Universiteit Leiden

ASTRON

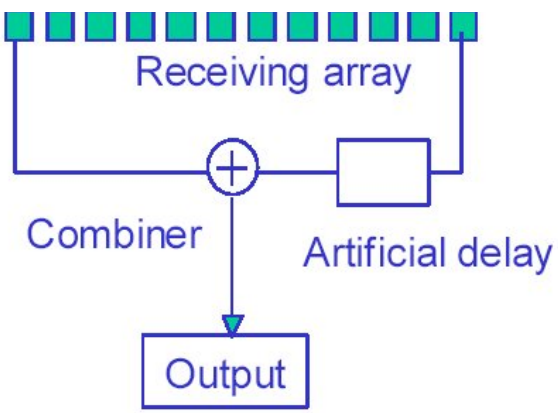
Aperture Arrays -Past, Present & Future!

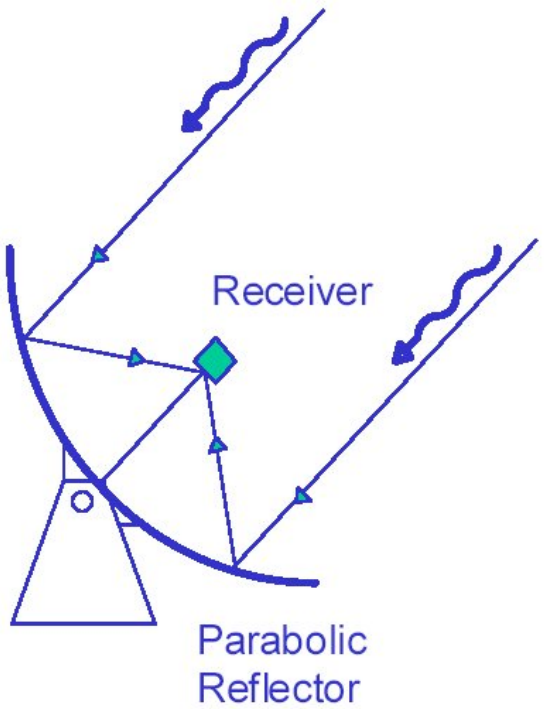
Prof. Michael Garrett

ASTRON, the Netherlands Institute for Radio Astronomy
Leiden University.

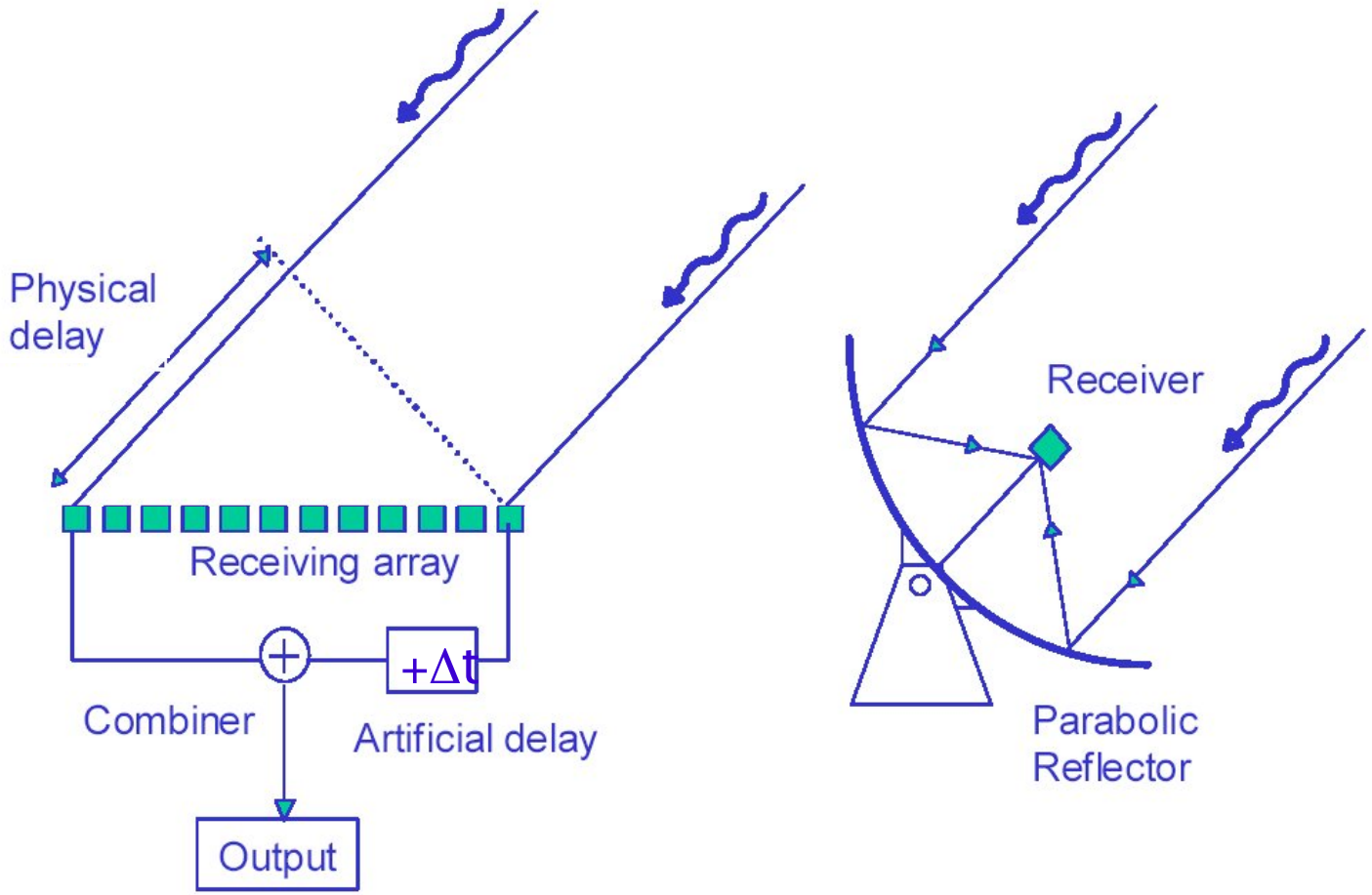
Aperture Array concept

ASTRON





Aperture Array concept



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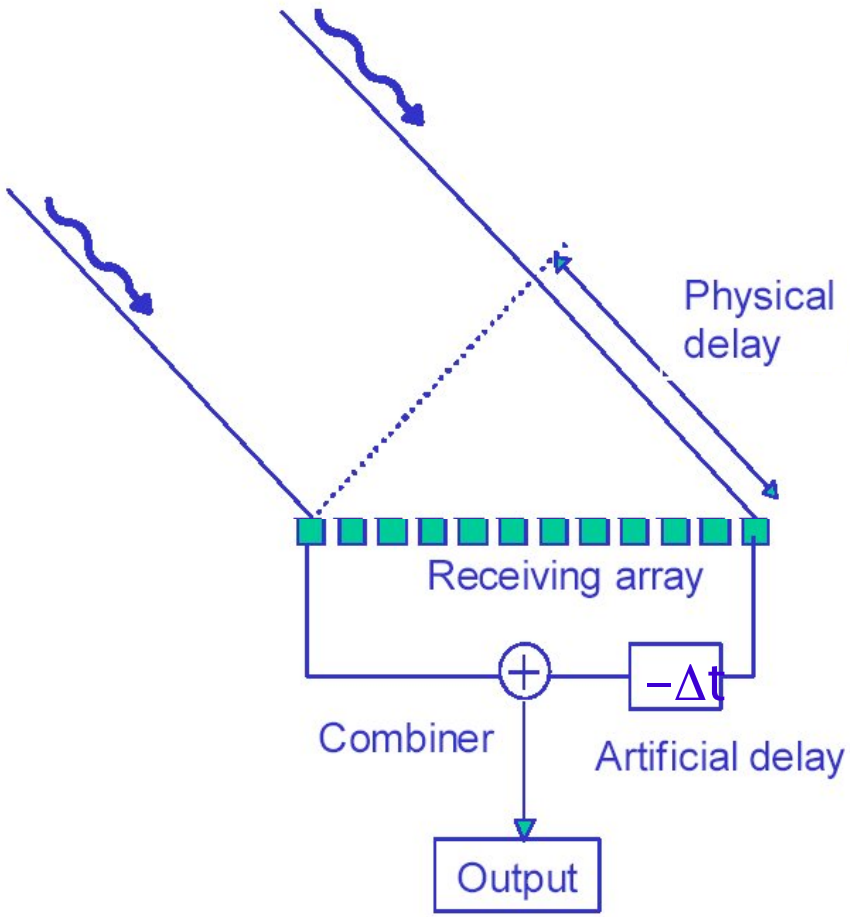

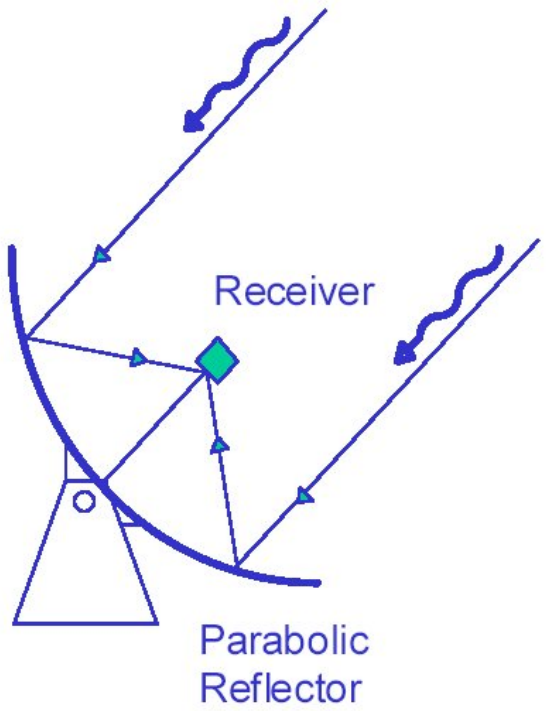

- Unblocked aperture with full view of the whole sky!
- Ultimate flexibility with no moving parts!
- Beams are formed and controlled electronically at element level

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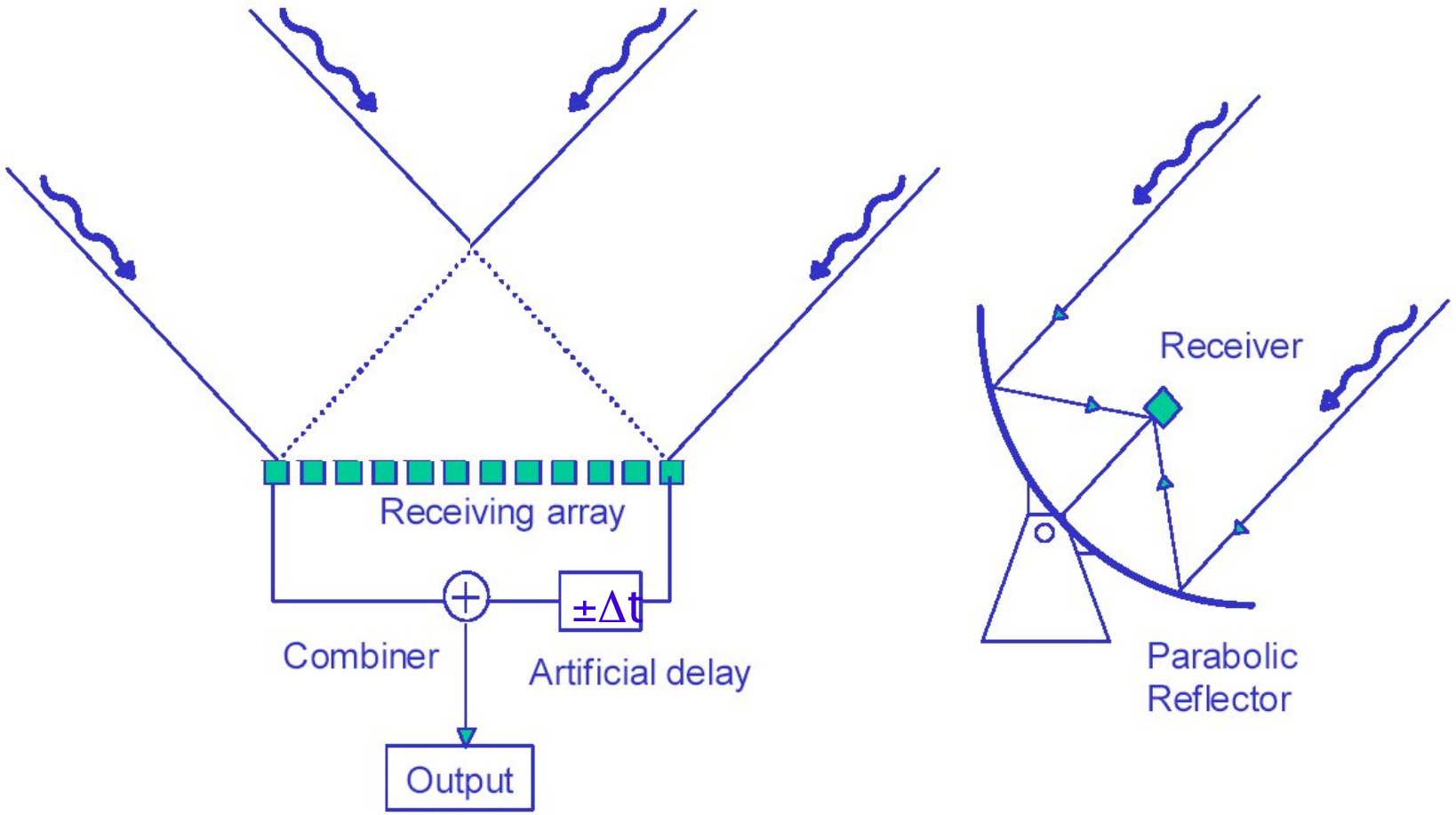
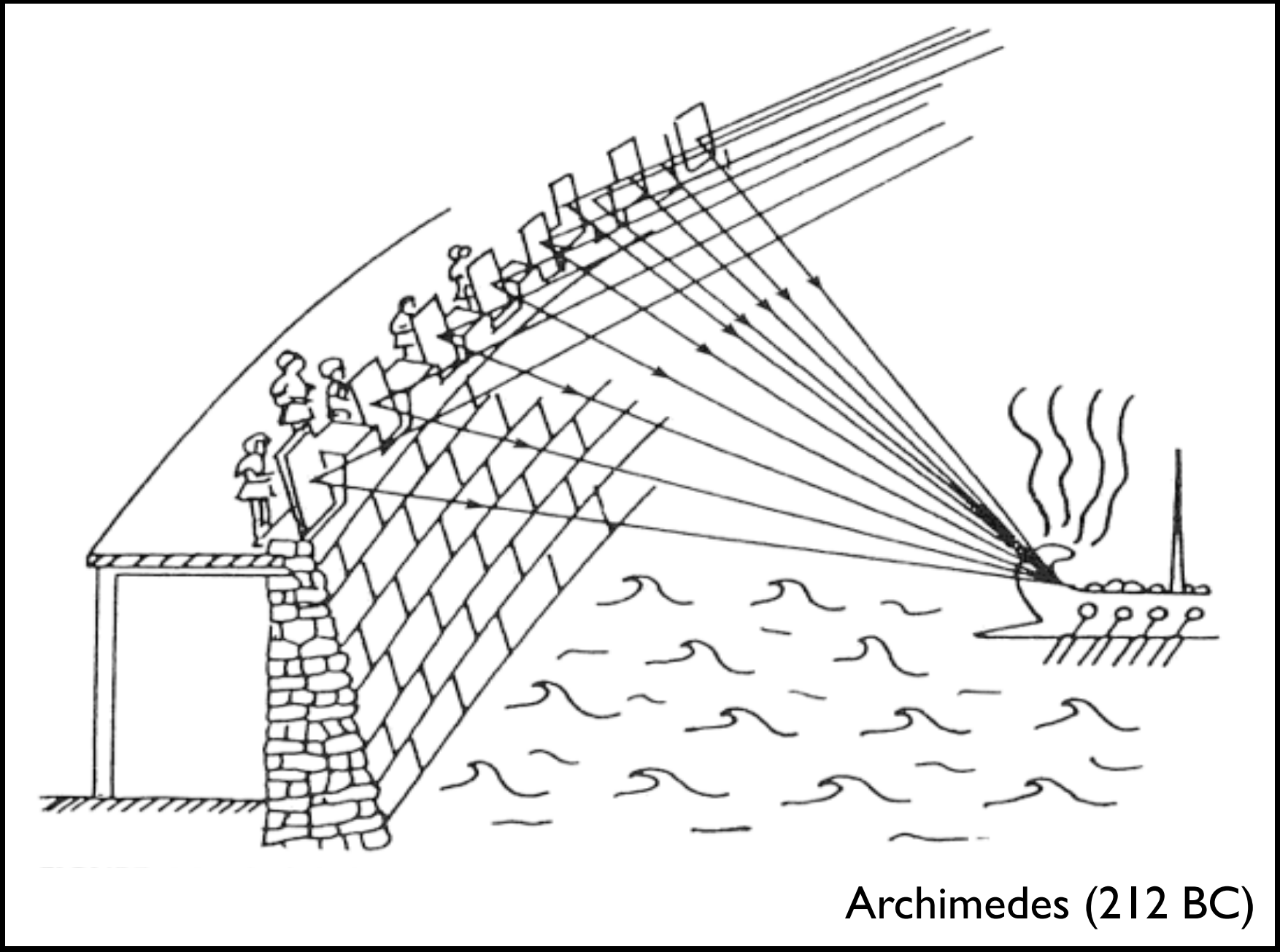


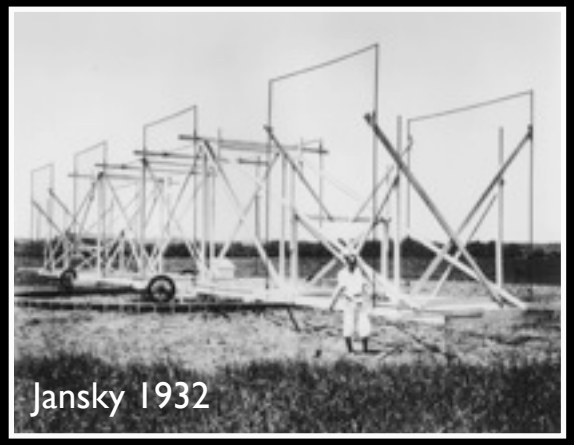
- Unblocked aperture with full view of the whole sky!
- Ultimate flexibility with no moving parts!
- Beams are formed and controlled electronically at element level
- Permits concurrent, possibly associated, multi-beam observations
- Technology of choice at frequencies < ~1.5 GHz

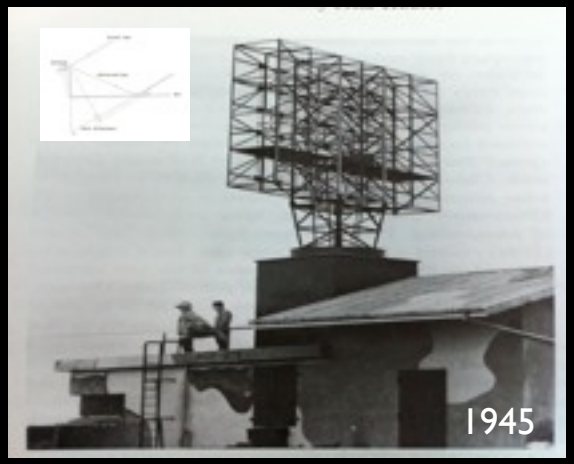
Not a new idea...

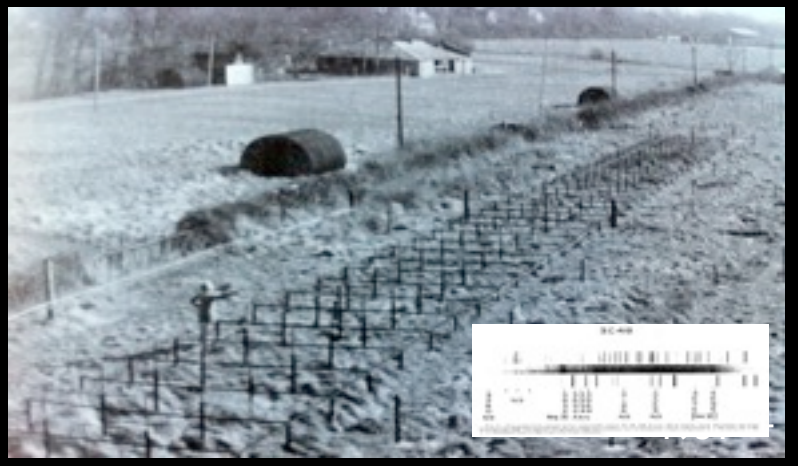


Archimedes (212 BC)

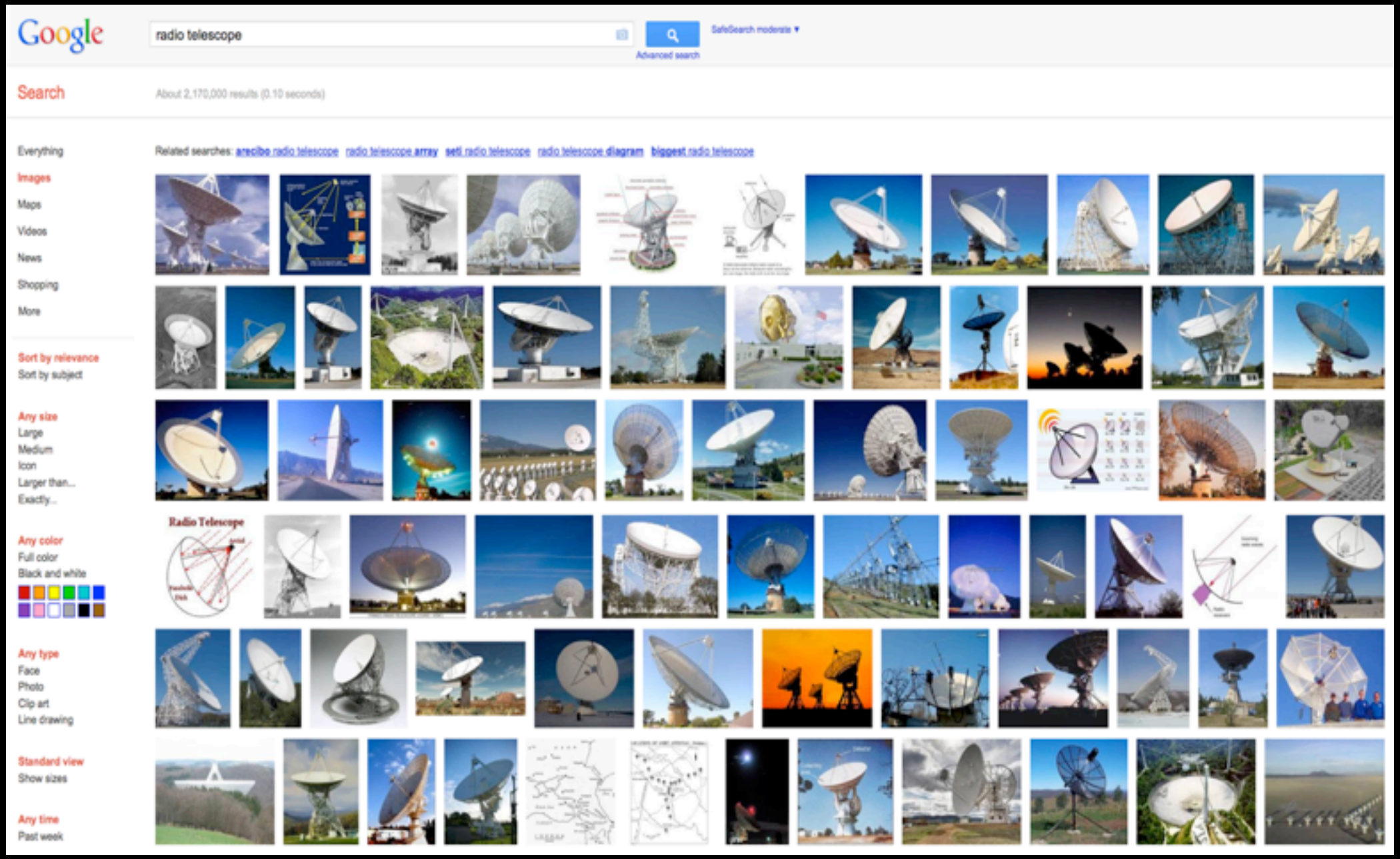
Dipole (Aperture) Arrays - *Past*







Aperture Array "a lost technology": 1970-2010...?

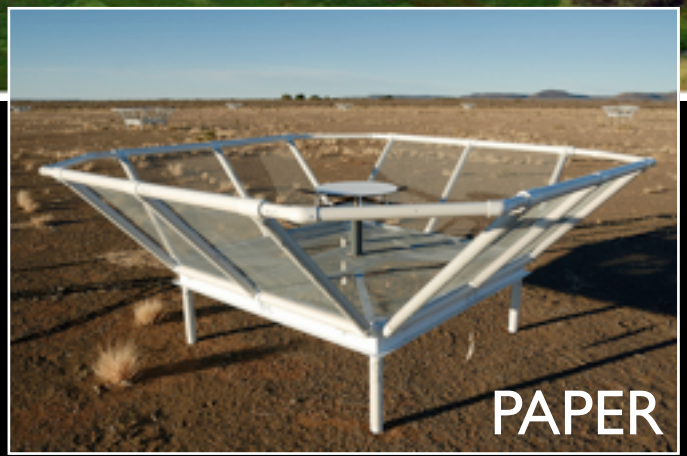


Aperture Arrays - 40 years on - *Present*

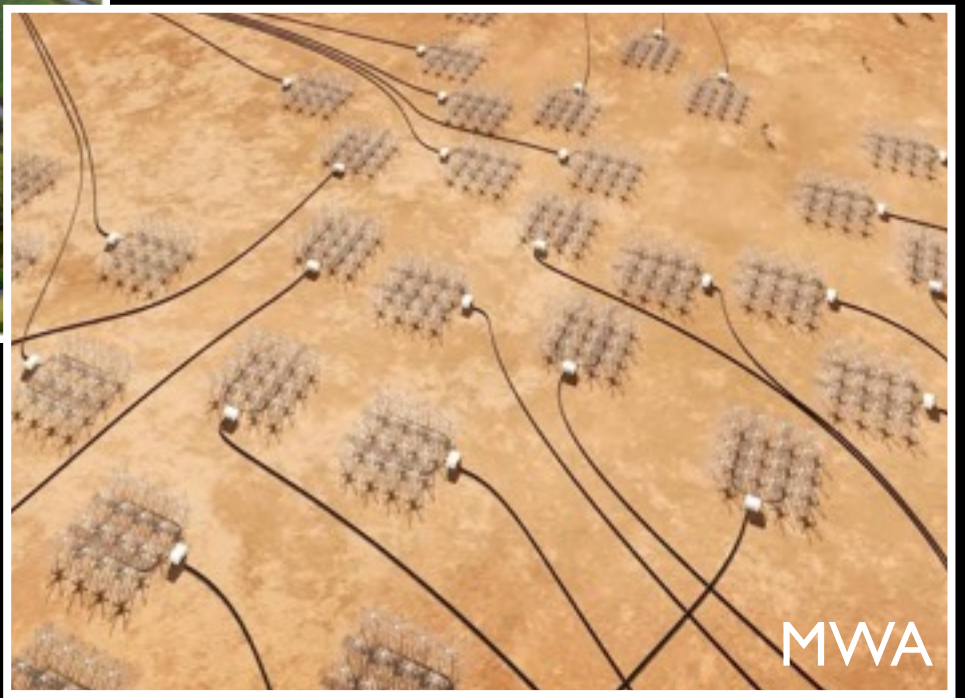
- "Radio Astronomy Re-invented" - Cesarsky et al.

LOFAR

LWA



PAPER



MWA

Imaging

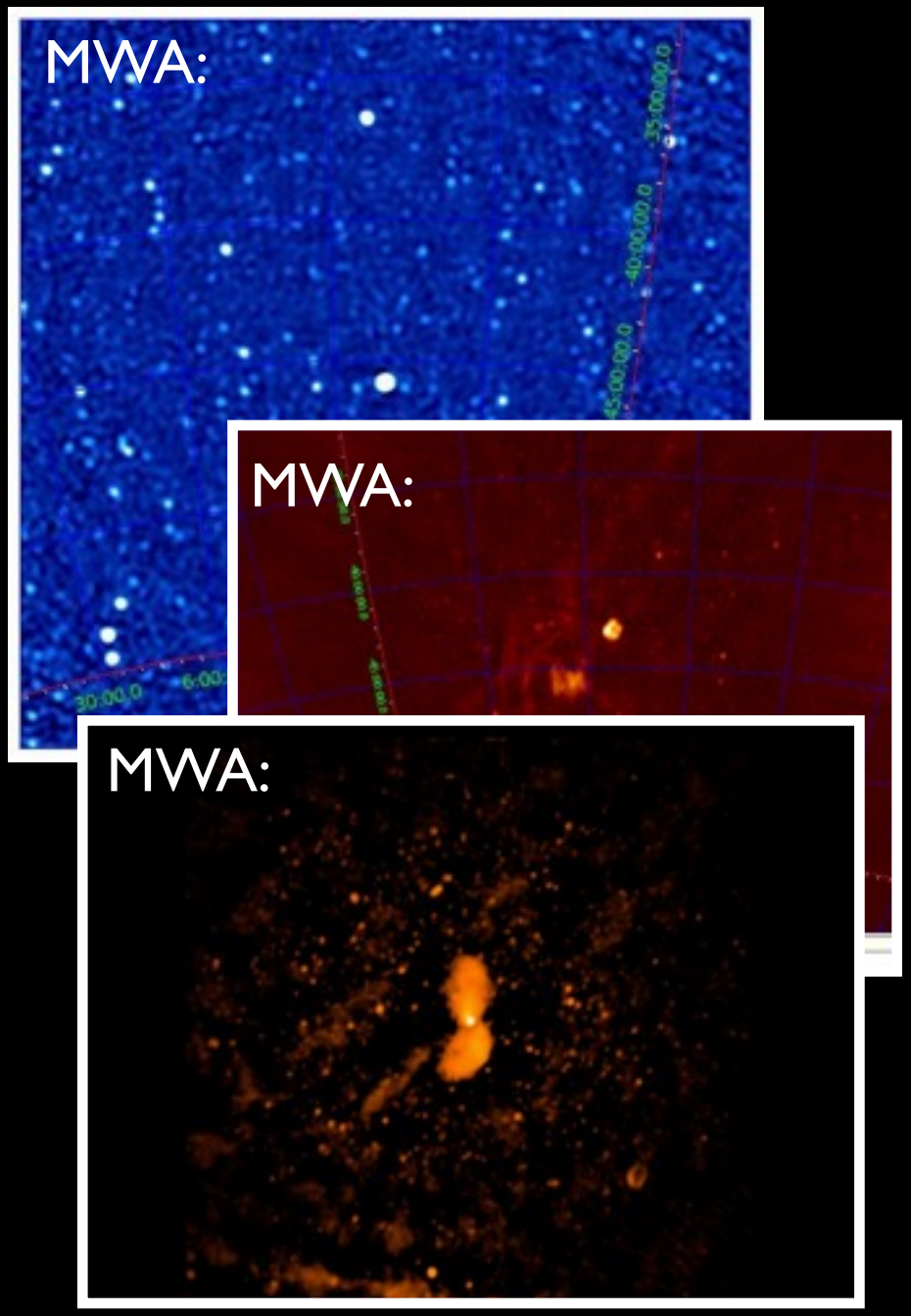
Non-imaging applications

MWA:

MWA:

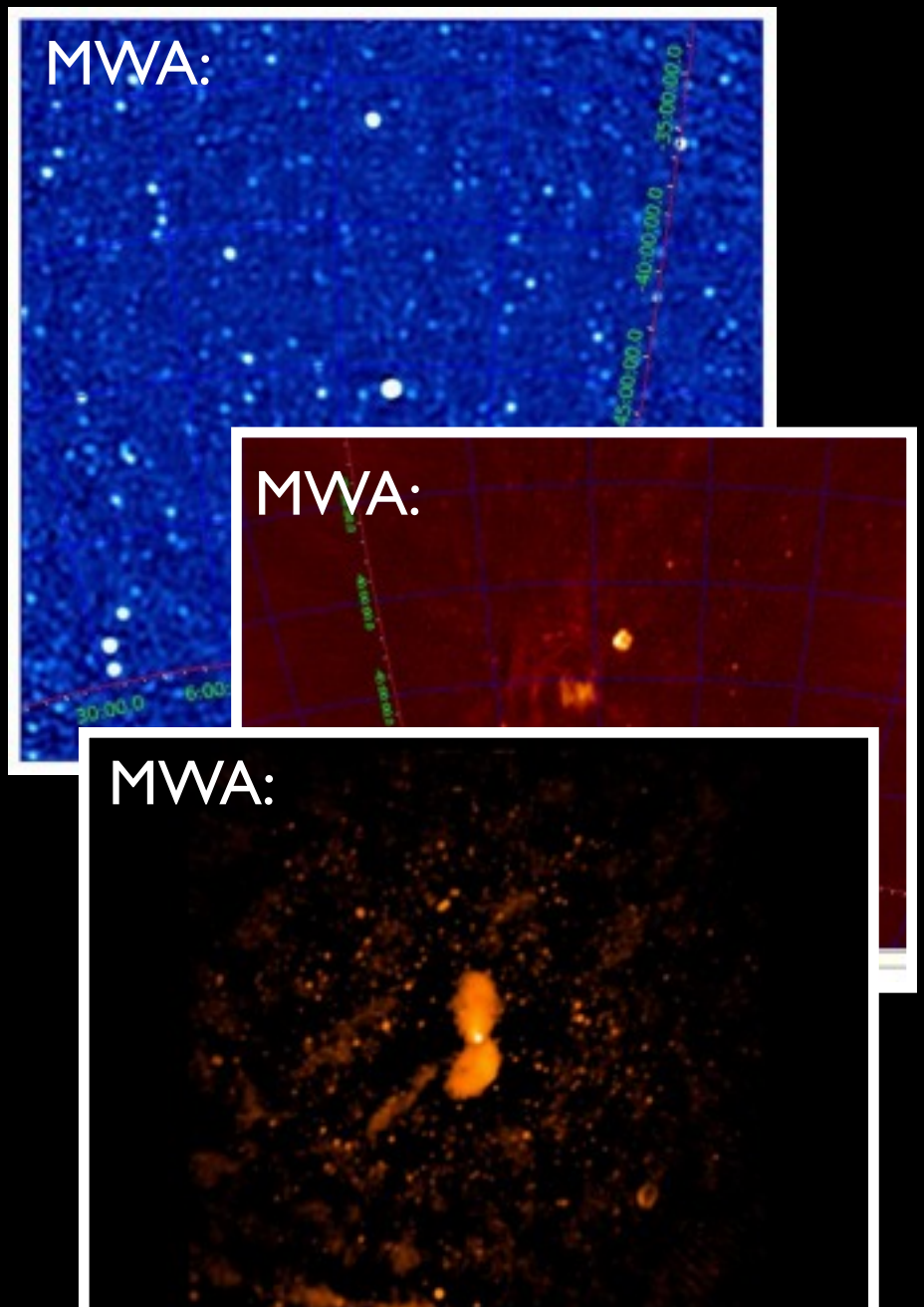
MWA:

Imaging

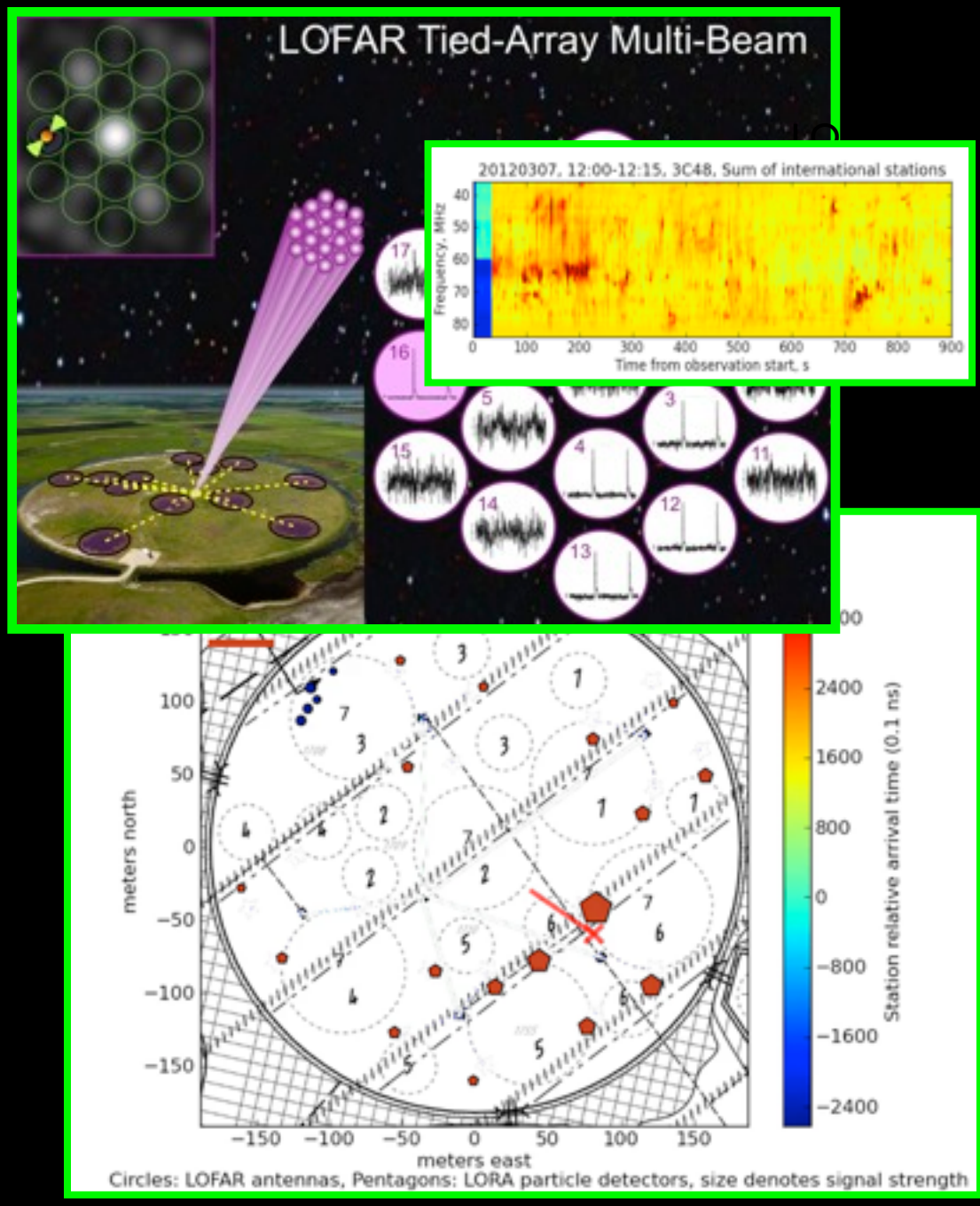


Non-imaging applications

Imaging



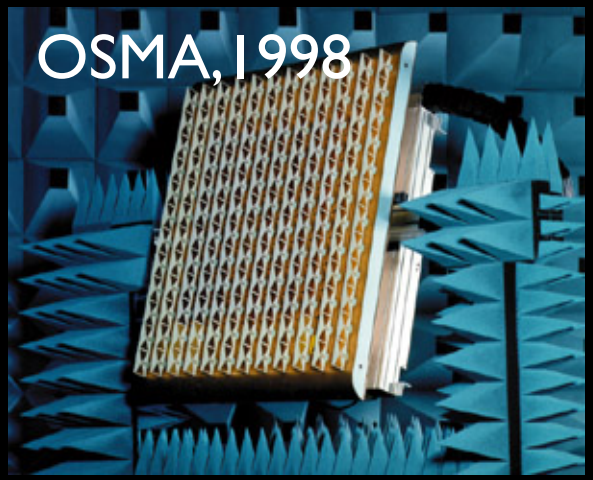
Non-imaging applications



Mid-frequency Aperture Array Developments at ASTRON (1995-2010)

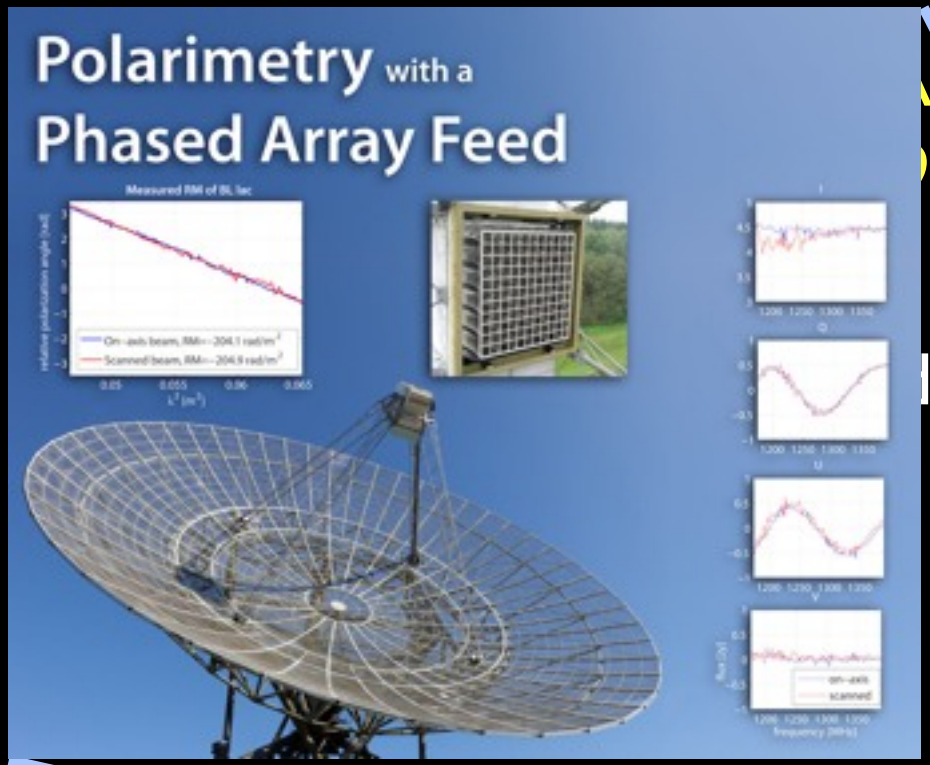
Aperture Arrays R&D focused on:

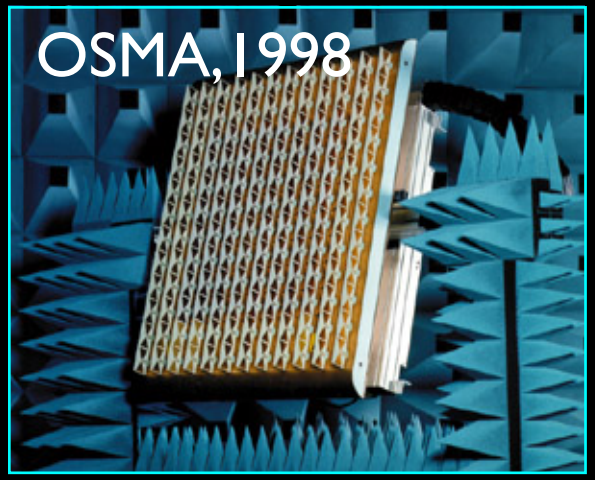
- concept demonstration,
- integration,
- cost reduction.



rray Developments at ASTRON
995-2010)

l on:





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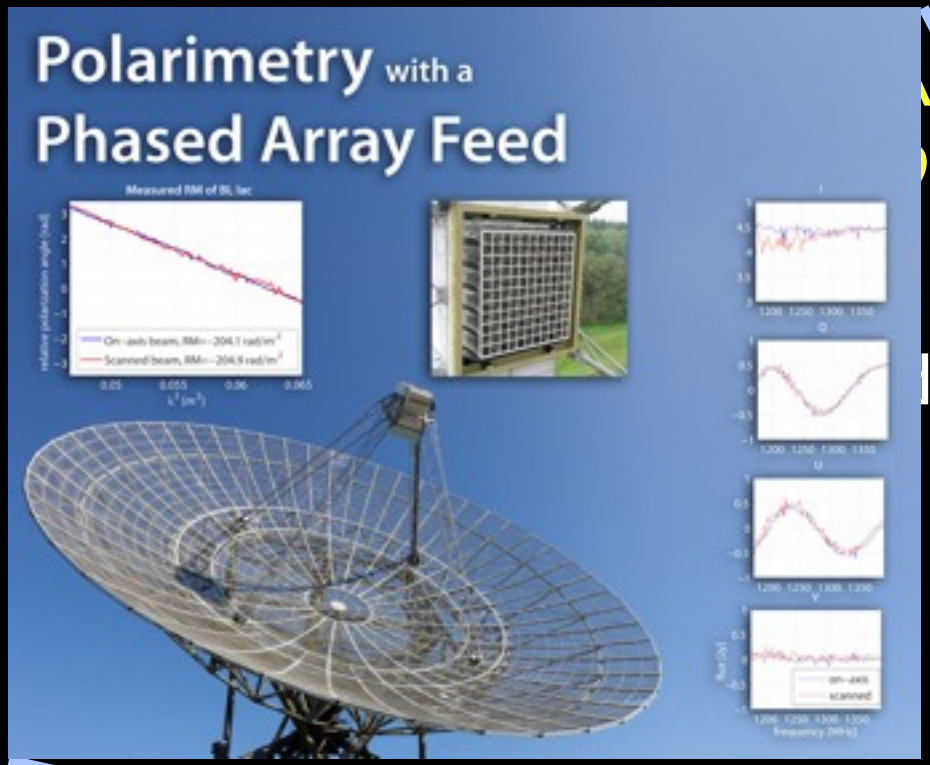
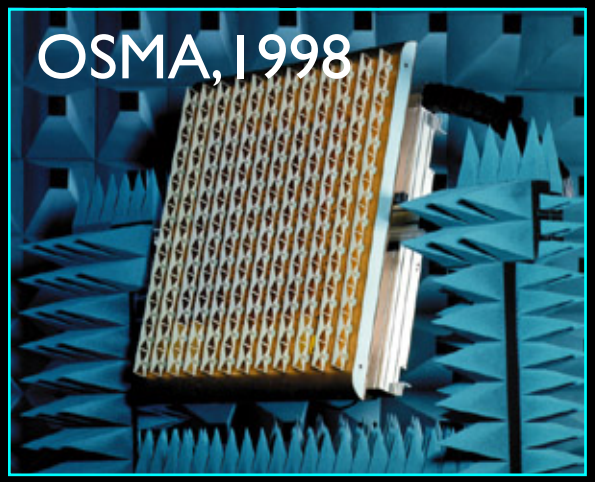
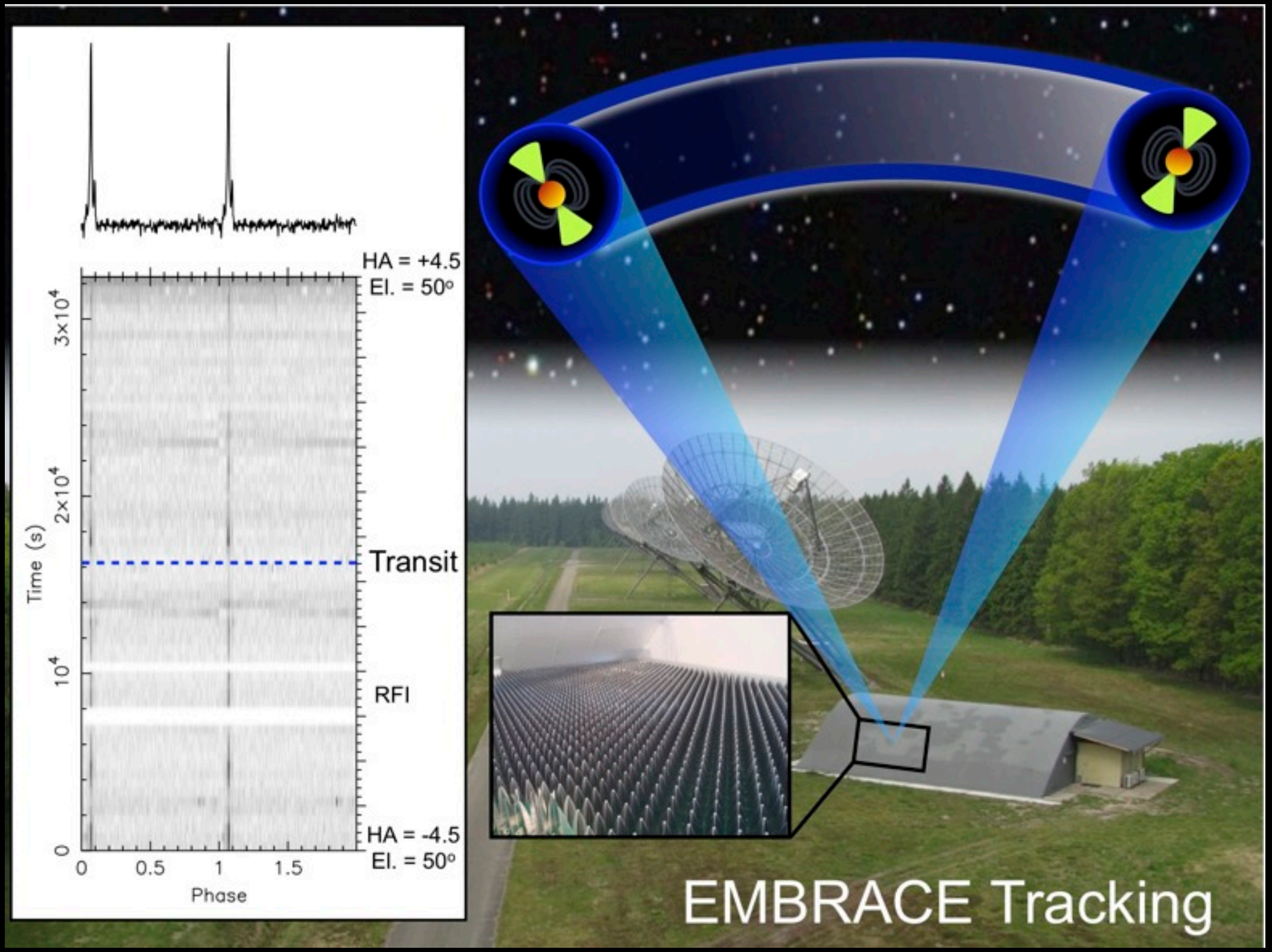
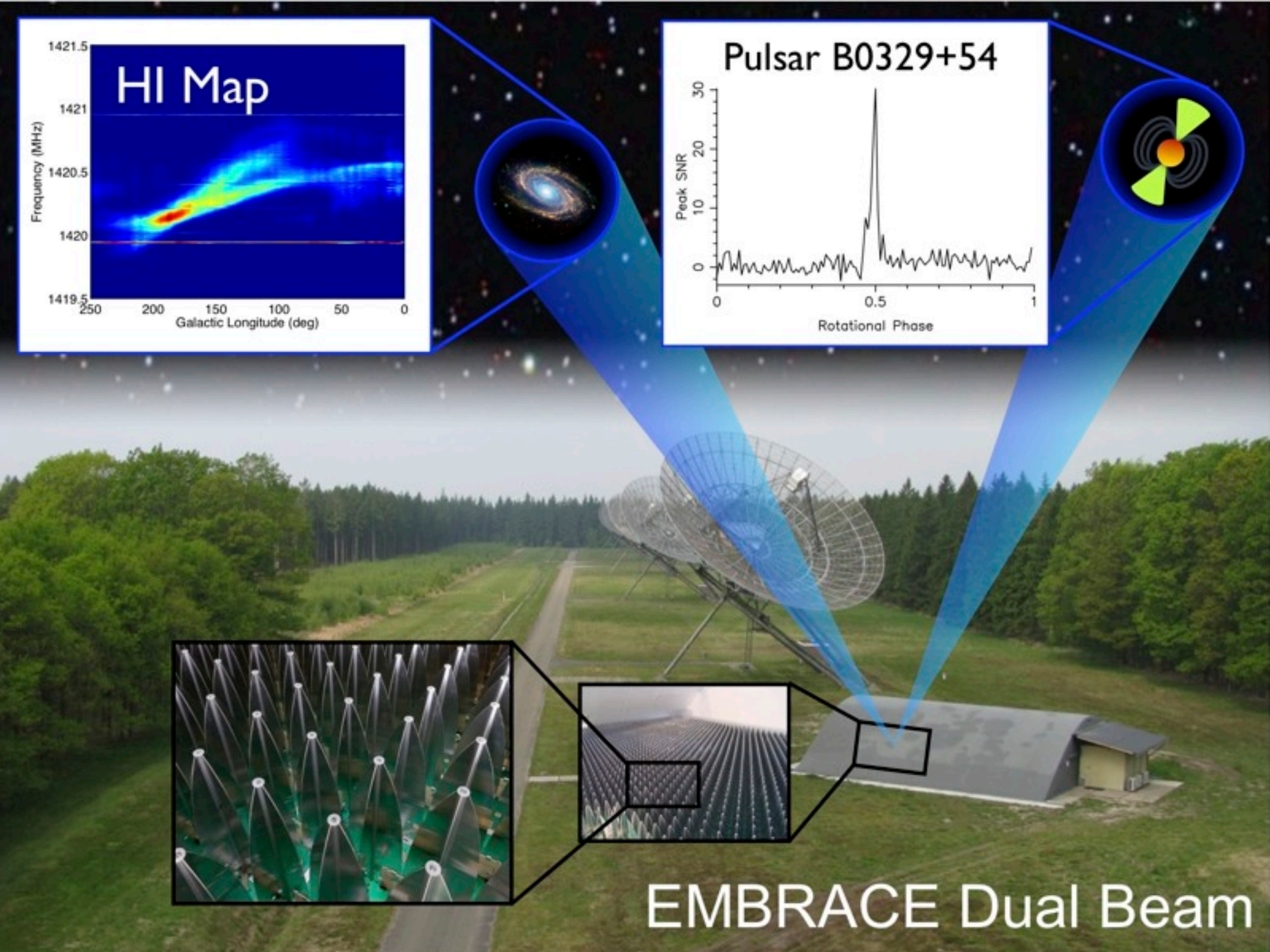




Ardenne et al.
Kant et al.
Capellan et al.
Faulkner et al.
bij de Vaate et al.


HA = +4.5
El. = 50°
3x10^4
2x10^4
Time (s)
Transit
10^4
RFI
0
HA = -4.5
El. = 50°
0
0.5
1
1.5
Phase
EMBRACE Tracking


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

Mid-frequency Aperture Arrays - beyond Radio Astronomy - Present...

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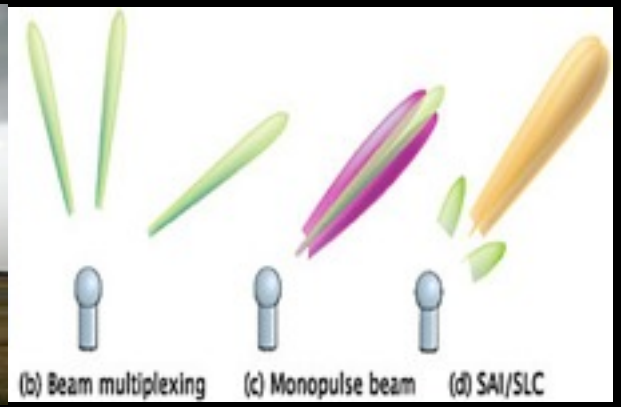
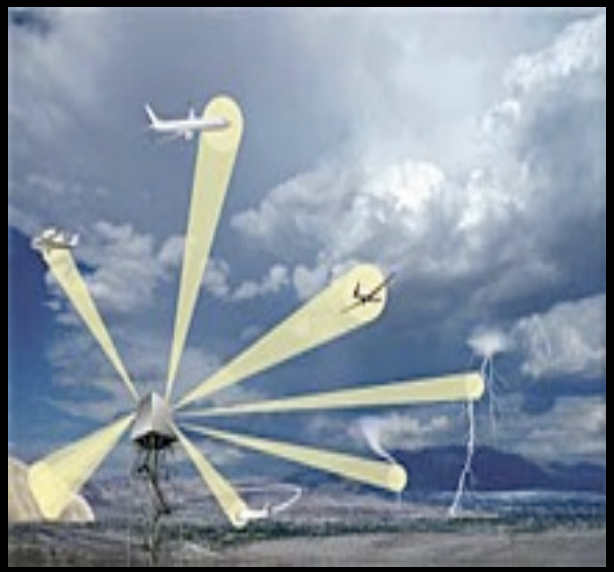
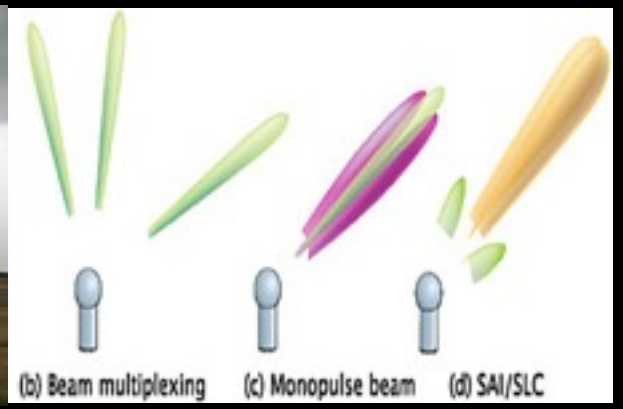
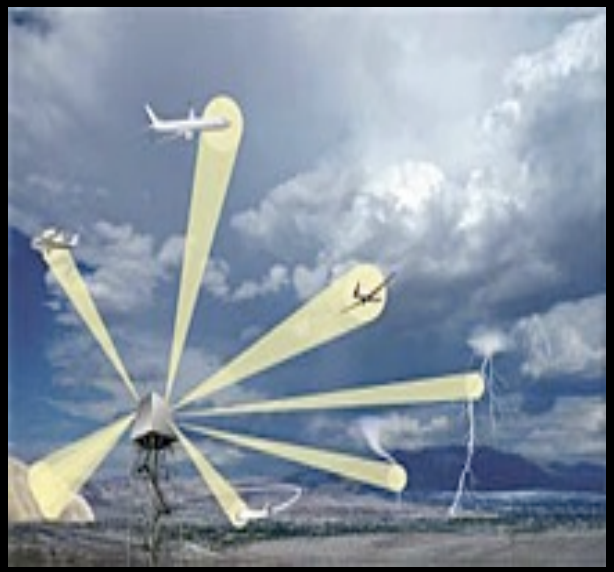
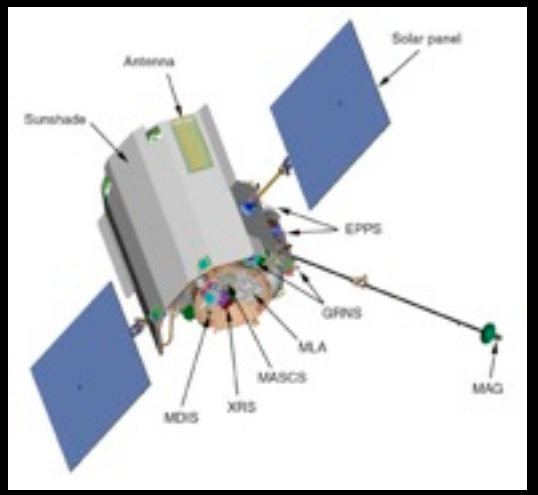




Mid-frequency Aperture Arrays - beyond Radio Astronomy - Present...







Mid-Frequency Aperture Arrays - the Future

SKA at mid-frequencies:

- simply building a “VLA on steroids” is not good enough!
- need to be as innovative as technology will allow.

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The development of a *scientifically capable* 21cm Dense Aperture Array demonstrator is necessary on route to SKA-2.


That's all Folks!


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or is it ?