

The Static Universe

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ASTRON/LFAA consortium

Science from 50-350MHz

- Epoch of Reionization
- Cosmic Dawn
- 21-cm forest
- HI absorption
- Continuum surveys



EoR conceived image



EoR & CD



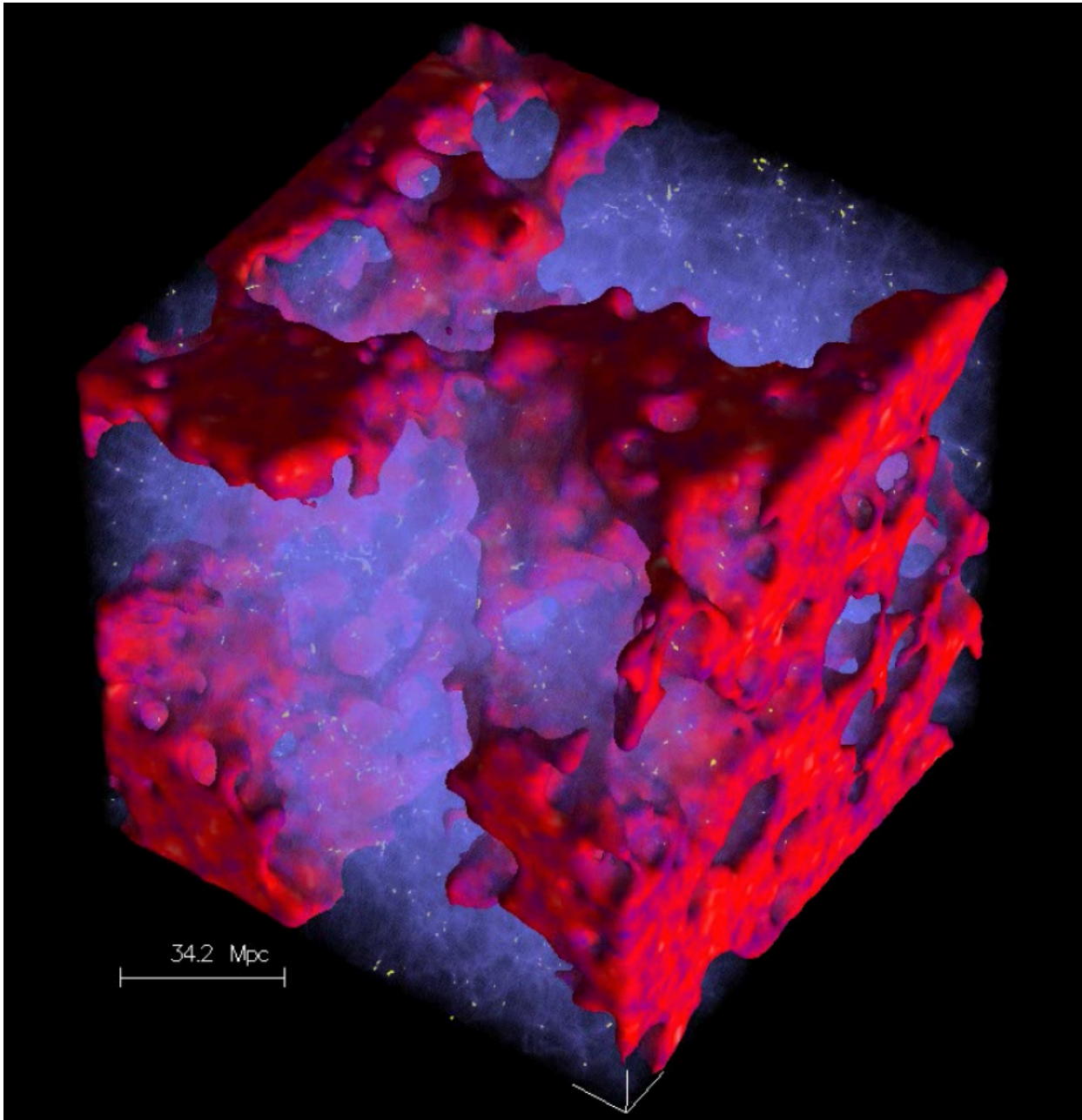
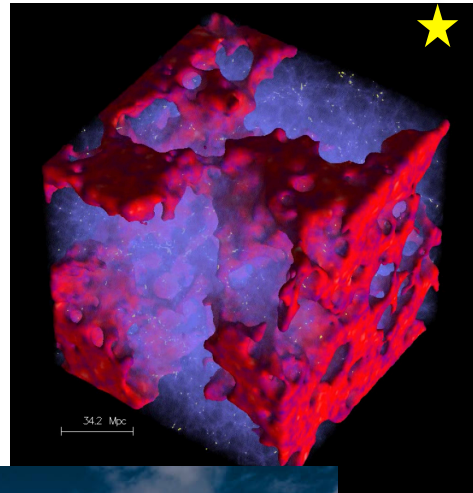


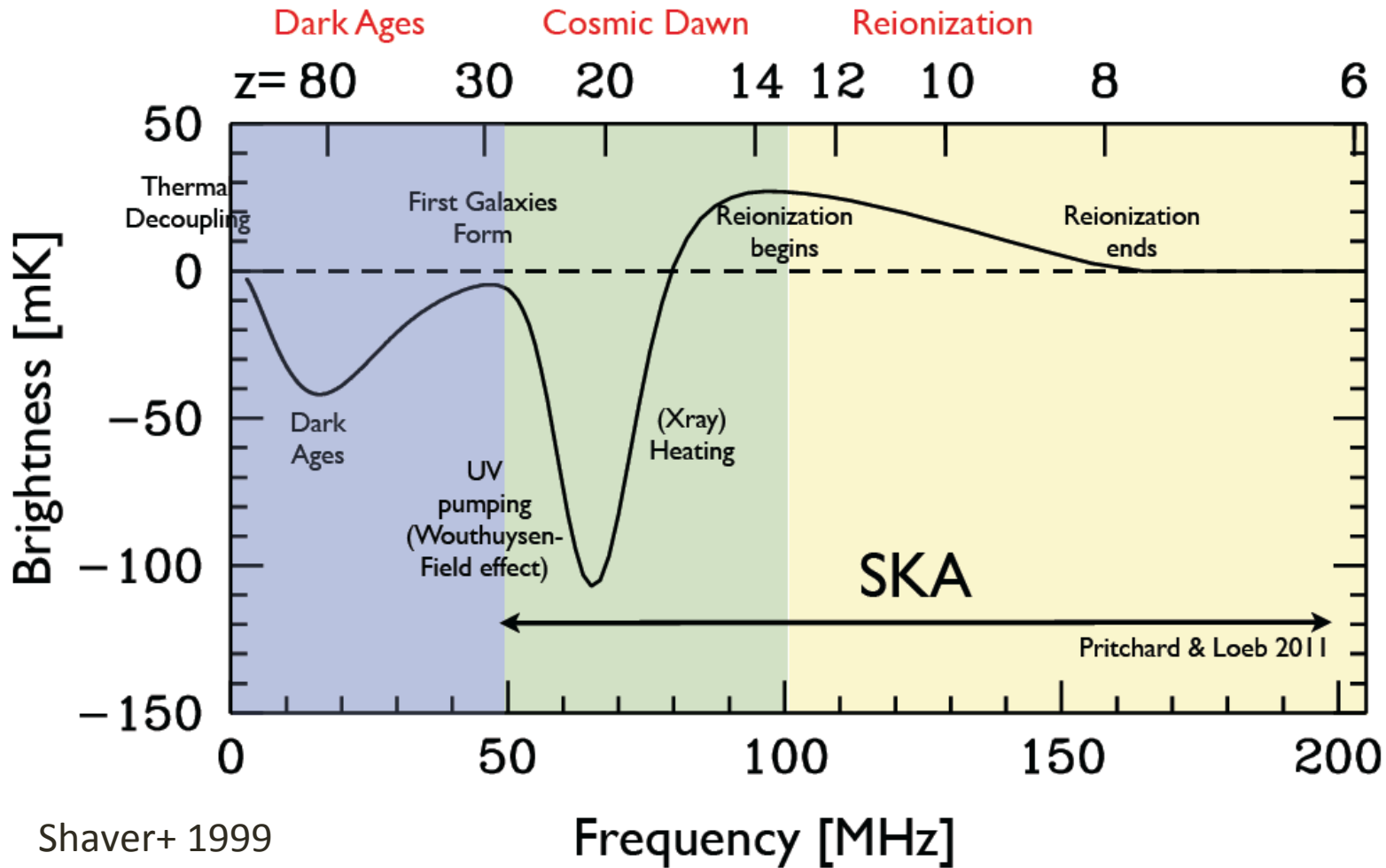
Figure courtesy:
Benoit Semelin

How to detect

- Global signal
- Fluctuations in the signal
- Tomography (imaging)
- (21-cm forest)



Global signal

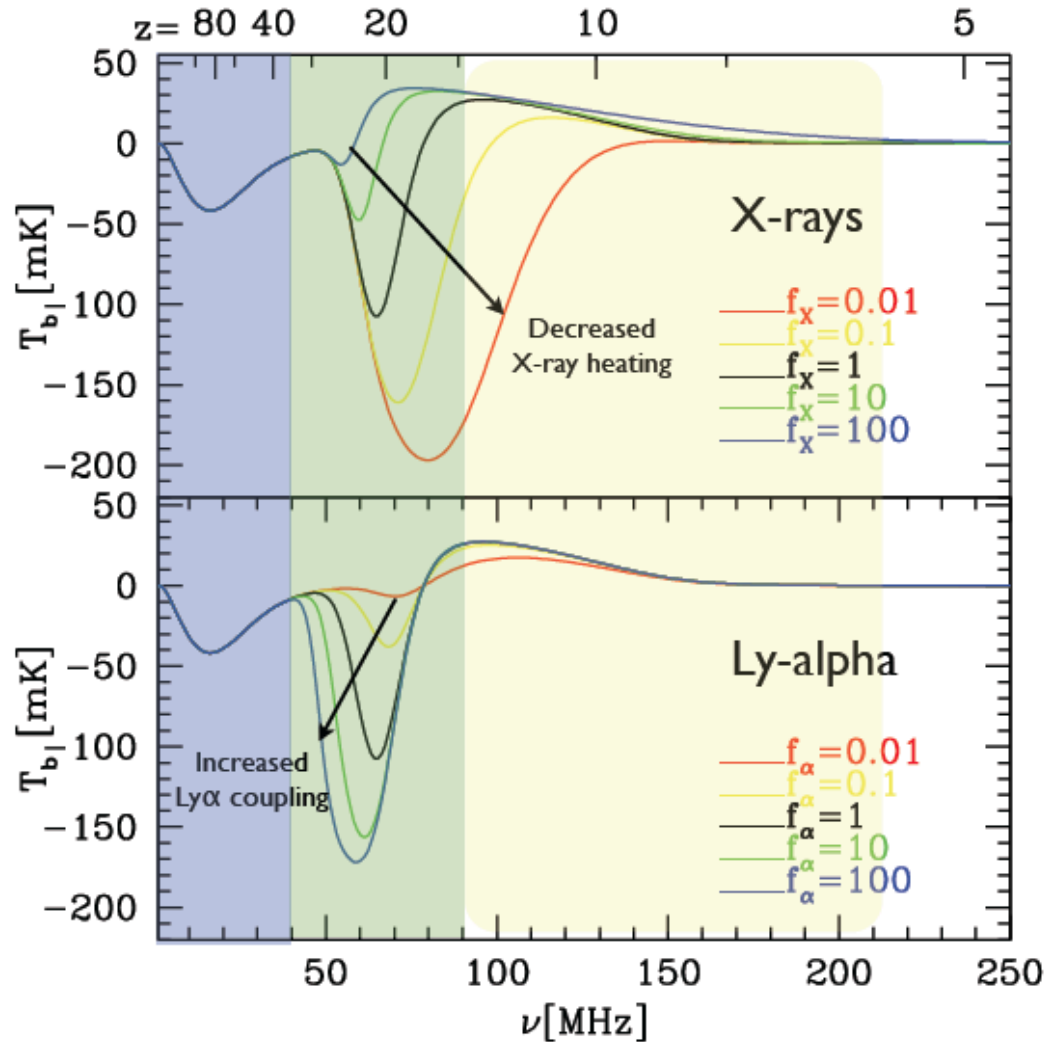


Shaver+ 1999

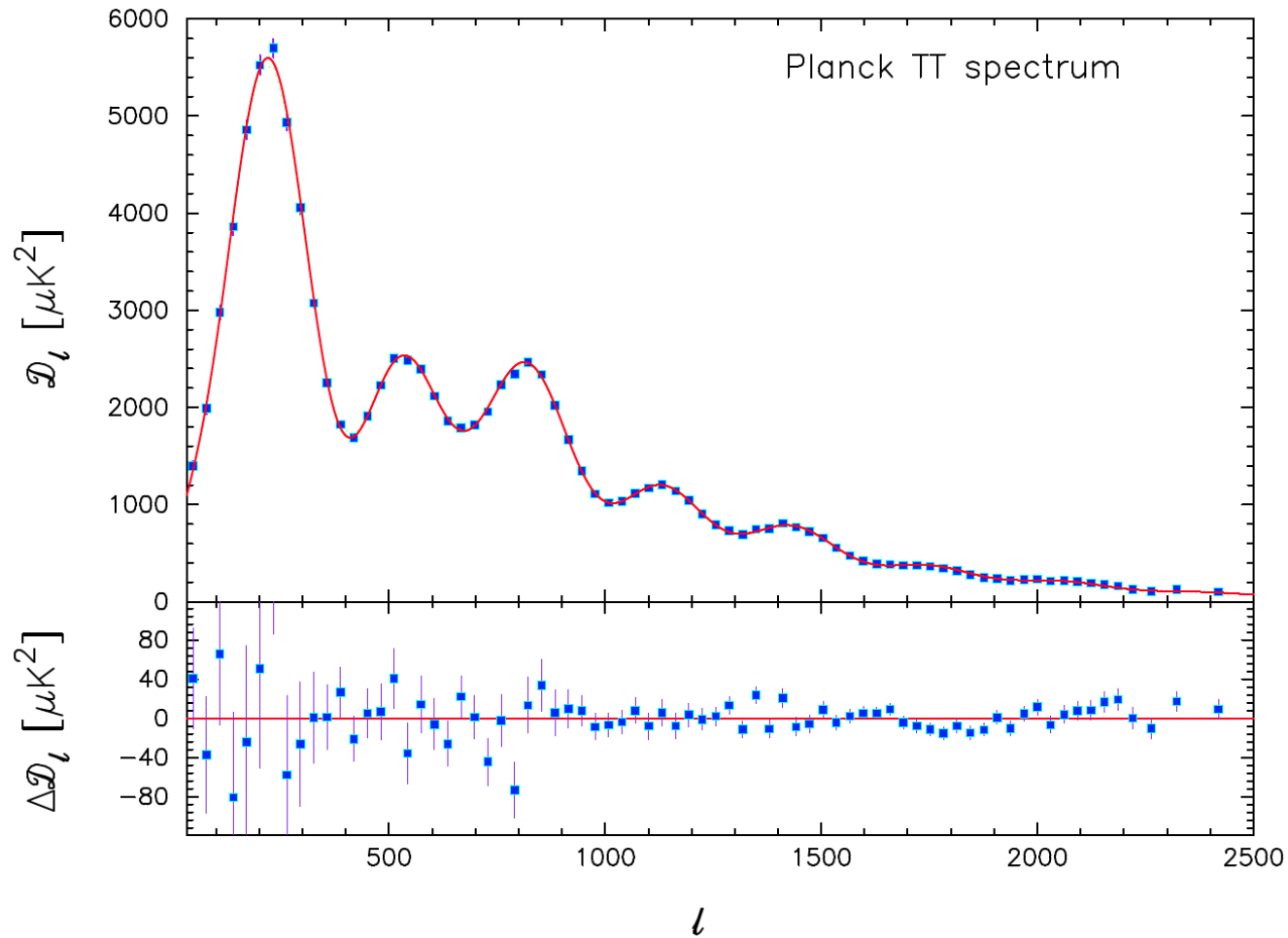
Furlanetto 2006

Pritchard & Loeb 2010

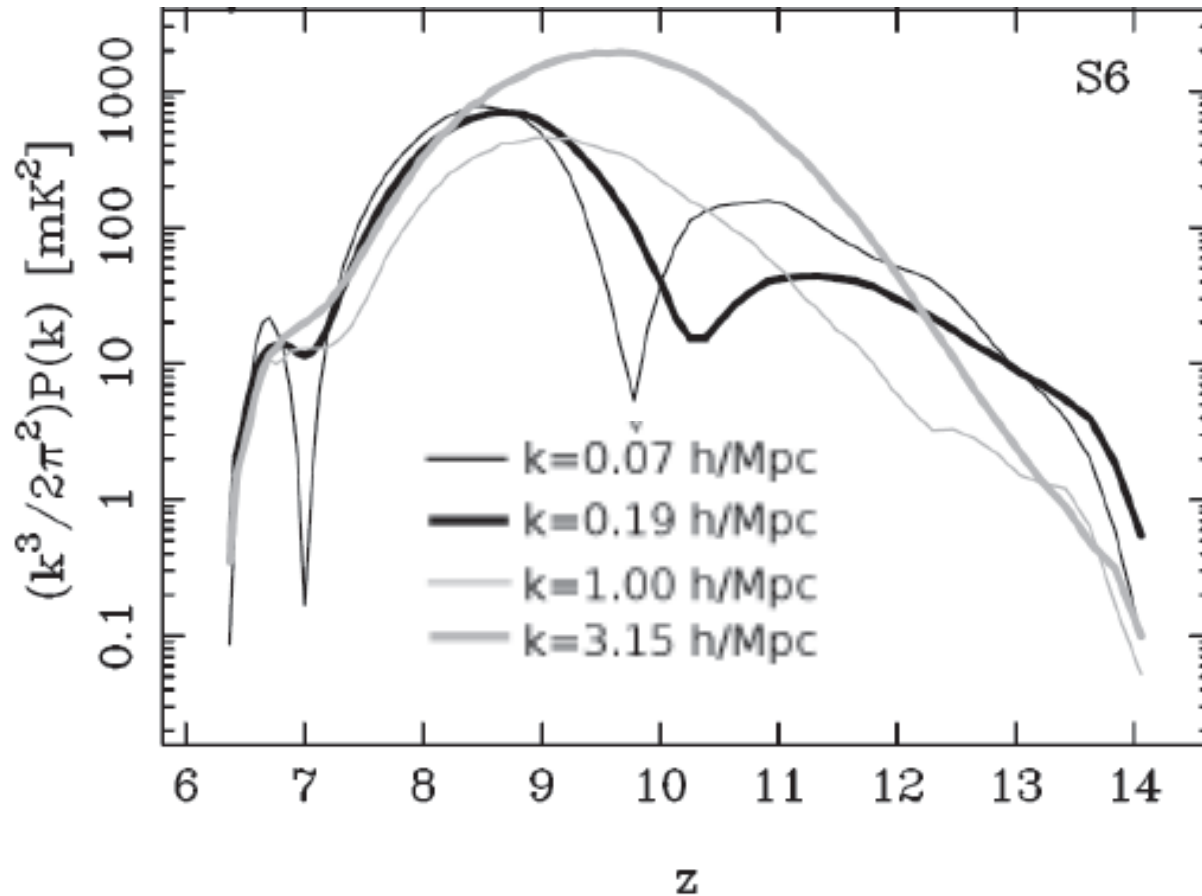
Global signal



Fluctuations: power spectrum



Fluctuations: power spectrum



Baek+ 2010

Santos+ 2010

Tomography

- ~ few degree field
- 1 arcmin resolution
- 0.1 MHz
- 1 mK

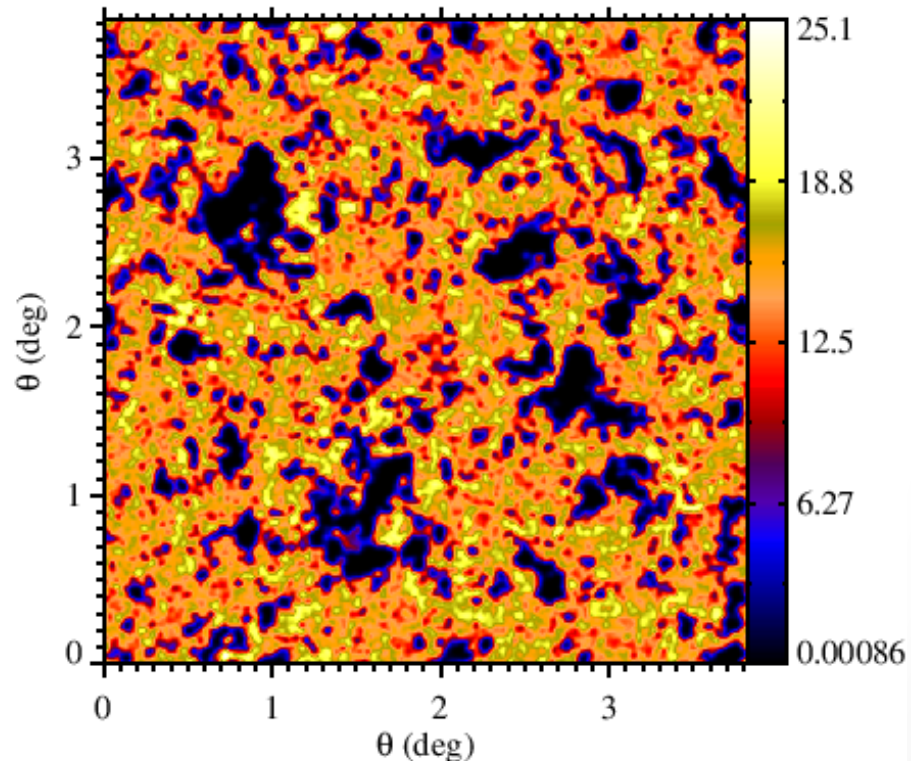


Figure courtesy: Mellema & Iliev

Foregrounds

Remove:

- Point sources
- Diffuse emission
- Galactic foreground
- Ionosphere
- Instrumental effects

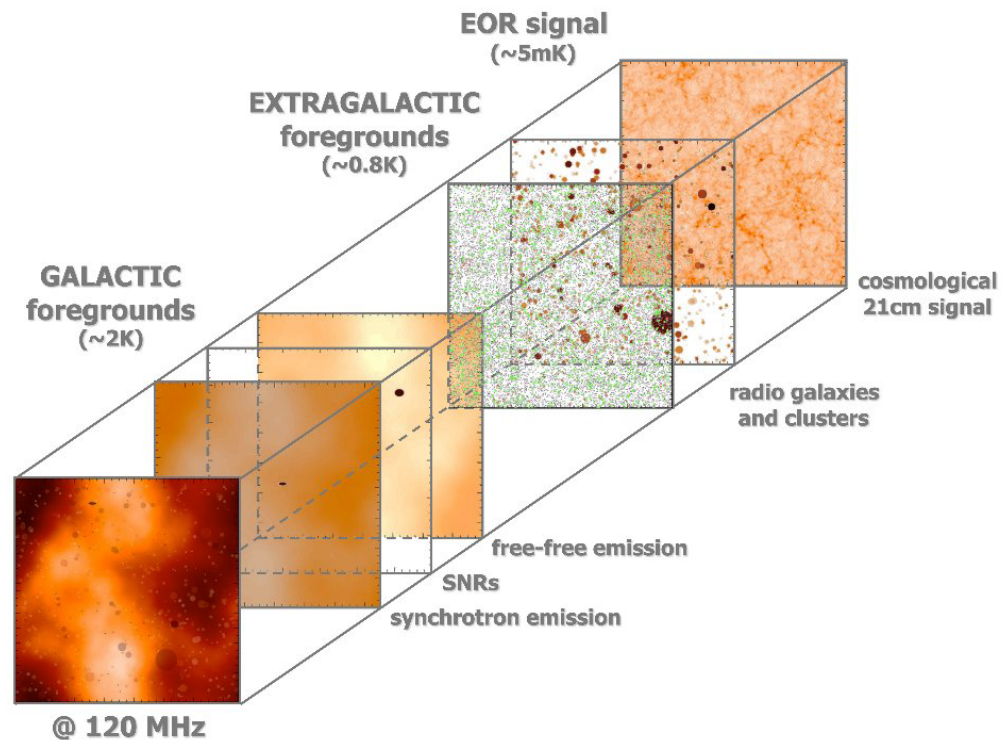
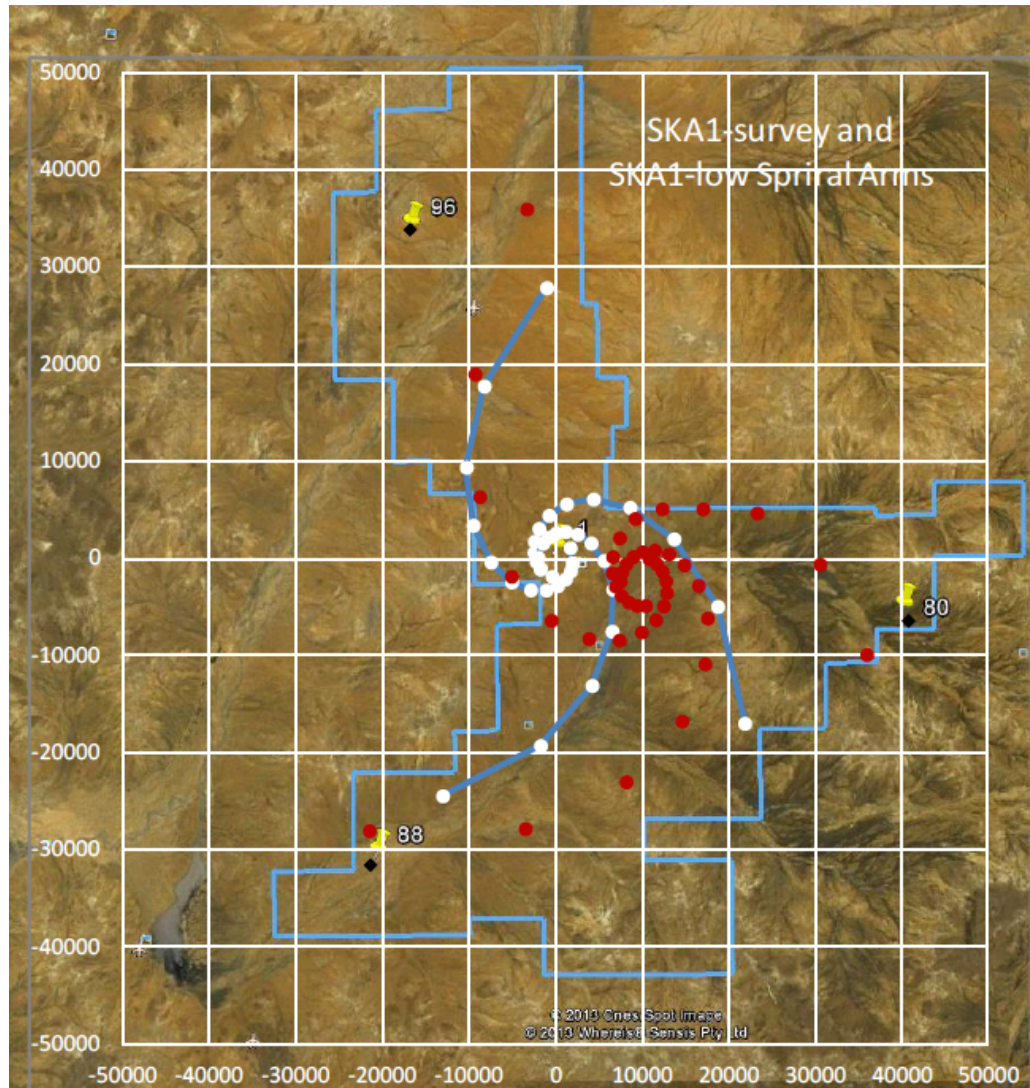


Figure courtesy Vibor Jelic

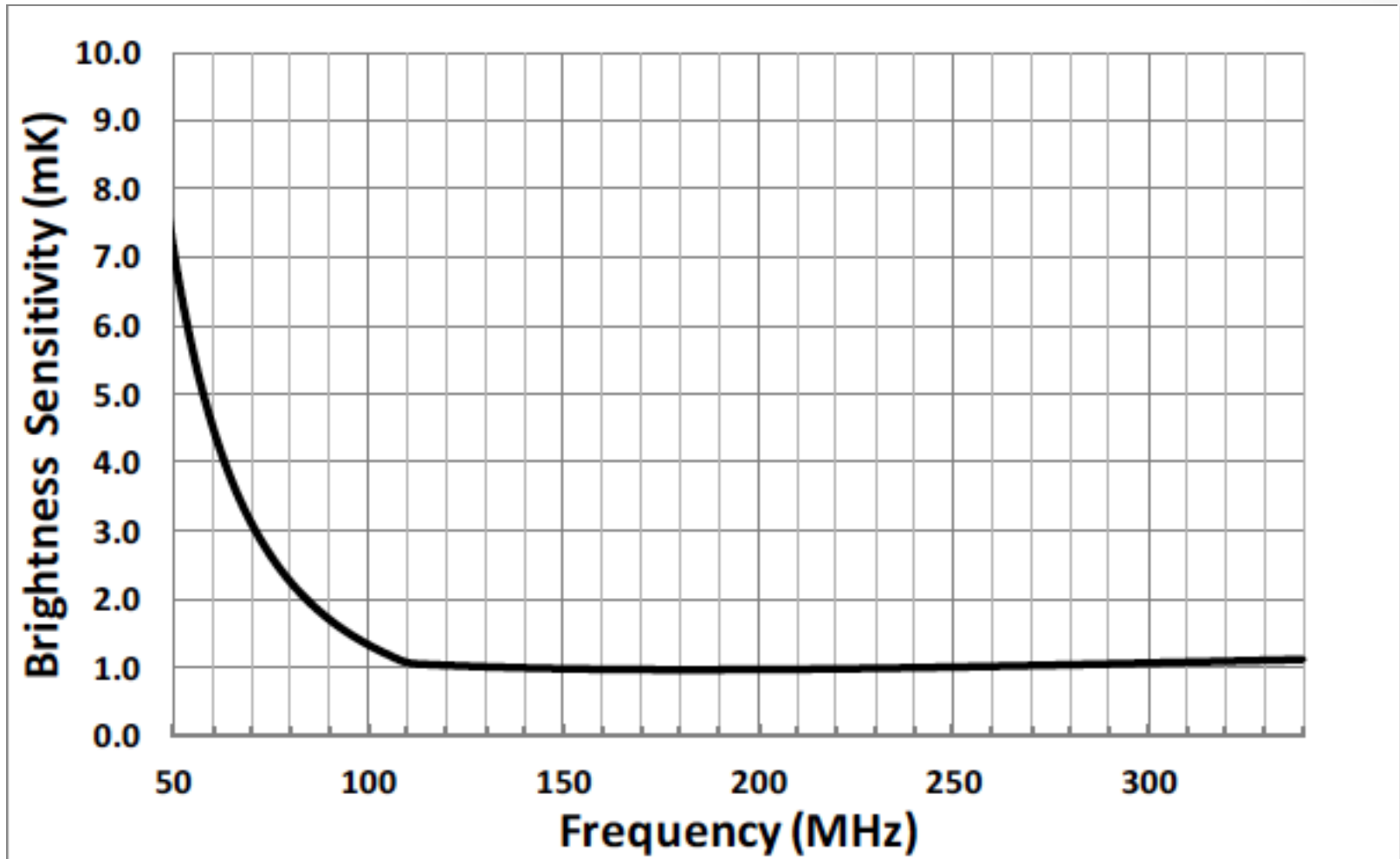
Instrument requirements

- Foregrounds:
 - Filled core and/or redundant baselines
 - Long baselines for sky model
 - Large stations for ionosphere
- Largest scales & cosmic variance: field-of-view
- Sensitivity: $A/T \sim 1000 \text{ m}^2/\text{K}$ (T_B sensitivity $\sim 1\text{mK}$)
- Cosmic Dawn: low frequencies

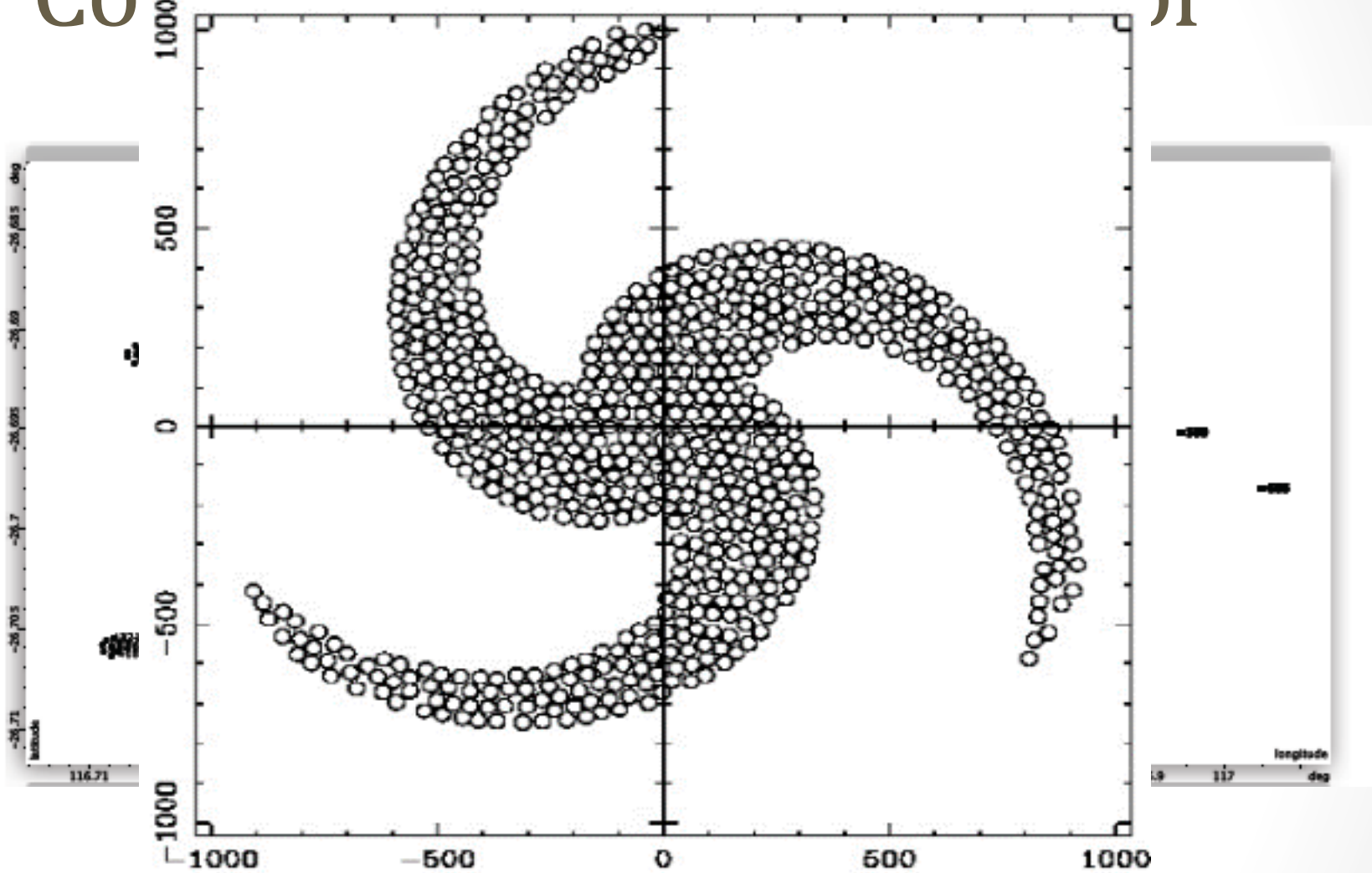
Compare to BD: baselines



Compare to BD: A/T

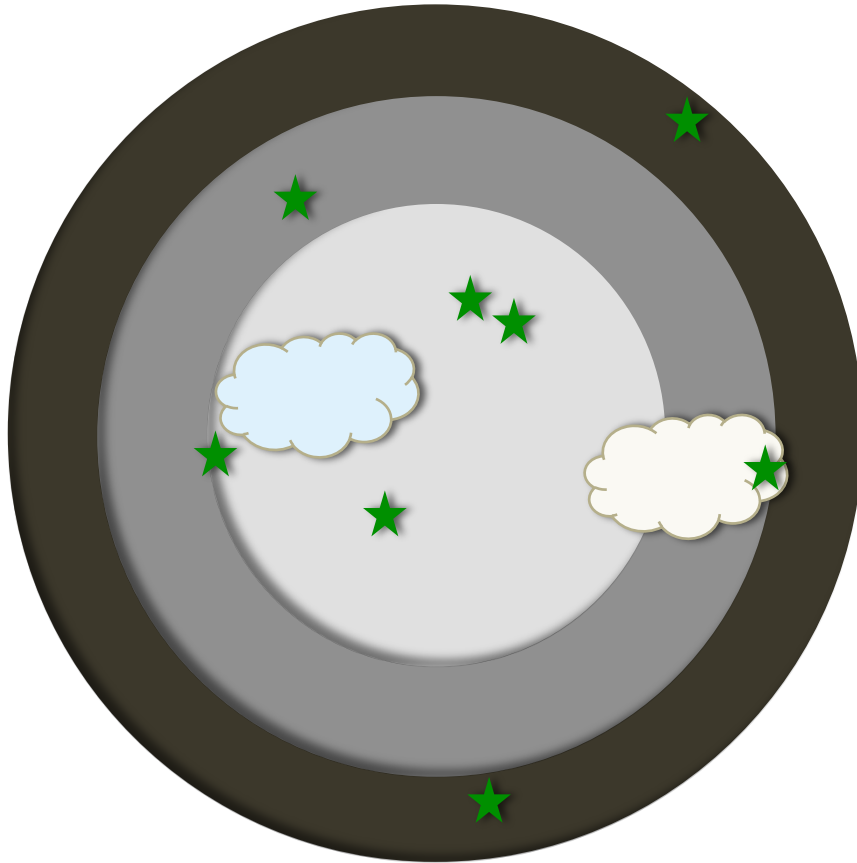


Compare to DD. filling factor



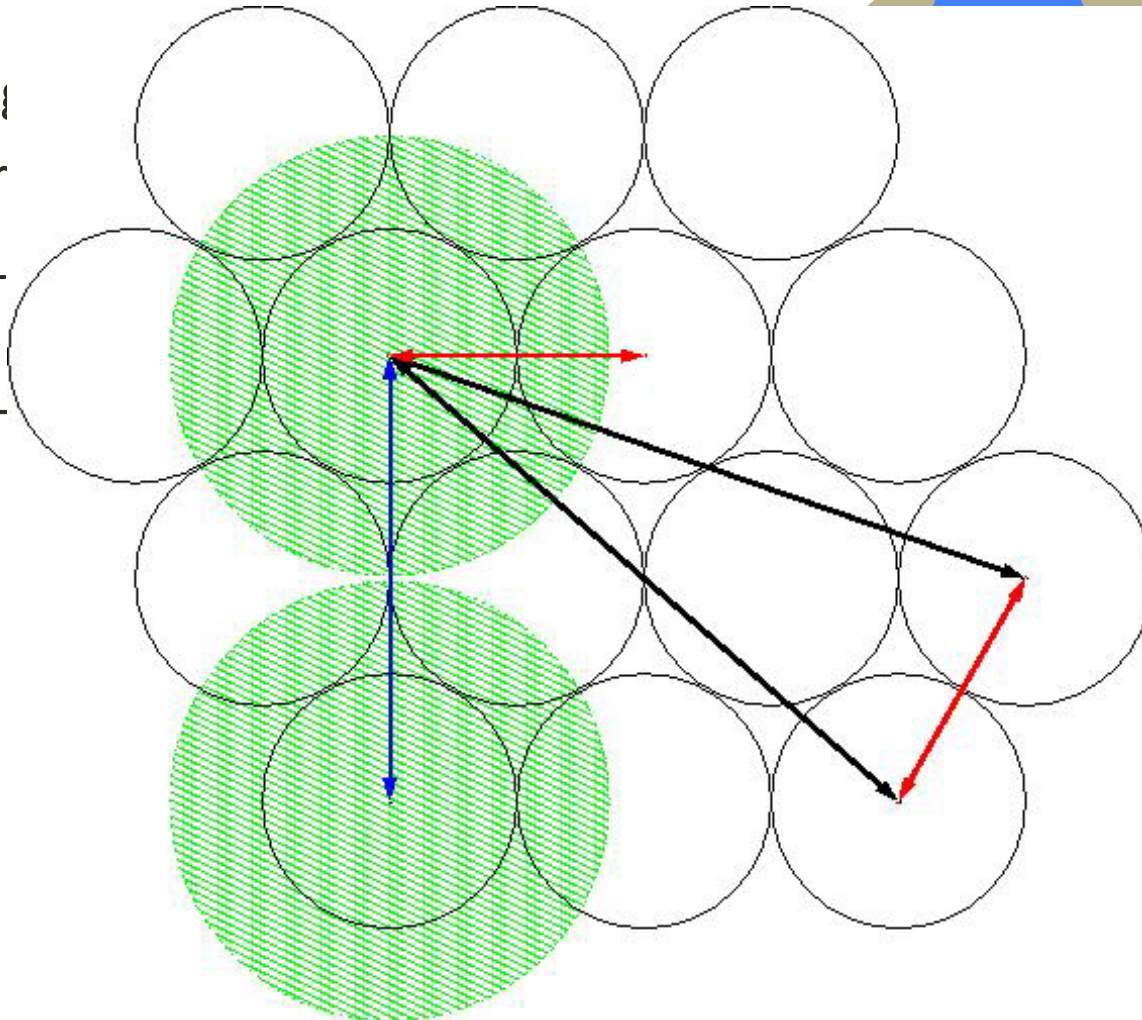
BUT: processing per individual core element

Flexible beams



Flexible stations

- Large
- Variable
- $z \sim 1$
- BU

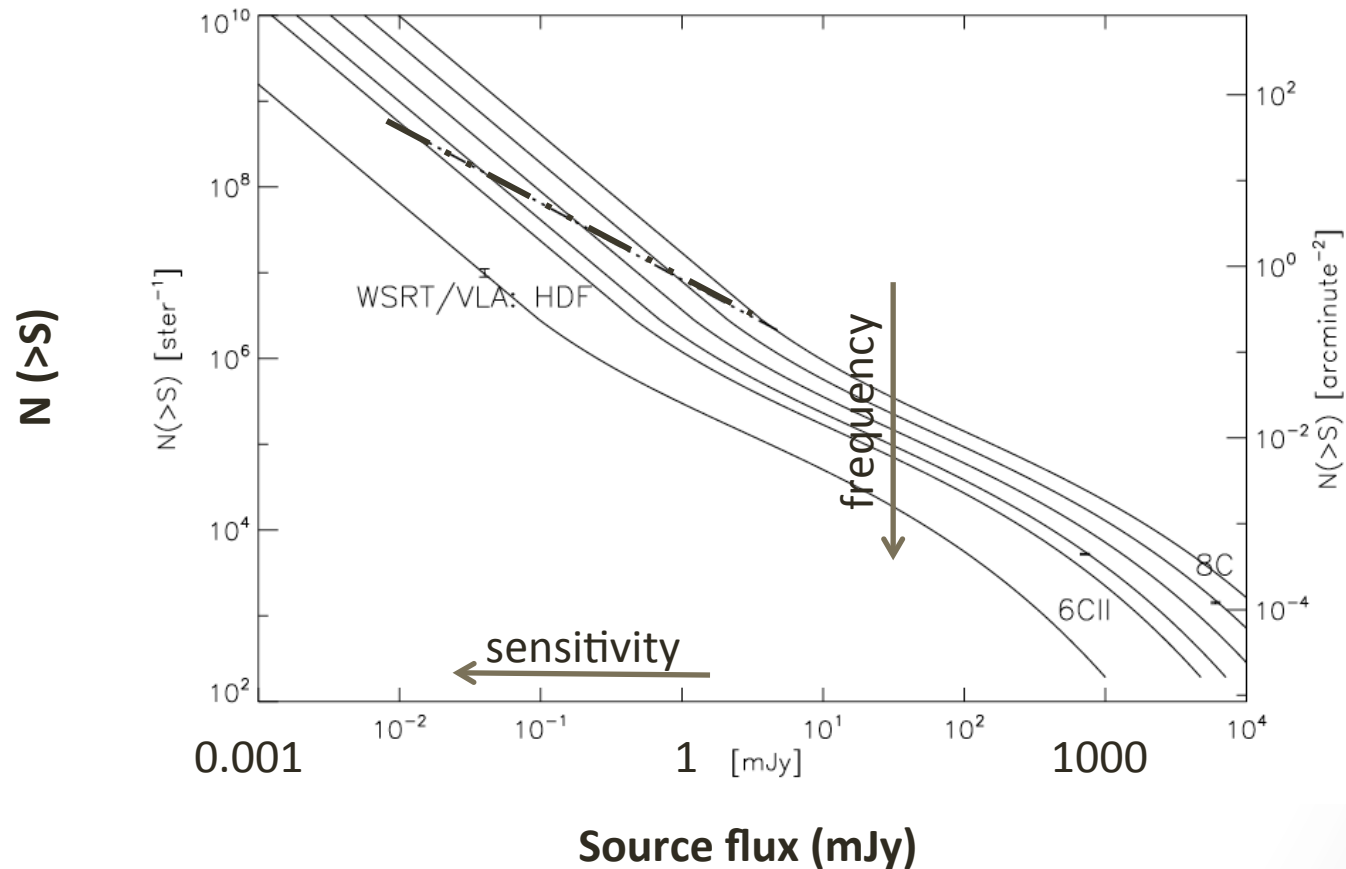


Instrument design

- ✓ Dense central core
- ✓ Flexible signal processing (station size, primary beam)
- ✓ ~100km baselines
- ✓ Sensitivity of 1mK
- ✓ 50-350MHz in 1 band

Continuum/HI science

... confused...



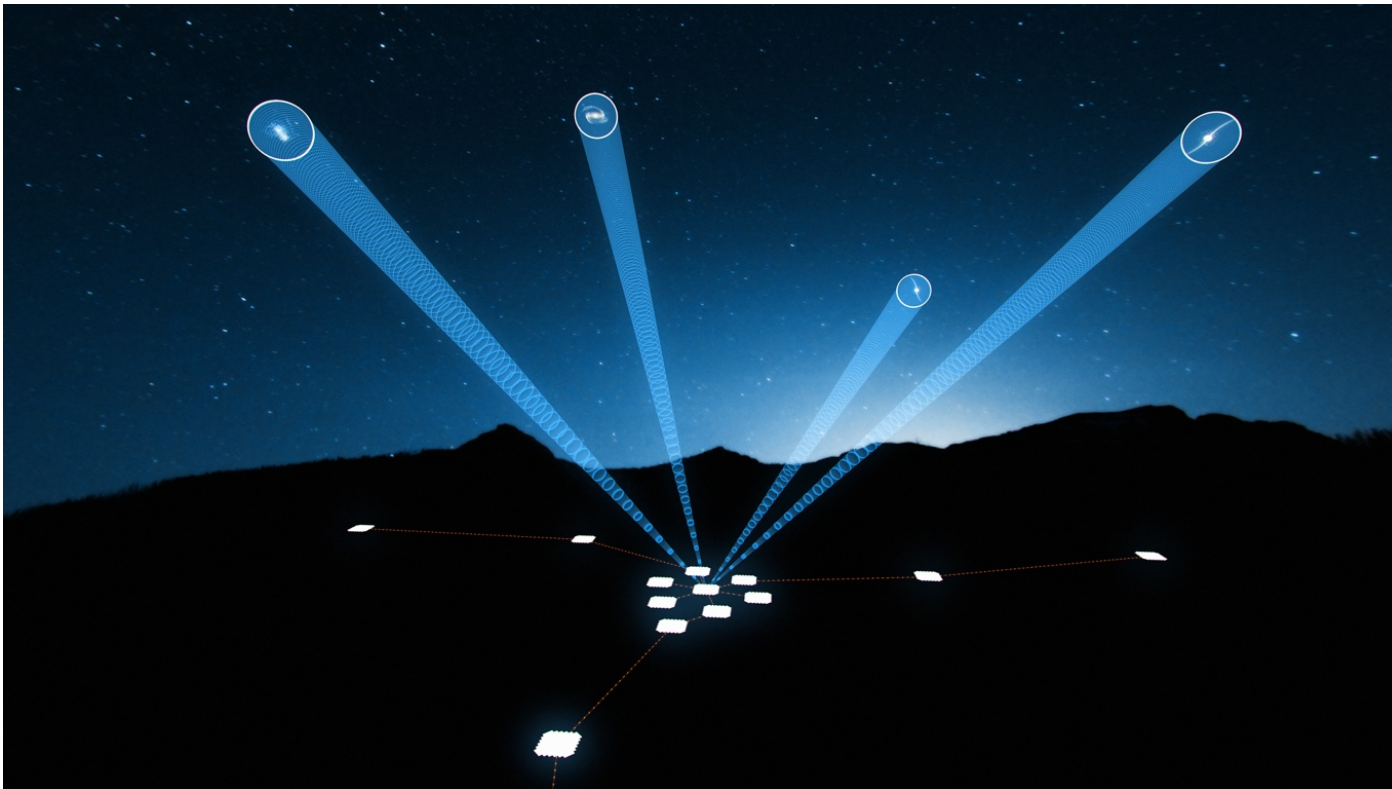
Dynamic Universe

- Dense core: 60000m² in 2km
- Flexible signal processing
- Sparse longer baselines
- Multiple beams...



Mid-frequency aperture arrays

Seminar tomorrow at 2PM!



EoR/CD white paper:
Mellema, Koopmans,+
arXiv 1210.0197

Continuum science:
Norris+
arXiv 1201.7521

