

## Concluding remarks - (highlights!)

- Mike Garrett

General & Scientific Director, ASTRON

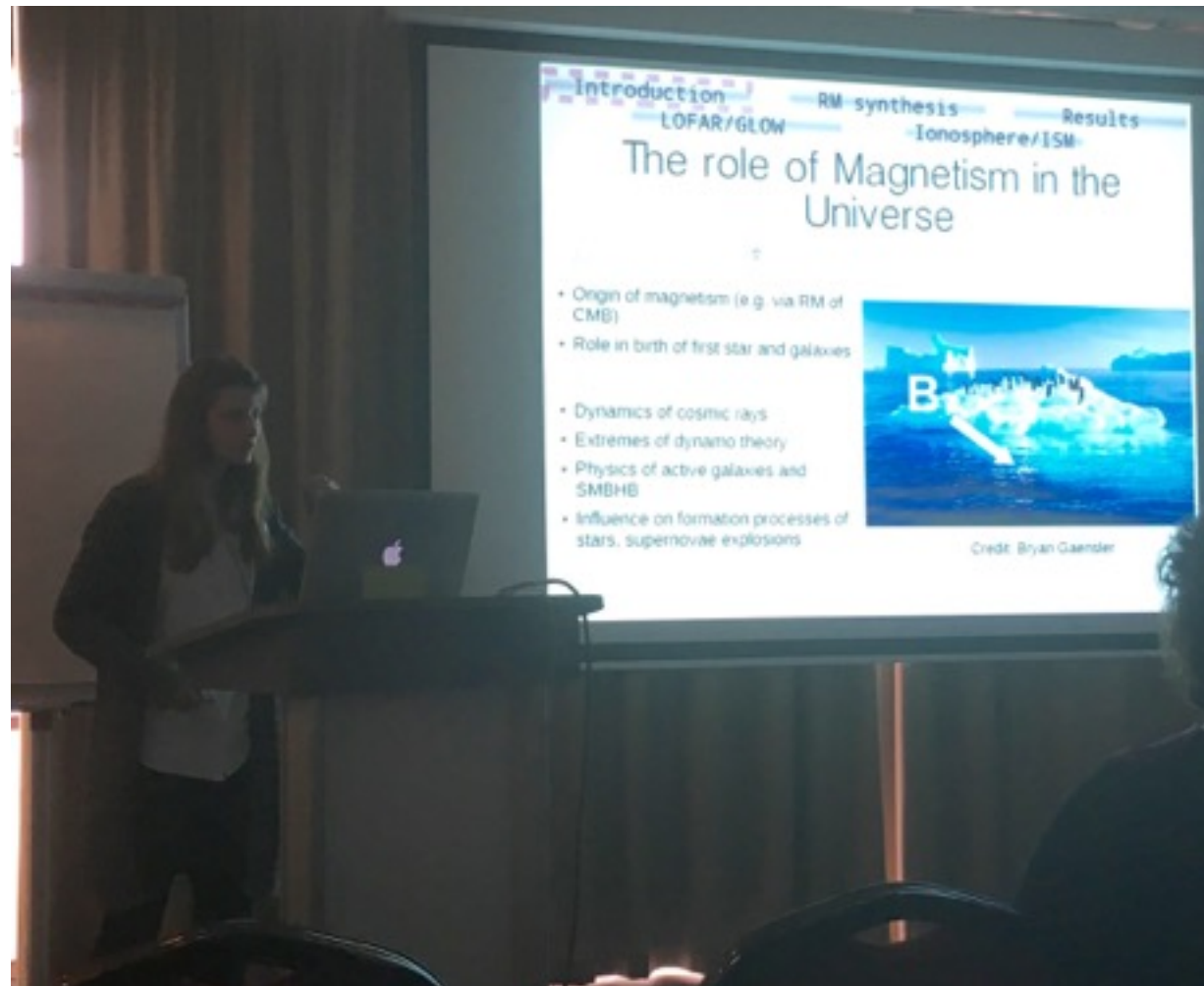
Also affiliated with Leiden Observatory.

# Prizes

# A talk of Titanic proportions

Most enthusiastic talk... highest bit rate...  
both speaker and audience left breathless...

- Nataliya Porayko



# Best Quote

***“If we don’t take into account magnetic fields, we are sailing on an astrophysical Titanic that will crash into a magnetic field Iceberg”.***

***- Nataliya Porayko***

# More Quotations

***“From science-ready, to science-fiction!”***

*- Emanuella Orru*

Cameron Van Eck

# LOFAR 3.0



edit: "Shield World Construction" by Adam Burn

Image credit: [astron.nl](http://astron.nl)



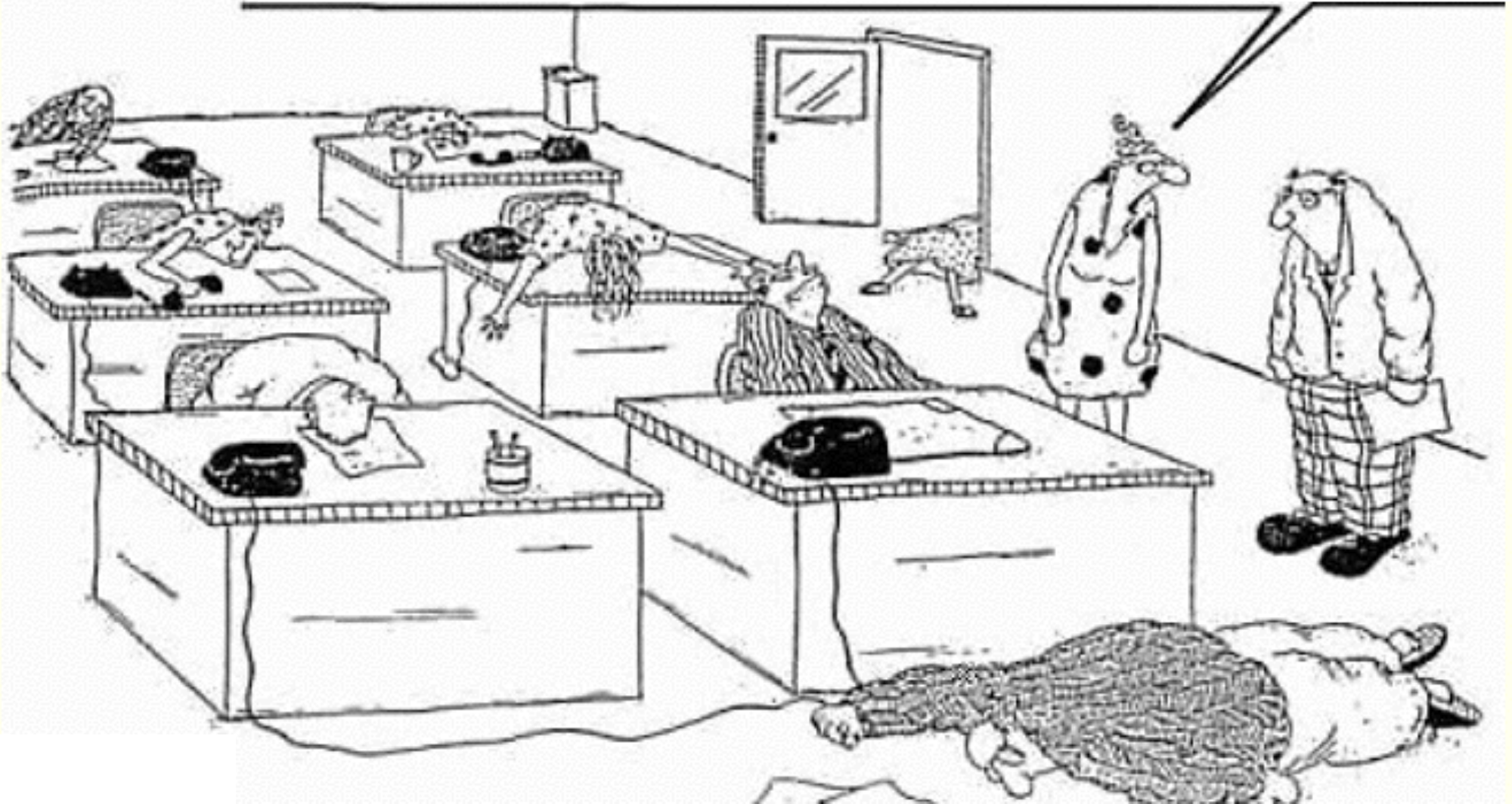
# ***Perseverance***

**...Samayra Straal - 40000 plots...**



# Perseverance ...Samayra Straal - 40000 plots...

**This must be the Department of Missing Pulsars...**



# More Quotations

***“I am not the first woman to discover a Pulsar” - Samayra Straal***

# More Quotations

***“I am not the first woman to discover a Pulsar”*** - Samayra Straal

***“We lost a RRAT!”***  
- Sotiris Sanidas



# A talk of Superlatives

## **“LOTAAS:**

- *222 beams per pointing*
- *8PB data*
- *35M cpu hours*
- *40 million candidates,*
- *200 microsec sampling,*
- *dec > -10.*

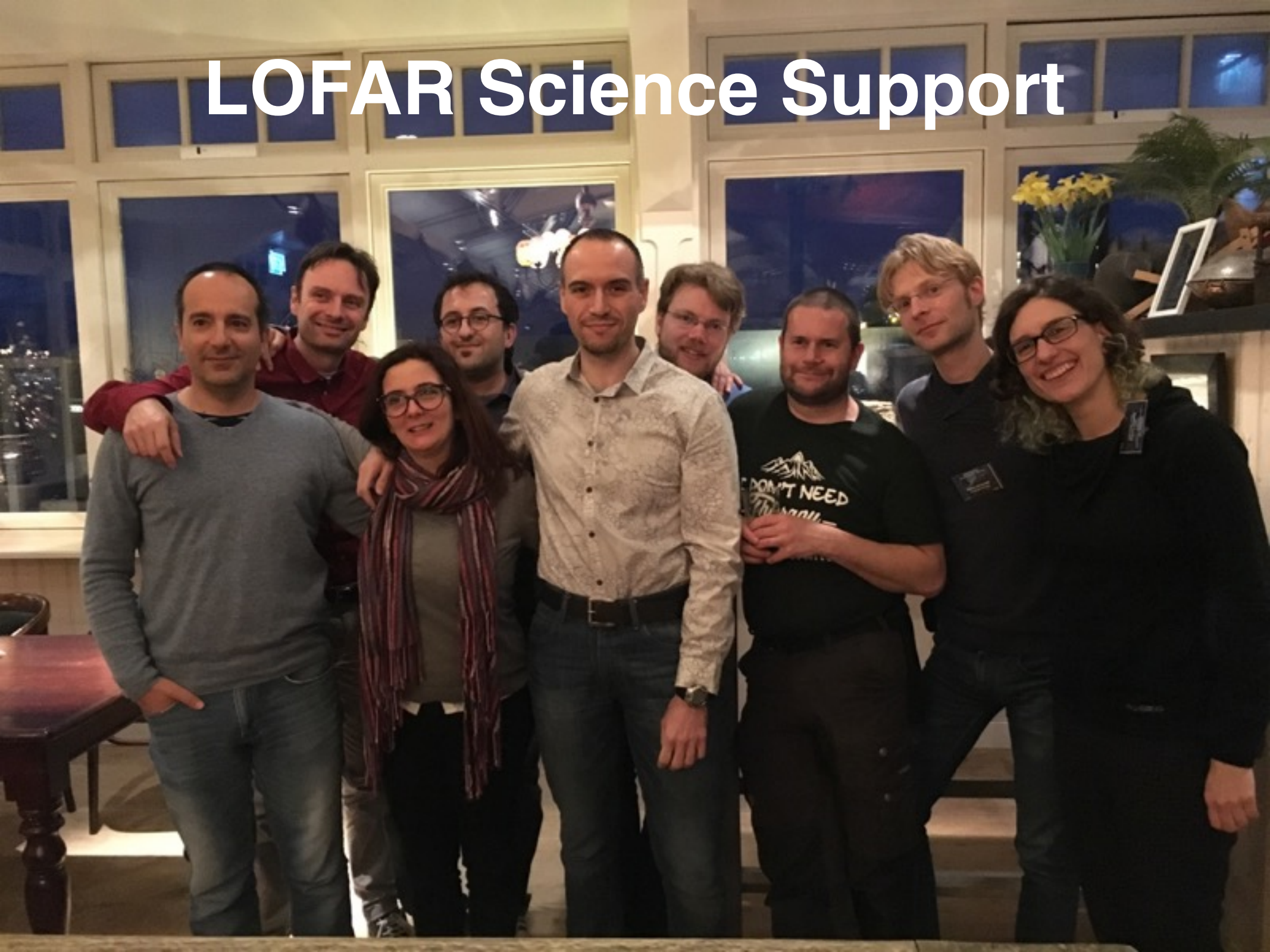
***Most successful PSR search at any freq.!***

- *Sotiris Sanidas*

# Dedication - KAIRA - Derek McKay



# LOFAR Science Support



# Best Title Slide



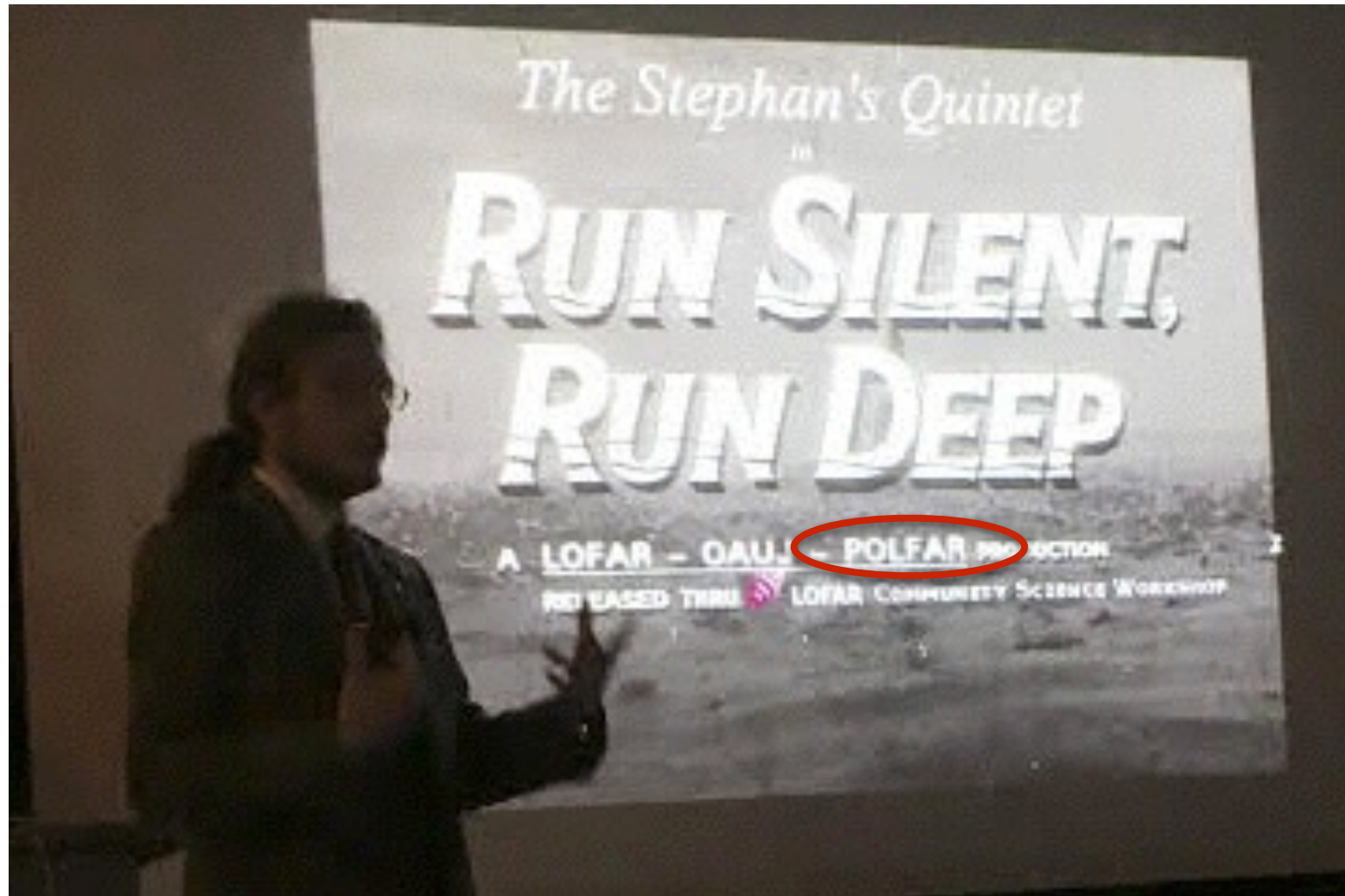
# Best Title Slide



***“Go smell some beautiful flowers”***  
*- Blazej Nikiel- Wroczyński*



# Best Title Slide



# Successes

# Cosmic Ray KSP... Scholten, Buitink, Rossetto, Corstantje, Trinh, Winchen et al.

LETTER

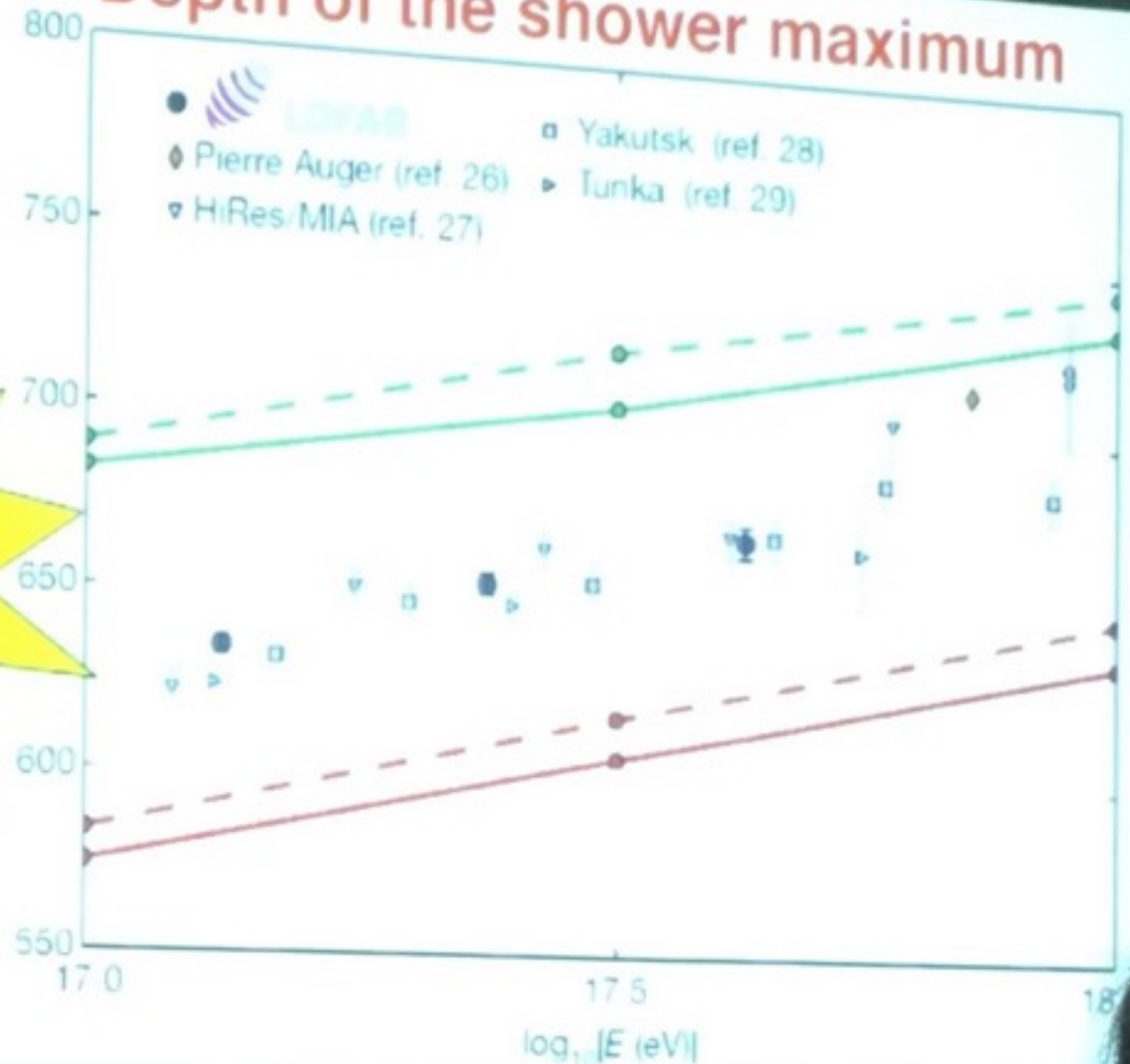
A large light-mass component of cosmic rays at  $10^{17}$ – $10^{18}$  eV from radio observations

publ.  
in natu

**Nature**

S. Buitink et al., Nature (2016)

## Depth of the shower maximum



# Multi-disciplinary LOFAR



NATURE | NEWS



## Cosmic rays reveal the secrets of thunderstorms

High-energy particles from distant space could help to illuminate the origin of lightning.

Daide Castelvechi

23 April 2015

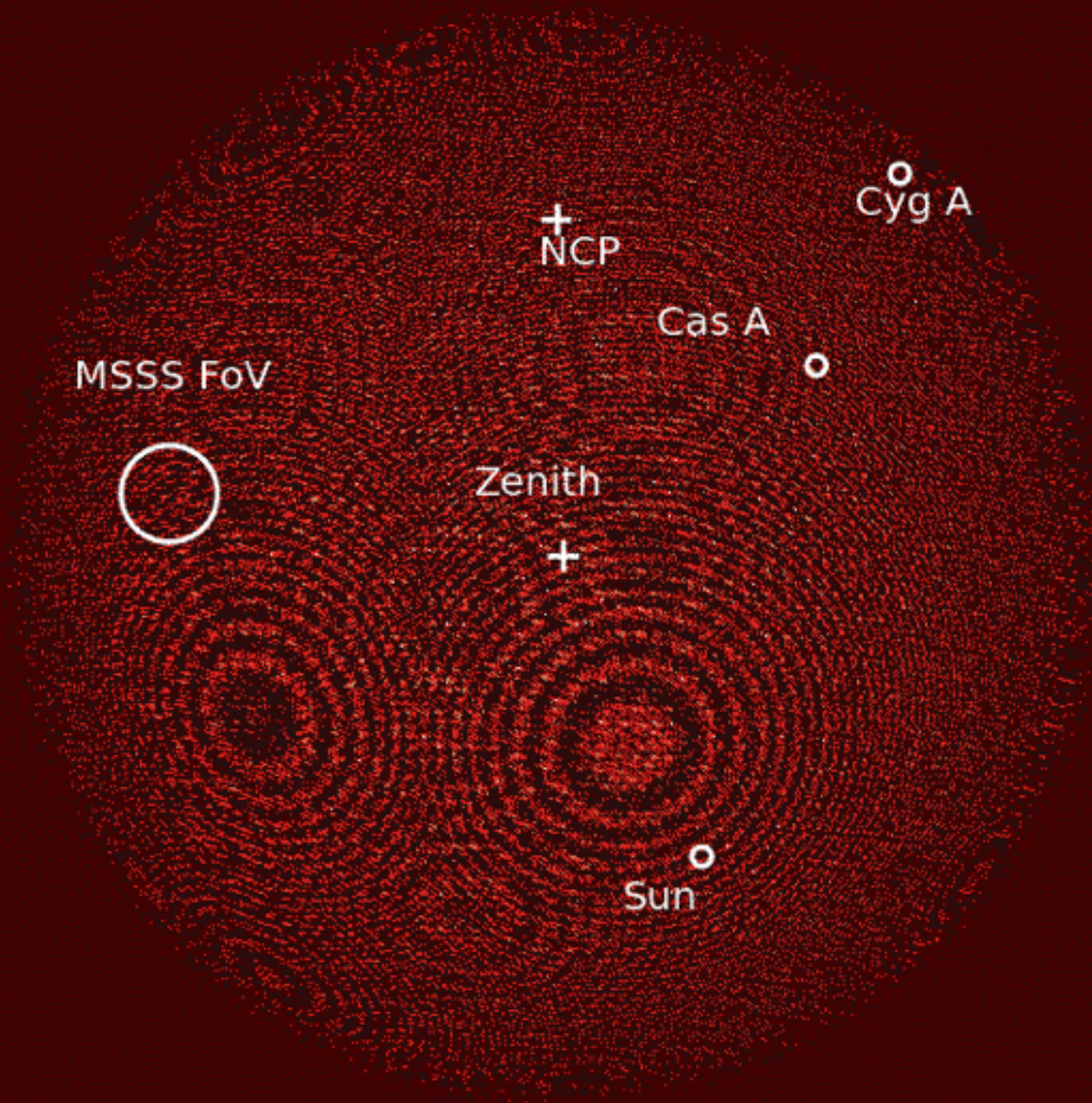
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### Cosmic ray simulation

A simulation of the shower of particles produced by a cosmic-ray proton after it collides with the atmosphere at an altitude of 20 kilometres. The actual duration of the event would be around 10 microseconds.

Casper Rutjes / ASTRON / Centrum Wiskunde & Informatica



# Multi-disciplinary LOFAR



NATURE | NEWS

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Cosmic ray simulation

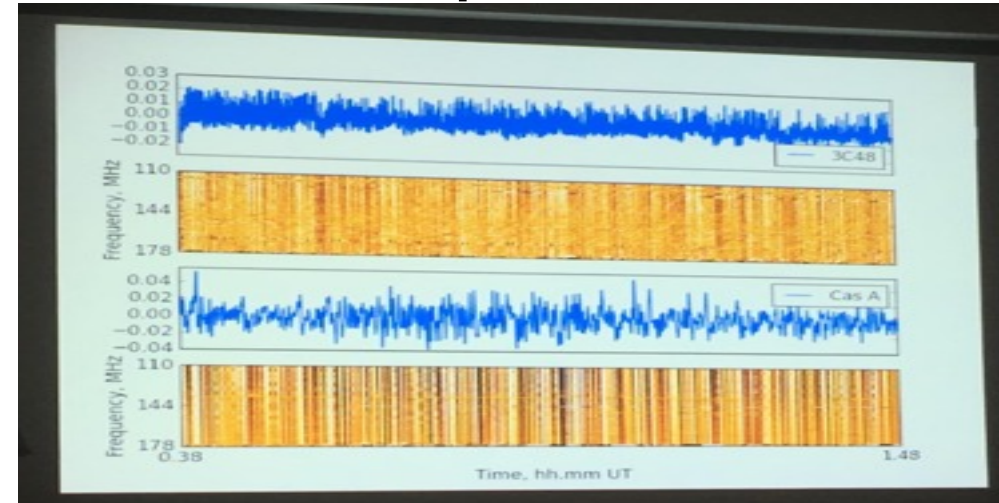
A video player showing a simulation of a cosmic ray shower. A bright purple and pink beam of light strikes a green landscape with a river and a circular structure. The video player interface includes a play button, a progress bar at 00:00, a duration of 00:17, and volume controls.

Cosmic ray simulation

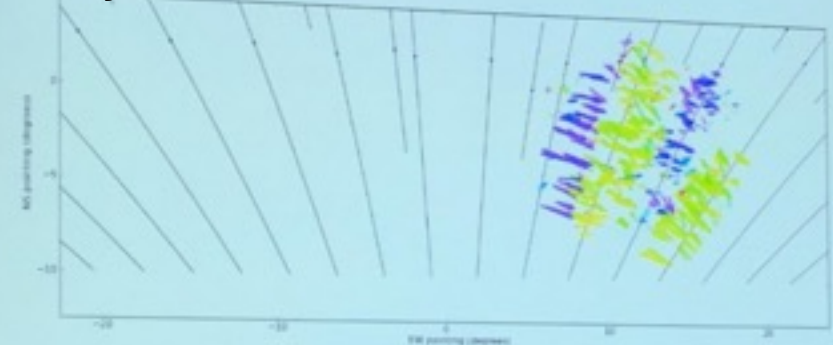
A simulation of the shower of particles produced by a cosmic-ray proton after it collides with the atmosphere at an altitude of 20 kilometres. The actual duration of the event would be around 10 microseconds.

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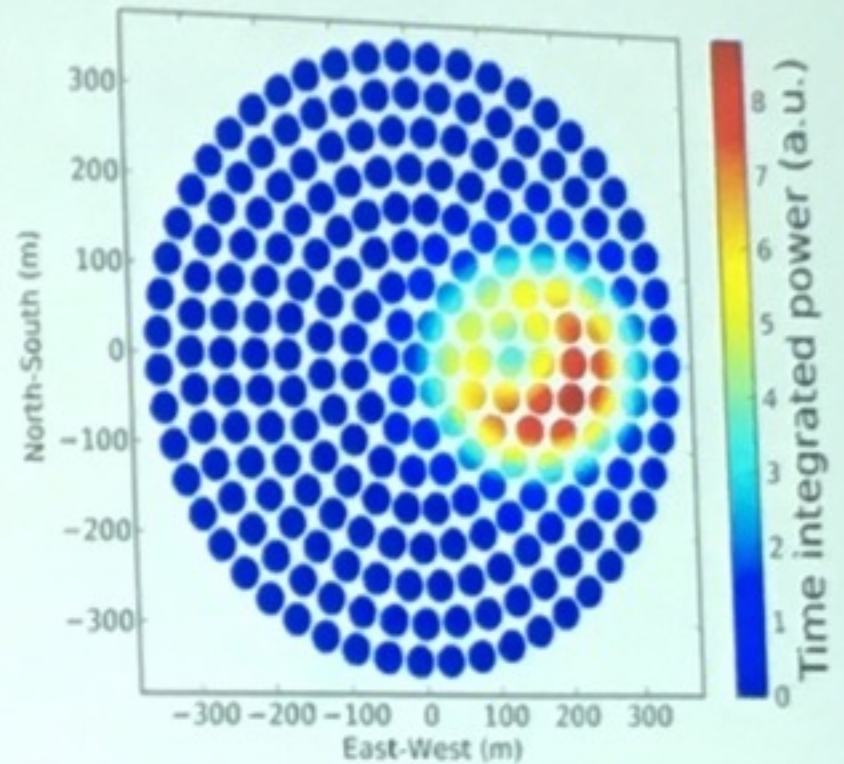
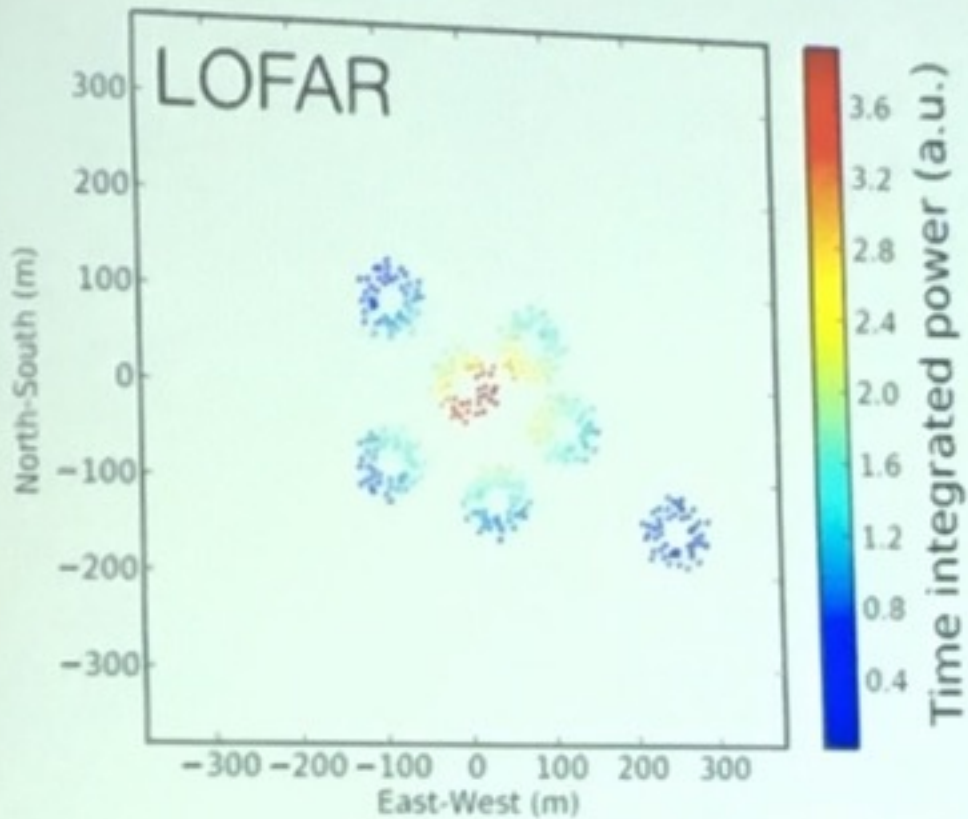
## IPS vs Ionosphere - Richard Fallows



## LOFAR Ionospheric stereo vision - Maaijke Mevius,



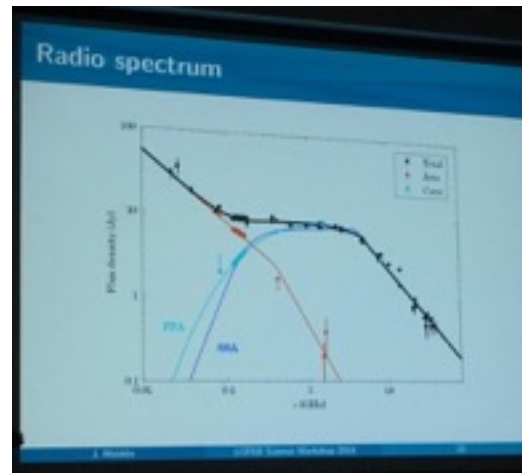
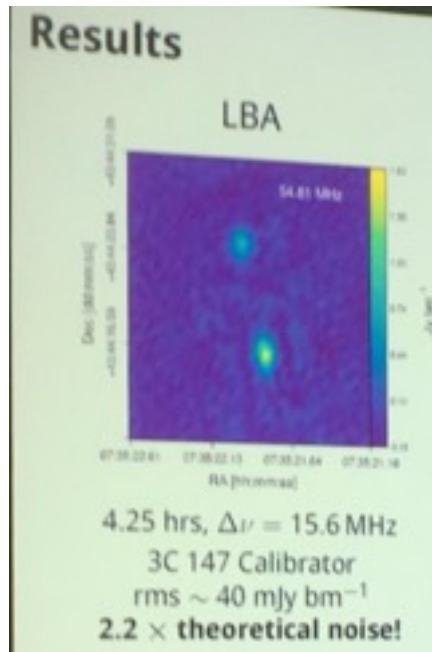
# SKA: ultrahigh precision measurements



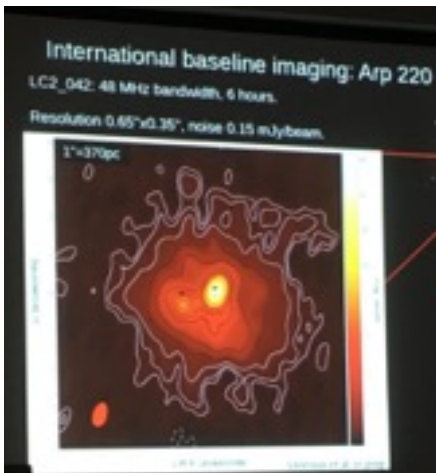
SKA-low

# International Baseline science

- Varenus et al., Mirabito et al. Moldon et al.



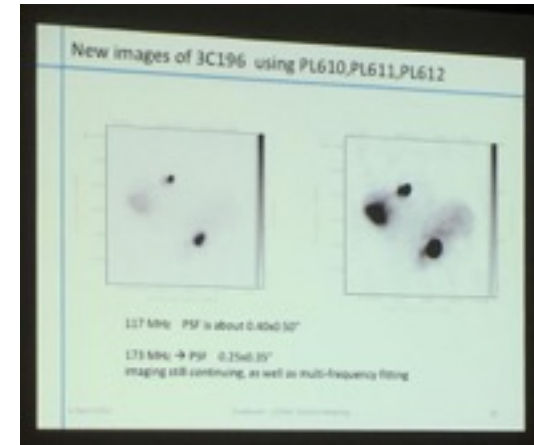
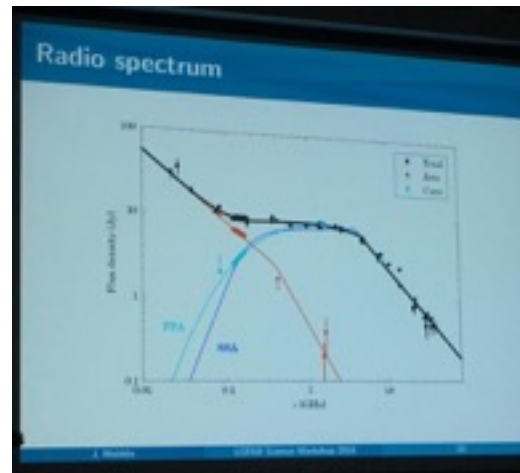
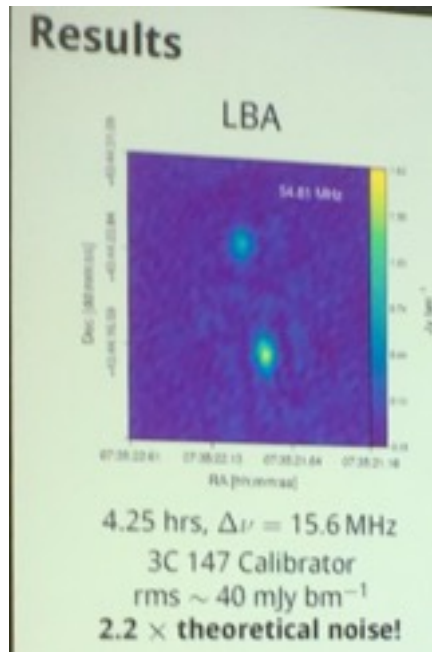
Synergy... EVN, e-MERLIN, VLBA, VLA,  
WSRT-APERTIF, see also A. Clarke et al.



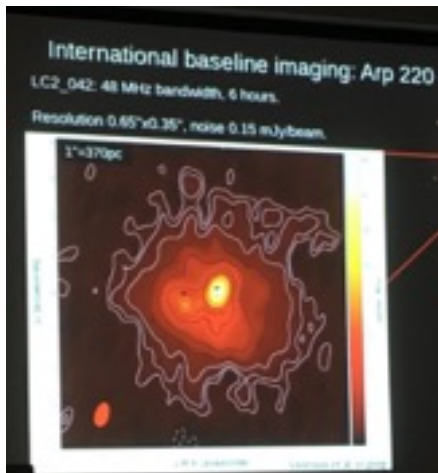


# International Baseline science

- Varenus et al., Mirabito et al. Moldon et al.



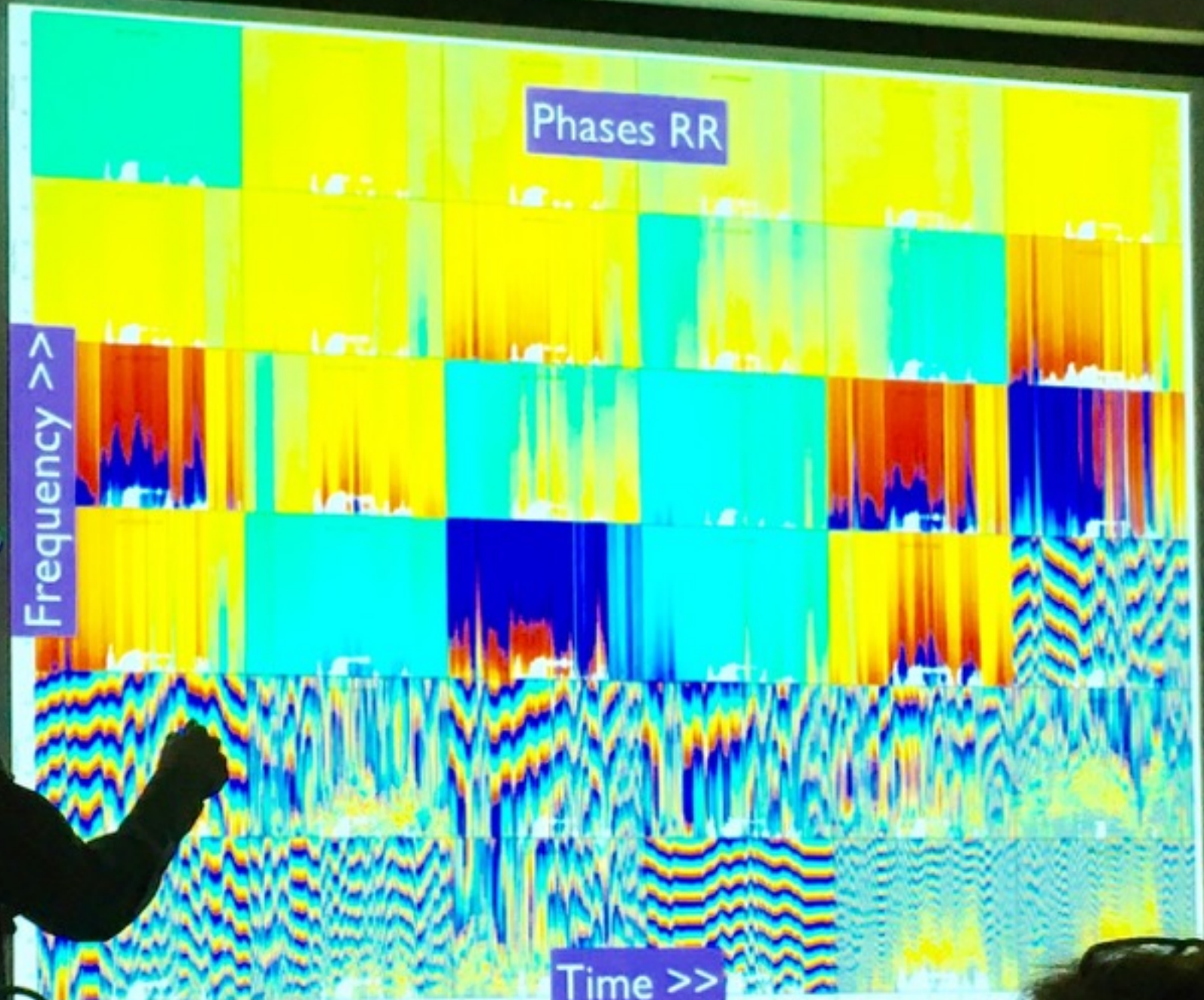
EoR de Bruyn et al.



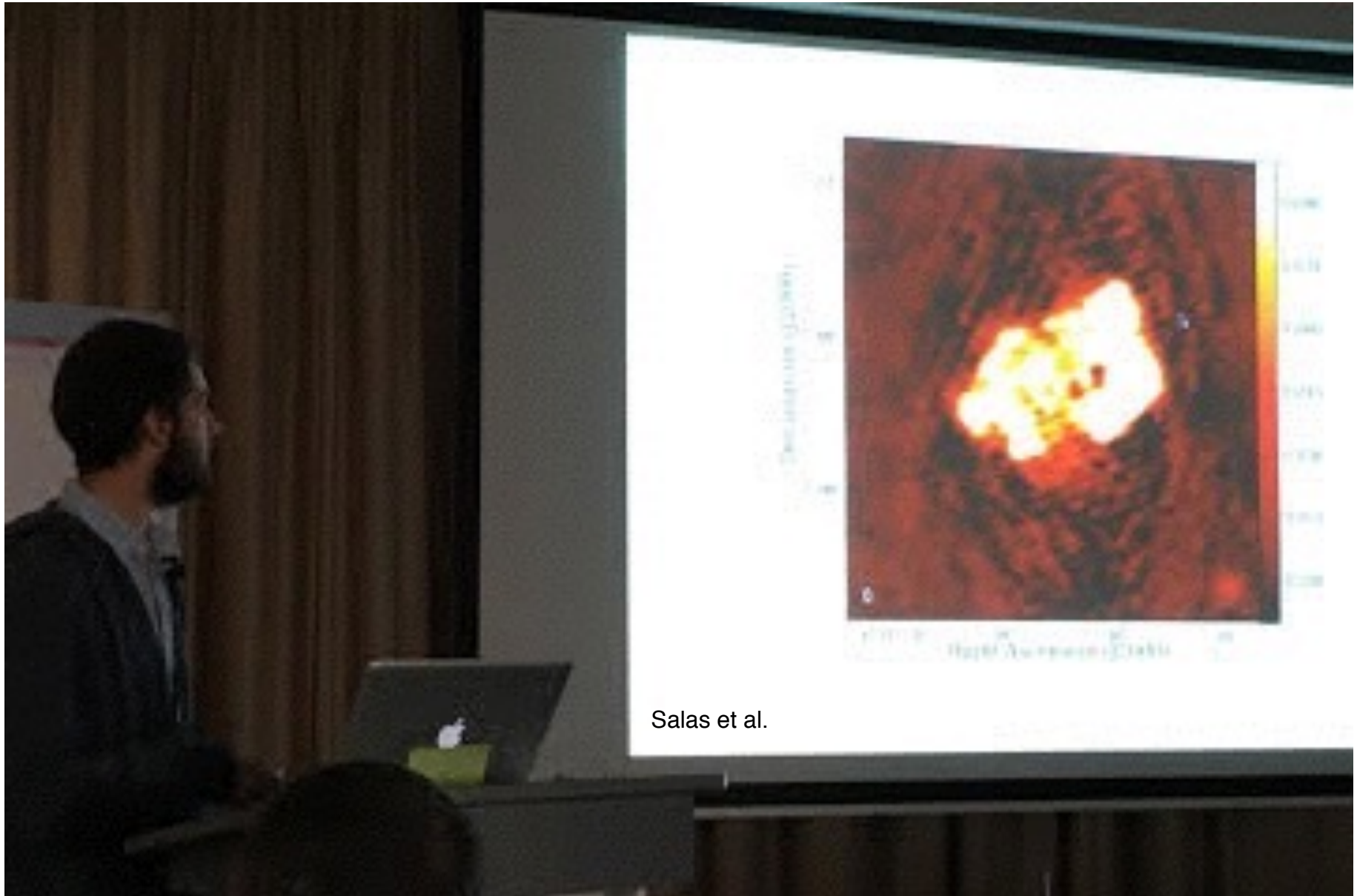
Synergy... EVN, e-MERLIN, VLBA, VLA, WSRT-APERTIF, see also A. Clarke et al.

**Challenges/Opportunities ahead...**

# LBA calibration - Francesco de Gasperin



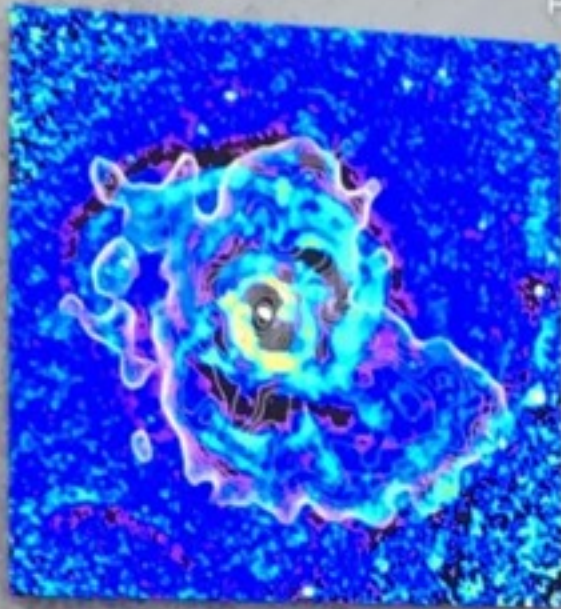
# LBA & RRL - Oonk, Salas, Toribo, Emig et al.



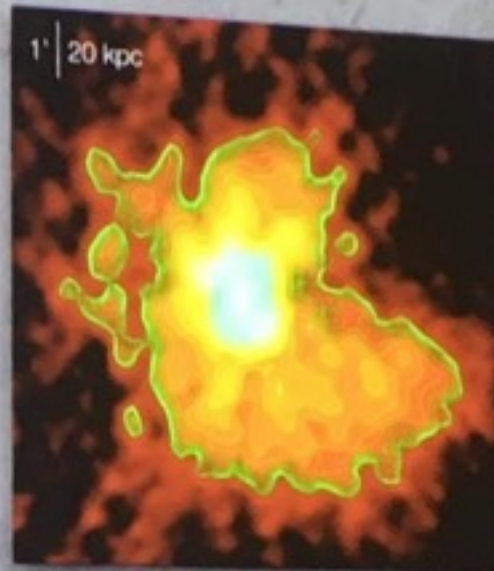
# LBA & Clusters -Kokotanekov, Drabent et al.

## Comparison with X-rays

Perseus



X-ray residual map with radio contours



Reprocessed MSSS at 140 MHz  
res. 21"  
noise 20 mJy/beam

***“LOFAR has a really steep learning curve”***  
*- Mary Knapp.*





# Rapid Response Telescope

## Current rapid response capabilities at low frequencies



### LOFAR

- ~30 minutes
- High spatial resolution
- Capability:
  - Imaging and/or beam formed
  - Transient Buffer Boards

### MWA

- ~10 seconds
- Low spatial resolution
- Capability:
  - Imaging



# Era of Multi-wavelength & Multi-messenger astronomy

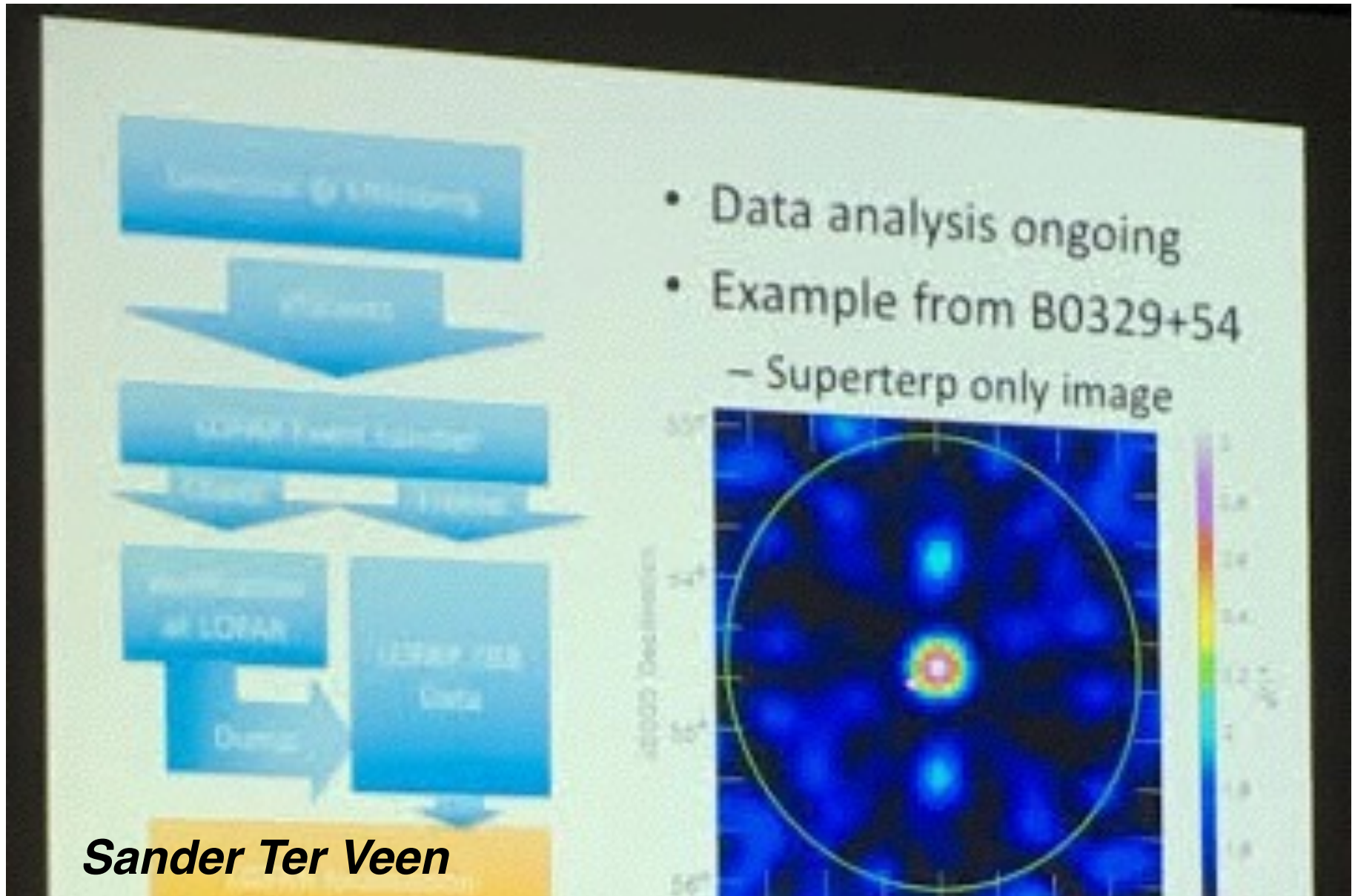
## LOFAR follow-up of GW 150914



- Mosaic of 8 SAPs at 145 MHz with a bandwidth of 11.9 MHz
- Resolution 50"
- RMS noise  $\sim 2.5$  mJy and  $>2000$  sources
- Contours: cWB probability map
- Timescales of 1 week, 1 month and 3 months

*Antonia Rowlinson*

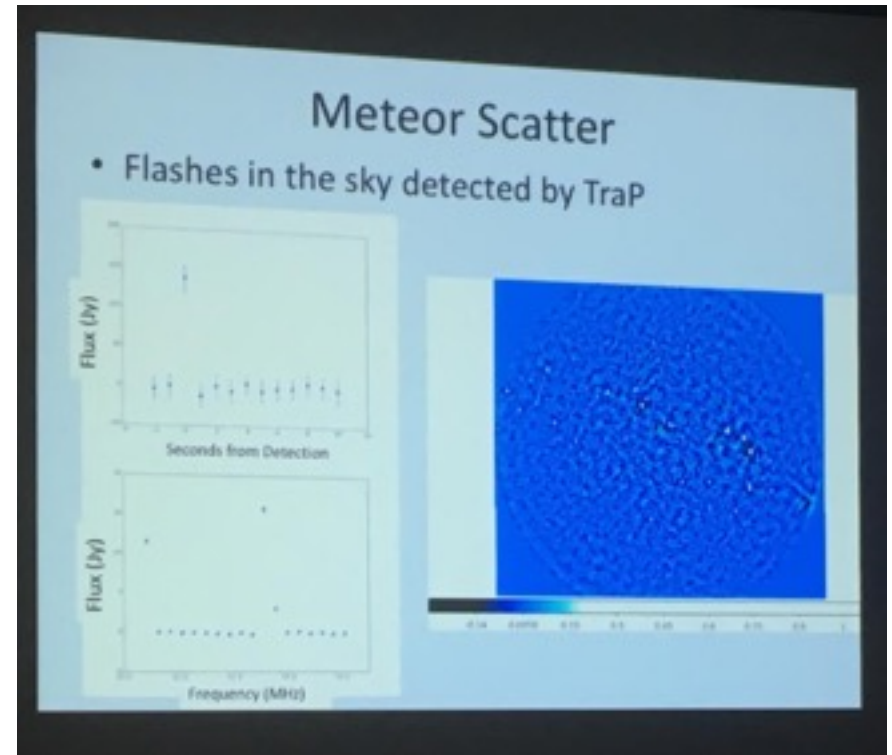
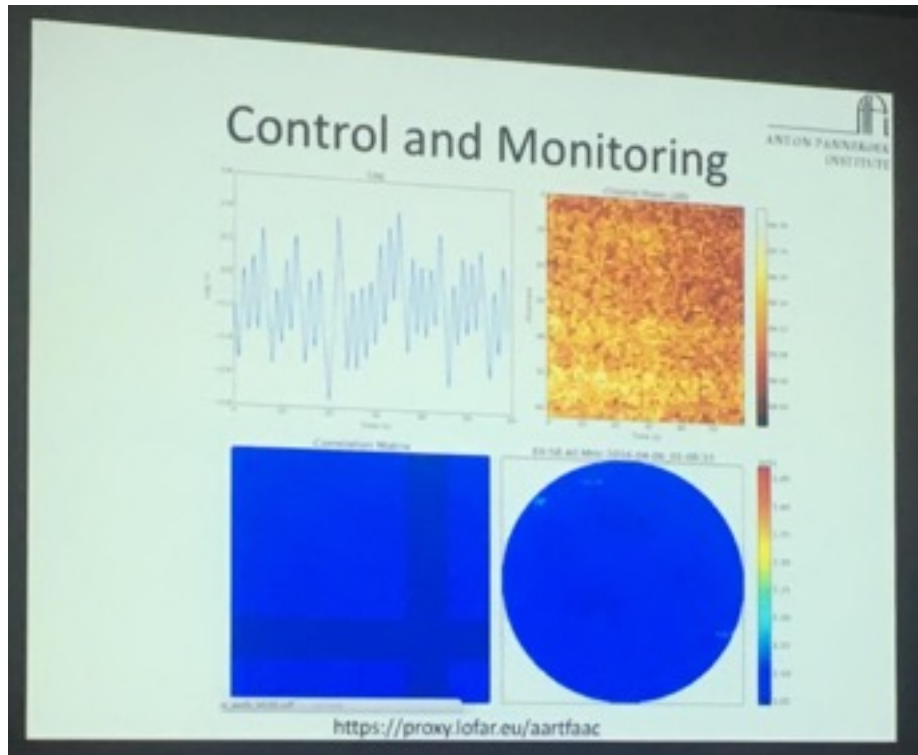
# Transients, FRBs....



# AARTFAAC-12 online:

- Peeyush Prasad, Yvette Cendes

## AARTFAAC TV (ATV)



***Machine learning***

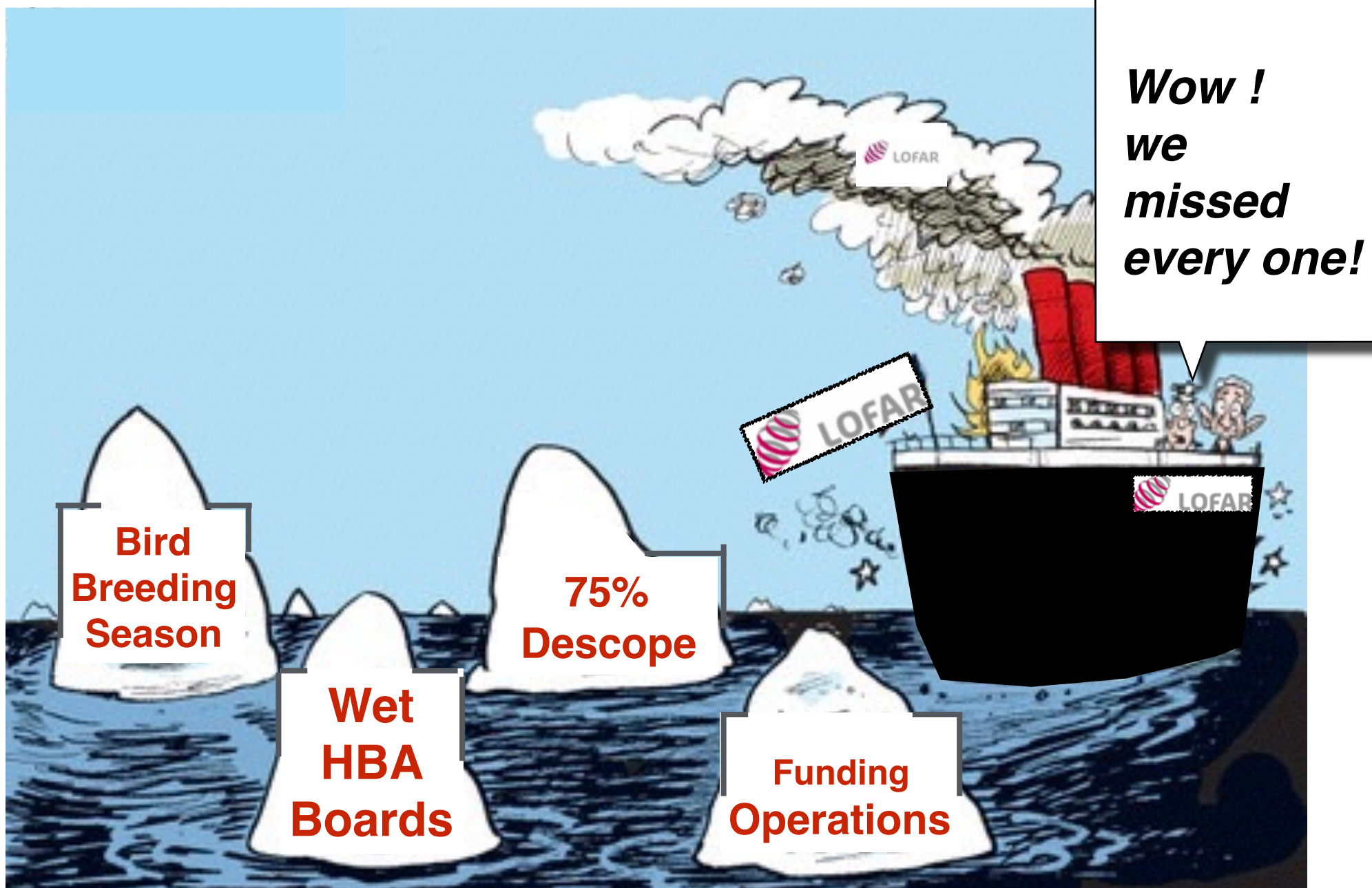
***- Chia Min Tan***

***Cloud computing...***

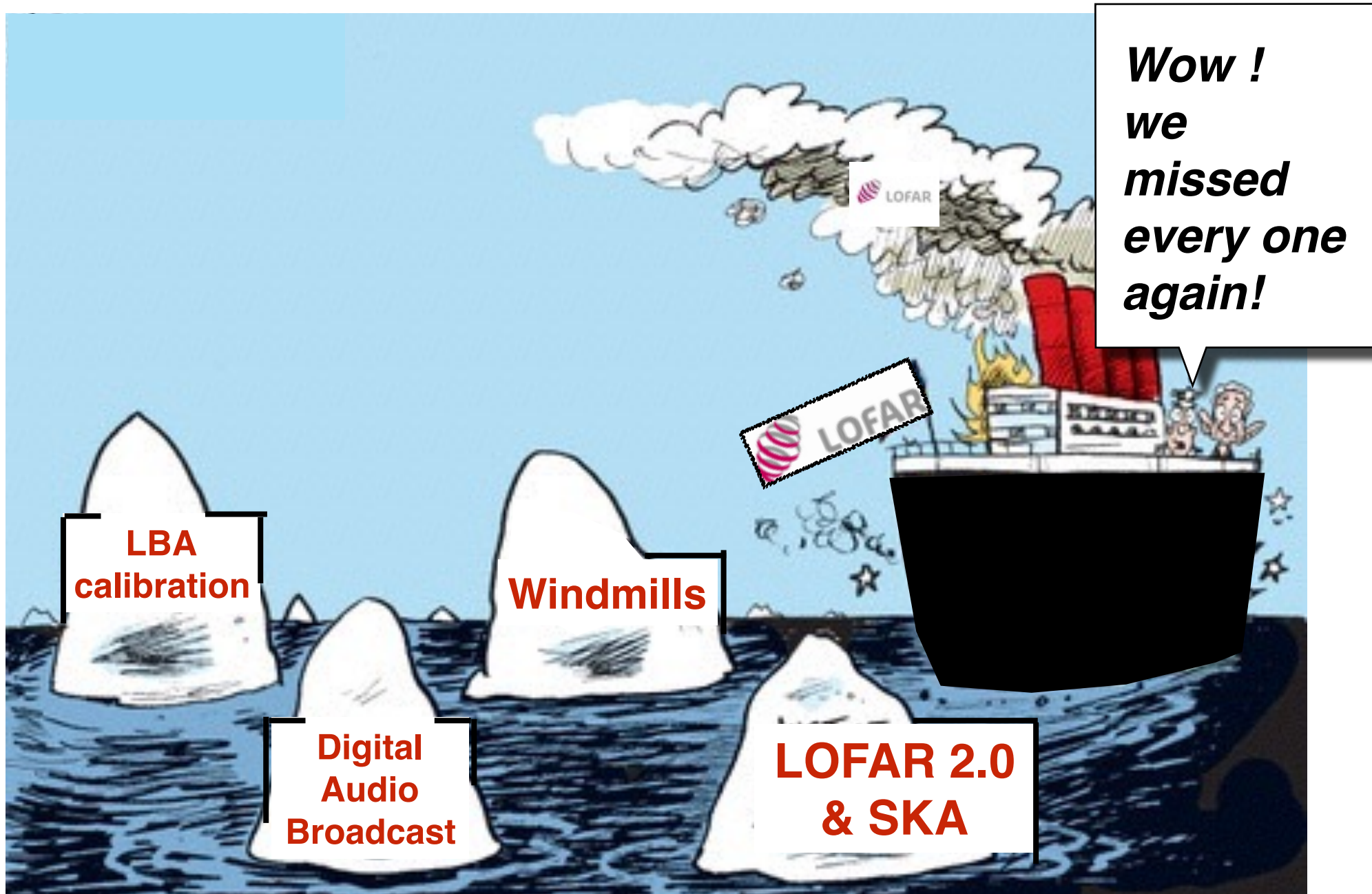
***Advanced Data Analytics...***



# LOFAR has come a long way...



# A Titanic perspective



***“Go smell some beautiful flowers”***

*- Blazej Nikiel- Wroczyński*