

# DIRAC

## Distributed Radio Astronomical Computing

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### Big science with big data



Interferometer

#### 1.OBSERVATION

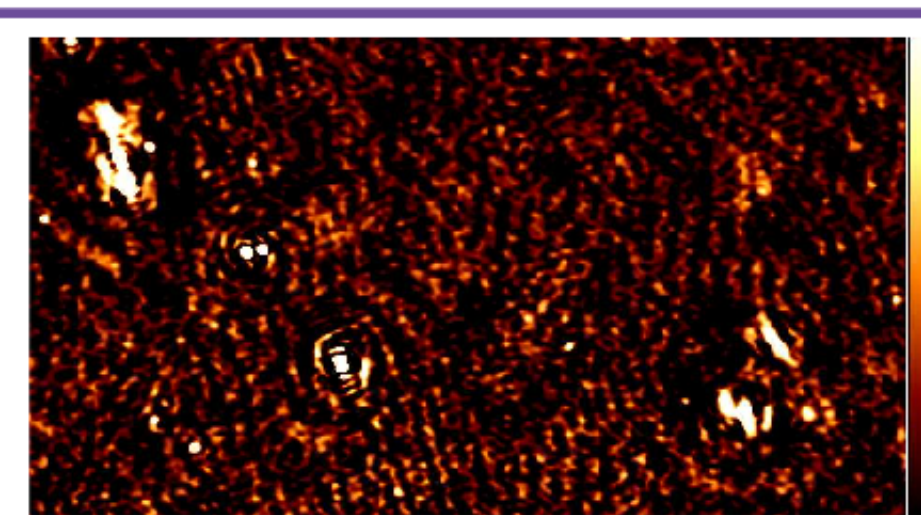
Image of the sky is observed using correlation.

#### 2.INTERFERENCE MITIGATION

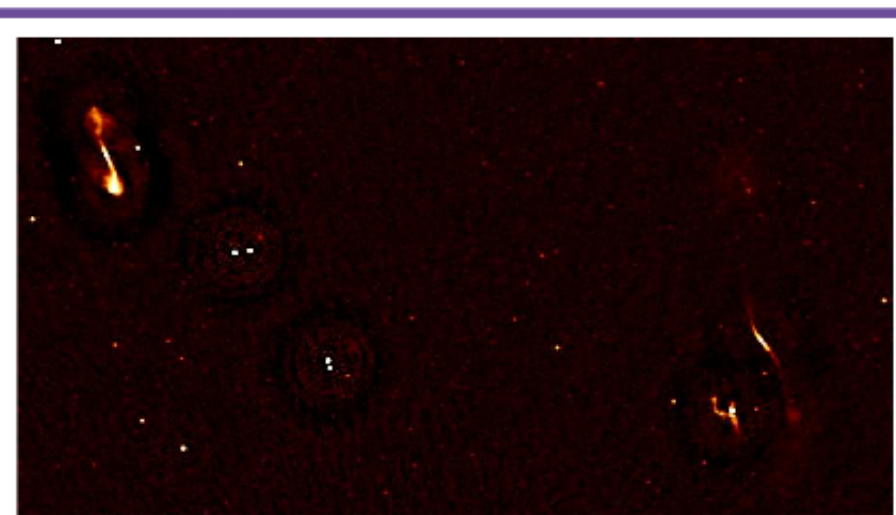
Pre-processing (i.e. radio signals, lighting) are flagged or removed.

#### 3.CALIBRATION

Systematic errors are estimated and the data is corrected.



Before calibration



After calibration

#### LOFAR - Low-frequency Array

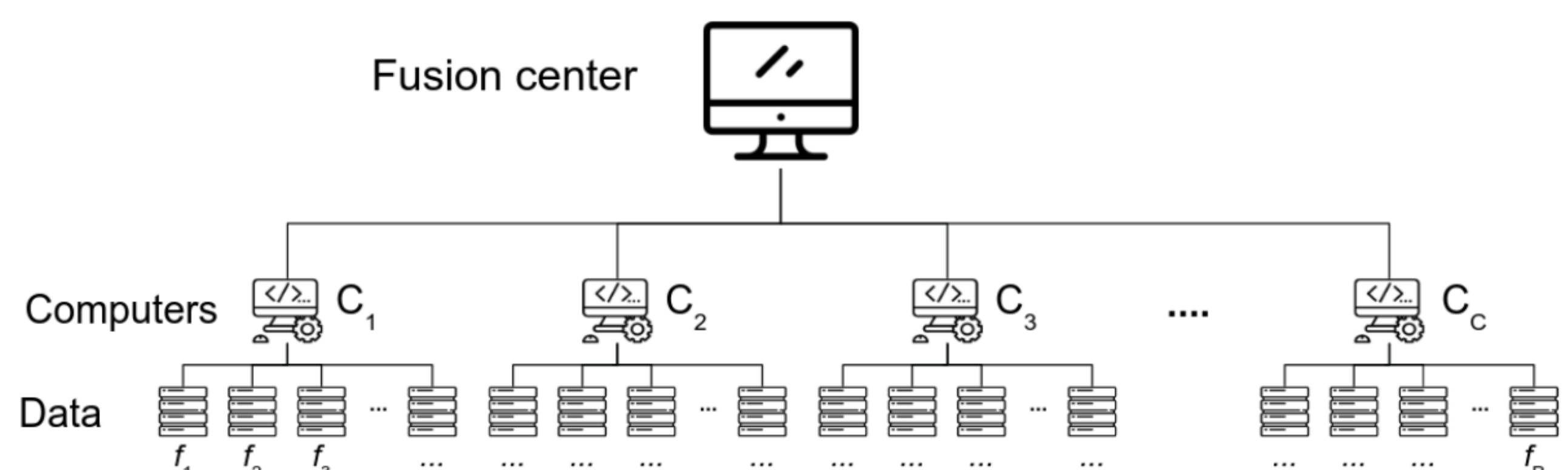
- Software radio telescope searching for faint signals from the early universe
- The signal is order of magnitude fainter than the most contaminating signals (e.g. Galactic foregrounds)
- Need to eliminate all systematic instrumental, ionospheric etc.) errors to sufficient levels (i.e. **"calibrated"**)
- The calibration is done in parallel on different data frequencies which requires processing of **many terabytes of data**
- Future



The central core section of LOFAR is located in the province of Drenthe, Netherlands.

### Distributed calibration

- The calibration is done by solving a complex non-linear optimization problem with **millions of unknown parameters**
- In order to achieve the highest accuracy and precision in the calibration, a **global calibration scheme** is needed
- The calibration solutions should also be **continuous** over frequency



#### The existing code

##### SAGECAL

Used for calibration of LOFAR  
Candidate for SKA

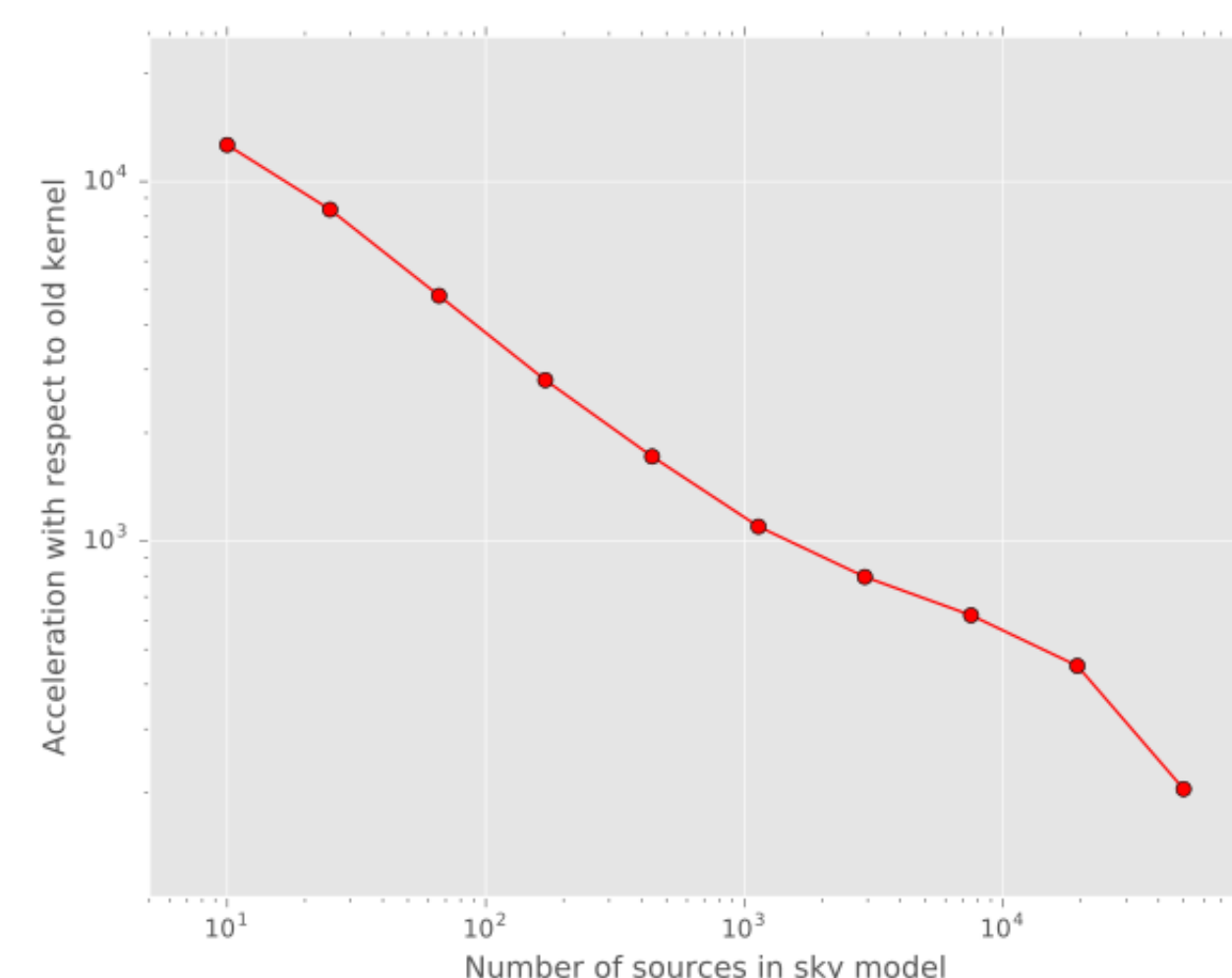
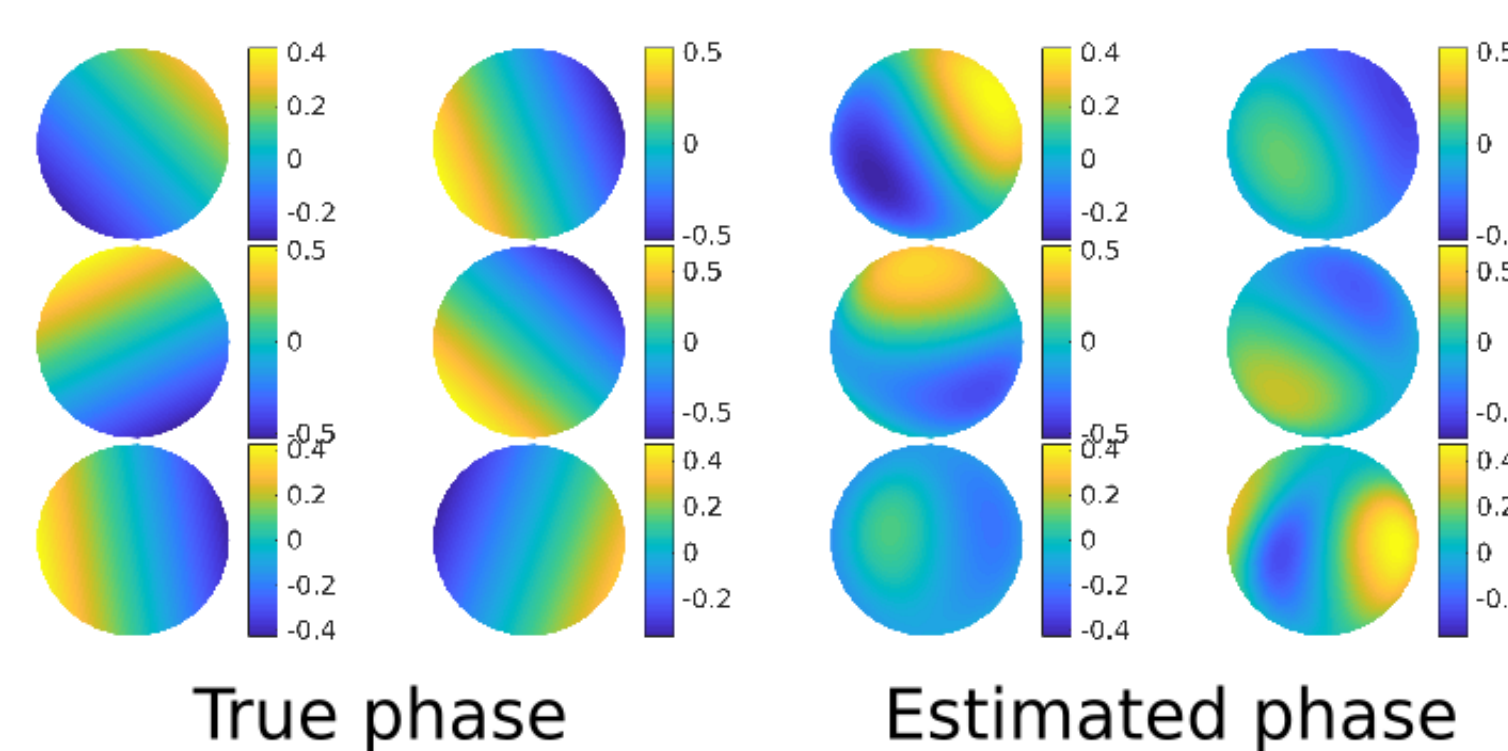
- written in C/C++
- using MPI
- has GPU support

#### eScience Center contribution



- Optimization and generalization of the **existing code** for the state-of-the-art GPU architectures
- Migrating the optimized code to **big data (Apache Spark)** platform
- Optimizing the workflow for Big data platform

### Status



MORE INFO

MORE INFO

- S. Yatawatta, F. Diblen, H. Spreeuw "Data Multiplexing in Radio Interferometric Calibration", Monthly Notices of the Royal Astronomical Society, **under review**
- S. Yatawatta, F. Diblen, H. Spreeuw "Adaptive ADMM in Distributed Radio Interferometric Calibration", IEEE CAMSAP 2017, **Accepted**
- S. Yatawatta, F. Diblen, H. Spreeuw "Distributed Model Construction in Radio Interferometric Calibration", ICASSP 2018, **in preparation**

### eScience Challenges

- Acceleration and improvements of GPU implementation of SageCal  
eChallenge: Efficient Computing
- Processing extremely big datasets  
eChallenge: Optimized Data Handling, Big Data Analytics