

Early-Science call for observing time with SAM-FP

1. General description

SOAR is opening a call for proposals for early-science with SAM-FP in 2016B, for 4 nights (September 29 – October 2, 2016). SAM-FP is a restricted-use instrument; it is a new mode of operation of SAM for spectroscopy using a Fabry-Perot (FP) and SAMI. Ongoing tests of the instrument are underway, performed by the instrument team (C. Mendes de Oliveira, P. Amram, B. Quint). There are two Fabry-Perot devices available for the present early-science call, one high order $p=609$ Fabry Perot, with Finesse ~ 18.5 and a free spectral range (FSR) of 10.8 Angstroms, enabling data cubes with spectral resolution $R\sim 11200$ at H α and a low order $p=134$ device, with Finesse ~ 30.5 , Free spectral range FSR=49 Angstroms yielding $R=4100$ at H α , both over a field of view 3×3 arcmin. We have had two successful runs with the high order, high resolution Fabry Perot so far and some of the data taken are shown in the next section and in Mendes de Oliveira et al. 2016, as examples of what can be done with this instrument. The low-resolution Fabry Perot has also been successfully tested on sky but bad weather conditions did not allow us to make observations for science use. A high-resolution Fabry-Perot with GLAO can be a unique tool in the study of kinematics of emission-line objects such as star forming galaxies, gas flows, planetary nebula, HH objects, and giant HII regions, among others. The low-resolution is mainly interesting for AGN work, galactic outflows, studies of T Tauri stars and mass loss events. The process for proposal submission is described in Section 3; time is open to investigators from all SOAR partners. *We expect feedback from those who receive the requested datacubes within 6 months of data delivery*, so that we can improve the instrument and data-taking process for future wider use of the instrument by the community.

2. Examples of data cubes obtained with the high-resolution Fabry Perot

We had one night observing with the SAM+FP on March 17, 2015 and two nights on December 3-4, 2015. The night of March 17 was obtained through Brazilian DD time and the nights in December were Brazilian nights obtained through the regular TAC process. The data described below correspond to cubes obtained on March 17. Data for 30 Dor, taken on the same night, are described in detail in Mendes de Oliveira et al. (2016).

Seeing PSF values on the night of March 17, as recorded by the seeing monitor, were quite variable, from as good as 0.5'' in the beginning and end, to about 1.4'' in the middle of the night. After laser correction, the images had FWHM ranging from 0.4-1.0''. The night was photometric only in the first two hours, with the presence of some thin cirrus in the rest of the night. Our main goal in this run was to check if the high-resolution FP $p=609$, finesse 18.5 and $R=11200$ could take scientifically useful data. A mechanical adaptor was fabricated and installed, which allowed the FP to be placed in and out of the instrument. This adaptor is now permanently mounted inside SAM. Another adaptor was fabricated to host the CS100 controller, which has been fixed to the structure of the telescope, in a convenient location. H α cubes for 30 Doradus,

NGC 3621 and the Antenna galaxy, in $H\alpha$, were taken successfully with SAM-FP and laser guide stars. All data were taken with binning 4×4 , yielding cubes with a pixel size of 0.18×0.18 arcsec (sufficient to sample the seeing even with GLAO correction). The data on 30 Dor are described in Mendes de Oliveira et al. (2016, submitted to MNRAS – available on this site). Monochromatic maps and radial velocity maps obtained for the galaxies NGC3621 and the Antenna are shown below, with the aim of showing a couple of examples of what can be done with this new SAM mode.

In Figs. 1 and 2 we show the $H\alpha$ map and velocity field for the Antenna galaxy and NGC 3621 respectively. The exposure times were 2.5 minutes for each of the 40 channels taken for the Antenna and NGC 3621. In the case of NGC 3621, we also took an extra field, 4 arcmin west of the object, to measure the sky (see Fig. 3). Fig. 4 is a copy of Fig. 7 of Mendes de Oliveira et al. (2016) and shows the diversity of $H\alpha$ profiles obtained in a very small area of 30 Dor, covering 9×9 arcsec.

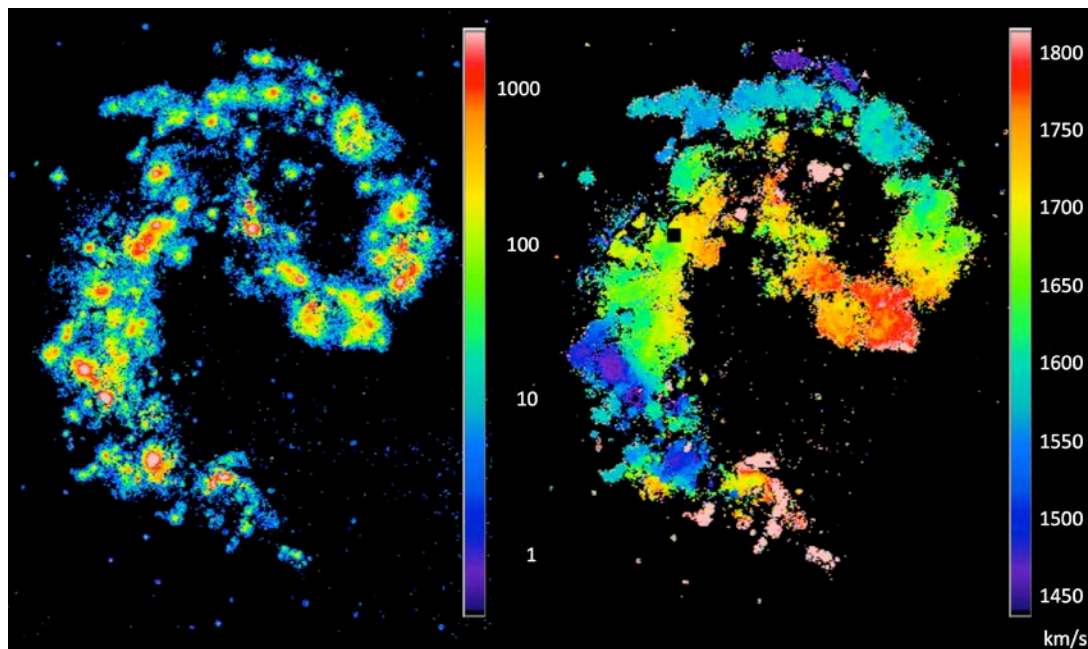


Fig. 1 – Monochromatic image (left panel) and Velocity field (right panel) of the Antenna. North is up and East is to the right. The monochromatic image has arbitrary units (given that the data are not flux calibrated) and it is in log scale.

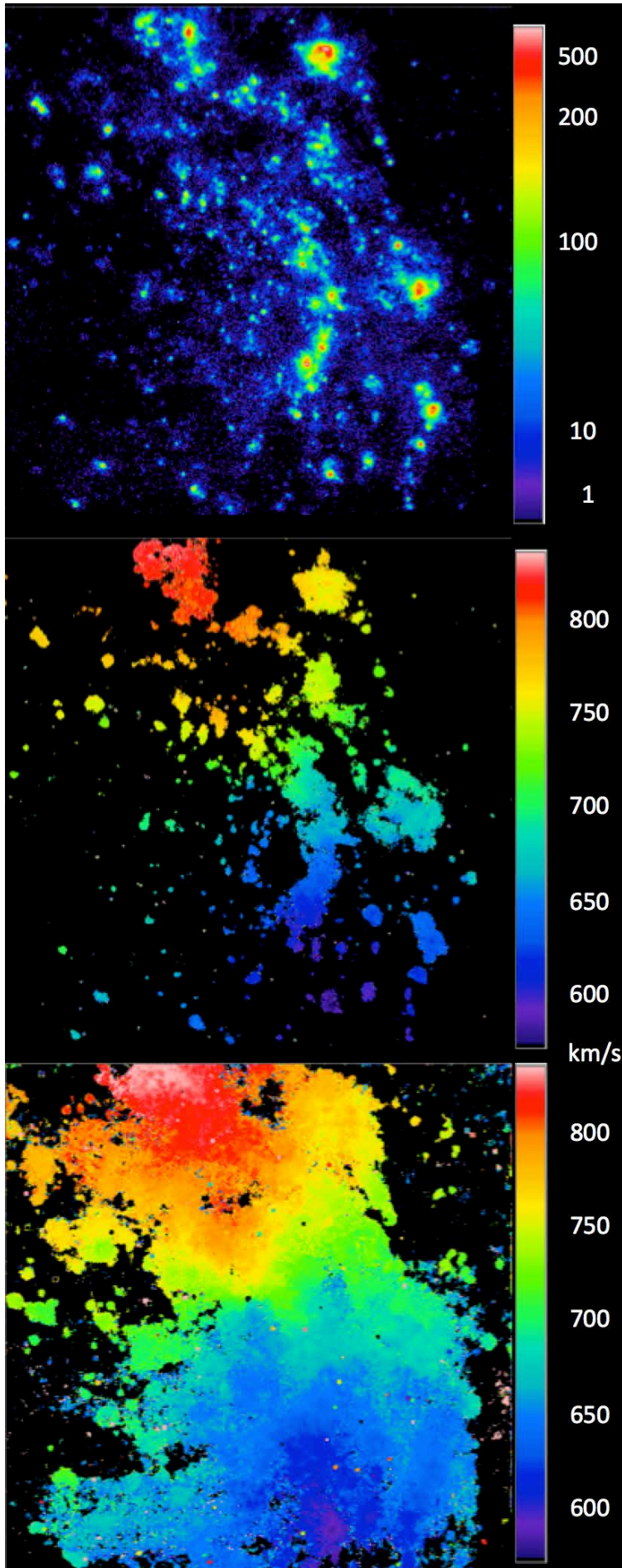


Fig. 2 –
 Monochromatic
 image (top panel),
 velocity field with
 no binning
 (0.18"/pix) and with
 a Gaussian spatial
 binning of 4 pixels
 of NGC 3621
 (middle and lower
 panels respectively).
 The field of view is
 3 x 3 arcmin.
 The monochromatic
 image has arbitrary
 units (given that the
 data are not flux
 calibrated) and it is
 in log scale.

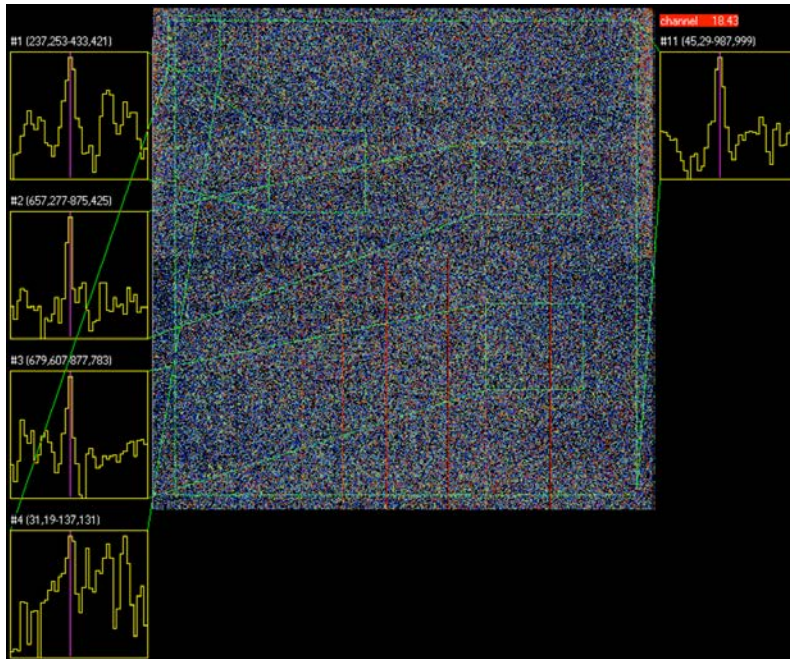
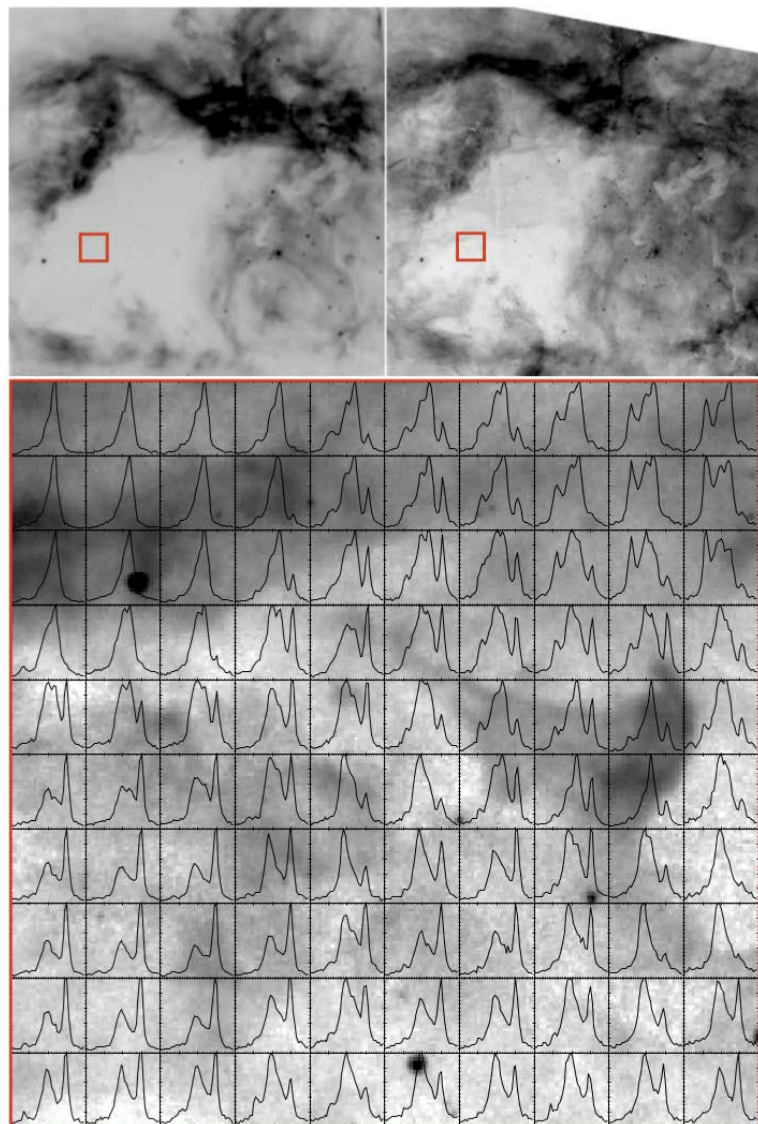


Fig. 3 – Sky data cube, 4 arcmin west of NGC 3621, exposed for 10s per channel, for sky subtraction. Insert to the right shows the profiles integrated over the whole field of view. Inserts to the left of the figure show profiles integrated over small windows.

Fig. 4 - Profiles of one selected area of 30 Dor (the area indicated by the red square in the top images). Top left panel: Halpha image of 30 Dor extracted from one of the channels of the Fabry-Perot data cube taken on March 17th. The red square indicates the region whose profiles are shown in the lower panel. Top right panel: HST H-alpha image of the same region. Bottom panel: Halpha profiles over a 10 x 10 array of binned pixels. Each "pixel" is now 0.9 arcsec on a side. The purpose of this Figure is to show the diversity of profiles in a small area of only 9 x 9 arcsec. This diversity is typical of the whole area observed of 30 Doradus. Note that the profiles can be easily traced from one pixel to the next.



3. Early-science observations

- The Fabry Perot devices available for use are:
 - one with order 609, finesse=18.5, that yields cubes with a spectral resolution of $R=p.F=11200$.
 - one with order 134, finesse=30.5, that yields cubes with a spectral resolution of $R=p.F=4100$.

If interested, please contact us at Claudia.oliveira@iag.usp.br or bquint@ctio.noao.edu.

- Best targets for the high order Fabry Perot are emission-line objects in the nearby universe with radial velocities -300 to 2800 km/s, given that for these we have suitable 3 x 3 filters readily available (if you are interested in observations of the H α line). If you want to observe objects with other radial velocities ask us if we have the right interference filter for it (it is also possible to borrow filters from the Laboratoire d'astrophysique de Marseille set).
- We have suitable blocking filters available for rest wavelengths in the following lines in the high resolution FP: H α , [NII] 6583 and [SII] 6717/6731, and centered on H α for the low resolution FP (with the low-order FP the two [NII] lines are also observed). Please check with us if you are interested in redshifted lines or other bright emission lines.
- We have a single observing block of 4 nights in 2016B for the early-science with SAM-FP, from 29 September through October 2. Objects have to be observable in this period.
- The deadline for proposal submission is *August 15*. Submission is through the contacts listed above. Brazil is contributing half of the time, so some preference will be given to Brazilian observers.

We will deliver data cubes that will be overscan- and bias-subtracted, flat fielded and cosmic ray cleaned. We will phase correct the data and clean for night-sky line. The final cube will be wavelength calibrated (modulo the free spectral range). Calibration data will not be regularly taken unless otherwise specified. Therefore, if needed, the user should include in the observing plan the request for observation of a bright emission-line target suitable for calibration purposes (e.g. a bright planetary nebula). Flux calibration of the data cubes will not be performed by the team; it can be done in a similar manner to that shown in Mendes de Oliveira et al. (2016). Visualization of the cubes and ways for measuring physical quantities are facilities that will not be supplied to the user. For that, the user can use public classical tools such as e.g. DS9, Qfitsview, FLUXER and/or public softwares developed for Fabry-Perot data, such as ADHOCw, PyQubeVis (<https://bitbucket.org/bepinat/pyqubevis>) and computeeverything (http://www.astro.umontreal.ca/fantommm/reduction/routines_reduction/node1.html).

This instrument has been developed with the team's resources and the Fabry-Perot mode is a restricted-use instrument on SOAR. As a recognition of the effort made by the team to make this instrument available to the community and to make the data ready for the user to do science with it, it is requested that the three team members be co-authors of any published work that may result from the observations (note that the time that the team member Bruno Quint (post-doc researcher and SOAR resident astronomer) spends on this instrument comes out from his "research" time and is not part of his Brazil or SOAR support duties).

06/14/2016, Claudia Mendes de Oliveira (IAG), Philippe Amram (LAM), Bruno Quint (SOAR)