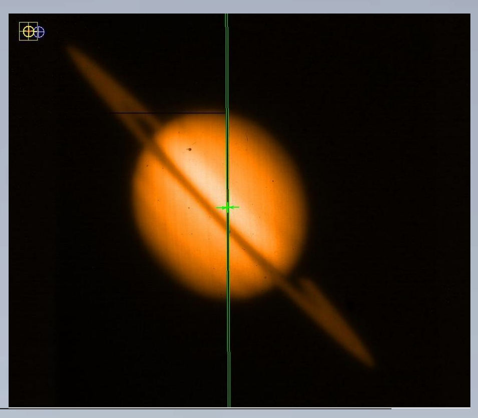
ESO
European Organization
For Astronomical
Research in the
Southern Hemisphere

TASK SYNCHRONIZATION in the OBSERVATION CONTROL SOFTWARE for the ESO-VLT CRIRES INSTRUMENT

E. Pozna[1], A. Smette[2], R.Schmutzer[2]

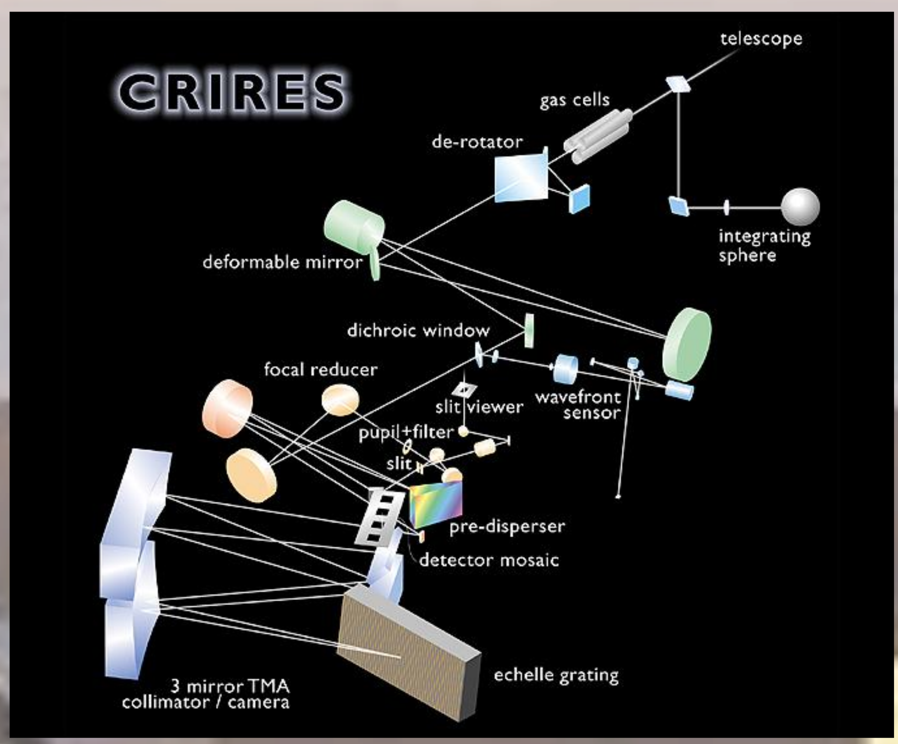
[1] European Southern Observatory, Garching, Germany
[2] European Southern Observatory, Santiago, Chile

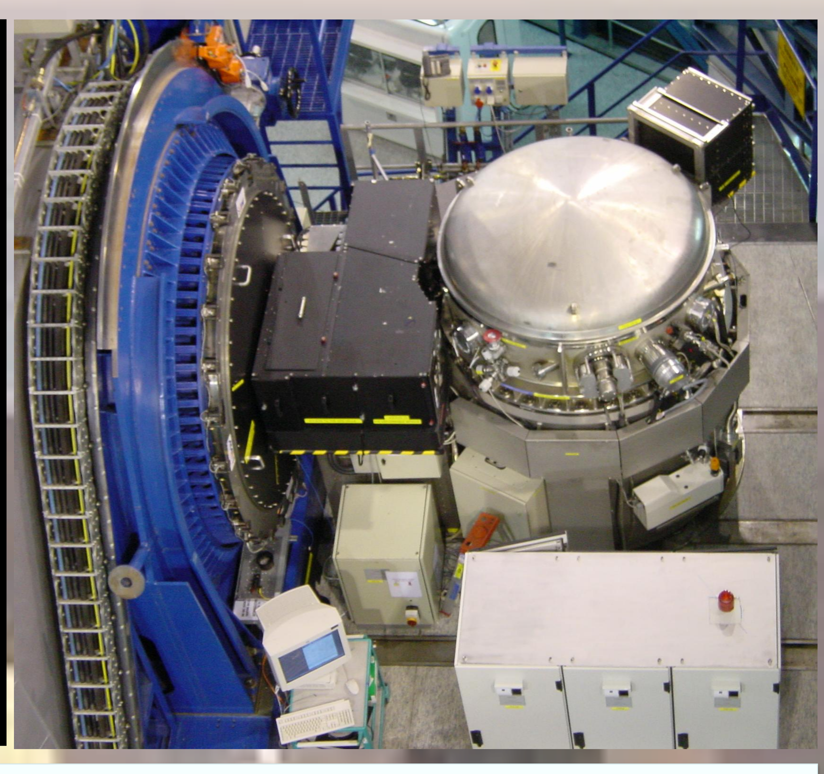


Abstract

The ever increasing pressure for both high spectral and high angular resolution spectrograph imposes an increasing complexity on astronomical instrument control software, now a critical component in the instrument design. To achieve the accuracy required to maintain the image of the target within its 0.2 arcsec entrance slit, the Observation Control software (OS) for the ESO-VLT CRIRES instrument must take into account a number of optical phenomena (differential atmospheric refraction, distortion, etc.), some of them time dependent, even when observing an object moving at a rate different from the object used for auto-guiding. Four internal software control loops adjust the position of mechanical devices and/or the telescope in addition to the OS standard functionalities (e.g. monitoring, exposure handling). Besides internal activities, the OS must promptly response to sequential commands as well as simultaneous interruptions/adjustments from operator via GUI interface. The required advanced synchronization mechanisms are implemented as an extension to the OS framework (a tool collecting the general features of all instrument OS) while allowing for maintainability and future generalization.

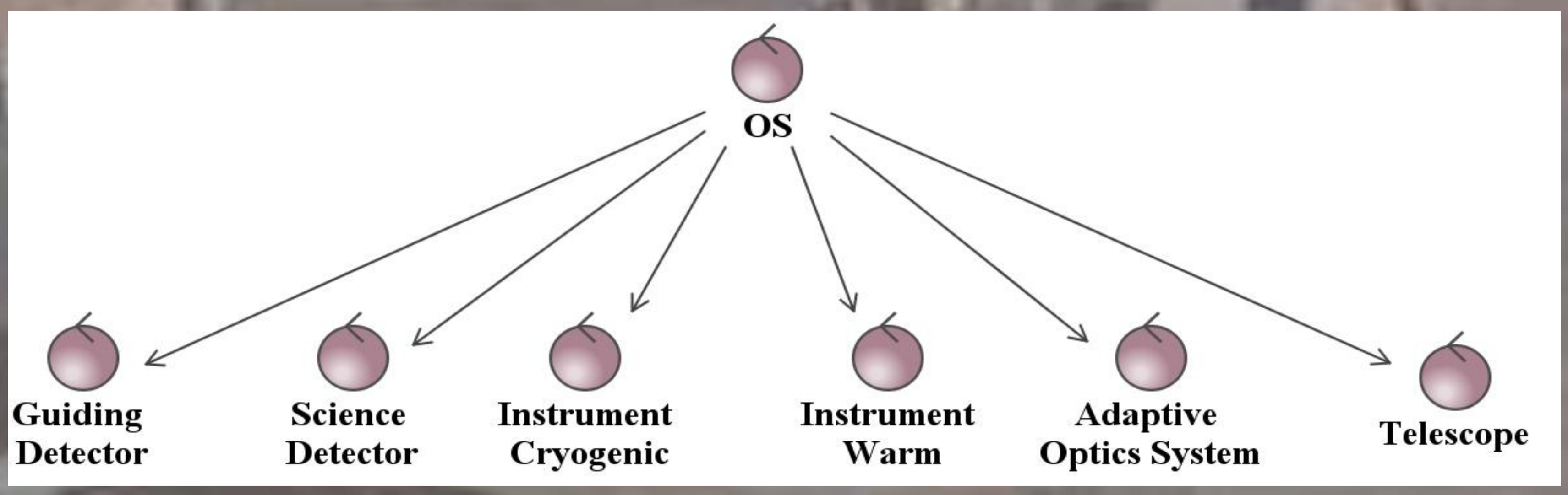
The VLT cryogenic high-resolution infrared echelle spectrograph (CRIRES)





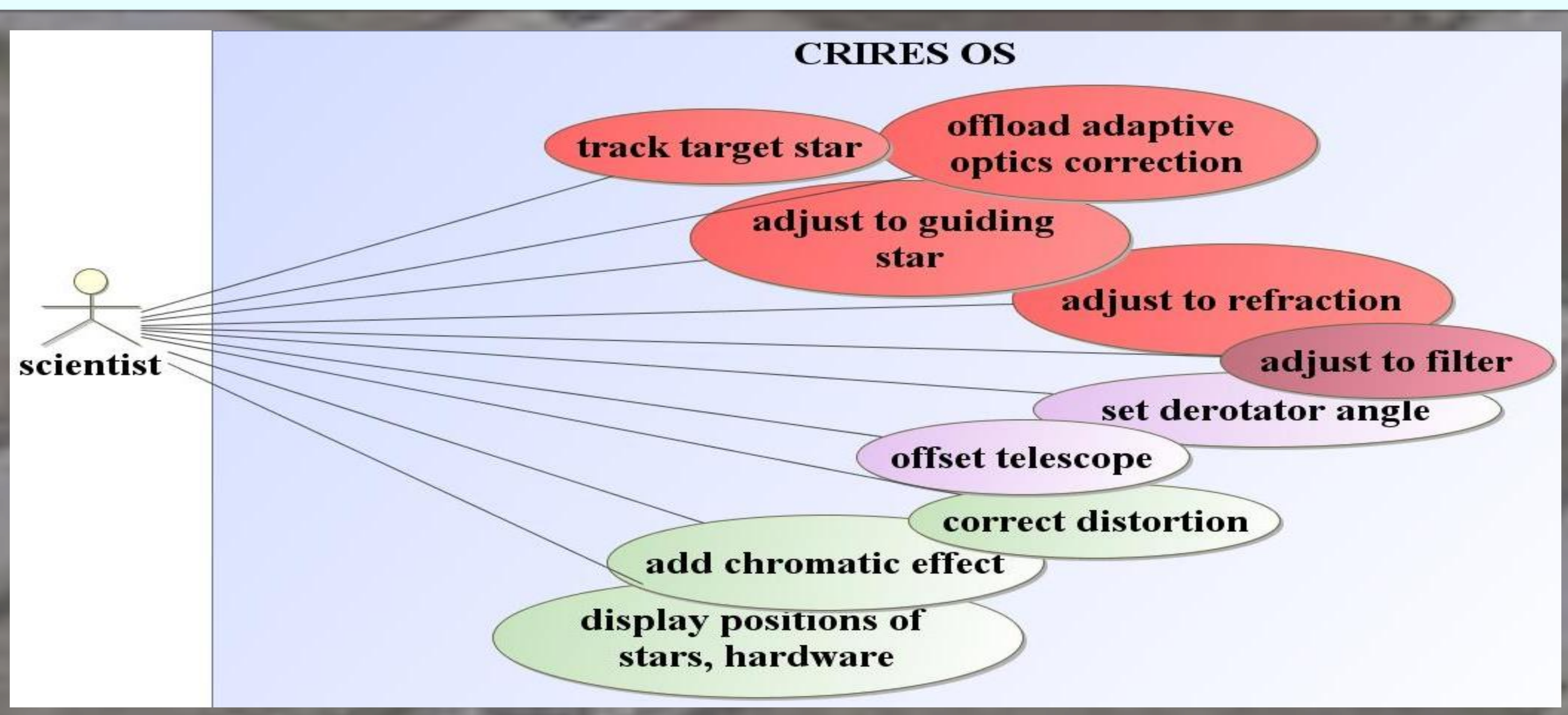
The Very Large Telescope (VLT) is a system of four separate optical telescopes (the Antu telescope, the Kueyen telescope, the Melipal telescope, and the Yepun telescope) organized in an array formation, built and operated by the European Southern Observatory (ESO) at the Paranal Observatory on Cerro Paranal, a 2,635 m high mountain in the Atacama desert in northern Chile. Each telescope has an 8.2 m aperture.
CRIRES (CRyogenic InfraRed Echelle Spectrograph) is one of the instruments mounted on the Antu telescope. It is assisted by adaptive optics and provides a resolving power of up to 100,000 in the infrared spectral range from 1 to 5 micrometres.

Observation Software

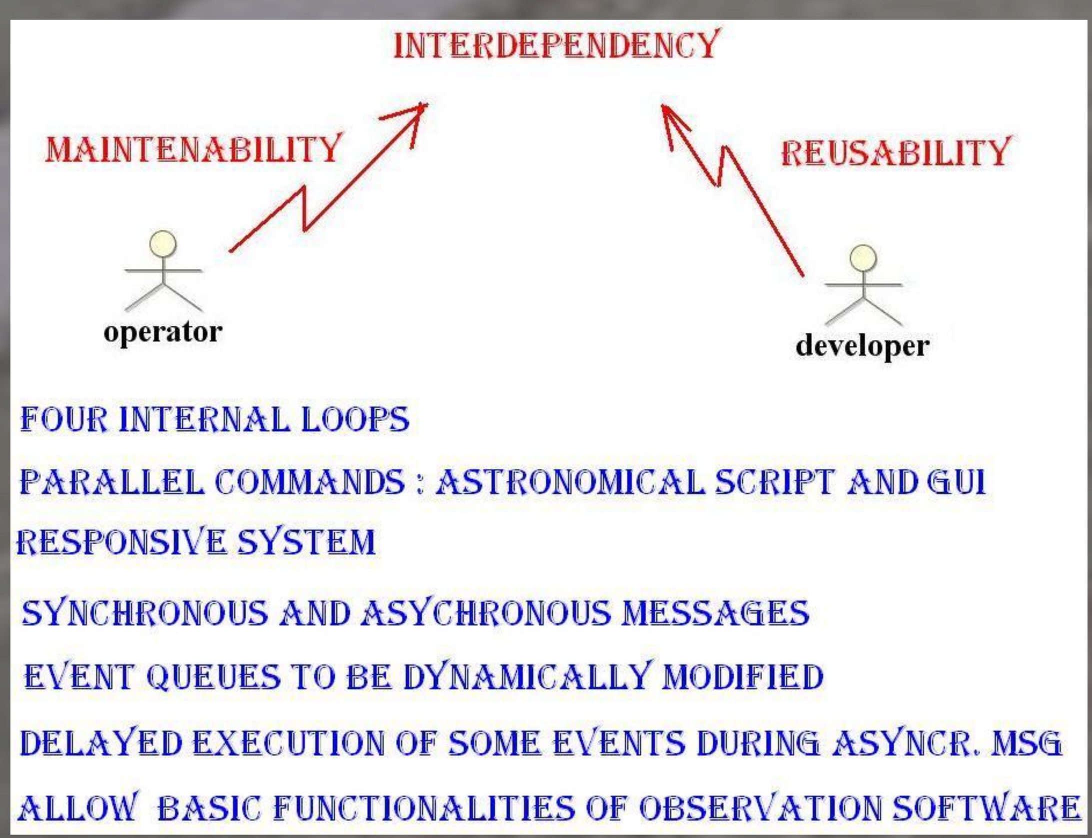


The Observation Software (OS) of an astronomical instrument is the top level control software that carries out the instructions of astronomers (given as sequential command series) in order to record astronomical images.
The generic functionalities are supported by the framework **BOSS**.

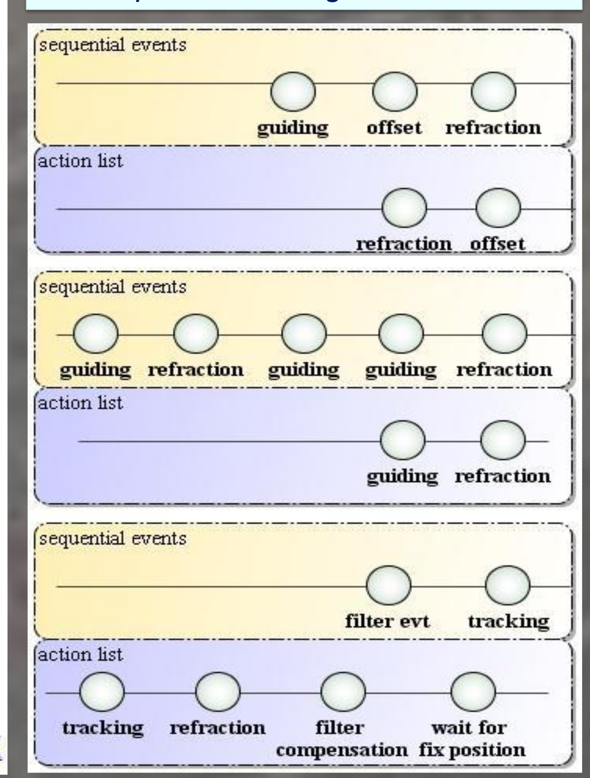
CRIRES specific requirements



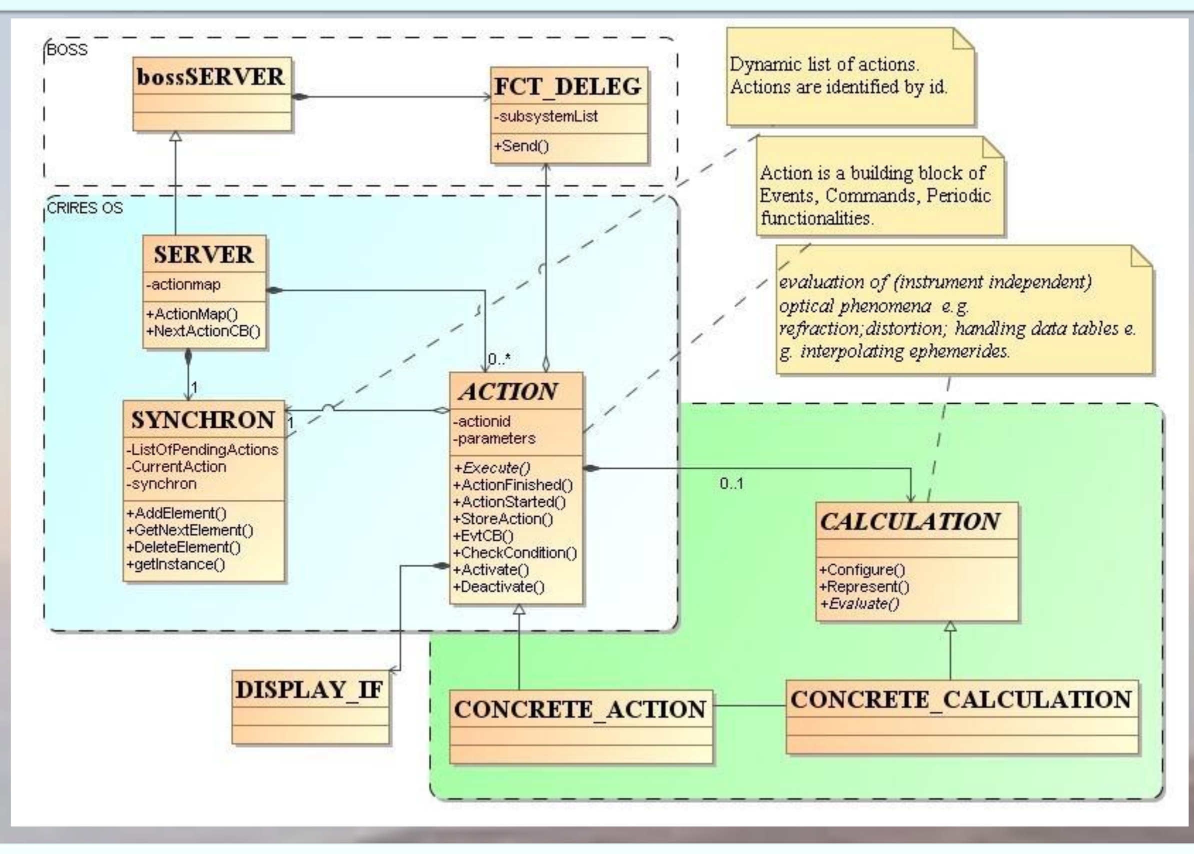
Analysis



Event queue handling…

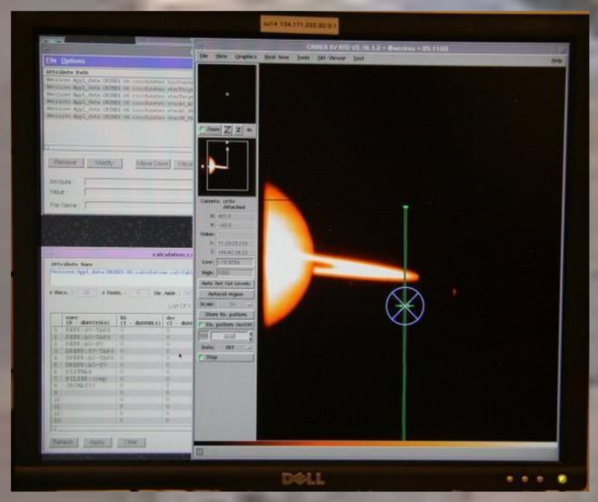
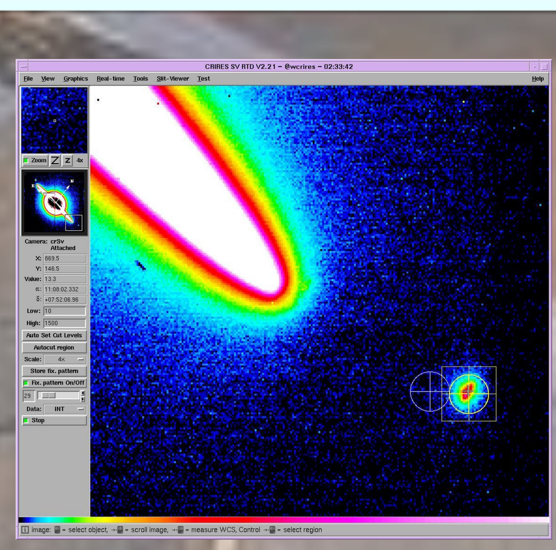
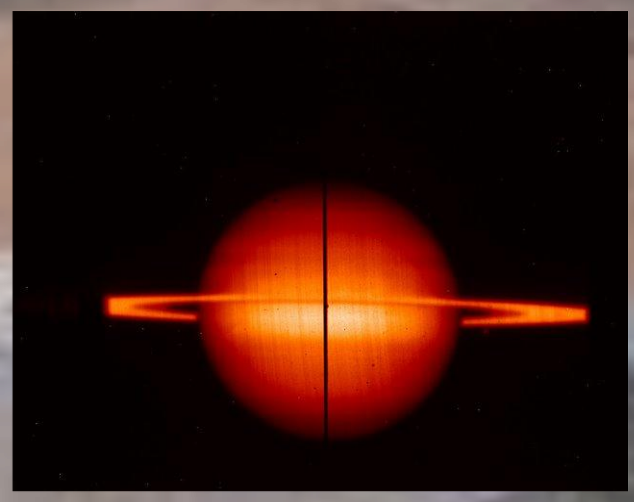


implementation

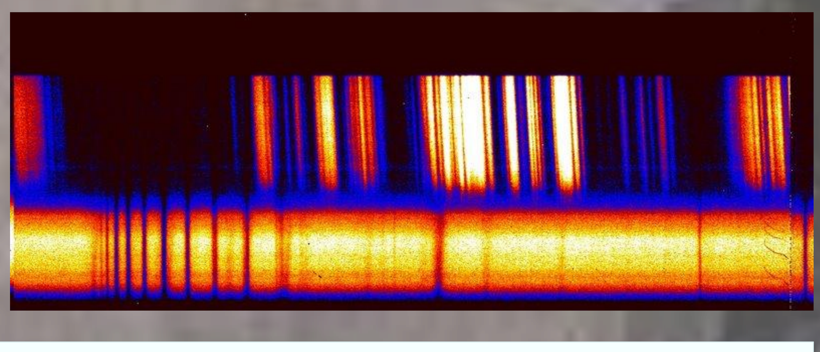


Remove interdependency by breaking down the individual functionalities into a list of reusable components (actions).
When an event is caught, add the belonging sequence of actions (i.e. their Id-s) to the 'action-list'.
Execution of the list of actions is managed by a supervisor (via event signaling when action is terminated).
Map the actions with Id-s so that a non-supervisor can refer to them.
Change the course of actions already on the list according to the latest event.
Set a maximum occurrence for each action to protect event queue from growing indefinitely.

in operation

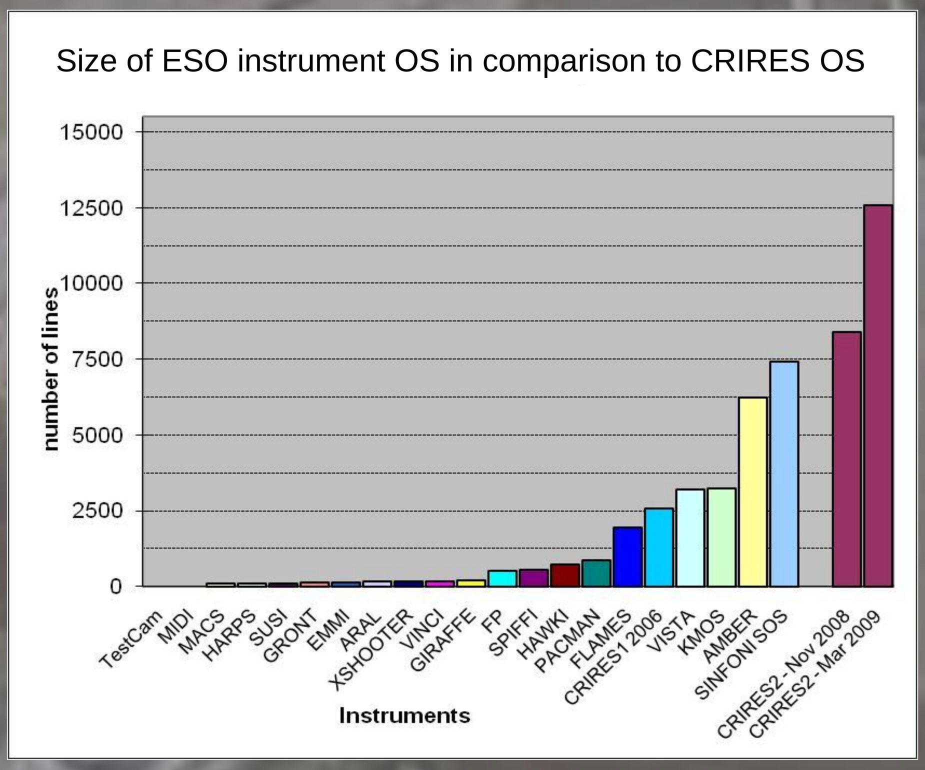




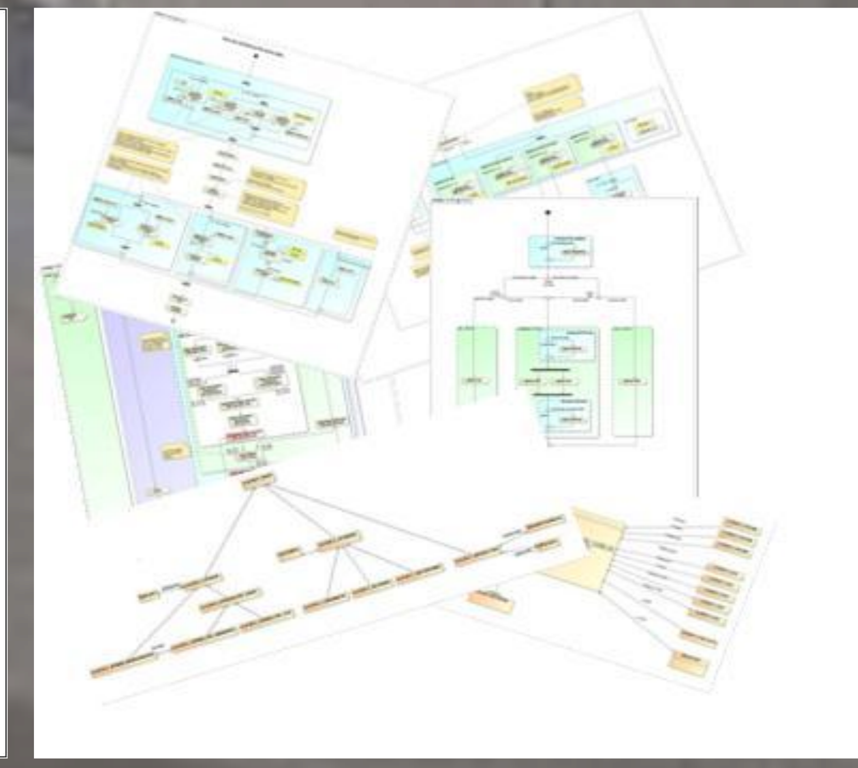
Imaging detector is used for positioning the target



The light that goes though the slit is caught by the science detector supplying the astronomers with the spectra of the target.

In order to observe Saturn, all internal functionalities must work together.
Guiding takes place via a moon of Saturn, since a big blurry object is not applicable for the positioning measurement.
To correct the relative motions two tables of ephemerides are used during the differential tracking.

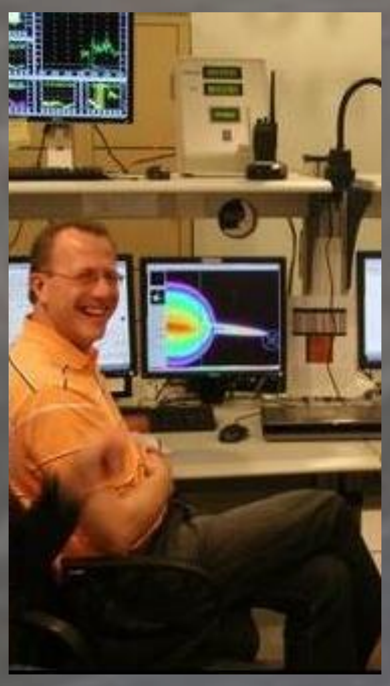




Lesson learnt and Future Consideration

One of the most challenging parts of the project was to identify the possible source of problems, that even if unhandled may remain hidden during tests, but can cause disturbance during operations.
The system described above has been in operation for several months without any brake down, and offers an easy way for future updates (e.g. adding additional loops). The software design created can be also easily turned into a reusable framework.
The authors of this paper believe that CRIRES software might be just the first of its kind at ESO. The increasing resolution of the detectors imposes higher demand on the control aiming to achieve (and/or not to loose) the level of precision that the new detectors are now allowing.

The Authors.



ESO