



# Green Flash

High performance computing for real-time science

Contribution from Observatoire de Paris on WP7  
Final Design Review, April 6<sup>th</sup> 2018



# Contribution to WP 7: SW stack

OdP team responsible for SW stack development

- Covers HRTC, SRTC and simulator
- Based on standard, free and as much as possible open source SW
- Rely on external collaborations (KAUST, Subaru)

Main contributions

- Consistent stack architecture across subsystems
- Identify and use optimized libraries in dedicated pipelines
- Optimized SW blocks for HRTC and SRTC

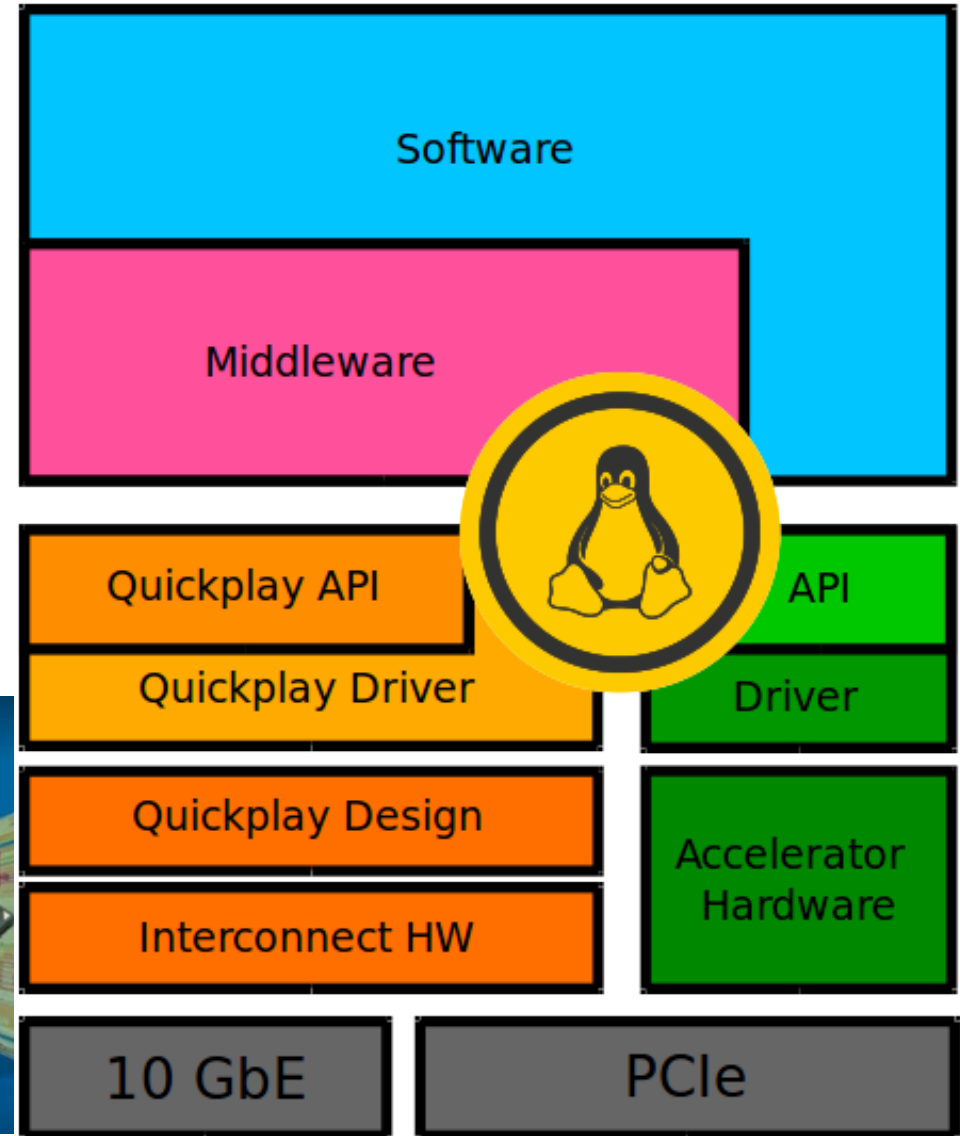


# Green Flash SW stack

## HW landscape



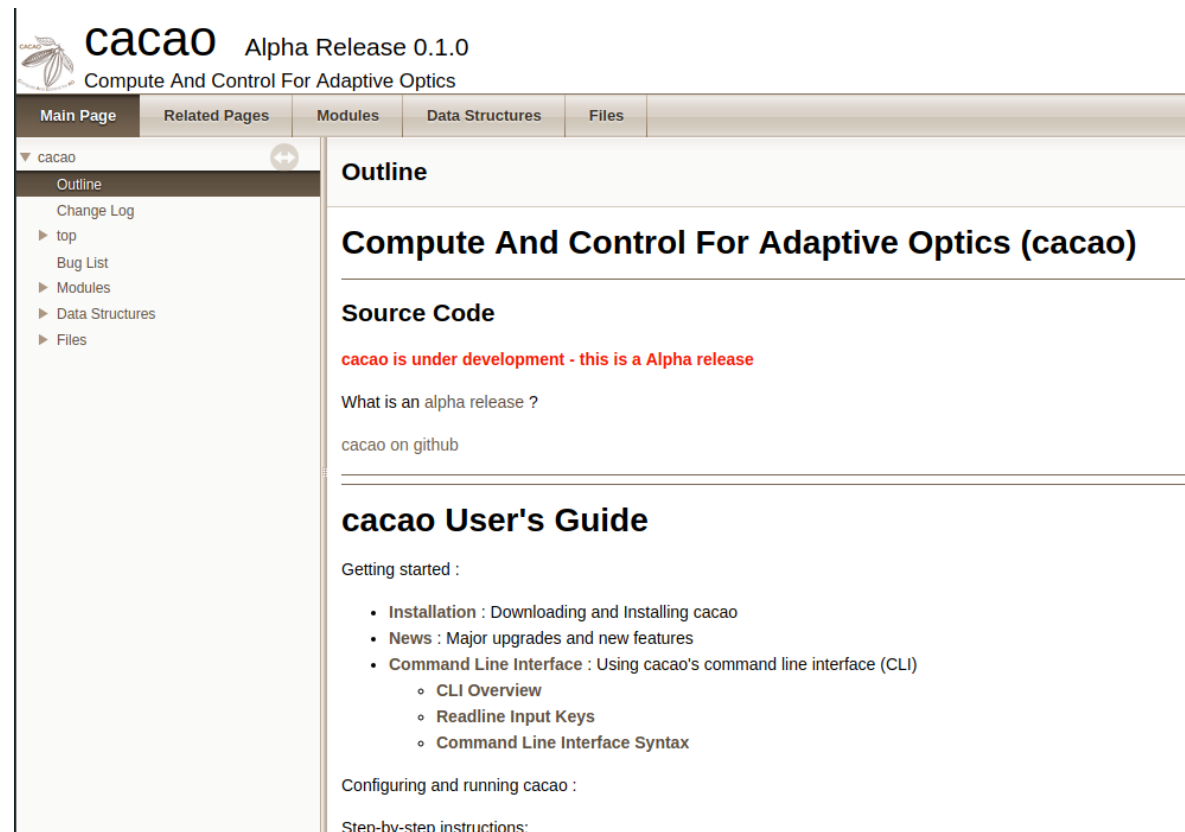
20cm





# Building blocks

- CACAO: <https://github.com/cacao-org/cacao>
- Open source
- Multi-platform  
CPU or CPU+GPU
- Used on SCExAO
- Relying on  
shared memory  
and tmux for  
processes sync and  
management





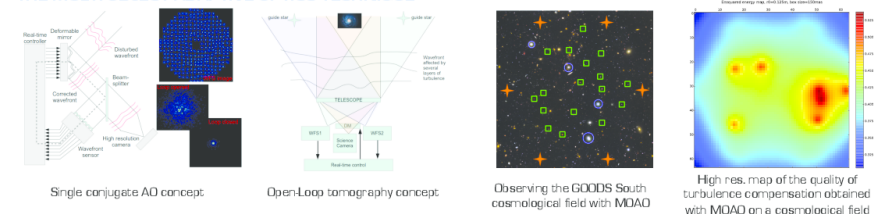
# Building blocks

- MOAO:
- <https://github.com/ecrc/moao>
- Open source
- Multi-platform  
CPU or CPU+GPU  
or CPU+Xeon Phi
- Relying on  
standard  
numerical libraries
- Used for supervisor

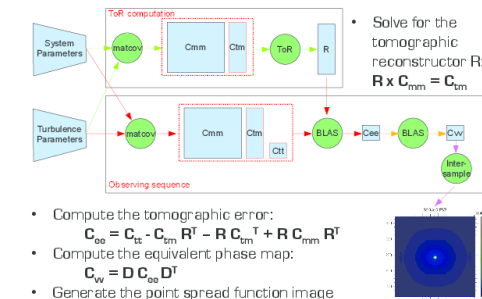


The Multi-Object Adaptive Optics (MOAO) framework provides a comprehensive testbed for high performance computational astronomy. In particular, the European Extremely Large Telescope (E-ELT) is one of today's most challenging projects in ground-based astronomy and will make use of a MOAO instrument based on turbulence tomography. The MOAO framework uses a novel compute-intensive pseudo-analytical approach to achieve close to real-time data processing on manycore architectures. The scientific goal of the MOAO simulation package is to dimension future E-ELT instruments and to assess the qualitative performance of tomographic reconstruction of the atmospheric turbulence on real datasets.

## THE MULTI-OBJECT ADAPTIVE OPTICS TECHNIQUE



## THE PSEUDO-ANALYTICAL APPROACH



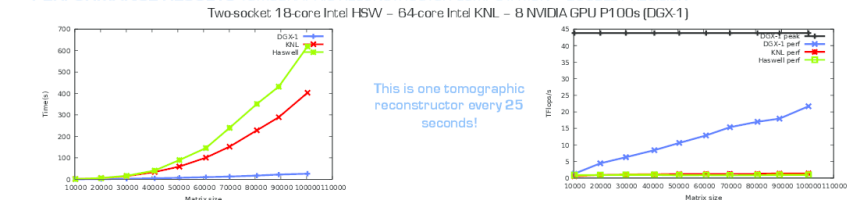
## MOAO 0.1.0

- Tomographic Reconstructor Computation
- Dimensioning of Future Instruments
- Real Datasets
- Single and Double Precisions
- Shared-Memory Systems
- Task-based Programming Models
- Dynamic Runtime Systems
- Hardware Accelerators

## CURRENT RESEARCH

- Distributed-Memory Systems
- Hierarchical Matrix Compression
- Machine Learning for Atmospheric Turbulence
- High Resolution Galaxy Map Generation
- Extend to other ground-based telescope projects

## PERFORMANCE RESULTS TOMOGRAPHIC RECONSTRUCTOR COMPUTATION - DOUBLE PRECISION



DOWNLOAD THE SOFTWARE AT <http://github.com/ecrc/moao>

A collaboration of



With support from



Sponsored by



April 6<sup>th</sup> 2018

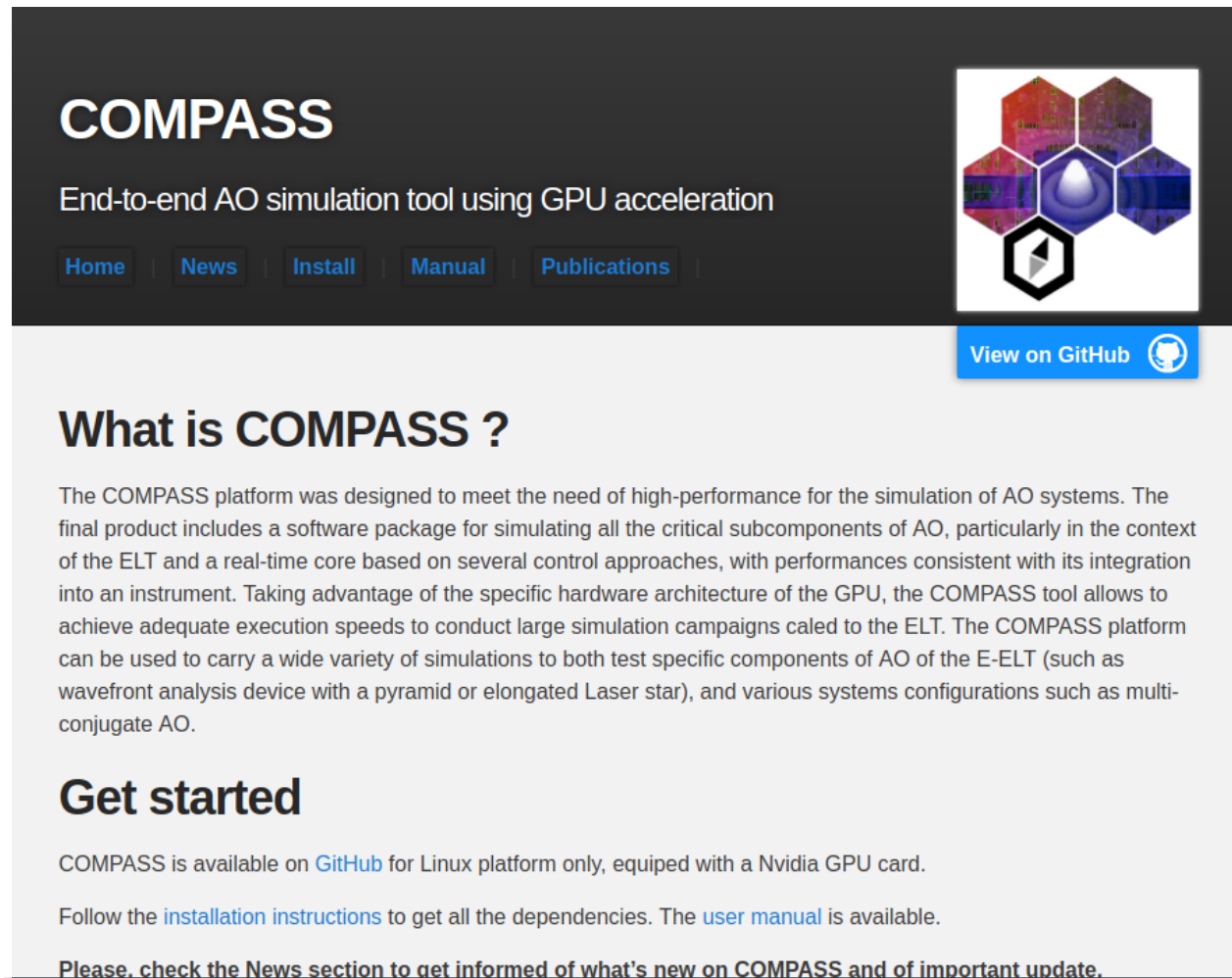






# Building blocks

- COMPASS: <https://github.com/ANR-COMPASS>
- Open source
- GPU only
- Versatile
- Supporting various system scales and concepts



**COMPASS**

End-to-end AO simulation tool using GPU acceleration

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[View on GitHub](#)

### What is COMPASS ?

The COMPASS platform was designed to meet the need of high-performance for the simulation of AO systems. The final product includes a software package for simulating all the critical subcomponents of AO, particularly in the context of the ELT and a real-time core based on several control approaches, with performances consistent with its integration into an instrument. Taking advantage of the specific hardware architecture of the GPU, the COMPASS tool allows to achieve adequate execution speeds to conduct large simulation campaigns caled to the ELT. The COMPASS platform can be used to carry a wide variety of simulations to both test specific components of AO of the E-ELT (such as wavefront analysis device with a pyramid or elongated Laser star), and various systems configurations such as multi-conjugate AO.

### Get started

COMPASS is available on [GitHub](#) for Linux platform only, equipped with a Nvidia GPU card.

Follow the [installation instructions](#) to get all the dependencies. The [user manual](#) is available.

Please, check the News section to get informed of what's new on COMPASS and of important update.

April 6<sup>th</sup> 2018