A network of vanguard groups

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Vanguard groups?...

- n. a group of people leading the way in new developments or ideas: *the experimental spirit of the modernist vanguard.*
- a position at the forefront of new developments or ideas
- the foremost part of an advancing army or naval force.
- The Vanguard Group was an anarchist political group active during the 1930s
- Vanguard is a United States investment management company that manages approximately $1 trillion in assets…

The “Lisbon story”: Portuguese Path2SKA

- “On the pathway to SKA: Science with the next generation of radio-telescopes”
  - “…unify and strengthen the national capability to master these ground-breaking new facilities. This will be achieved by addressing a set of six key research topics…”
  - “…develop PhD projects in these areas, effectively using the Portuguese network to create knowledge in the community by training the next generation of scientists who will use the SKA.”
- Project recently approved (PI: MS) – 175K (max 200K)
- Includes postdoc hires, studentships, etc
- Support for further calls (2 three year postdocs + 3 four year PhDs)
- Group:
  - IST (CENTRA)
  - FCUL (CAAUL)
  - FCUP (CICG)
- Team: 7 researchers/prof., 4 postdocs and a few students + new hires in 2010…
- Build connections to the European Path2SKA (SR is also in the PT_Path2SKA team)

PT_Path2SKA

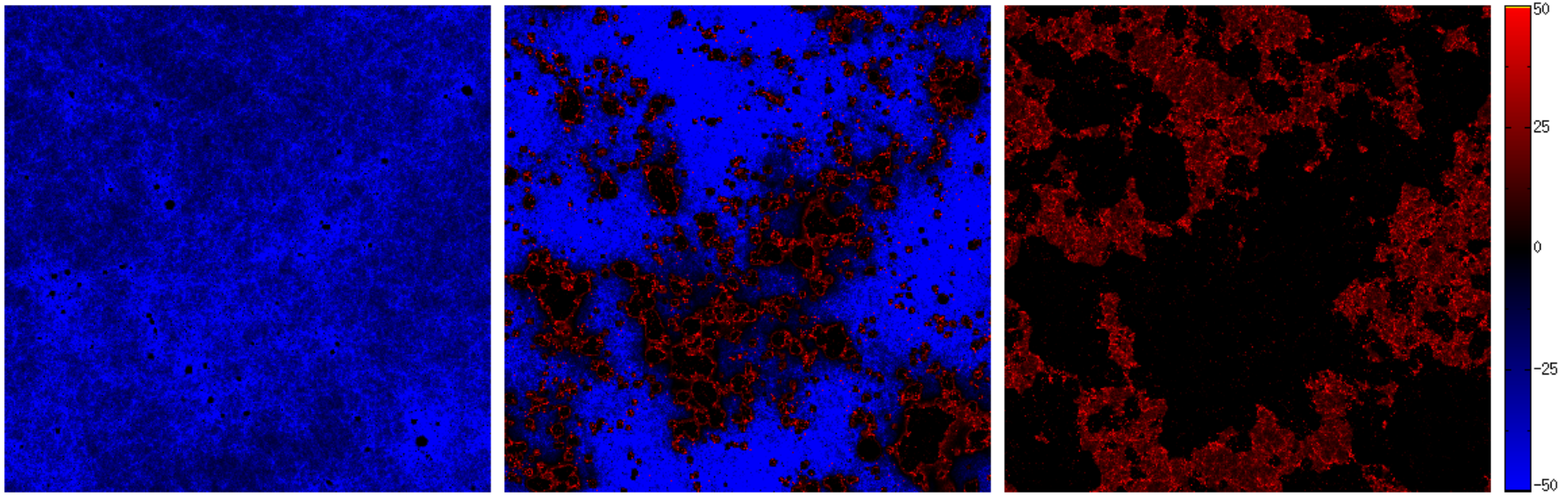
- Cosmology and High Energy Physics
  - Epoch of Reionization
  - The nature of dark energy
  - Explore the radio signatures of hadronic dynamics from Cosmic Ray air showers.
- Galaxy evolution
  - Evolution of galaxies and AGN content
  - Star-formation history of the Universe over the last 50% of its age
  - Search for the first radio galaxies
- But also Software development/support…

Software…

- "To improve our understanding of the technical setup of the new instruments and develop software tools for proper data reduction of the expected raw output from the next generation of radio telescopes effectively creating a knowledge database for this crucial skill in Portugal"

- "Vanguard group"
  - team members will use Meqtrees and related tools in their science work (the "end user") but also contribute with new tools
  - e.g. data analysis, calibration and image reconstruction
  - Need more human resources (Path2SKA)
  - Can't get software development for free (sorry) – unless they give papers
- Also create ALMA Regional Center (CASA – connect to above, led by CAAUL)
- Exchange knowledge with industry

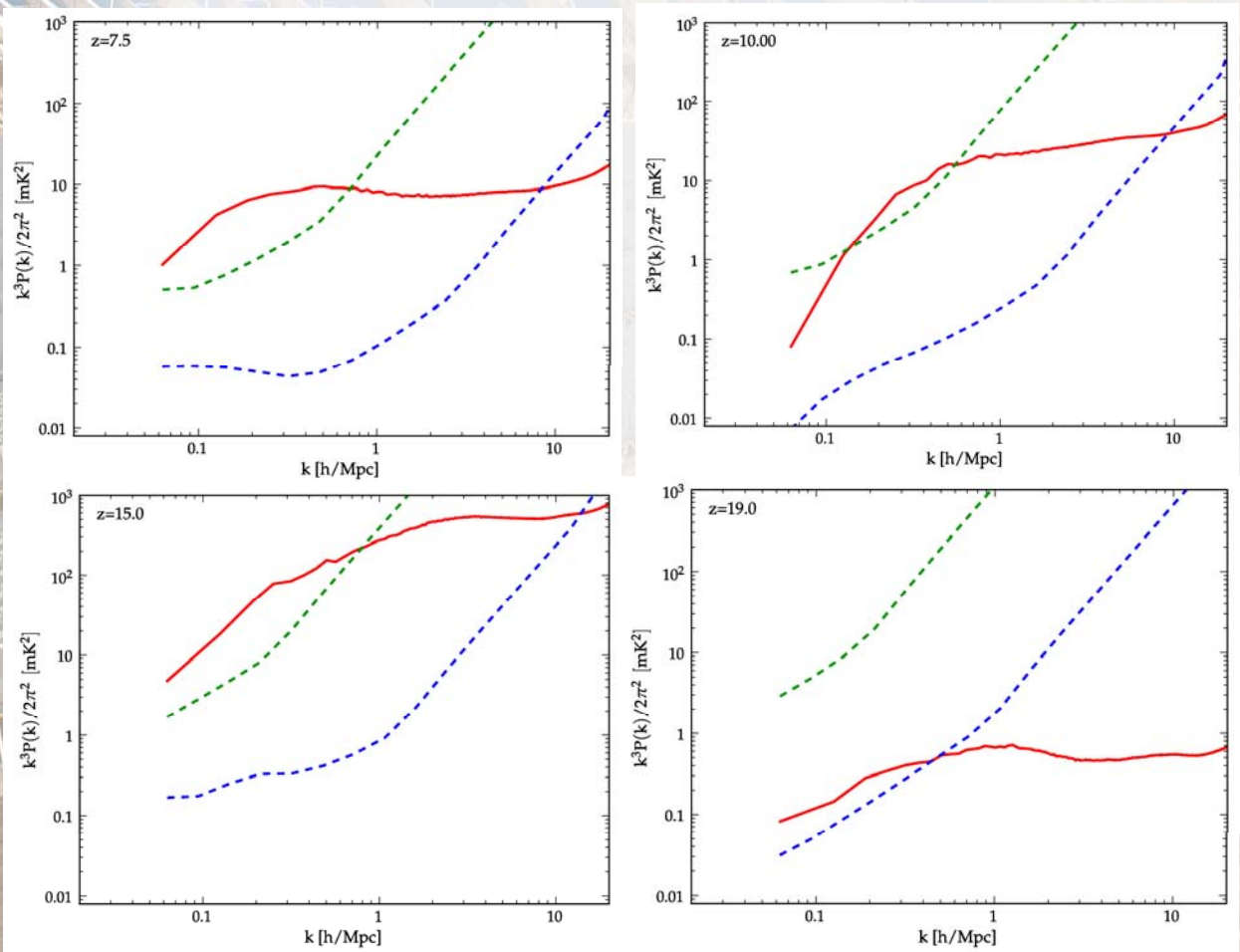
Some examples



Z=17.2, xHI=0.99 Z=12.1, xHI=0.83 Z=8.0, xHI=0.27

- How to simulate this sky? (LOFAR, MWA, SKA)
- I need to understand the noise properties/calibration in order to check how to remove foregrounds (e.g. galactic synchrotron and undetected point sources
- Still don’t now if this measurement is feasible!

Power spectrum - errors



- T_{sky} ~ 1215 K @ 100 MHz
- Bandwidth ~ 8 MHz per redshift
- t_{tot}=1000 hours

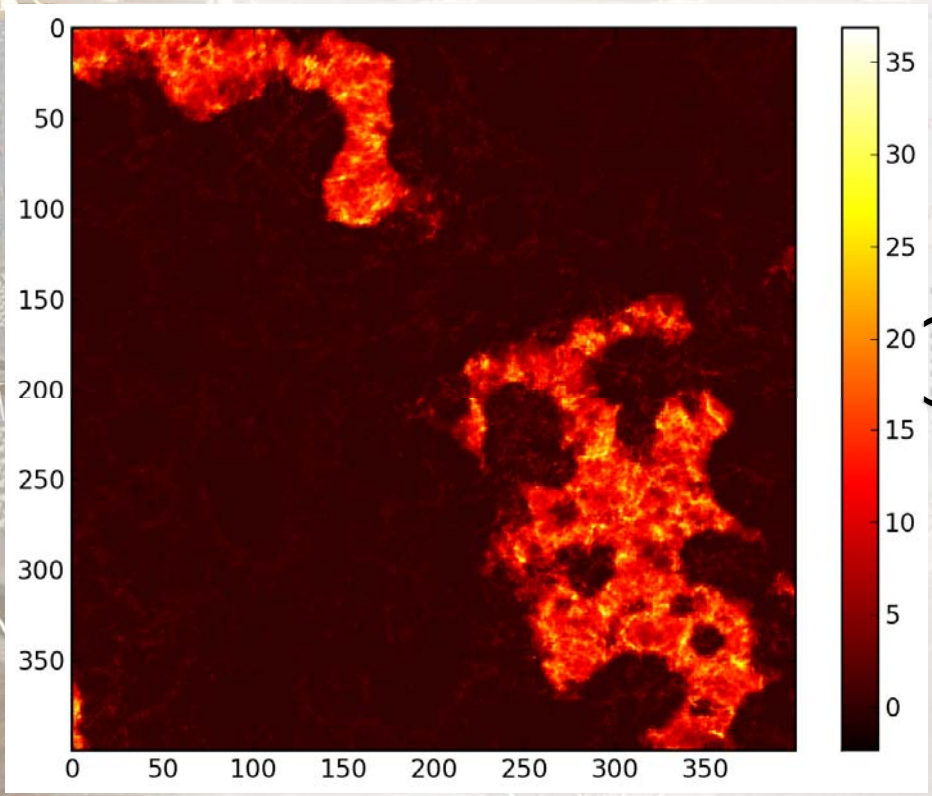
- **Blue (SKA type):**
- A_{eff}=4000 m^2/K @ 100 MHz
- FoV ~ 200 deg^2
- D_{max}=5 Km (with 70% of A_{eff})
- D_{min}=15 m

- **Green (LOFAR type):**
- 130 m^2/K @ z=6 (ν=203 MHz)
- FoV ~18 deg^2 (x2)
- D_{max}=2 Km
- D_{min}=50m

- **Red solid line**: brightness temperature 3-d power spectrum with all fluctuations included
- Dashed lines: total error in the power spectrum; bins=0.5k

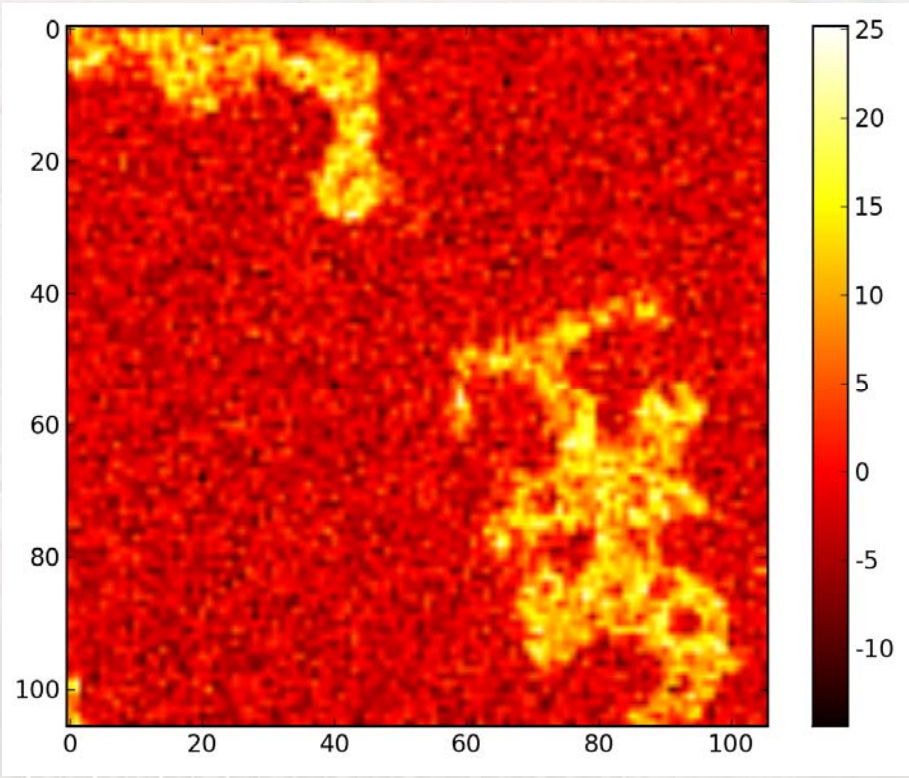
Map making with SKA

Signal



z=7, ν=177 MHz, θ=1 degree, $\Delta\theta$=9”

Signal + Noise

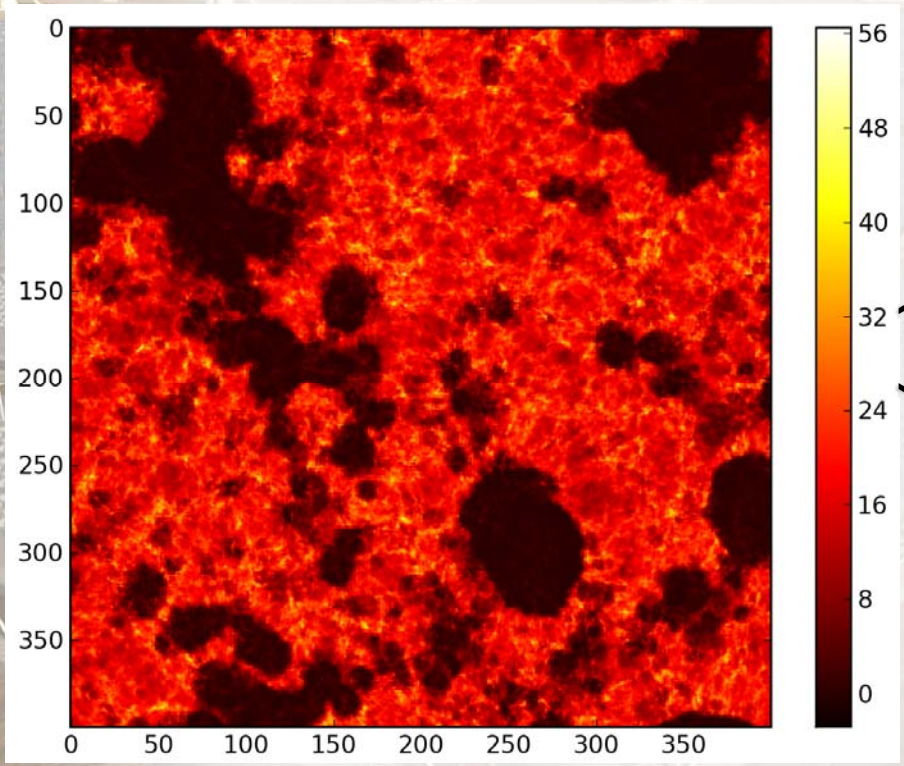


z=7, ν=177 MHz, $\Delta\nu$=2 MHz, θ=1 degree, $\Delta\theta$=35”

No foregrounds…

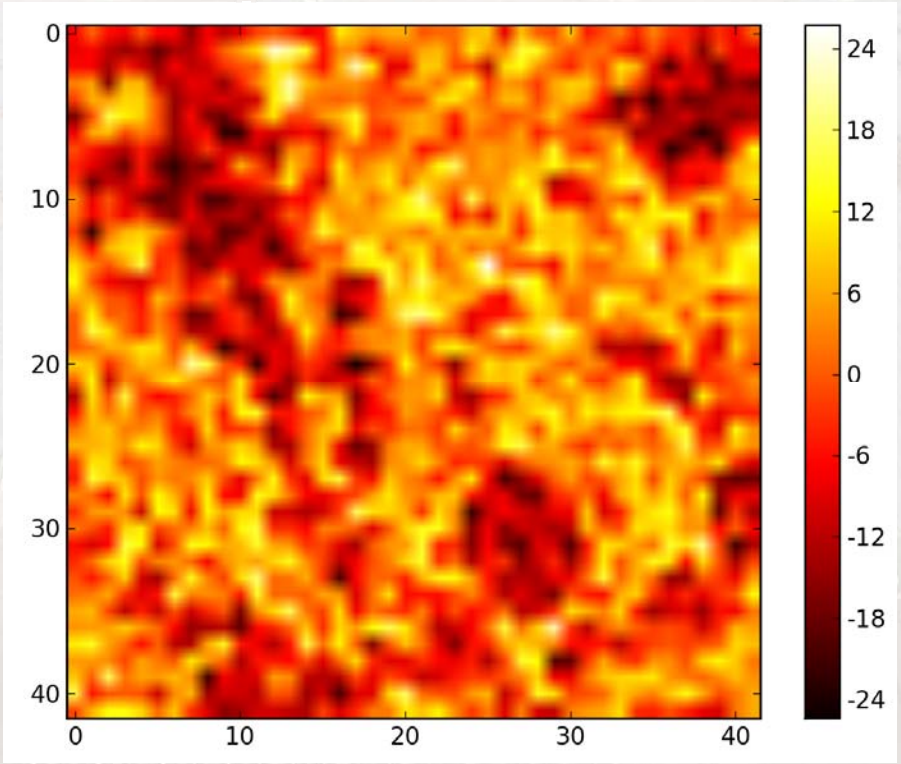
Map making - 2

Signal



Z=9.2, ν=140 MHz, θ=32', $\Delta\theta$=4.8"

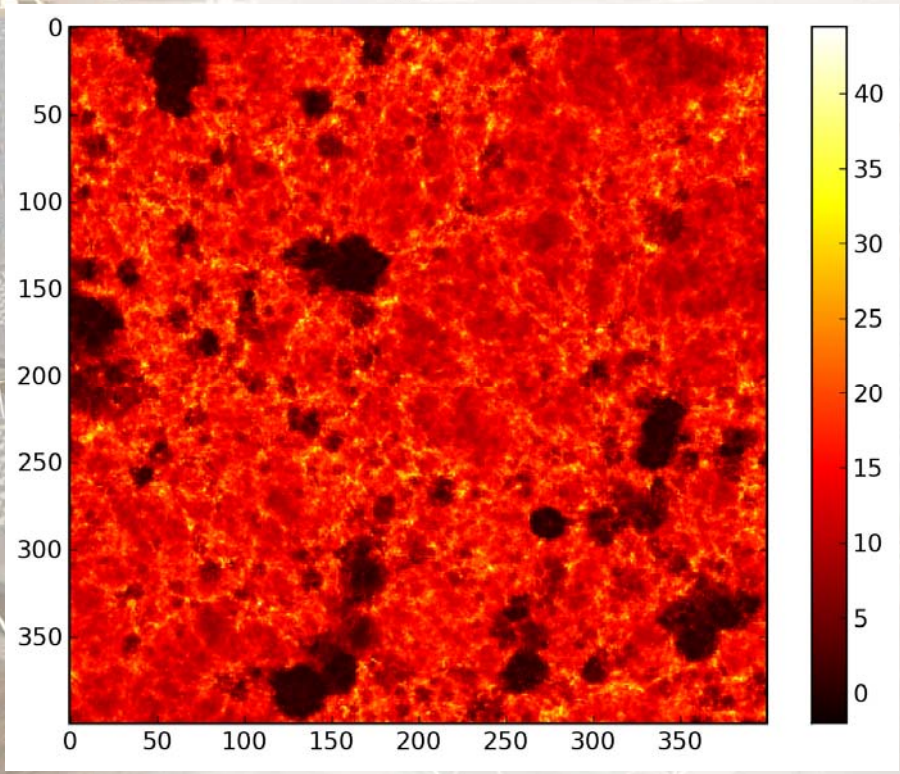
Signal + Noise



Z=9.2, ν=140 MHz, $\Delta\nu$=2MHz, θ=32', $\Delta\theta$=46"

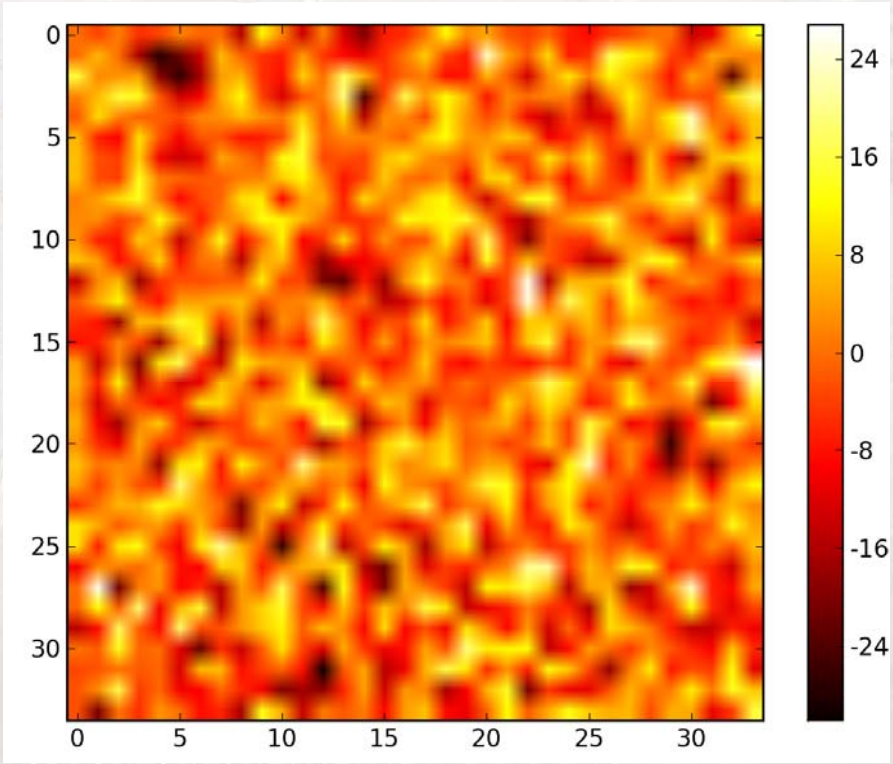
Map making - 3

Signal



z=12, ν=110 MHz, θ=32', $\Delta\theta$=4.8"

Signal + Noise



z=12, ν=110 MHz, $\Delta\nu$=2 MHz, θ=32', $\Delta\theta$=0.94'

PT_Path2SKA

(CAAUL group)

- Mainly doing deep surveys (GMRT but ASKAP and ALMA next) – develop algorithms alongside for calibration.
- Development of algorithms to calibrate beam effect/pointing errors – test it with GMRT observations (source on the first null of the beam)
- Deep radio surveys and large bandwidth – algorithm for automated flagging of RFI (residual-based flagging)
- Position dependent solutions for the ionospheric calibration (source – based self-calibration)

- “We aim to work alongside the developers of the most recent radio-interferometry software packages (CASA; MeqTrees), by comparison with long-standing radio-interferometry packages like AIPS.”

Some thoughts

- We wouldn’t mind to hire “pure” software developers… what about EC money? Path2SKA or other?
- We will setup a web page for the PT_Path2SKA (important to make the project more concrete)
- Use Forum type approach to get discussions going…