

Experiences from the Cosmic Ray Key Science Project

LOFAR Cosmic Ray Key Science Project:

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Radio pulses
(nanoseconds)

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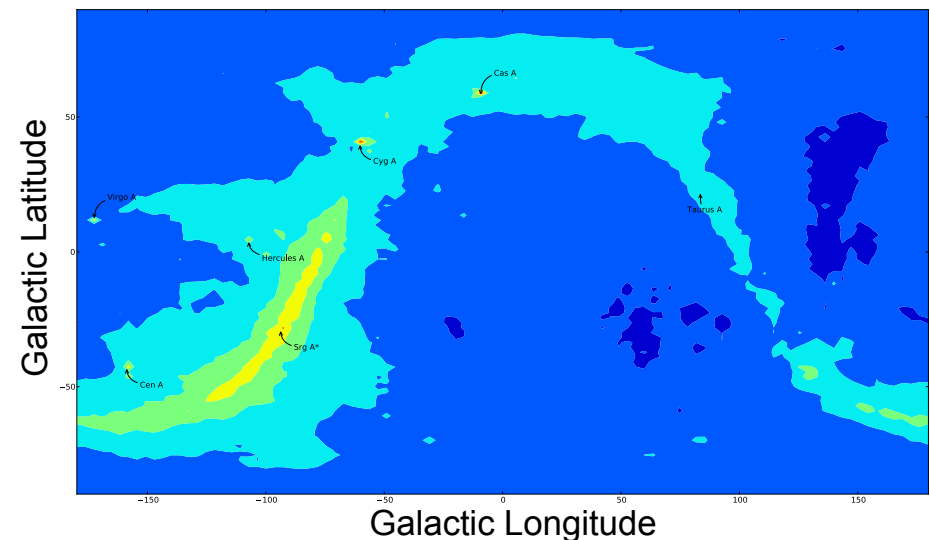
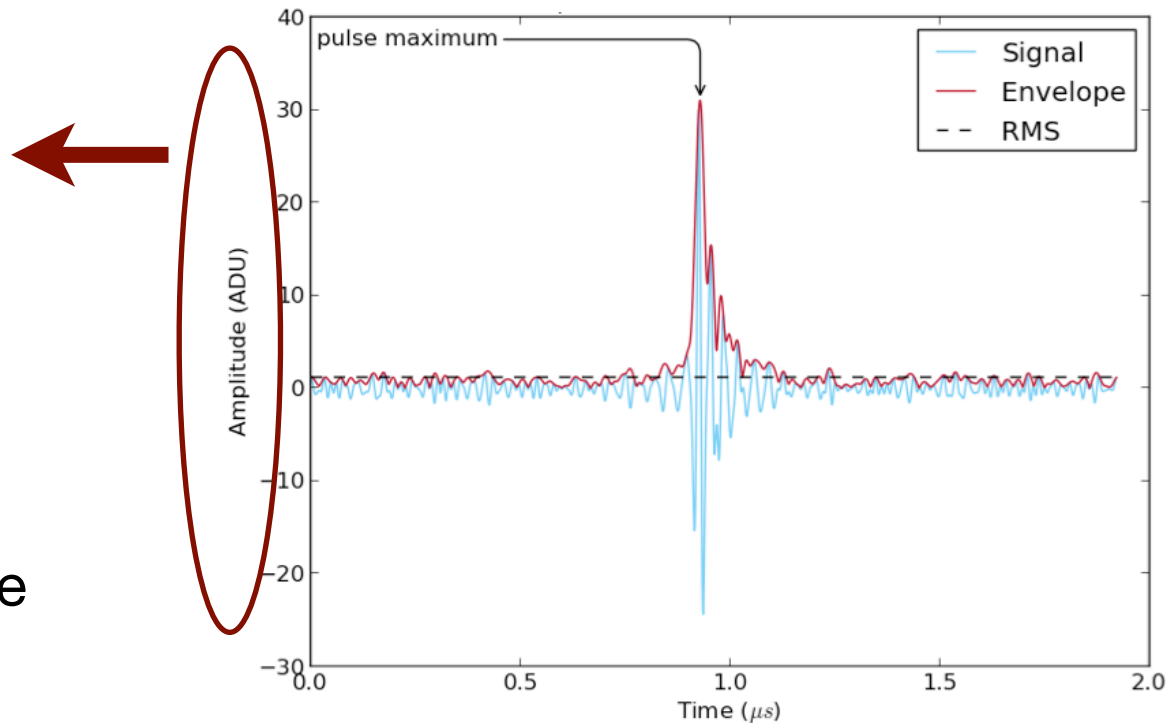
“Science is going well”

- **6 published or submitted (full-LOFAR) articles**
 - LBA detection and pipeline description, **A&A**
 - HBA detection, Cherenkov ring, **Astroparticle Physics** (submitted)
 - Wavefront, **Astroparticle Physics** (submitted)
 - Mass composition, **Nature** (submitted)
 - Parameterization of emission pattern, **Astroparticle Physics** submitted
 - Description of particle detectors, **Nuclear Instruments and Methods**, submitted
- > 4 (full-LOFAR) articles in preparation
- Routine operation is working fine for **cosmic rays** with a lot of support from the observers
- Successful **FRATS observations** with TBBs require manual intervention
- Automated **data-transfer pipeline to LTA** is being tested
- Currently still has to handle back-lash of 2 years of data
- Data volume manageable (< 10 TB)
- Number, collection and updating of files challenging
- Hope to be fully up to date at end of May

Open Issues

Absolute Calibration

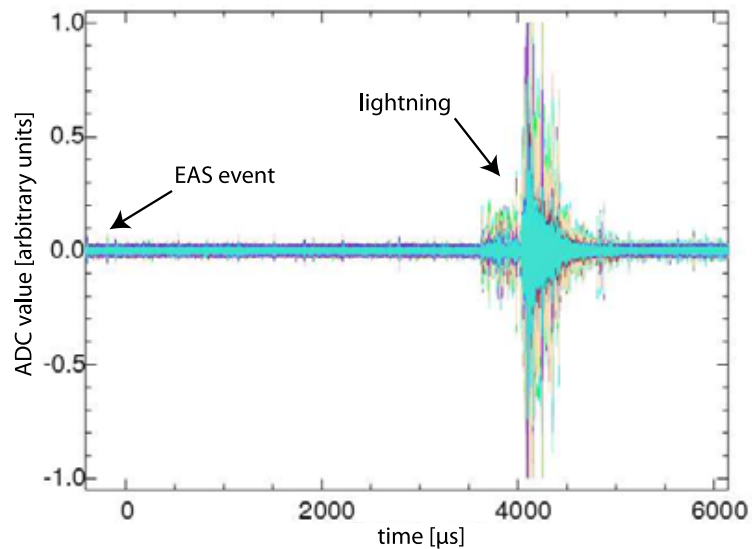
- V/m instead of ADU
- => cross-calibration campaign scheduled May 2014
- => calibration in the LOFAR field, usage of one station for ~ 3 days
- additionally:
“dominant noise is the Galaxy”
=> RMS of voltage traces can be predicted



Open Issues

Weather station at the LOFAR core

- Electric field affects air showers



- electric field meter and weather station installed
=> **how to make data available to all users?**



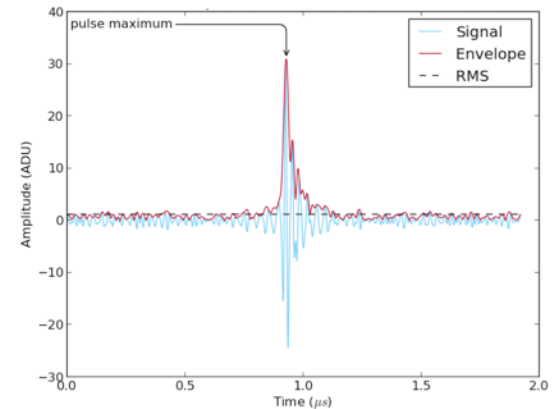
TBB data taking

Trigger

- LORA particle detector
- pulse detection on voltage trace
- pulse detection of incoherent beam
- ...



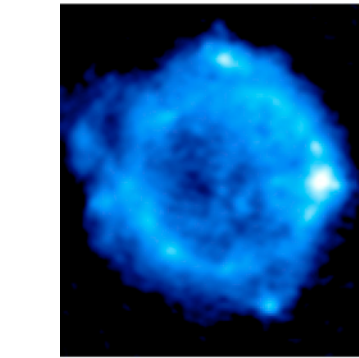
Read-out
Buffers (TBBs)



Get up to 5 seconds of
“raw data” per antenna



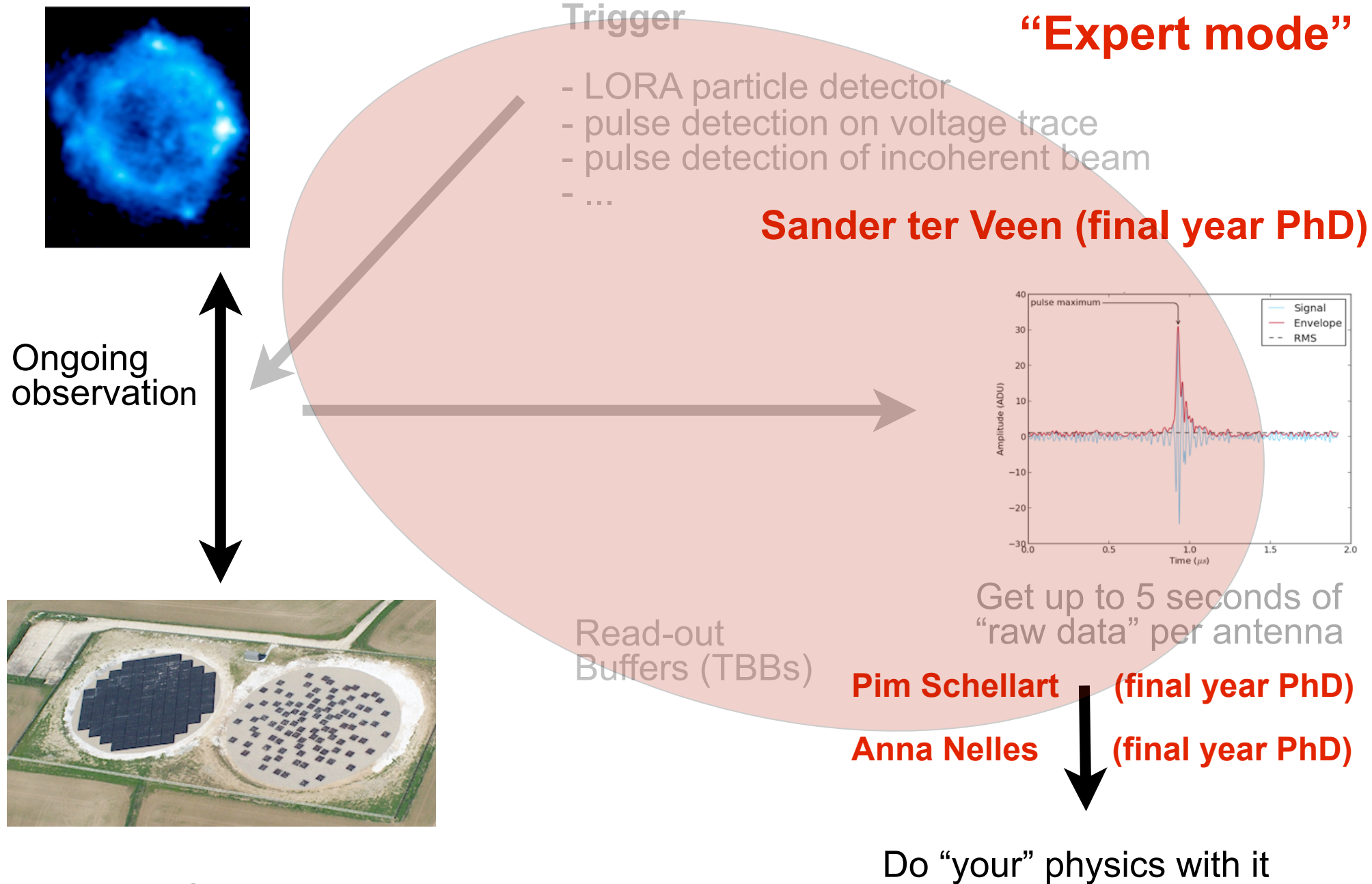
Do “your” physics with it



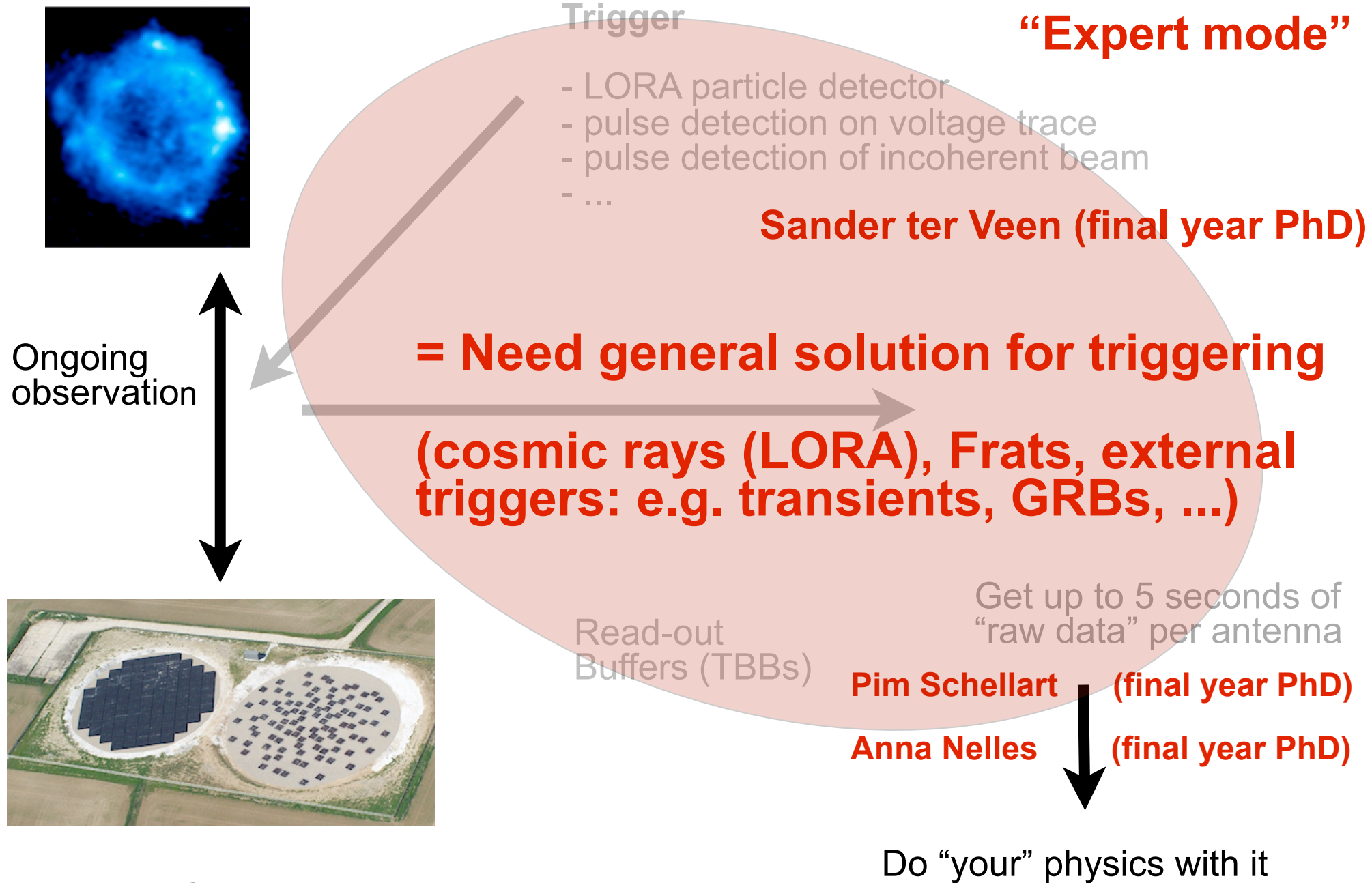
Ongoing
observation



TBB data taking



TBB data taking



Needs of CRKSP

- Triggering and TBB operations should no longer rely on a lot of manual intervention and “private” scripts
- Unless in conflict, **TBBs observations in parallel to ALL observations**
- **Superterp (+x) stations always running in TBB mode** even if not used for the primary project
- Idle stations should only be switched off if technically required
- **The system receives and handles TBB triggers**
- Logging of all the triggers (origin, actions performed, status)
- No abortion of TBB dumps at the end of an observation
- Until general solution is found:
Compatibility to old system has to be preserved (COBALT compatibility)
 - Granted access to stations
 - Writing of parset files

“Wishes” of CRKSP

- Implement a “observer-friendly” way of allowing and scheduling TBB observations
- Allowing for **multiple triggers of subsets of stations** (e.g. CR for superterp, FRATS for remote stations)
- Allowing **combined LBA and HBA** observations
- Allowing for different types of triggers from outside of LOFAR
- Implement subband-mode for TBBs
- Beamformed-data in parallel to imaging data (FRATS)
- Developing the **NuMoon mode** (pulse searches in beams on the moon)
- Making TBB observations with international stations possible

Summary

- Cosmic ray observations performed routinely with no major problems
- Cosmic ray data-set delivers excellent results
- FRATS searches on the way
- **Weather station installed, data-access needs to be enabled**
- **Generalization of TBB observations needs to be implemented**
- TBB observations should no longer rely on expert knowledge and “private” scripts
- Details:
TBB user requirements document
(requirements for cosmic rays,
fast radio transients, preliminary
for future TBB users)
- **Thanks to all the support from the ASTRON staff**

