

(Introduction to)  
The CAOS Problem-Solving  
Environment  
&  
The Software Package CAOS  
+  
AO Simulations...

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# The CAOS “PSE”...

- CAOS means **Code for *Adaptive Optics* Systems.**
- “PSE” means **Problem-Solving Environment.**
- It is written in IDL, and based on a **modular structure.**
- It is composed of a global interface (the **CAOS Application Builder**), a library of utility routines (the **CAOS Library**), and some scientific packages (the **Software Packages**).
- a **Software Package** is a set of modules dedicated to a given

# CAOS Problem Solving Environment -1

CAOS  
Application Builder

global interface

CAOS Library

ASTROLIB Library

libraries

Software Package CAOS

Software Package AIRY

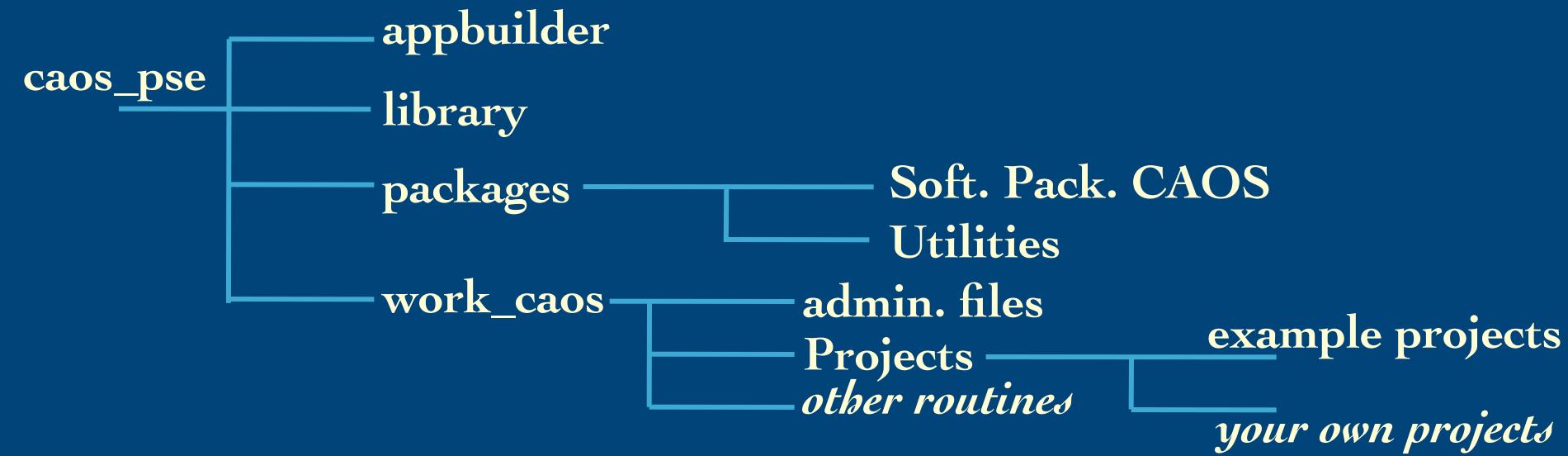
Software Package PAOLAC

Software Package SPHERE

Software Package AIRY-LN

packages

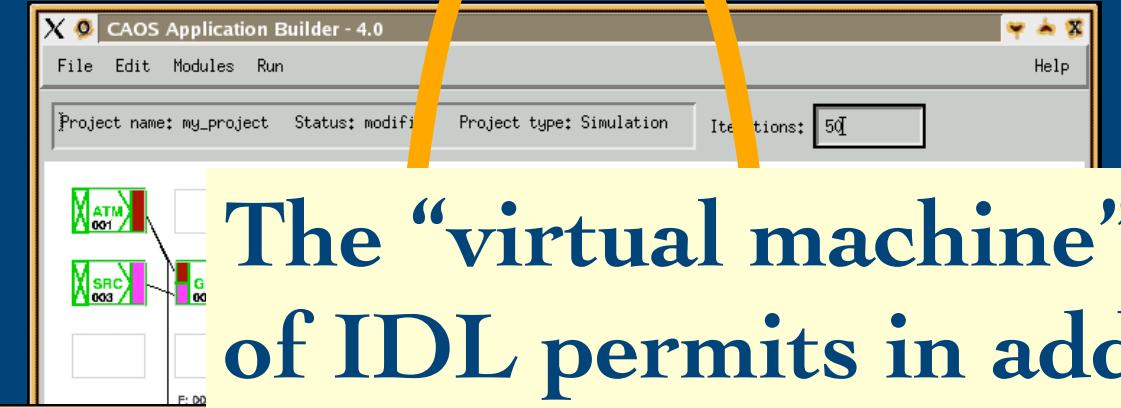
# CAOS Problem Solving Environment -2



somewhere else: astrolib, *some other library*

# CAOS Application Builder

The “virtual machine” feature of IDL permits in addition to have an IDL-liscence-free version of a given project...  
What you will use later on.



A screenshot of the CAOS Application Builder interface showing a Shell - Konsole window and an IDL code editor. The Shell window shows session settings and a command history. The IDL code editor contains the following script:

```
COMMON caos_block, t
ret = mds(0_001_00,
           mds_00001_p,
           INIT=mds_00001_c)
IF ret NE 0 THEN ProjMsg, "mds"
ret = src(0_002_00,
           src_00002_p,
           INIT=src_00002_c)
IF ret NE 0 THEN ProjMsg, "src"
ret = gpr(0_002_00,
           0_001_00,
           0_003_00,
           gpr_00003_p,
           INIT=gpr_00003_c)
IF ret NE 0 THEN ProjectMsg, "gpr"
ret = dis(0_003_00,
           dis_00010_p,
           INIT=dis_00010_c)
IF ret NE 0 THEN ProjectMsg, "dis"
; Loop Control
print, "==== RUNNING... ===="
FOR this_iter=1, tot_iter DO BEGIN
    print, "==== ITER. #"+strtrim(this_iter)+" / "+strtrim(tot_iter)+"..."
    @Projects/pyr_calib/mod_calls.pro
ENDFOR
; End Main
;
END
```

It is essentially a worksheet where the user can place small blocks, connect them with lines to form a

project is built and can be saved on disk, generating the IDL code which implements the simulation program.

# CAOS PSE: availability

All (*public!*) parts of the CAOS PSE are available for download:

<http://lagrange.oca.eu/caos/>

Current status of the dedicated mailing-lists  
(as on september 2016):

- Soft. Pack. CAOS: 117 subscribers,
- Soft. Pack. AIRY: 30 subscribers,
- *Soft. Pack. SPHERE: 23 subscribers,*
- *Soft. Pack. PAOLAC: 3 subscribers.*

# End-to-end AO modeling with the Software Package CAOS -1

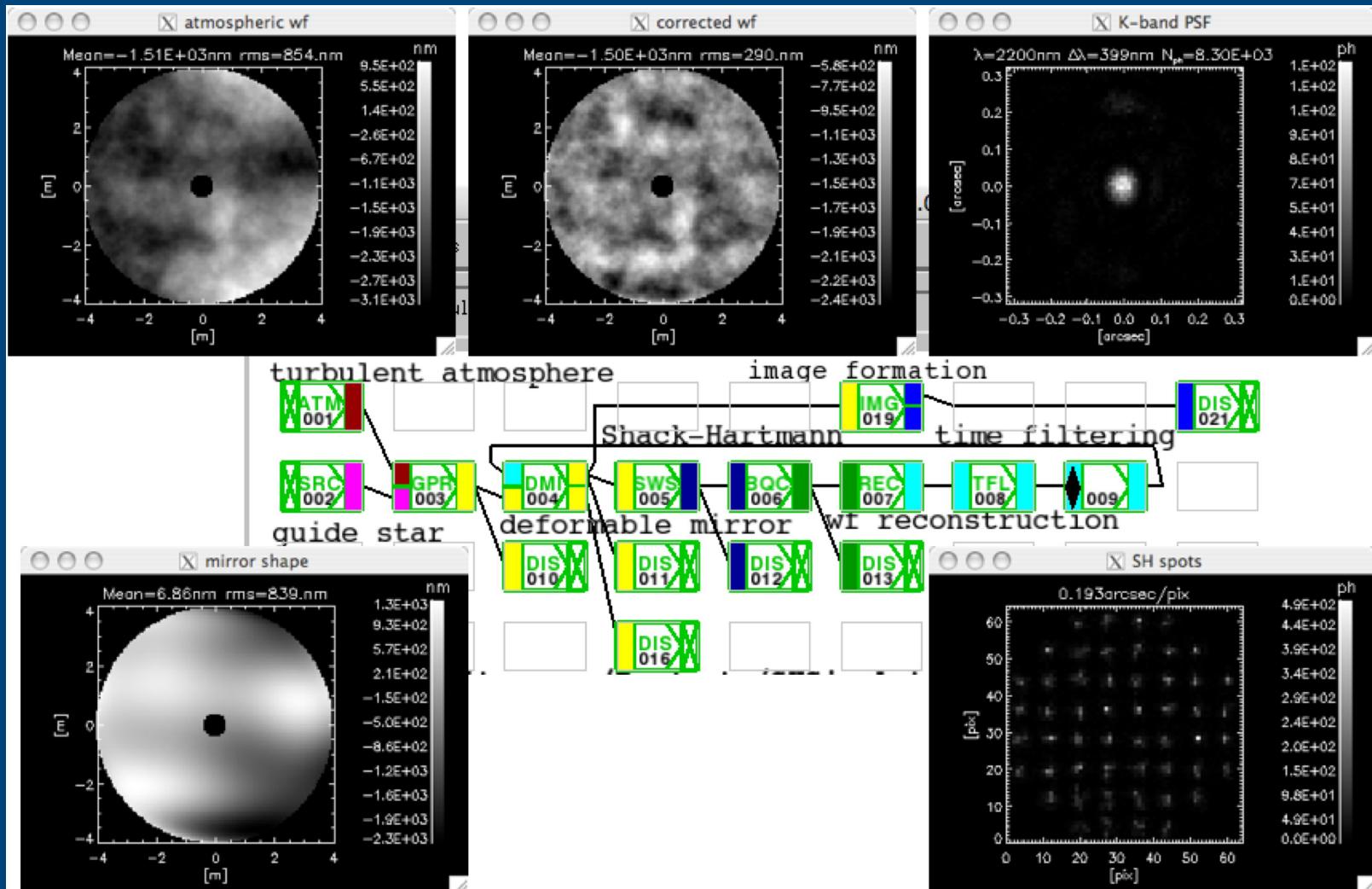
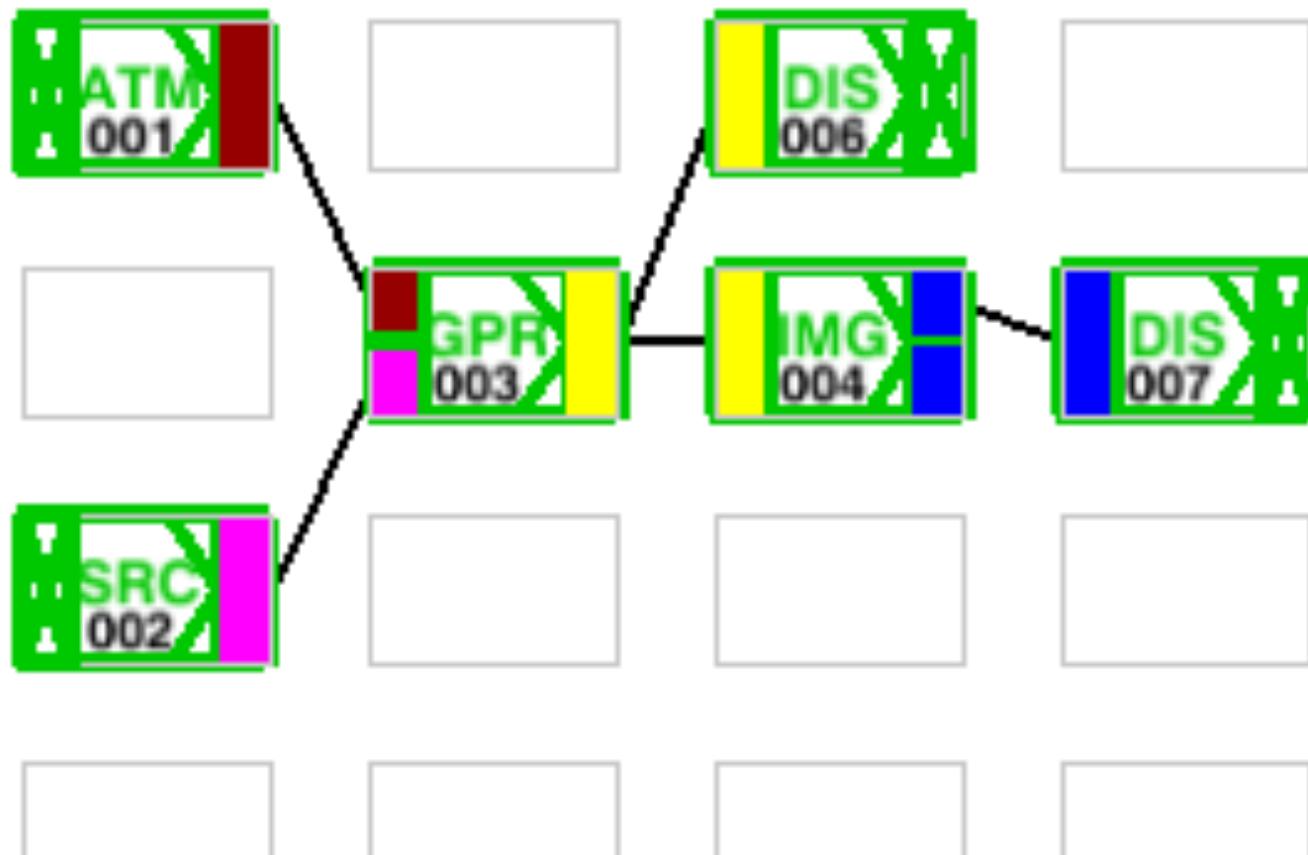


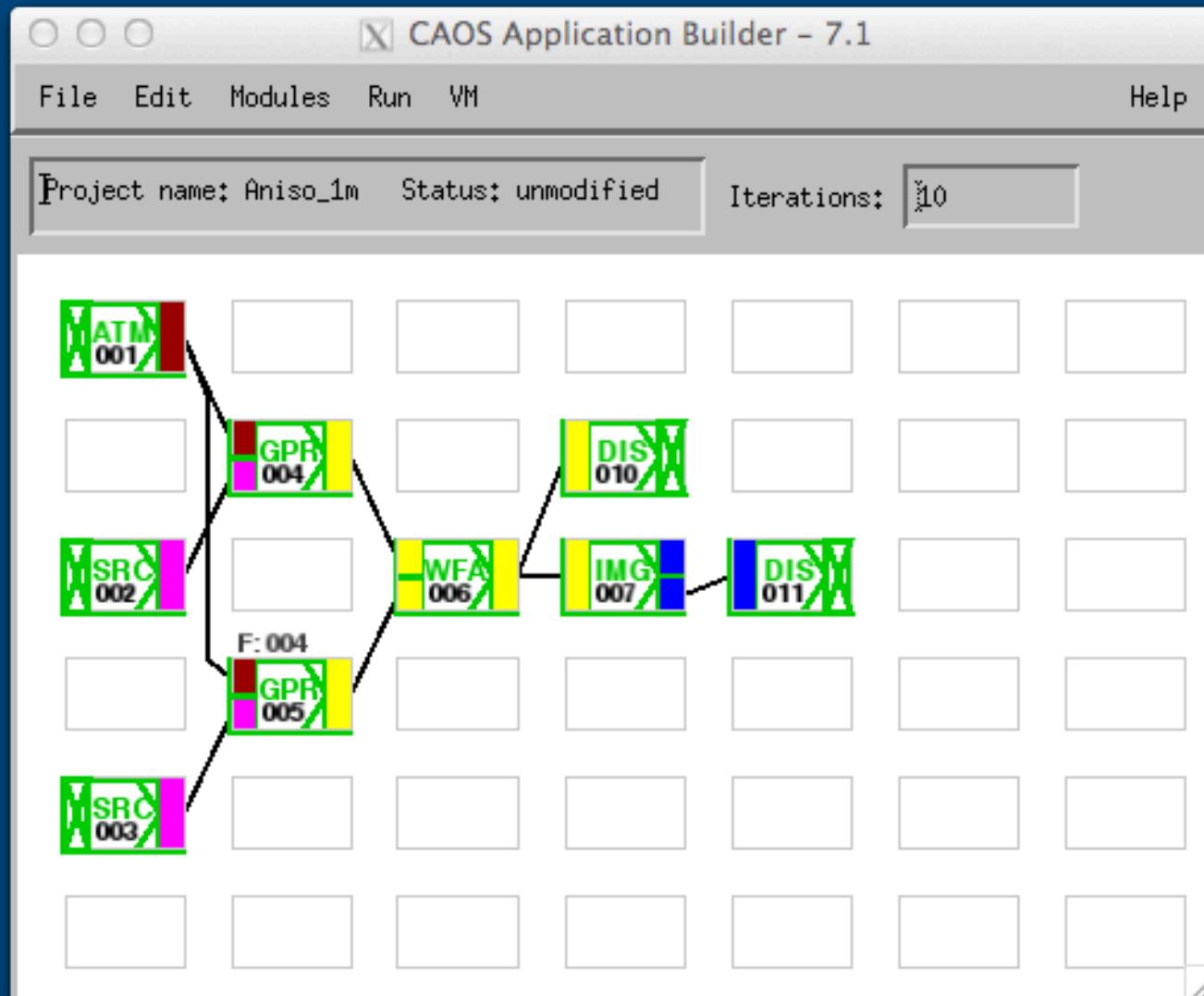
Table 1. The 31 modules of the Software Package CAOS, version 7.0.

Module	Purpose
<b>Optical turbulence &amp; image formation</b> ATM - ATMosphere building  SRC - SouRCe definition GPR - Geometrical PPropagator IMG - IMaGing device	-builds the turbulent atmosphere (FFT+subharmonics, Zernike) (see also utility PSG - Phase Screen Generation) -characterizes the guide star/observed object -propagates light from source to telescope through atmosphere -forms an image of the observed object (+detector noises)
<b>Wavefront sensing</b> PYR - PYRAMid wavefront sensor SLO - SLOpe computation SWS - Shack-Hartman Wavefront Sensor BQC - Barycentre/Quad-cell Centroiding IWS - Ideal Wavefront Sensing TCE - Tip-tilt CEntroiding	-simulates the pyramid wavefront sensor -computes the slopes from the pyramid signals -simulates the Shack-Hartmann (SH) wavefront sensor -compute the signals from the SH spots centroiding calculus -applies "ideal" wavefront sensing (see text) -computes and reconstructs tip-tilt
<b>Wavefront reconstruction, control &amp; correction</b> REC - wavefront REConstruction TFL - Time-FiLtering SSC - State-Space Control DMI - Deformable MIrror TTM - Tip-Tilt Mirror	-reconstructs the wavefront -applies time-filtering after wavefront reconstruction -applies state-space control -simulates the behavior of a deformable mirror (DM) -simulates the behavior of a tip-tilt mirror
<b>Calibration</b> CFB - Calibration FiBer characterization MDS - Mirror Deformation Sequencer SCD - Save Calibration Data	-defines a fiber to be used for calibration purpose -generates a sequence of DM modes or influence functions -saves the calibration data (interaction matrix+set of deformates)
<b>Wide-field AO</b> AVE - signals AVERaging COM - COMBINE measurements DMC - Deformable Mirror Conjugated	-averages measurements from various wavefront sensors -combines measurements from various wavefront sensors -corrects at different conjugated altitudes
<b>Other modelling modules</b> LAS - LASer characterization NLS - Na-Layer Spot definition IBC - Interferometric Beam Combiner COR - CORonagraphic module AIC - Achromatic Interfero-Coronagraph BSP - Beam SPLitter	-defines laser projector characteristics -characterizes the Sodium-layer behavior -combines the light from two apertures -simulates various coronagraphs (Lyot, Roddier&Roddier, FQPM) -simulates the Achromatic Interfero-Coronagraph -splits the light beam
<b>Other utility modules</b> WFA - WaveFront Adding ATA - ATmosphere Adding IMA - IMage Adding STF - STructure Function	-adds or combines together wavefronts -adds or combines together atmospheres -adds or combines together images -calculates the structure function and compares to theory

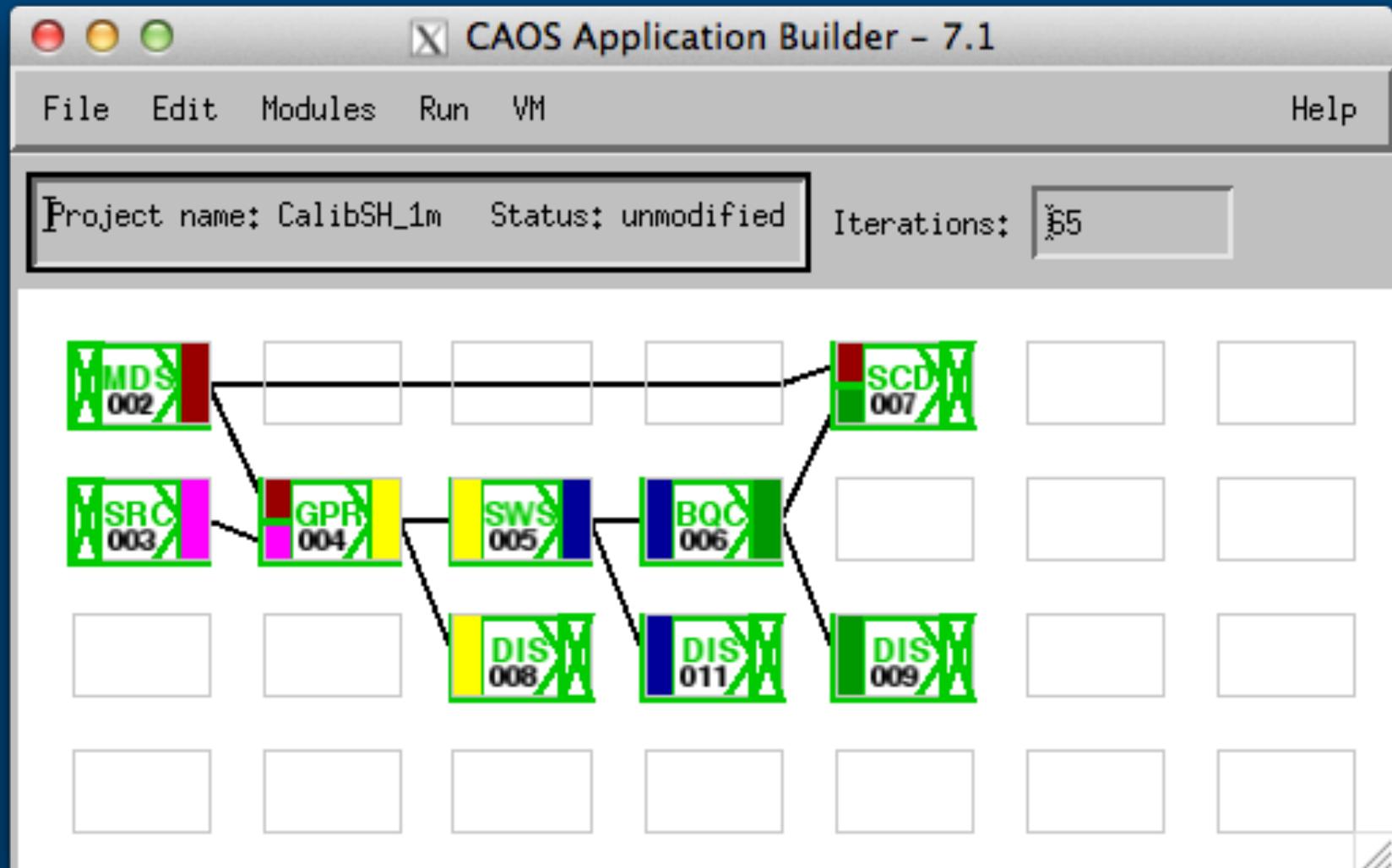
# Imaging through the turbulent atmosphere: loss of resolution !



# Imaging through the turbulent atmosphere: anisoplanatism !



# End-to-end simulation of a complete AO system: calibration



# End-to-end simulation of a complete AO system: running...

