

High Performance Streaming Data Processing

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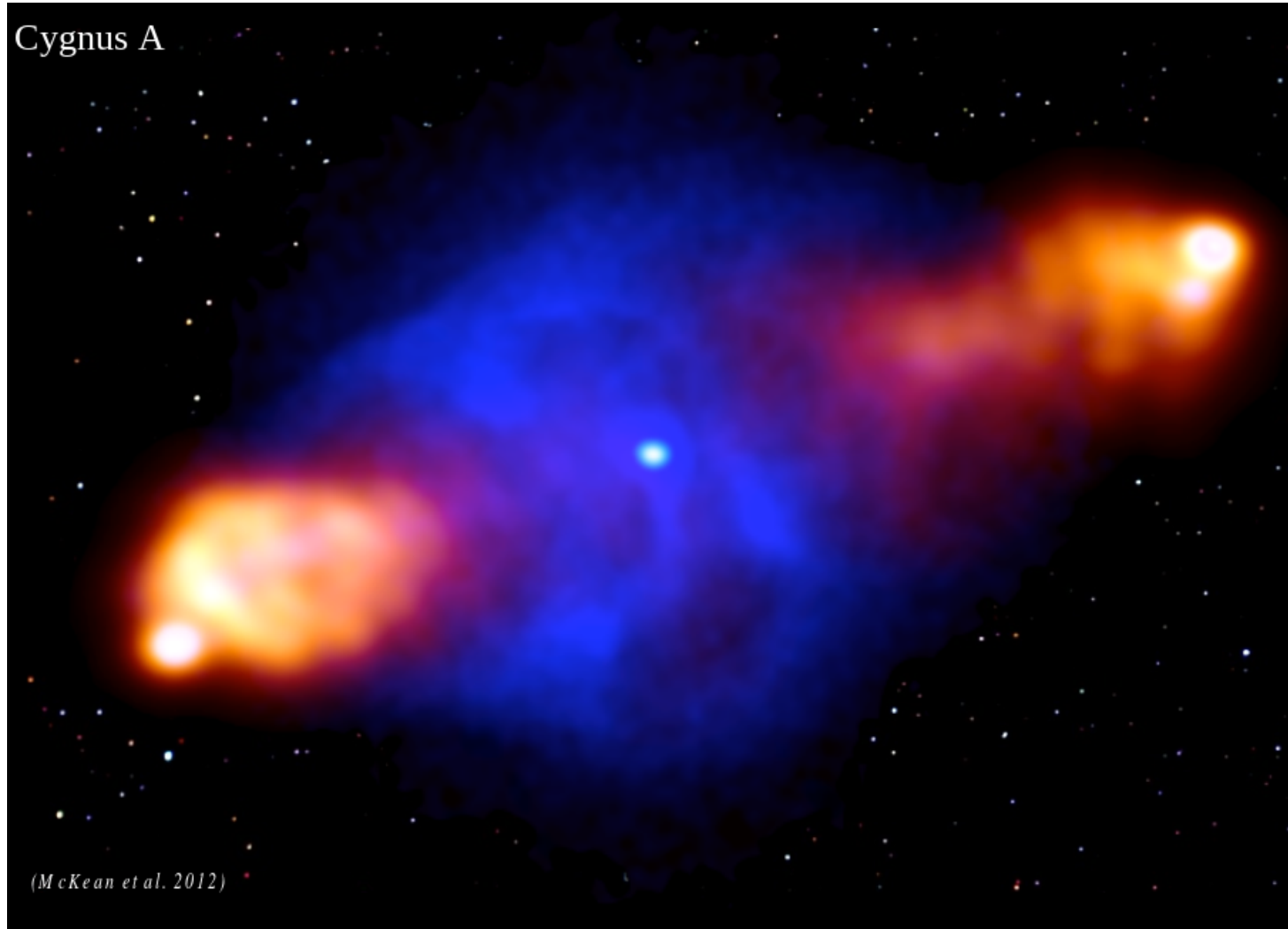
ASTRONOMICAL INSTITUTE
ANTON PANNEKOEK

Radio Astronomy

- Study celestial objects in radio frequencies
- LOFAR (**LOW** Frequency **AR**ray)
 - 7000 Antennas
 - Below 250 MHz
 - Multiple stations
 - Biggest in the world
 - New design



Example image LOFAR



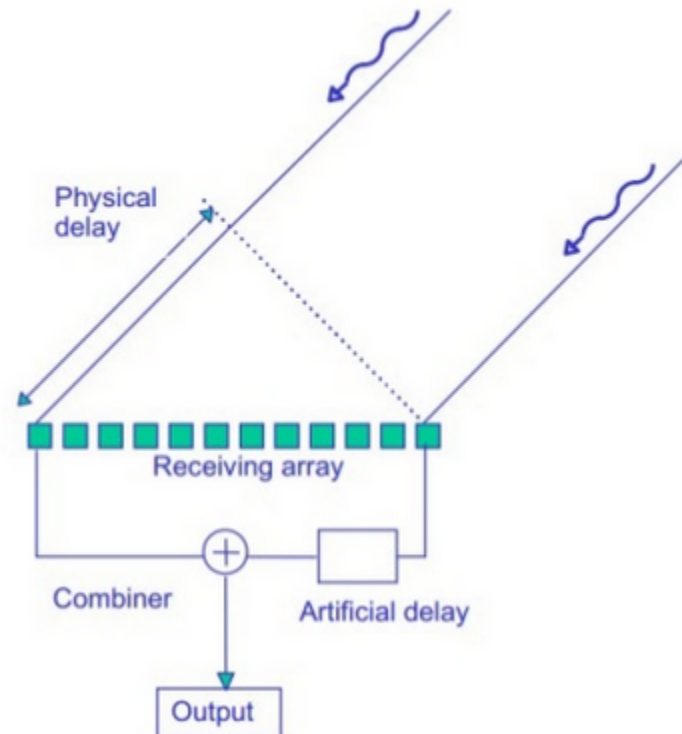
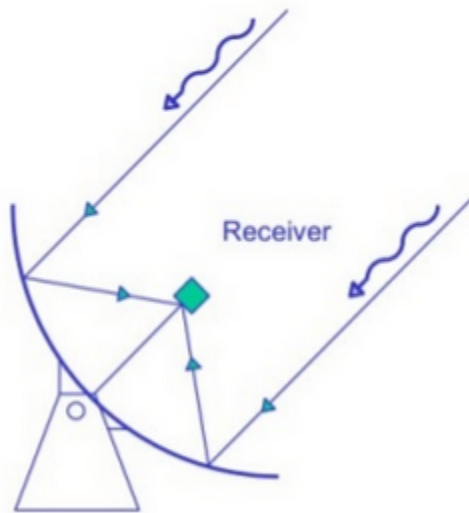
LOFAR Superterp

- 6 Stations
- 288 usable ants
- 300m diameter



New Antenna Design

- Direction by phase delays between antennas
- Highly computational
- Cheap antennas



Enter The AARTFAAC Project

- **Amsterdam Astron Radio Transients Facility And Analysis Centre**
- 120 degrees FOV
- Realtime imaging
- Looking for transients
 - Non static objects
 - Pulsars
 - Galaxies
 - Jets
- Superterp only
- Trigger LOFAR



Computational Challenges

- Correlator: 12 Uniboards of FPGAs @ Astron
- Visibilities: $(288*289)/2*4 = 166464$ (dual pol.)
- Bandwidth: up to 13.8 MHz (576 images)
- Dump time: Every 1/10th second
- Data rate: 40 Gb/s
- Commensal to LOFAR
- Responsetime: ≤ 1 second

Pipeline Framework Candidates

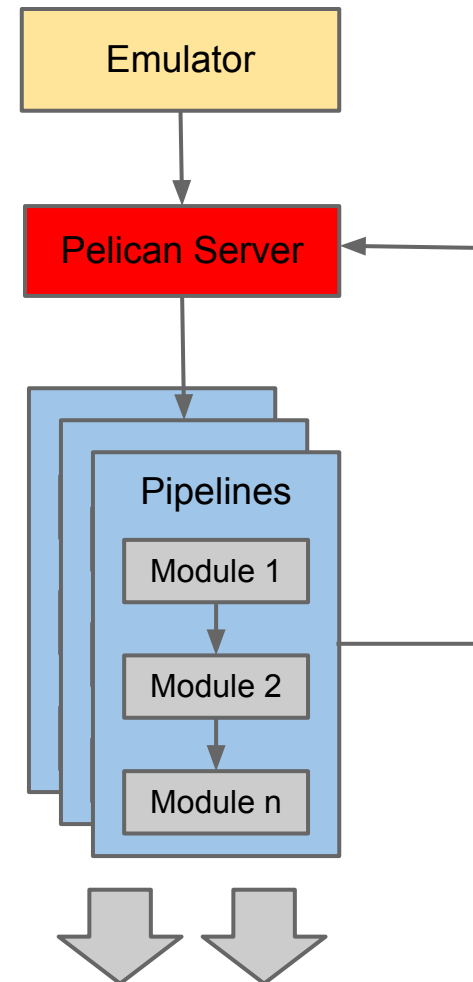
- Hadoop
 - - No streaming data (batch processing)
- Storm
 - + Twitter
 - + Define your own topology easily
 - - Meta data overhead
- Pelican
 - + Close collaboration
 - + Astronomy examples/projects
 - - Young
- 0-MQ
 - - Low level
 - + Large userbase, docs

Pelican Framework (1/2)

- Streaming data processing
- Developed by OeRC (Oxford)
- C/C++
- Depends
 - Boost (minimal)
 - Qt framework
 - CppUnit
 - Doxygen
 - CMake
- Designed with astronomy in mind
- Modular

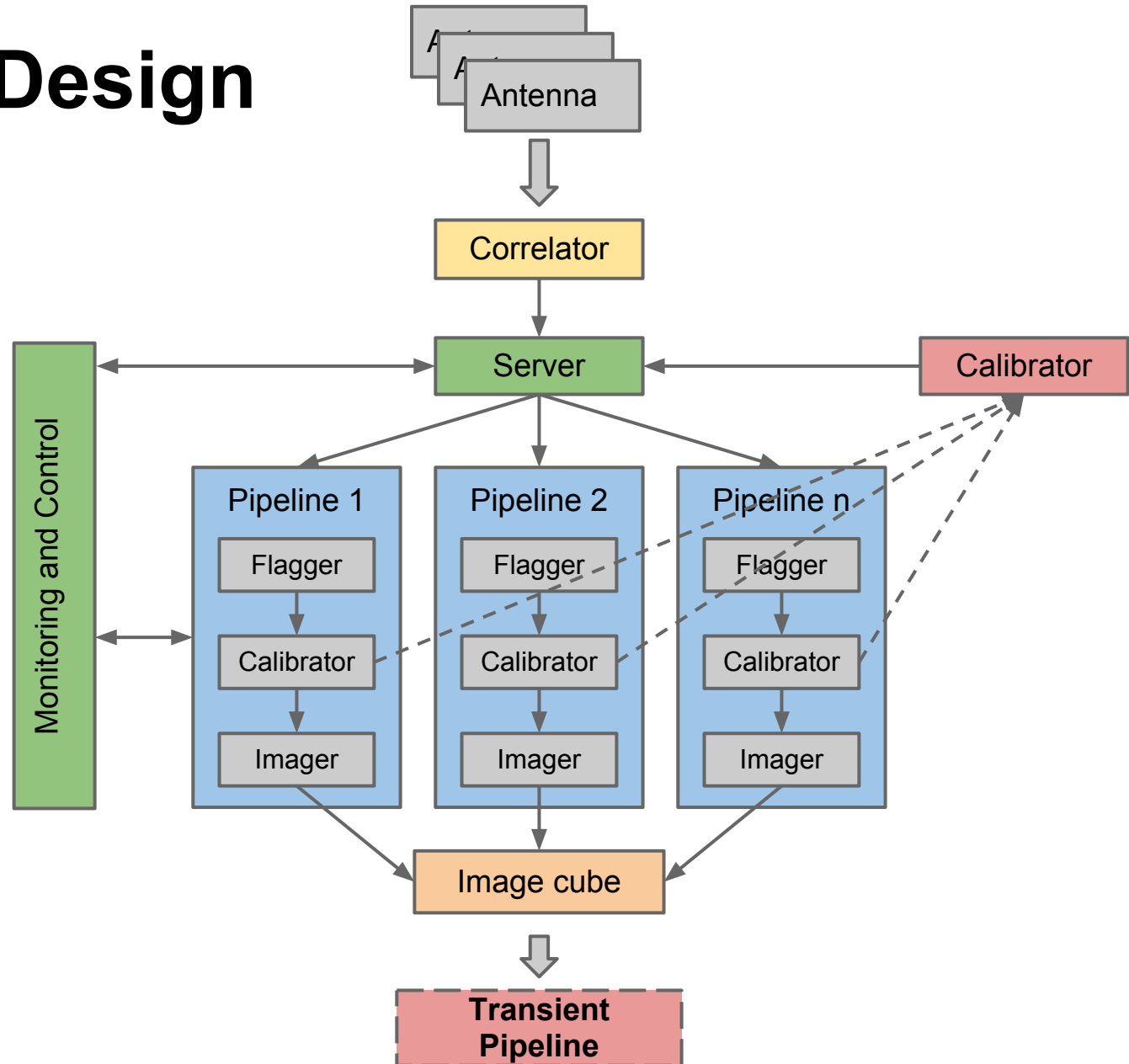
Pelican Framework (2/2)

- **Emulator**
 - Read from disk, self
 - Send udp packets
- **Server (bottleneck)**
 - Creates chunks from udp
 - Sends tcp packets
 - First come first served
- **Pipeline**
 - Creates datablobs from tcp
 - Manipulate datablobs with modules
 - Send/Store elsewhere

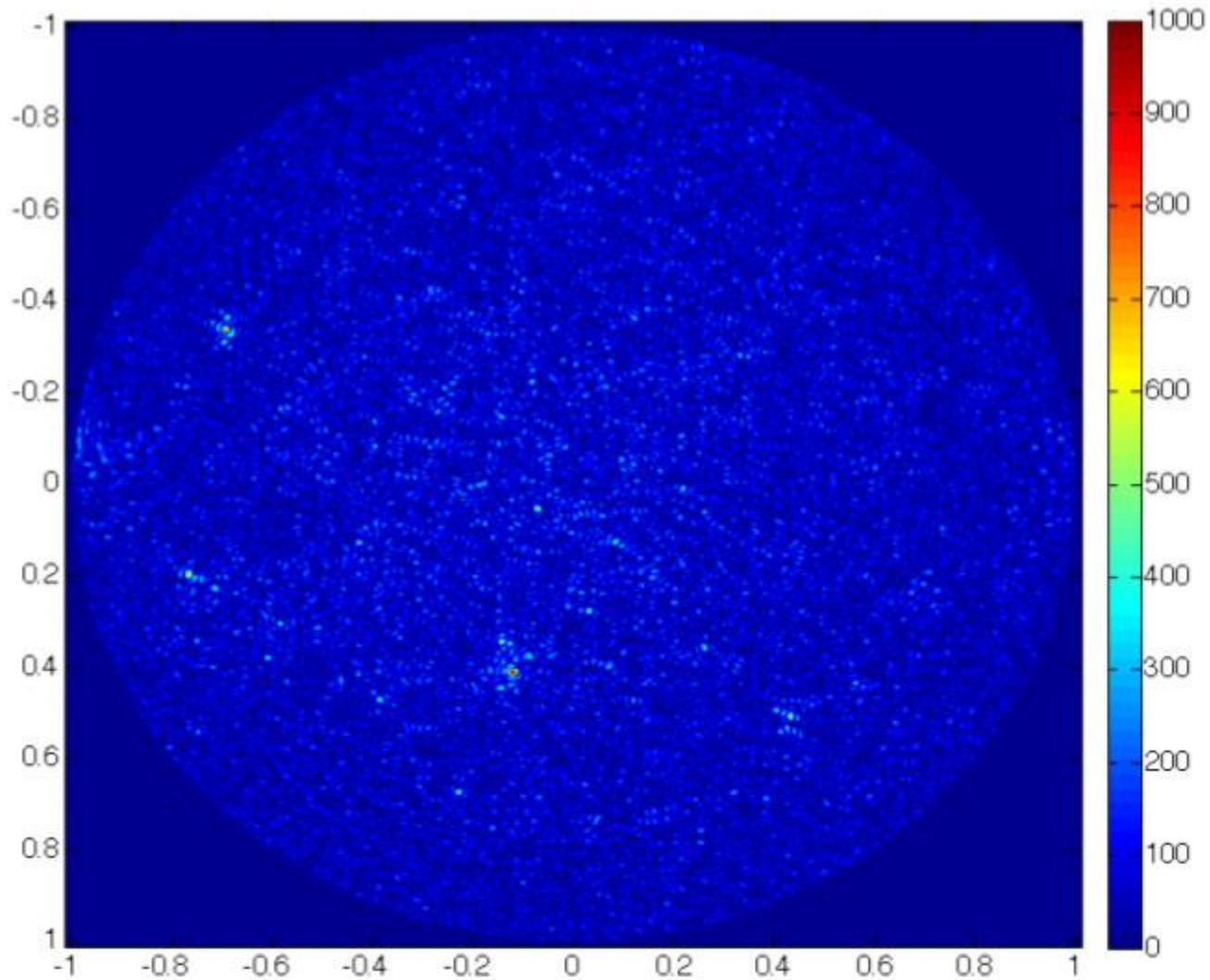


Pipeline Design

- Matlab
- Pelican
- CppUnit
- Eigen3
- Jenkins



Example Image AARTFAAC



More info

- Sourcecode
 - Sorry, not yet
 - Nearby future!!
 - Some legal issues
- www.aartfaac.org
- www.lofar.org
- github.com/pelican/pelican
- eigen.tuxfamily.org

Questions

