QSO for ESPaDOnS
Scope, Development, Staffing

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Date: 02/13/2007
QSO-031, v1.0

A – Introduction

Since 2006, CFHT is operated at 85% under the New Observing Process (NOP) scheme. MegaCam and WIRCam observations are completely done under QSO and reduction pipelines produce pre-reduced data coming out from both instruments. The third major instrument currently offered at CFHT is ESPaDOnS. In the past 2 years, it has proved to be a very reliable and highly efficient instrument. ESPaDOnS is on average used for about 50 – 60 nights per year, usually covered in 2 or 3 long runs every semester. Despite this success, it now appears clear that ESPaDOnS would also benefit to be operated under NOP for several reasons:

1. Highly ranked scientific programs remain at the mercy of bad weather, in particular if those programs have a small number of nights. This is an area where queue observing shines, since it has proved over the years that the best-ranked programs get a very high level of completion, even when weather is quite worse than usual.

2. A large number of ESPaDOnS programs require severe and sometime very specific time constraints. It has been possible to meet those scheduling constraints during classical runs but it has required a lot of discussions and compromises between PIs. Time critical programs are common in QSO for MegaCam and WIRCam and this problem with ESPaDOnS will be best addressed by that mode.

3. An automated data reduction pipeline is mandatory to operate ESPaDOnS under the NOP. That includes a complete, well-developed calibration plan; that should result in even higher quality data than it is possible to achieve during a short classical run. Fully reduced spectroscopic data are much more valuable for archiving purposes as well.

4. The availability of QSO for ESPaDOnS will make the possibility to link the instrument, used in its spectroscopic mode only (not polarimetry) with a fiber from either MegaCam or WIRCam prime focus systems. This would improve the scientific productivity of CFHT as a whole, when sky conditions do not allow taking useful data with our wide-field imagers.

For information purpose, here's some statistics on the sage of ESPaDOnS in classical mode during the 2005A/B and 2006A/B semesters. This might help in prioritizing the design and implementation phases.

- *Observing Mode:* 82% polarimetry; 12% star + sky; 6% star only
- *CCD Readout mode*: 74% normal; 18% slow; 7% fast; 0% Xslow

- *ADC*: 95% on; 5% off
- *Airmass constraint*: < 5; 90% at *secz* < 2

B – QSO Development: Scope & Overview

Scope

As with MegaCam and WIRCam, the scope of the QSO project for ESPaDOnS is to optimize the scientific output of the instrument, by **1)** Achieving high completeness for highly ranked programs; **2)** Increase scheduling flexibility in particular for scientific programs requesting time critical observations; **3)** Improve the observing efficiency; **4)** Improve the quality of the calibrations.

Overview

Without going into the design and details of implementation, several new developments will have to take place within QSO to be able to meet the scope defined above.

Program Submission: PH2

PH2 will require important modifications and additional tools, although it is expected that new developments will not be as numerous as with WIRCam. The main changes or new options that will be required include:

- Finding charts generator, for ambiguous targets
- New instrument configuration options: Instrument modes, CCD readout modes, Stokes parameters, calibrations
- Constraint: S/N, cloud coverage, seeing
- Observation Blocks: guiding options?
- Observation Groups: Time constraints

Queue Preparation

Preparing queues with ESPaDOnS will not differ significantly from what we currently do, although additional support tools will be needed;

- Scheduling tool to extract windows of opportunities for time critical observations
- Review of finding charts, if necessary

Observations

Queue observing with ESPaDOnS will be similar to that of MegaCam and WIRCam although more "manual" intervention might be needed for centering the object in the fiber and guiding acquisition:

- Centering and guiding (ESPaDOnS and Cass) control + finding charts display
- New Breaker: Triggering the right scripts for instrument configuration and observations

Evaluation/Validation

Real-time data evaluation requires the development of new tools, in particular an automated tool that will provide a quick and reliable evaluation of the S/N obtained or expected versus S/N requested through PH2. Also, since iteration numbering is different for ESPaDOnS – that is, one Stokes parameter generates four different odometer files - the validation cascade will have to be modified as well.

C – NOP Other Developments

NEO

It is likely that significant work will be required on the NEO side in order to make the communication between QSO and the instrument/TCS workable. Current operations of ESPaDOnS are done through a ensemble of scripts, some to configure the instrument and other to control the exposure parameters. As much as possible, current existing commands should be used but it is likely that new commands will have to be developed. In the current scheme, observing flexibility is diminished since atomic commands are not generated as with MegaCam and WIRCam; if this loss in flexibility is acceptable in order to keep the technical development as simple as possible remains to be investigated.

Calibrations/Pipeline

As described in section A, item 3, an automated data reduction pipeline is needed to operate ESPaDOnS under the NOP. A sub-component might have to be developed also to provide quick real-time analysis during observations, in order to estimate if the observations meet the constraints or not. To achieve this, several developments are needed:

- A full calibration plan
- Automated pipeline based on the Libre-Esprit reduction package
- Real-time analysis for supporting observations

DADS

Distribution of data for ESPaDOnS will require also some development. The exact data format remains to be identified.

D – Schedule and QSO Staffing

Schedule

The following include a very rough schedule for the development of the components of QSO only. The ultimate goal is to offer ESPaDOnS under QSO **for the semester 2008A**.

- PH2 Design: Feb-Mar 2007
- PH2 Implementation: May – October 2007
- QSO Tools Design: Apr – July 2007
- QSO Tools Implementation: May – October 2007
- Testing phase: October- December 2007
- Phase 2 for 08A : January 2008

Staffing

With CFHT almost fully operated in QSO mode, the following QSO staff will be needed: 4.5 Service Observers; 5-6 Coordinators.