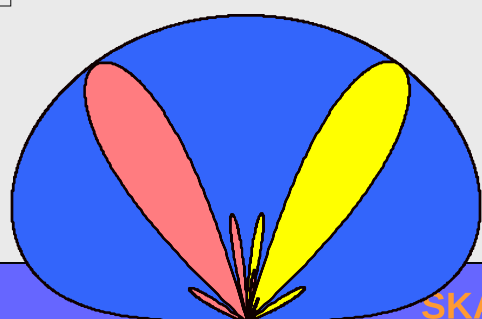
Draft specs for AA_MID/AIP

AAVS			Remark
	A_{eff}	~2000 m^2	Effective area
Front-end	A_{eff} / T_{sys}	40 m2/K	0.5 – 1.2 GHz, at broadside
	Array distribution	14 stations	2D configuration, baseline < 1km Indicative, uv coverage calculation will determine number of stations
		0.4 – 1.4 GHz	Smooth degradation for 1.2 – 1.4 GHz $Aeff_{1,45GHz}$ > 0.5 $Aeff_{1,2GHz}$ No Grating lobs < 1,45GHz (< 45° scan)
	Inst. Bandwidth	350MHz	
	Array type	Dense	Close packed, Nyquist sample incoming wave front, approx. constant A_{eff}, best dynamic range
	System Temp	<50K	@ 1GHz
	Scan angle	±45°	
	Beamformer	Phase and time delay ≤ 45° steps	Analogue beamformer at tile level
	Polarisations	2 linear	
	Sidelobes	<12 dBc	With uniform taper, other tapers possible with implications for Aeff
Processing	*Substation beamforming*		
	Inputs	128 x 4	Assumes 14 substations of 128m^2, each square meter produces 1 RF output, Dual pol, 2 FOVs
	No. beams	32	Generated within each FoV
	Freq. channels	16.000	
	Correlator		For 14 substations, full Stokes, 2 pol
	Imager		
System	Phase/amplitude stability		
	Sensitivity		

For PDR: detailed technical requirements/design explorations

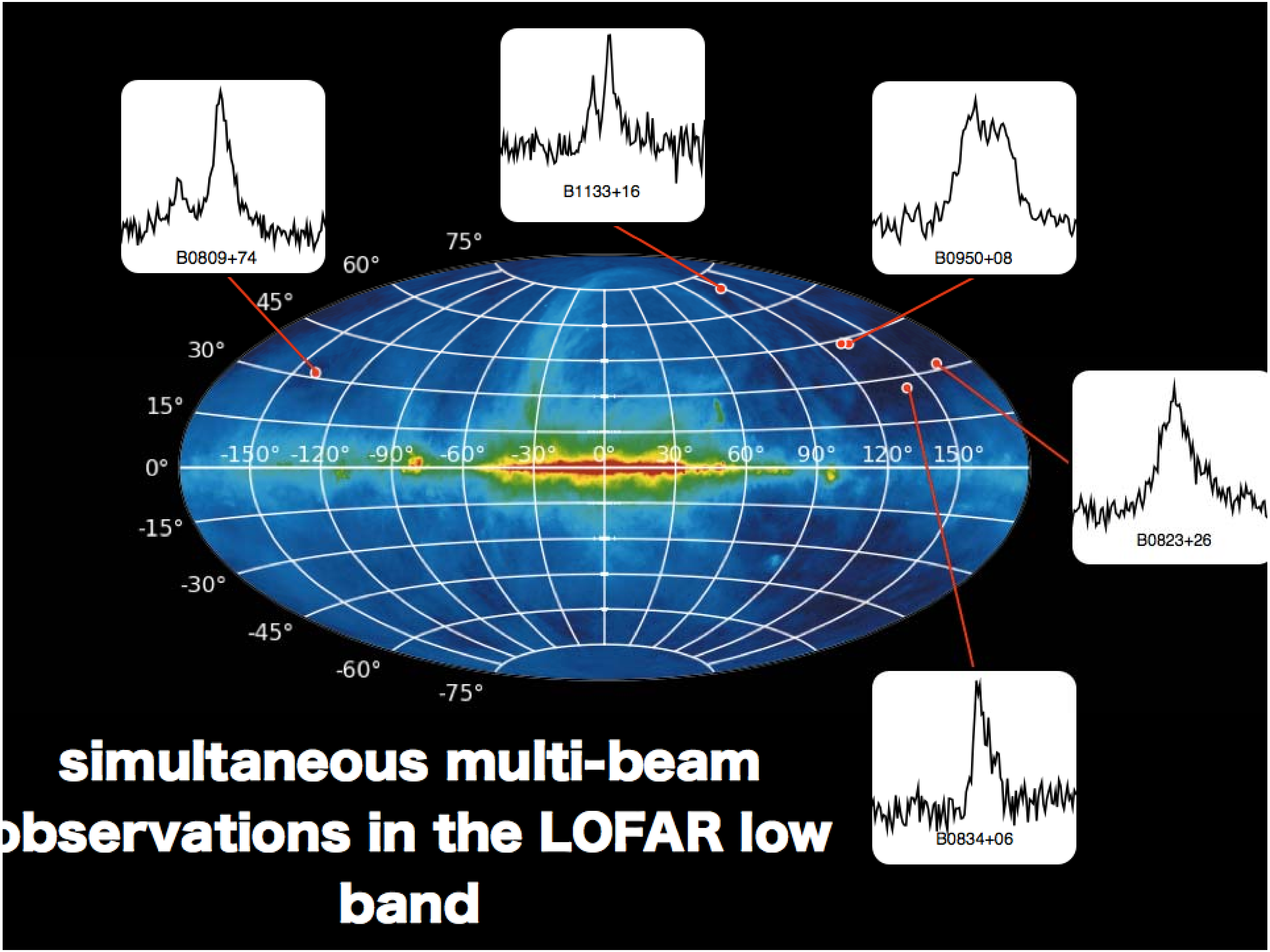
Principles widefield Radiotelescopes for SKA





LOFAR (dipool-antennes)

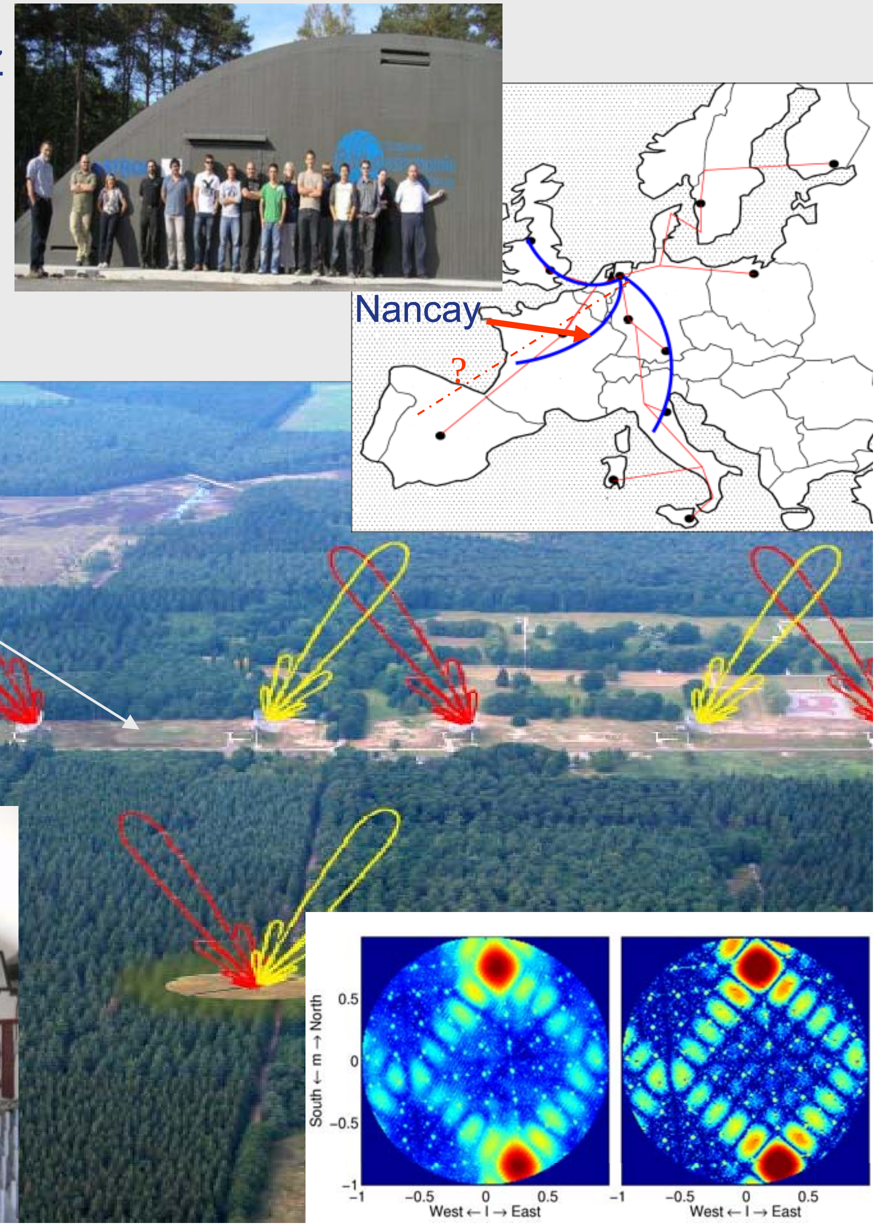
LOFAR Stations Across Europe; 70% naar Nl industrie

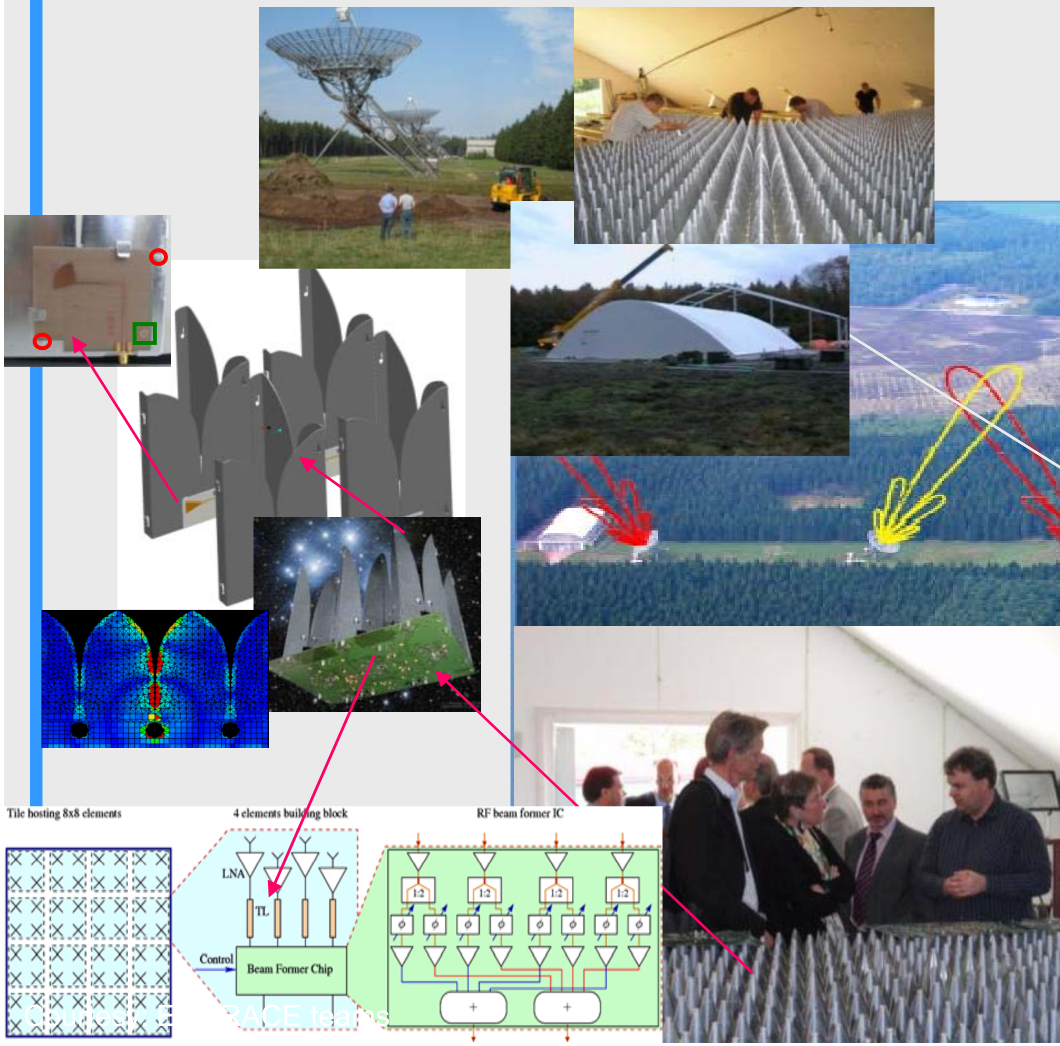

B0809+74
B1133+16
B0950+08
B0823+26
B0834+06
75°
60°
45°
30°
15°
0°
-15°
-30°
-45°
-60°
-75°
-150°
-120°
-90°
-60°
-30°
0°
30°
60°
90°
120°
150°
simultaneous multi-beam observations in the LOFAR low band

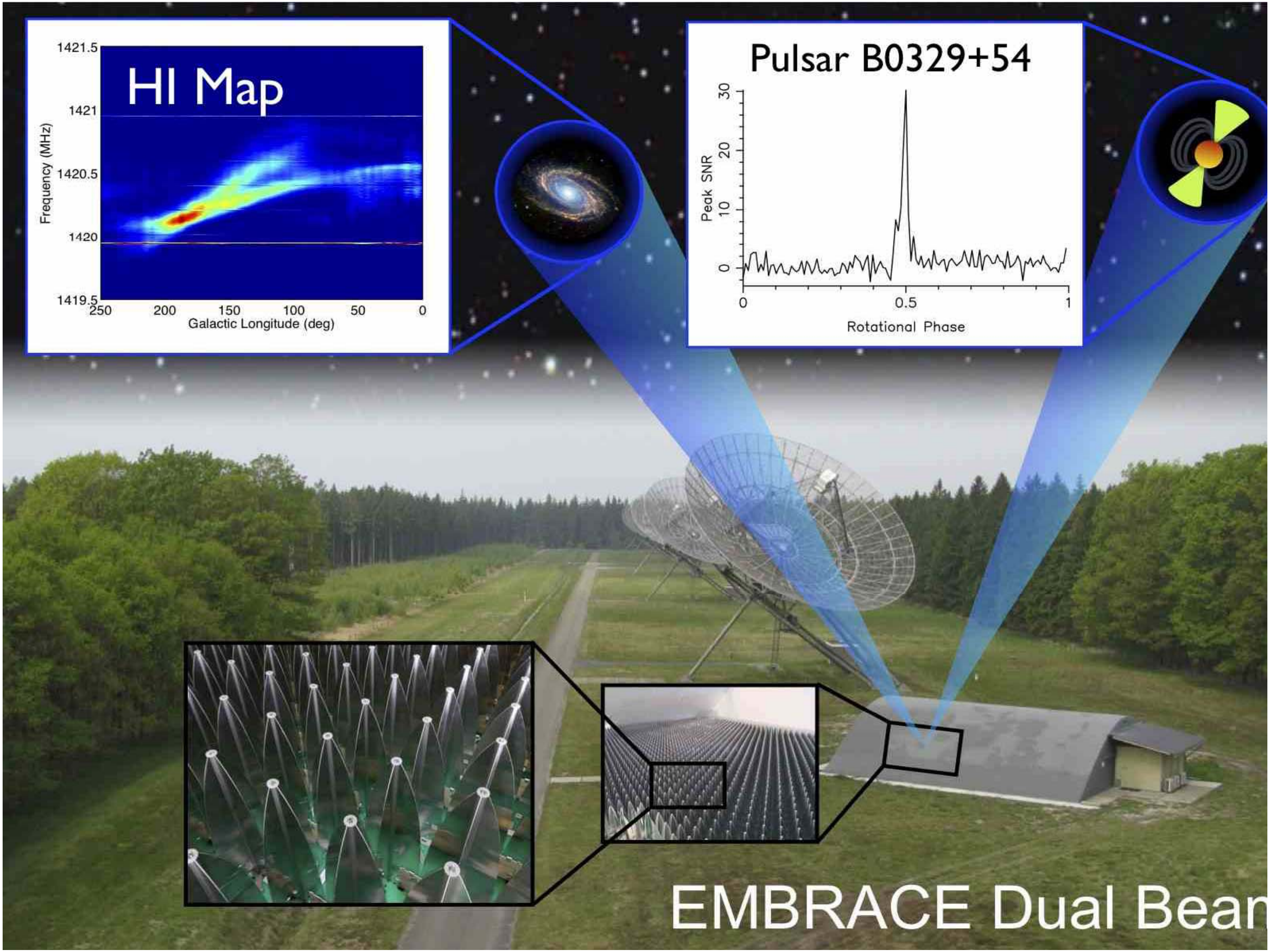
EMBRACE;
a world-first 0.5-1.5GHz Dense SKA-AA Demonstrator

FOV: ~ 140 sq. deg. / tile beam @ 1200 MHz

Courtesy: ASTRON, OPAR, INAF, MPIfR






HI Map
1421.5
1421
1420.5
1420
1419.5
Frequency (MHz)
250
200
150
100
50
0
Galactic Longitude (deg)
Pulsar B0329+54
30
20
10
0
Peak SNR
0
0.5
1
Rotational Phase
EMBRACE Dual Bear

Principal Deliverables in time

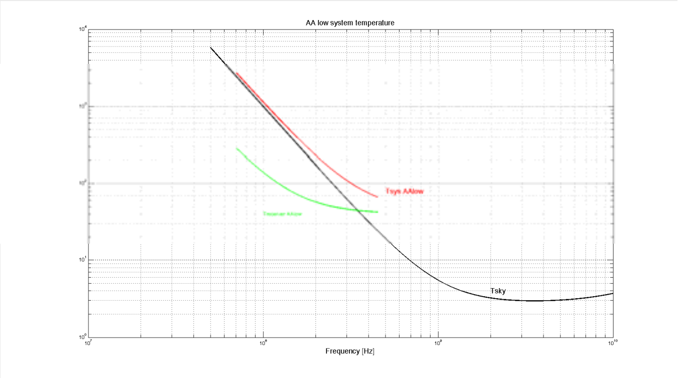
AA-low	Technol. demonstrator & Costed sub-system design	AAVS1	2013
	SKA_1 full pre-production prototype array	AAVS2	2015
	SKA_1 manufacturing data package		2015
AA-mid	single array performance demonstrator	AAVS1	2013
	multi-array interferometer performance demonstrator	AAVS2	2014
	SKA_1 capable costed design		2015
AA system	AA-lo and AA-mid CoDR		2011
	SKA_2 technology roadmap & costed system design		2015

Programmatics 2011

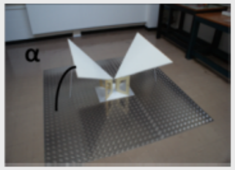
- 1Q2011: Updated AAVP project- and activity plan Updated org-diagram, Collaboration agreement being finalized
  - *AAVP reports to "Board" i.e. AAVP Steering Group (met once);*
  - *Stakeholders responsible "per national activity"*
- Appointed Project Manager and Verification Scientist
  - *Derek McKay-Bukowski (PM)& Ilse van Bemmel (VS)*
  - *Funded through PrepSKA-SPDO*
- SPDO AADomain specialist 50%
  - *Andre Gunst*
- AA-CoDR 19-20 April follows SKA deltaSystem CoDR
- AA-low workshop held in Perth 6-9th September (ICRAR is hosting)
  - Main purpose: Preparing for Preliminary Design AA-Low review in December
- Prelim Des. Review in connection to AAVP Conference Dwingeloo
  - 12-16th December
  - PDR dates TBC
- ***Note: Workshop ICT in Aveiro(Pt) 24-25 May***

AA- design issues

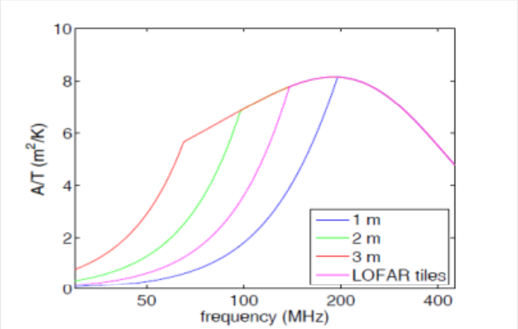
- Dealing with strong frequency dependent skynoise vs receiver noise



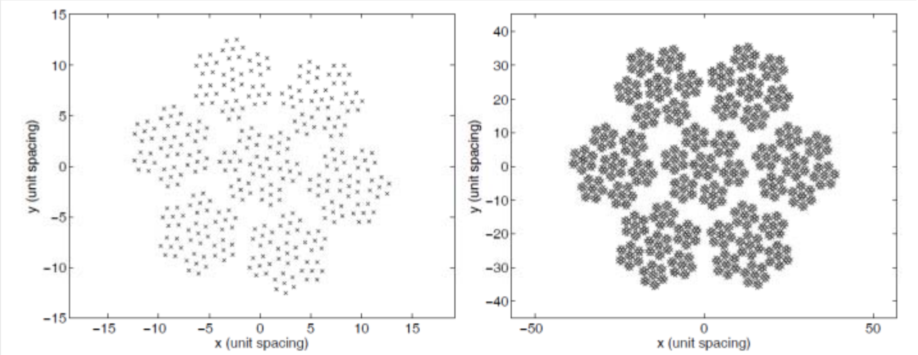
- Antenna design e.g dual vs single band



- Optimal frequency dependent Configuration (e.g. “snowflake”)



Sensitivity as function of unit spacing

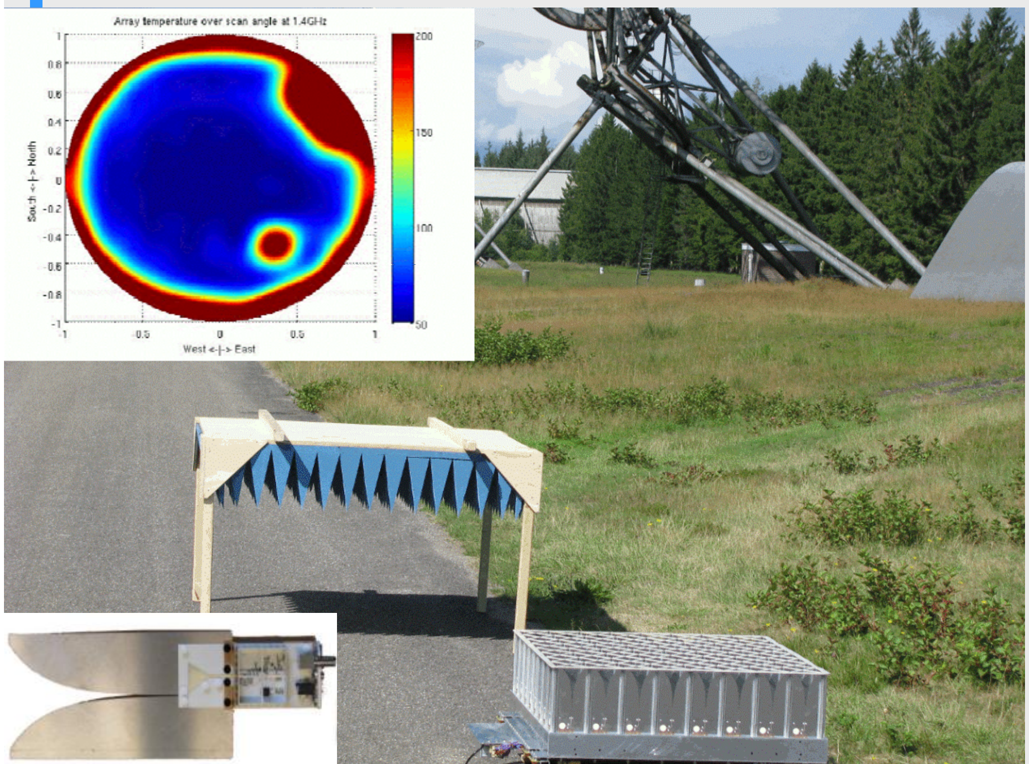


Bregman Wijnholds 2011, ASTRON-RP-468
Grating lobes -20dB

- Dense vs sparse vs science requirements
  - Connected to configuration, filling factor, calibratibility, e.m. design, etc. See see above.

AA's for SKA-Mid; outlook on system noise performance; <50 K Tsys

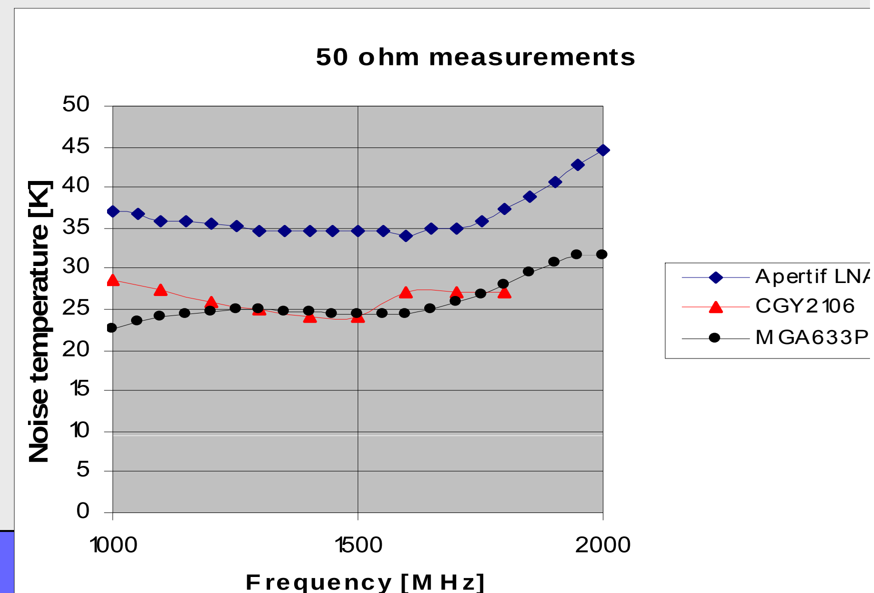
- setup for Y-factor method and zenith results
- system temperature distribution over the sky



Courtesy: Bert Woestenburg, Laurens Bakker, Wim van Cappellen

Tsys noise budget @ 1400 MHz
for Apertif AA-tile (49-element array, broadside)

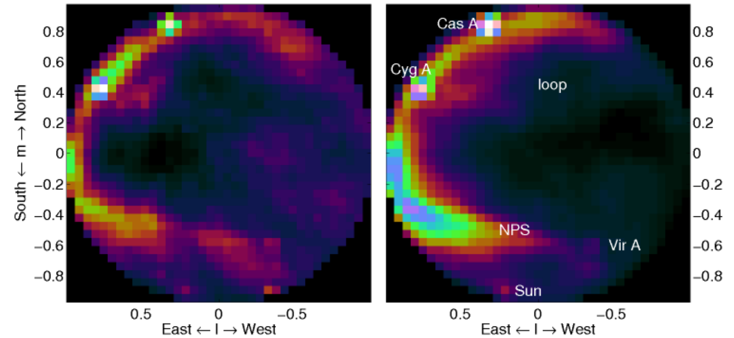
Antenna loss	4 K	
LNA (incl. 2-nd stage)	35 K	< 25 K
Noise coupling	7 K	
Spill-over	0 K	
Sky noise	3 K	
Total	49 K	<39 K



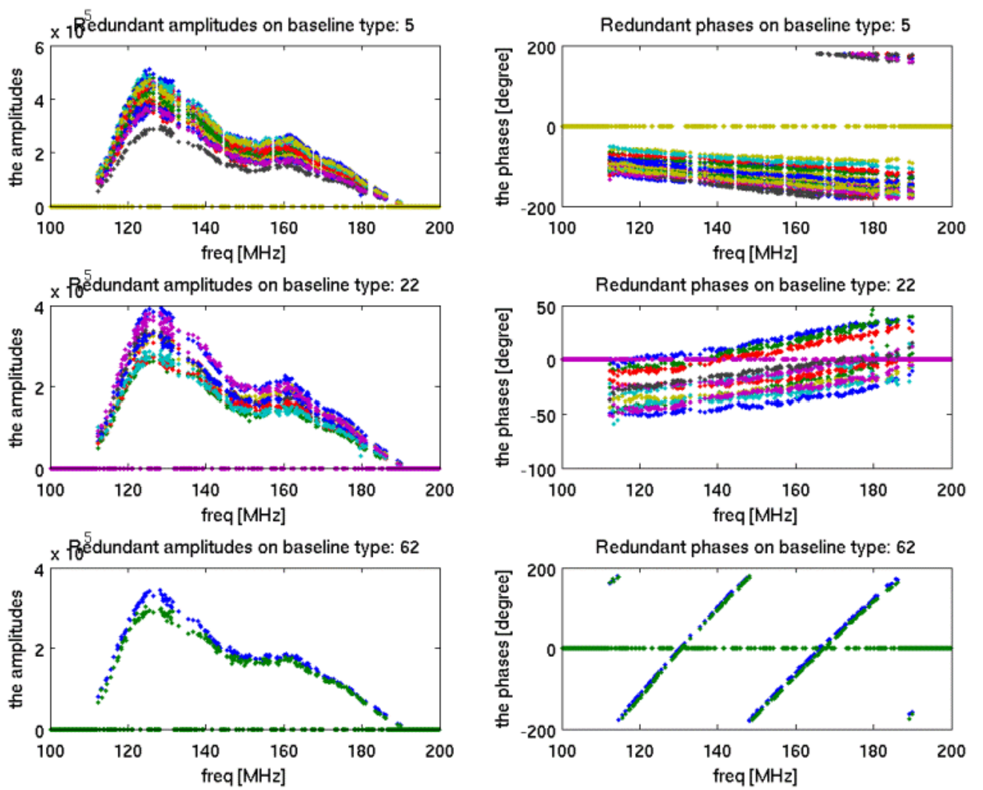
Calibration and Imaging

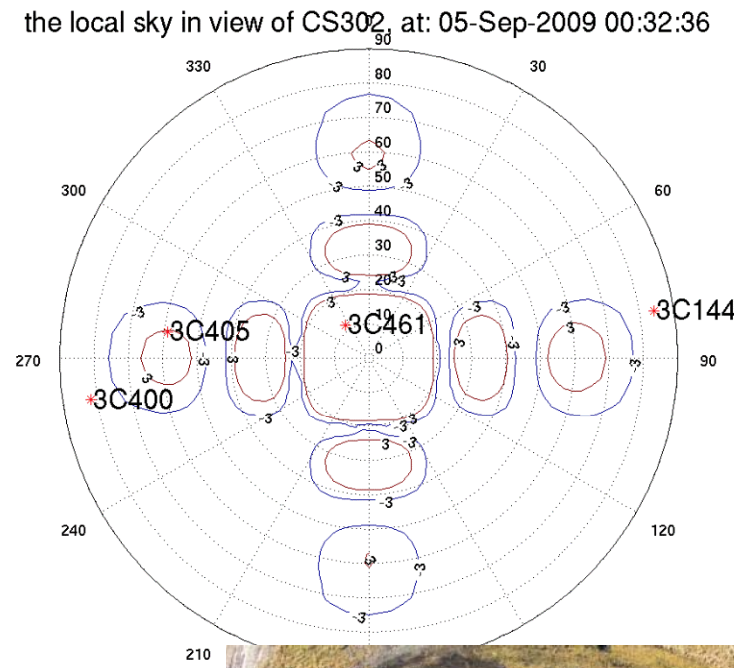
- Strong Calibration , Imaging and Commissioning team
  - Strong diffusion from LOFAR
  - Expanded to allow fresh thinking
  - Task lead by Keith Grainge (UCam). Core: Keith, Stefan Wijnholds (SP, algorithms, station calib), Oleg Smirnov (ME, HDR imaging), Ronald Nijboer (algorithms, math.), Tobia Carozzi (widefield polarimetric Imaging), Fred Dullich(beam sim.)
  - Associated: Jan Noordam, Parisa Noorishad, Paul Alexander, Rosie Bolton
- Complex multi-issue task
  - Dealing with frequency dependencies, configuration, computational efficiencies e.g. modelbased station calibration (N cubed vs NxNlogN) vs other approaches
  - (effects of) Multiple sources (changing over frequency), correlated noise, low SNR, propagation effects, computing resources (large data rates (Tbts, Ebps), real-time calibration)
- Interacts with SKA-Calim and co-workers
  - US, Aus, Europe
- Now drafting issue-based workplan
  - Dealing with TIDs, strong sources, mutual coupling, beamshape stability, calib. accuracy?

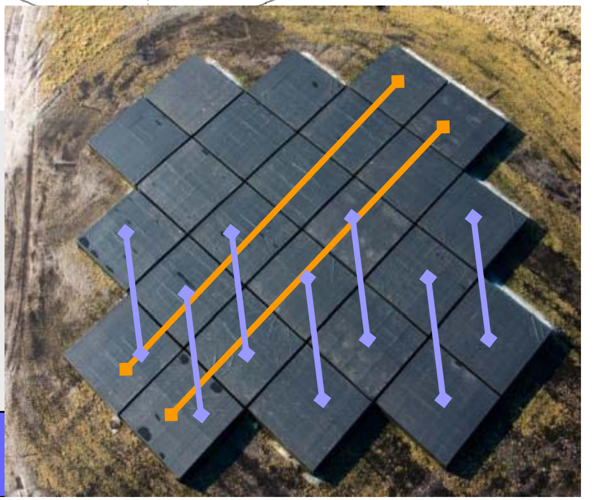
DFT vs. LS imaging (1)
S.J. Wijnholds, URSI Benelux Forum, Jun. 2009
S.J. Wijnholds, Ph.D. thesis, Mar. 2010



Demo redundancy monitoring: 24h observation at CS302, LOFAR HBA tile beam is formed at the zenith







When redundancy assumption holds for HBAs, its calibration algorithm works well

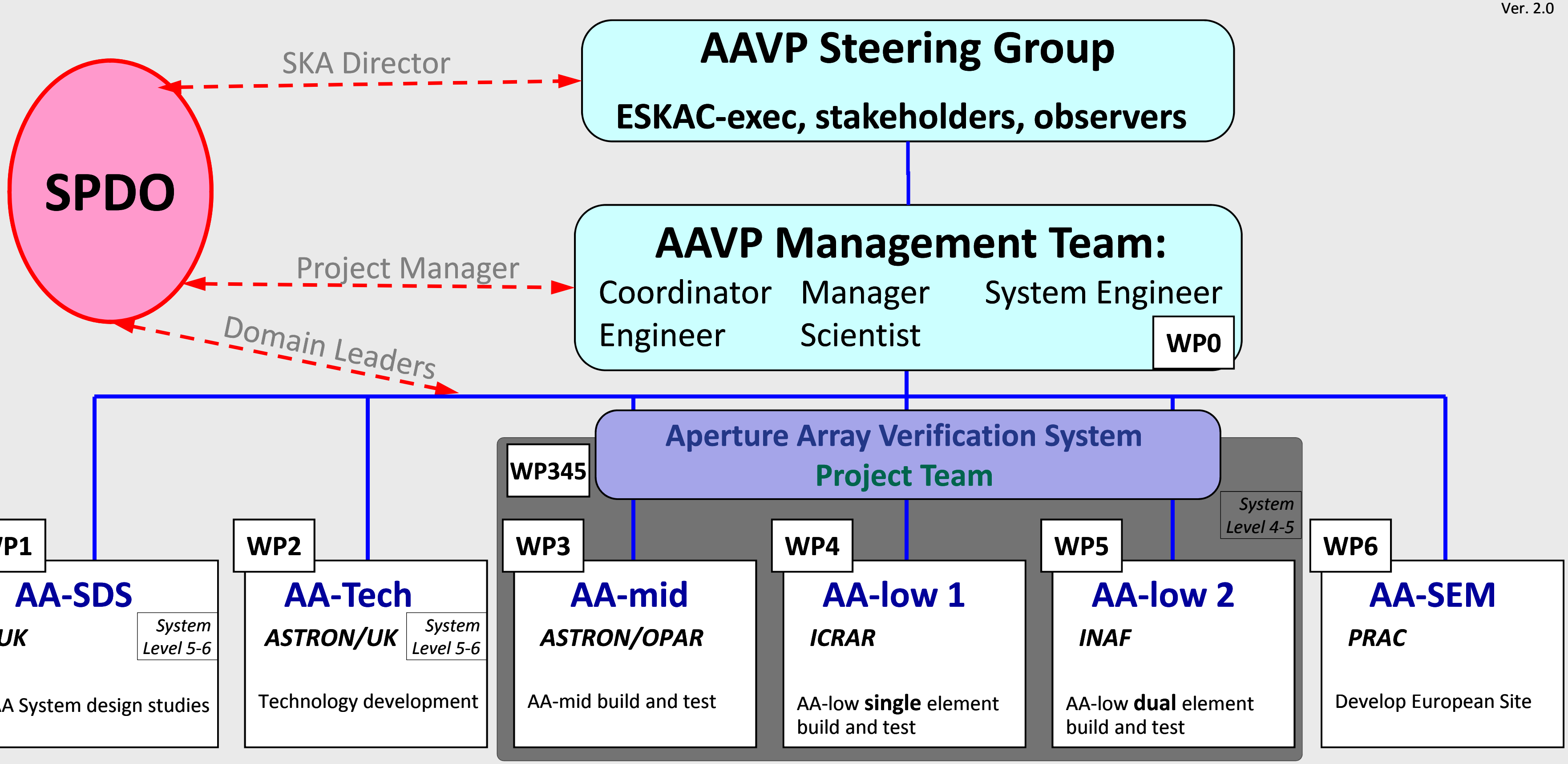
Courtesy: Parisa Noorishad, Stefan Wijnholts

Who are involved?

Consortium/Institute	Country	Main focus
UK-PrepSKA (UCam, UOxford, UMan)	UK	Mgt & VariousTechn.
ASTRON/Kapteyn Inst._RUG/Leiden Obs._Univ.Leiden/Radb.Univ./U.A'dam	Nl	Mgt & VariousTechn.
MPIfR	Germ.	Dig. Sign. Proc.
Obs. De Paris/Obs. Bord./Ud'Orléans	Fr	IC; BF & A/D
INAF_IRA	It	AA-Low
OAN	Sp	Observer
OSO_ChTU	Sw	Calibr.
TorunCentreofAstronomy_UMK	*Pol*	*Tbd*
JIVE	Europe	Dig.Sign. Proc.
PRAC	Port	Site dev.
ICRAR	Aus	AA-Low
NRF & … Observer status	R.S.A. & US	RSA:ESD/EMC?

AAVP Organisation

Ver. 2.0



List of WPx - Leaders and Task Names

AvA 201103v03

AAVP Leading participant	WP Tasks	Leading Participant	WP-Task	WP & WP-T Leaders
WP0 - Coordination and Management	Coordinator	ASTRON	Coordination and Management	Arnold van Ardenne
ASTRON			Program Office (ASTRON)	Truus van den Brink
www.ska-aavp.eu			Program Manager (ASTRON)	Andre van Es
secretary@ska-aavp.eu			Program Scientist (Oxford)	Steve Rawlings
			System Engineer (Cambridge)	Andrew Faulkner
			Program Engineer (ASTRON)	Jan Geralt bij de Vaate
WP1 - AA-System Design Studies	WP Leader	Cambridge	WP1 Manager	Andrew Faulkner
Cambridge				
	WP1 -T1-6		Taskleaders, SPDO_SE	
WP2 - AA-Technologies	WP Leader	ASTRON	WP2 Manager	Jan Geralt bij de Vaate
ASTRON/UK		UMAN		Tony Brown
	WP2 -T1-8		Taskleaders, SPDO_PE	
WP3a - AAVS Project Team and System Design	WP3a Leader	Cambridge	Project Manager	Derek McKay-Bukowski
Cambridge/ASTRON		ASTRON	Verification Scientist	Ilse van Bemmel
	Callm leader	Cambridge	Calibration & Imaging	Keith Grange
	AA-DS		AA-Domain specialist	Andre Gunst
	WP3-5		WP Project managers & System Designers	
WP3 - AA-Mid	WP Leader	ASTRON	Project Manager	Johan Pragt
ASTRON/Obs.Nancay		Obs.Nancay	System Design	Philippe Picard
		ASTRON	System Design	Dion Kant
	WP3-T1-5		Taskleaders	
WP4 - AA-Low1	WP Leader	ICRAR	Project Manager	Jan Geralt bd Vaate (a.i.)
ICRAR				
			System Design	tbd
	WP4-T1-4		Taskleaders	
WP5 - AA-Low2	WP Leader	INAF	Project Manager	Jader Monari
INAF				
			System Design	Federico Perini
	WP5-T1-4		Taskleaders	
WP6 - AA-Site Emulation	WP Leader	IT	WP6 Manager	Domingos Barbosa
PRAC		Logica	Site development	
	WP6-T1-4		Taskleaders	

Industrial involvement

"SKA as green ICT-intensive Research Infrastructure"

- Increased need for Industrial involvement
  - Moving from Technology demo's toward Industrial pototypes
  - Increase Political support; country dependent
  - Stipulate European role in SKA; also: green design as attractor

- Preparations for ISKAF2011:
  - Stimulate Industry Involvement
- Example: SKA-Eur. & Industry:
  - Neth.: Industry Consortium (Broad)
  - UK: Meetings, Discussions
  - Sweden: Discussions
  - Italy: Large Industries
  - Portugal: Large Industries (Networks, Energy/Solar)
  - Germany: Energy/Solar, other?
  - France: MicroElectr., other?
  - Aus.: Industry Consortium (Broad)

AA-CoDR 19-20 April;

- Docs for your perusal over 21
- Contributions form whole team assembled through AAVP –MT plus AA-domain specialist and SPDO contribution
- Full Charge agreed and drafted
- Panel members:
  - Peter Dewdney, SPDO
  - Raf Roovers NXP Central R&D
  - Richard Williams Cambridge Consultants
  - Colin Lonsdale, MIT/Haystack
- Assessment reporting
  - First impression end meeting (closed session)
  - Written report in a few weeks