Brazilian Large and Long Program (BrLLP) LP002
Progress Report - March 2017

Title: AGNIFS - NIFS survey of feeding and feedback processes in nearby Active Galaxies

Thaisa Storchi Bergmann (PI, IF-UFRGS, Instituto de Física, Univ. Federal do RGS)
Rogemar André Riffel (UFSM, Universidade Federal de Santa Maria)
Rogerio Riffel (IF-UFRGS)
Marlon R. Diniz (UFSM, PhD thesis advised by Rogemar A. Riffel)
Astor Joao Schoenell Jr. (IF-UFRGS, PhD thesis, advised by Thaisa Storchi Bergmann)
Natacha Z. Dametto (PhD thesis, advised by Rogério Riffel)
Luis Gabriel Dahmer Hahn (PhD thesis, advised by Rogério Riffel)

1. Executive summary

We have been awarded 82.5 hours (spread over 6 semesters: 2015A-2017B) to complete NIFS+ALTAIR observations in the J and K bands of the inner few hundred parsecs of a distance limited sample of 26 nearby Seyfert galaxies drawn from the Swift-BAT 60-month catalogue and selected to have 14-195 keV luminosities larger than $10^{41.5}$ erg/s, redshifts $z<0.015$ and being accessible to NIFS ($-30° < \delta < 73°$). Our goal is to map the ionized and hot molecular gas distributions and kinematics, as well as the stellar population and kinematics in order to answer the following questions: (i) How much mass is available for accretion, what mechanisms bring gas to the environs of the SMBH and what are the mass inflow rates? (ii) How do outflows interact with the interstellar medium, what are the mass outflow rates and kinetic power? Can the outflows strip the ISM away from around the BH? (iii) What is the role of star formation in the process? Can we find signatures of recent star formation in the vicinity of the AGN -- a signature of co-evolution of the bulge and SMBH?

In order to complete the observations of the sample of 26 nearby Seyfert galaxies, we need to observe 16 galaxies in the J and K bands plus one galaxy, NGC2110, only in the J band, as we have previous NIFS observations of 10 galaxies of the BAT sample. We have estimated we need 5 hours per galaxy, thus a total of 82.5 hours for the completion of the observations. The first semester of observations was 2015A, the last is now expected to be 2017B.

2. Answers to the comments and questions raised by the NTAC:

We begin by answering the questions raised by the NTAC in response to our previous report of September 2016.

Question - It appears a bit cumbersome to have to obtain NIR slit spectra for each object in order to cross-fluxcalibrate the J and H spectra from NIFS. Could photometry from, e.g., 2MASS, not be used instead to simply scale the different NIFS spectra to a common flux scale?

Answer - We cannot obtain an acceptable calibration using 2MASS because the smallest apperture of the 2MASS photometry is 5", while we are analyzing spectra corresponding to a much smaller aperture. With NIFS we reach down to 0.1" and we do not get reliable constraints from 5" apperture data. We note that our observations cover only the J and K bands, thus we miss the H band in which many cases there is a change in curvature of the spectra according to the temperature of the dust around the nucleus (in most cases the torus). We have already the cross-dispersed near-IR spectra obtained using IRTF and the Blanco telescope for a related project that will be used to flux-calibrate the data.

Recommendation 1 - The NTAC would like to request that next time the team provides a more detailed report of the reasons of why exactly the time-losses occurred. Without such a break-down, it is difficult to assess where most of the time-losses of these program are incurred: please try to distinguish between schedulability issues (availability of NIFS+ALTAIR and competition with GMOS), problems with guiding on the faint nuclei of Seyfert 2s, and weather (where possible).

Answer: We have been inquiring about the reasons they did not execute the observations and all of the above apply: sometimes is due to schedulability issues, usually saturated RA ranges combined with the short duration of the NIFS runs; sometimes there are problems with the LASER and with the guiding. We have relaxed the conditions for some targets, but even so there have been problems. As previously suggested by the NTAC, we have modified SB=Any instead of SN=80% to improve the success rate and we believe that this may have made the guiding even more difficult. We have been in contact with Marie Lemoine-Busserole regarding the recent problem with the Laser and we have then revised the targets to check if we could use NGS. She told us that we could do many of the galaxies with NGS (using the nuclei and in one case a star in the field) but that we should change the SB to 80%, what we have done for the present semester (2017A).

Recommendation 2 - As emphasized by the team, the sample of 16 galaxies targeted in this LP2 is part of a larger parent sample of 26, of which 10 have already been observed in previous programs with identical setup. Pessimistically assuming that the final overall efficiency of the LLP remains ~60%, this actually means that the final sample (including the previous targets) will consist of 20 targets, or a reasonable ~80% completeness. Therefore, it is perhaps wise to make sure that targets are scheduled with a priority according to the types of galaxies that are still underrepresented in the subset observed to date. In other words, the NTAC recommends to prioritize the targets assuming that the final completeness of the 16 galaxies in the LP2 target list will remain ~60% (and overall completeness 80%).

Answer: Actually our "main sample" does contain 20 galaxies, with only 4 galaxies observed in previous runs. The other 6 comprise a "complementary sample" that do not comply with the range of luminosities and/or distances of the primary sample. We believe that 20 galaxies is the absolute minimum number of galaxies for us to be able to reach the goals of the project of relating the measured properties within the inner kiloparsec with the AGN luminosities and large scale host galaxy properties.

Recommendation 3 - The report did not contain a detailed publication plan. For the next report, we urge that the team lays out their detailed plan for publication of these data, including tentative paper titles, authors, sample used, main goals, and timeline.

Answer: We are presently working on 8 papers. One is being revised according to suggestions by a referee; another has just been submitted, and three others are well advanced and will be part of Astor Schoenell and Marlon Diniz PhD Theses that will be presented in May 2017 and August 2017, respectively. The last two are still in the initial phases. The titles and contents of the 8 papers are:

1. *Gemini NIFS survey of feeding and feedback processes in nearby Active Galaxies: I - Stellar kinematics*, by Riffel, R. A. et al.: this paper, containing the mapping of the stellar kinematics within the inner kiloparsec of all galaxies of the sample so far observed, was already submitted and is being revised after suggestions from the referee.

2. *Disentangling the near infrared continuum spectral components of the inner 500 pc of Mrk 573: two-dimensional maps*, by Diniz, M. R. et al.; this paper has just been submitted, and will be part of Diniz PhD Thesis, to be presented in August 2017.

3. *Gemini NIFS survey of feeding and feedback processes in nearby Active Galaxies: II - Definition and general properties of the sample*, by Riffel, R. A. et al.: this paper characterizes the sample (this part is ready) and we are now including also a census of the gas masses in ionized and molecular gas, as well as the corresponding surface mass density distributions and gradients of all galaxies observed so far in the project. This paper will also be part of Shoenell's PhD Thesis, as he has made the latter measurements.

4. *Gemini NIFS survey of feeding and feedback processes in 6 nearby Active Galaxies: surface mass density distributions and gradients and gas excitation*, by Schoenell, A. et al.: this paper is being finalized, containing data for all the galaxies we have obtained data for and that have not yet been published and will be the main paper of Schoenell's Thesis.

5. *Gemini NIFS survey of feeding and feedback processes in nearby Active Galaxies: III - Resolved 2D stellar populations in the inner kiloparsec,* by Diniz, M. R. et al.; this paper is in progress and applies the methodology developed in the paper number 2 above. It will be the main paper of Diniz PhD Thesis.

6. *Resolved 2D stellar population of the inner 500 pc of NGC 4151*, by Riffel, Rogerio et al.; this paper is well advanced and provides the mapping of the stellar population ages and nuclear continuum of this well known and nearby Seyfert 1.5 galaxy.

7. *Probing the AGN-SB connection in the Near-Infrared*, by Dametto et al.: this paper is in progress and will be the main paper of Dametto's Thesis, to be presented in second semester of 2018.

8. *2D Panchromatic stellar populations in Seyfert galaxies*, by Hahn et al.: this paper is in progress and will be the main paper of Luis D. Hahn Thesis, to be presented in 2018.

Recommendation 4 - In order to be able to review the team's request that the NTAC consider an extension of this program beyond 2017B in order to make up for the time losses, we request that the team provides a scientific justification for such an extension. The justification should explain which of the science goals cannot be achieved without the extension and why not, and which science goals can still be achieved taking into account the completeness of the observations at the time the next report is due.

Answer: As pointed out above our "main sample" contains 20 galaxies, with only 4 galaxies observed in previous runs. The galaxies observed so far are: NGC 3516, NGC 5506, J-band for NGC 2110, NGC 788, NGC 3227 and NGC 4235. In summary, during the 4 semesters (2015A, 2015B, 2016A, 2016B) of the LLP we have received data for only 6 galaxies of the 16 we need to complete the dataset of our project. We were awarded time to observe 3 galaxies per semester (15hs/semester), but, after 4 semesters, instead of having 12 galaxies (60 hours) to work with, we have only 6 (30 hours), thus an efficiency of only 50%.

In order to be able to reach the goals of our project, we still need to observe the remaining 10 galaxies. For the present semester (2017A) we hope to get observations of NGC 3393, NGC 3786 e NGC 5728. Although we recently learned that Altair will not have the Laser, we verified that all three galaxies can be observed with NGS after the change in SB conditions from "Any" to 80%. We have just changed the Phase II accordingly as requested by Marie Lemoine-Busserole, from Gemini.

For 2017B, as we did not get any observations in 2016B, and our proposal has rollover status, the galaxies requested for 2016B should be observed: NGC 2992, NGC 3081 and NGC 1125. We have checked that NGC 2992 and NGC 3081 can be observed with NGS, but not NGC 1125. We will request that NGC 1125 be replaced by NGC 3035.

We are entitled to another 15hs of time in 2017B, because the observations above are "rollover". We opt not to use this time in 2017B and ask instead for time in 2018A to observe two galaxies, NGC 4939 and NGC 4388. We will then ask for 10hs in 2018B to observe NGC 1125 and NGC 1194.

2. Progress of the work

Summary of previous semesters:

In 2015A we received only **~60%** of the approved observations. The project was awarded 20 hours: 15 hours in Band 1 under the project GN-2015-Q-3 and 5 hours in Band 2 under project GN-2015A-Q35. We received **11.5 hours** for the observations of the galaxies **NGC3516** and **NGC5506** in both the J and K bands, 1.5hrs more than requested because they had difficulty in the acquisition of NGC5506. We received also 2 (0.2 hrs) of 10 requested exposures for NGC4388 and no data for NGC4939.

In 2015B we received **~50%** of the approved observations. We were awarded a total of 15hrs in project GN-2015B-Q-29: 2.5hs to observe NGC2110 in the J-band, 10 hours to observe J and K bands of Mrk9 and NGC788, and 2.5hrs to observe the K-band of NGC3081, but only observations in the J-band for **NGC2110** and in the J and K bands of **NGC788** were obtained. We did not receive any data for Mrk9 and NGC3081.

In 2016A we were awarded 15hrs to observe three galaxies in project GN-2016A-Q-6: NGC3227, NGC4235, J-band NGC4388 and NGC4939, but received only **59%** of the awarded time, comprising observations of **NGC3227** and **NGC4235**.

In 2016B we were awarded 15hrs to observe three galaxies in the project GN-2016B-Q-26: NGC1125, NGC2992 and NGC3081 but received no data, **0%**! We received the following remark regarding this project: "This program is in band 1 and has been accepted for rollover into semesters 17A and 17B if not completed in 16B." Thus we expect to observe these three galaxies in 2017B.

Present semester:

In 2017A we were awarded 15hs to observe three galaxies in the project GN-2017A-Q-4: NGC 3393, NGC 3786 and NGC 5728. As pointed out above, these galaxies can be observed with NGS.

For 2017B, as we did not get any observations in 2016B, and our proposal has rollover status, the galaxies requested for 2016B should be observed: NGC 2992, NGC 3081 and NGC 1125. We have checked that NGC 2992 and NGC 3081 can be observed with NGS, but not NGC 1125. We will request that NGC 1125 be replaced by NGC 3035.

We are entitled to another 15hs of time in 2017B, because the observations above are "rollover". We opt not to use this time in 2017B and ask instead for time in 2018A to observe two galaxies, NGC 4939 and NGC 4388. We are entitled to 5hrs more (as we are asking for 10 hs instead of 15hs in 2018A) in 2018B to observe NGC 1125. We need only 5 hs more (thus a total of 10hs) in 2018B to observe the last galaxy, NGC1194.

Assessment of the data:

We have reduced all the data received so far: J and K-bands observations of NGC3516, NGC5506, NGC788, J-band observations of NGC2110, J and K-band observations of NGC3227 and NGC4235. The reduction effort was led by Rogemar Riffel.

Calibrations:

The data has good quality, but we have had a few problems with calibrations when there are observations of the same target in two different nights. We have been solving these problems via calibrated long-slit cross-dispersed spectra both from previous and new observations obtained by the student Luis Gabriel Hahn in the IRTF (InfraRed Telescope Facility, NASA, Hawaii) and at the Blanco telescope instrument ARCoIRIS.

Data analysis:

(1) We have been using a Butterworth filter to reduce the noise in the data.

(2) We have been using the program PROFIT (Rogemar Riffel) for the measurement of the emission lines via the fit of one or more Gaussians or Gauss-Hermite polinomials.

(3) We are using the program Starlight (Cid Fernandes 2004) adapted for observations in the near-IR by Rogério Riffel for the study of the stellar population, as well as black body components (to account for the contribution from the dusty torus) and a power-law continuum (to account for the AGN continuum).

(4) Stellar kinematics: We have obtained the stellar line-of-sight velocity distribution (LOSVD) of each galaxy by fitting the spectra within the range ~2.26–2.40 μm (rest wavelengths), which includes the CO absorption band-heads from ~2.29 to ~2.40 μm using the library of near-IR stellar spectra of Winge, Riffel & Storchi- Bergmann (2009). The fitting of the spectra was performed using the penalized Pixel-Fitting pPxf method (Cappellari & Emsellem 2004), that finds the best fit to a galaxy spectrum by convolving template stellar spectra with a given LOSVD, under the assumption that this distribution is well represented by a Gauss-Hermite series.

(5) We are modelling the stellar and emission line kinematics. In the case of the gas kinematics, we fit rotation models that, when subtracted from the measured kinematics, allows the isolation of non-circular motions, where we investigate the signatures of feeding (via inflows) and feedback (via outflows).

Software development:

Dr. Rogério Riffel and his students have developed a tool, called "MEGACUBE", with an initial goal to fit the continuum via spectral synthesis over the whole data cube (using different stellar population bases, continua and varying fitting parameters) to produce maps of the star formation history, mean ages, mean metalicities in a uniform way for all the datacubes obtained in the LLP. These maps will be stored in the Megacube together with the reduced data. A recent development is to include also in the Megacube maps for the gas flux distribution and kinematics as well as the stellar kinematics.

Collaborations:

We are collaborating with the group of Dr. Richard Davies from the Max Planck Institute for Extraterrestrial Physics, in the analysis of some X-Shooter data for a similar sample of nearby AGN as well as of a control sample. The control sample is important mainly for the analysis of the stellar population, and he agreed to collaborate with us allowing us to use their control sample.

Conferences:

Some of the results shown below as well as those from previous targets from the BAT sample were presented by Thaisa Storchi-Bergmann in invited talks at the IAU General Assembly, August

2015, Meeting #29, #2286157, entitled "Active Galactic Nuclei in 3D: feeding and feedback processes" and at the conference "The Interplay between local and global processes in galaxies", that took place in Cozumel, Mexico, in April 11-15, 2016.

3. Recent results

Stellar kinematics:

In an effort led by Rogemar Riffel, we have measured and analysed the stellar kinematics of the16 galaxies listed in Table 1 (the 4 previously observed + 6 galaxies observed via the LLP of the main sample plus other 6 galaxies from previous observations) via the program pPxf (Cappellari & Emsellem 2004), that finds the best fit to a spectrum by convolving template stellar spectra with a given LOSVD, under the assumption that this distribution is well represented by a Gauss-Hermite series. Results from these measurements as well as from the fit of a circular rotation model and its subtraction from the LOSVD is shown in Fig. 1 for the galaxy NGC788. A paper with the results for the 16 galaxies listed in Table 1 was submitted for publication and is now being revised according to the suggestions by a referee. Title of the paper: *Gemini NIFS survey of feeding and feedback processes in nearby Active Galaxies: I - stellar kinematics*, by Riffel, R. A. et al. 2017.

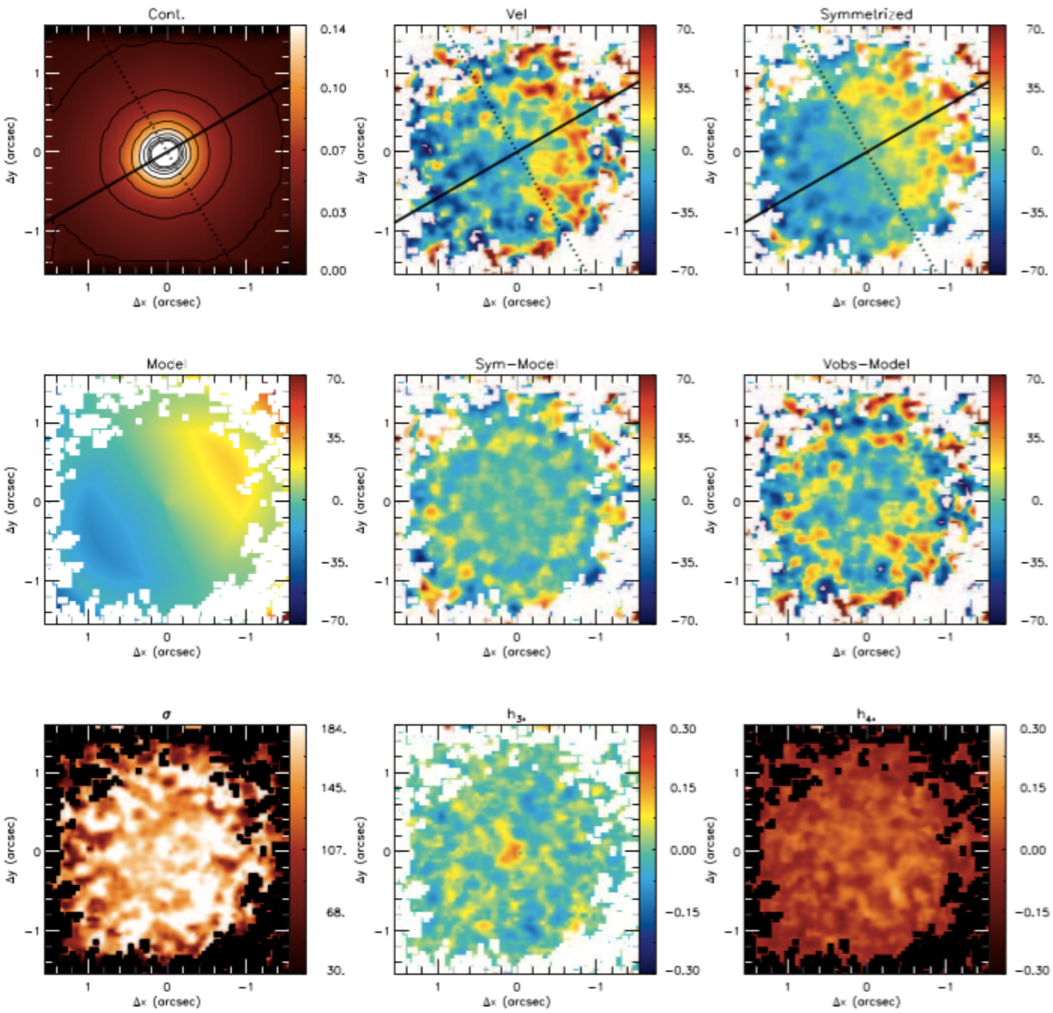

Figure 1. Stellar kinematics of the inner 3"x 3" of NGC 788: Top-left: K-band continuum image obtained by averaging the spectra, with the color bar shown in units of 10^{-17}erg cm^{-2} s^{-1}; top-center: stellar velocity field; top-right: symmetrized velocity field; middle-left: rotating disk model; middle-center: residual map for the symmetrized velocity field; middle-right: residual map for the observed velocity field; bottom-left: stellar velocity dispersion; bottom-center: h3 Gauss-Hermite moment and bottom-right: h4 Gauss-Hermite moment.

White regions (and black regions in σ and h4 maps) are masked locations and correspond to regions where the signal-to-noise ratio of the spectra was not high enough to allow reliable fits. The continuous line identifies the orientation of the line of nodes and the dotted line marks the orientation of the minor axis of the galaxy. North is up and East to the left in all maps. The color bar for velocity, model, residual maps and σ show the velocities in units of km s^{-1} and the systemic velocity of the galaxy was subtracted from the observed velocities.

Stellar Population

The stellar population is being analyzed by the PhD students Marlon Diniz under the supervision of Rogemar Riffel and by Luis Gabriel D. Hahn under the supervision of Rogério Riffel. While Marlon is focusing on the NIFS data only, Luis Gabriel is combining NIFS and GMOS data (when available for the same galaxies) to perform a panchromatic study of the stellar population. NIFS maps for the stellar population distribution as well as that of a Featureless Continuum and Black Body contribution attributed to a dusty torus are shown in Fig. 2 for NGC3516, and will be part of the PhD Thesis of Marlon Diniz. A paper with the results of the stellar population for Mrk573 obtained using the same method has been just submitted for publication.

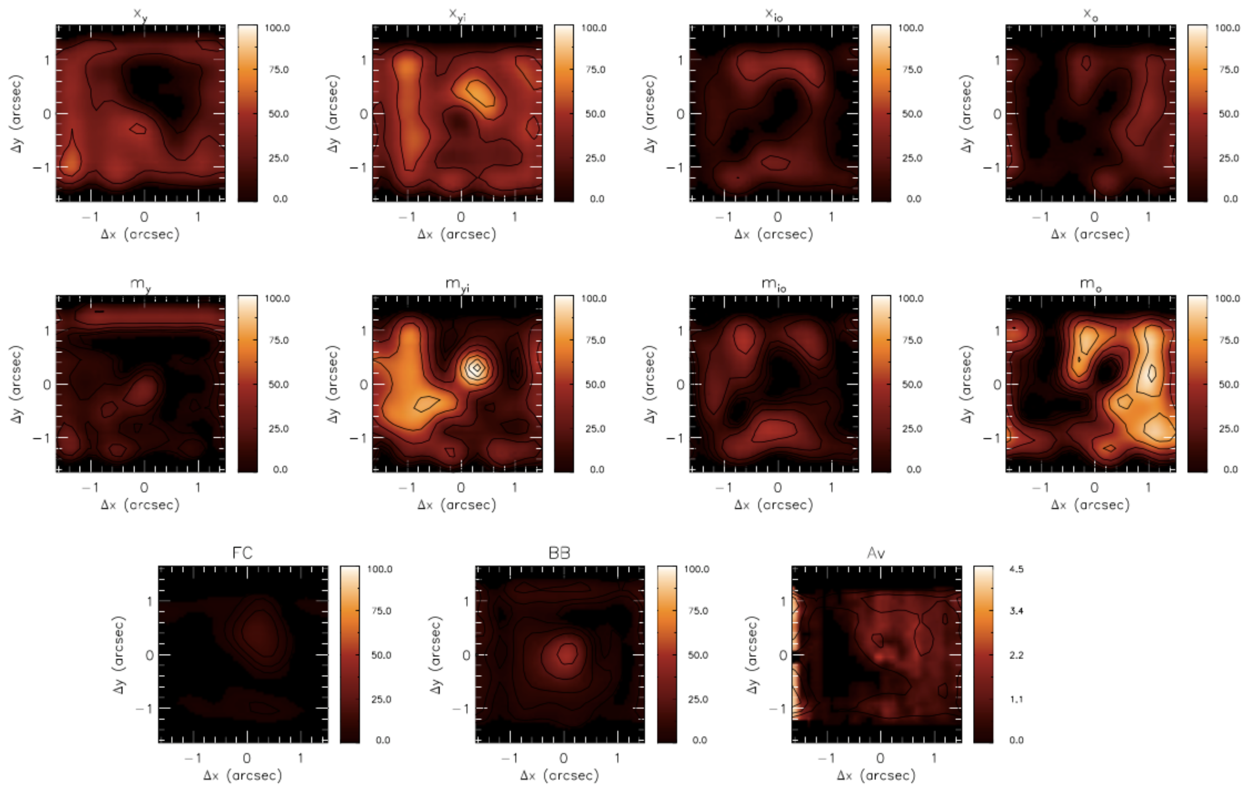

Fig. 2: NGC3516: Top row: Results of the spectral synthesis, where x_y, x_{yi}, x_{io} and x_o represent the percent contribution to the continuum at 2.2μm of stellar populations within the age bins (in yrs) 1E3-1E8, 1.01E8-7E8, 7.01E8-2E9, 2.01E9-15E9, respectively. In the second row we show the percent contribution of the each age bin in mass. The bottom row shows, from left to right, the percent contribution of the featureless continuum FC, the black body component (with temperature T~1000K to account for the torus contribution) and the reddening affecting the stellar population.

Emission line flux distributions, ratios, gas masses and kinematics:

We have obtained the gas flux distributions, excitation and kinematics in the J- and K-band emission lines for all galaxies observed, using the PROFIT routine to fit Gauss-Hermite polynomials to the emission lines. This is illustrated in Fig. 3 below for NGC 5506, and has already been obtained for all the galaxies observed in the LLP. On the basis of these measurements and assumptions regarding the gas density, we have also calculated the gas mass surface densities in units of $M_{\odot}$ per pc^2 for the ionized and hot molecular gas. We have also calculated the average gradients of these properties. This is illustrated for NGC 788 and Mrk 607 in Fig. 4 below. All these results will be published in a paper being prepared by the PhD student Astor Schoenell, as part of his PhD Thesis to be presented in May 2017.

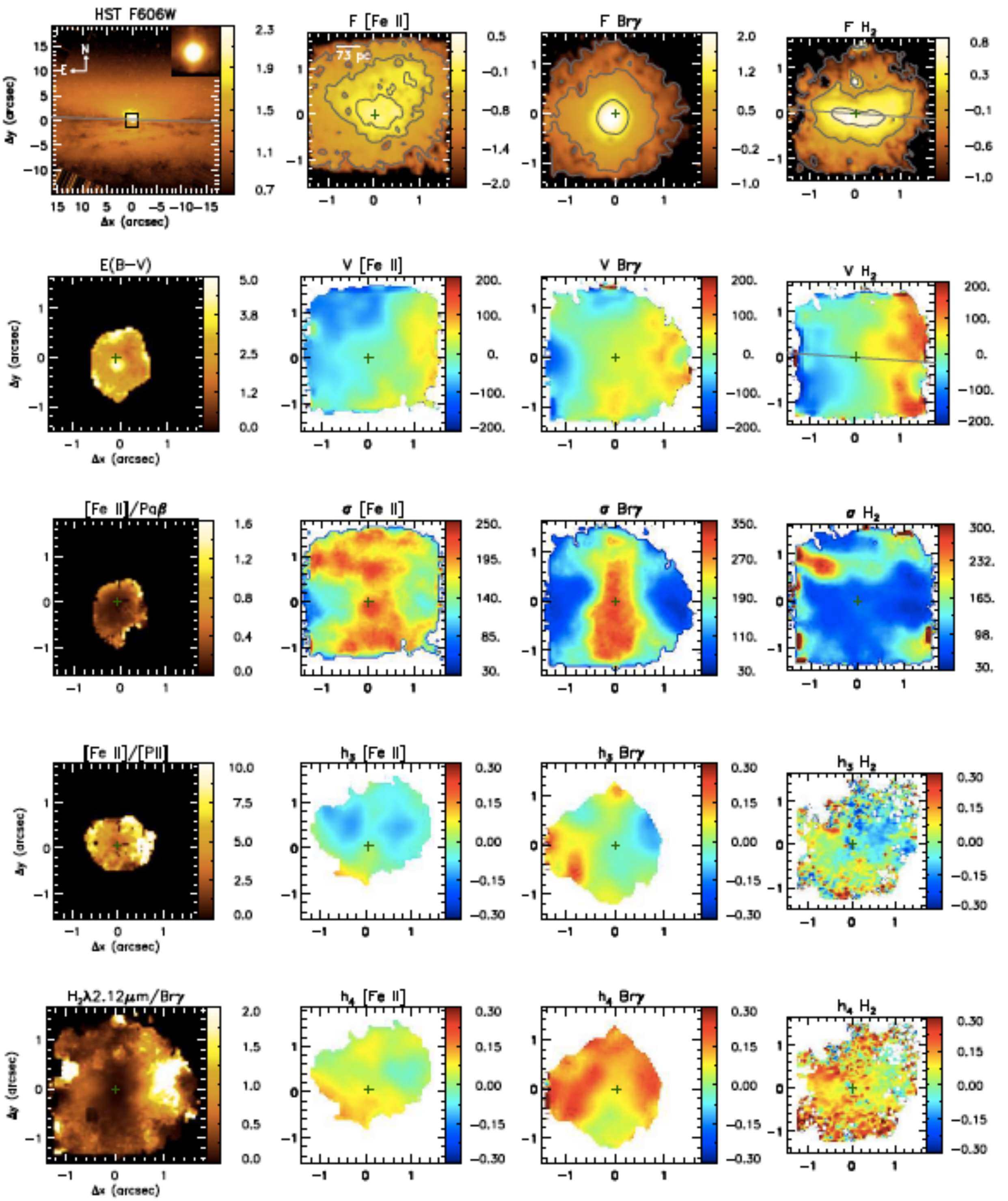

Figure 3: Top row: HST-WFPC2 continuum image of NGC5506 obtained through the filter F606W and flux distributions in the [FeII]1.257µm, Paβ and H_2 2.122µm emission lines; following rows: emission-line ratios and gas kinematics. The flux distributions are shown in logatithmic units of 10^{-17} erg cm^{-2} s^{-1}. The LOSVD (Vel) and velocity dispersion (sigma) are shown in units of km s^{-1}. h3 and h4 are Gauss-Hermitte moments.

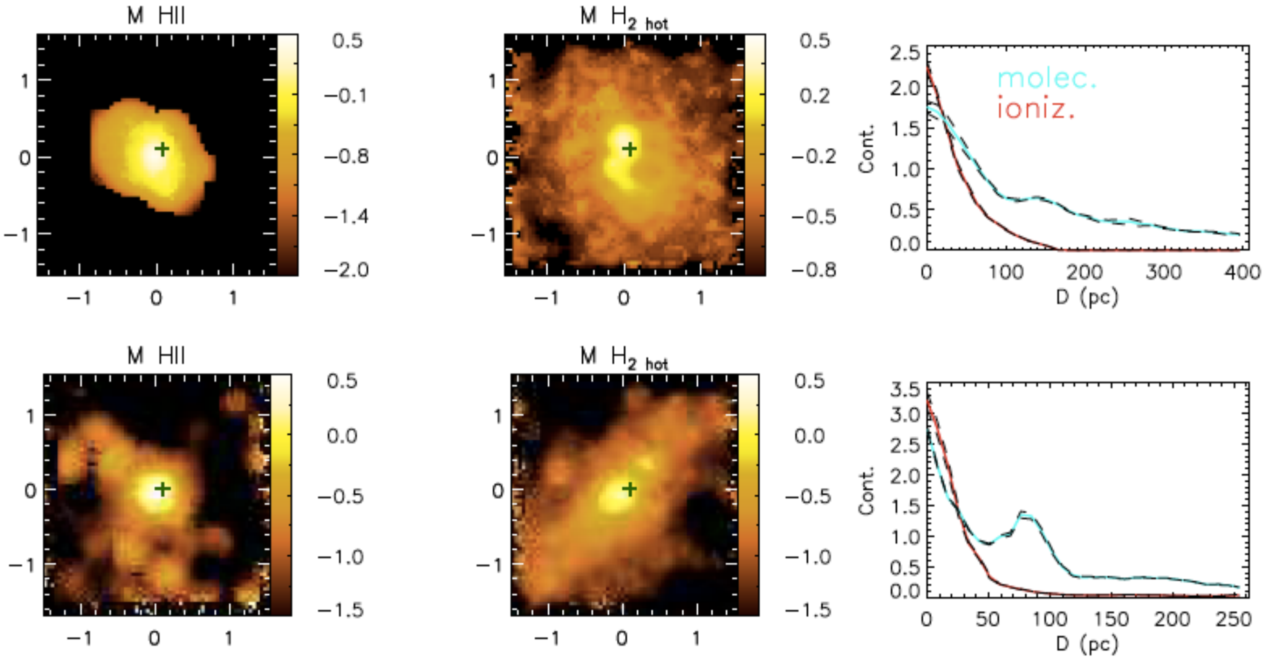

Fig. 4: Gas surface mass density distributions of NGC 788 (top) and Mrk 607 (bottom) for the ionized (left column) and hot molecular (central column) gas. Units are $10^4 M_\odot\ pc^{-2}$ for the ionized gas and $M_\odot\ pc^{-2}$ for the hot molecular gas. The third column shows the average radial profile of these two surface mass densities in the same units.

We have also calculated the total gas masses within the 3"x 3" FOV and average surface mass densitites, which are listed in Table 1 bellow for all the galaxies analyzed so far, which will also be part of the PhD Thesis of Astor Schönell.

Table 1 - Column (1): identification of the galaxies (including 5 galaxies from the LLP plus data from previous NIFS observations); (2) area corresponding to the emission of molecular hydrogen (in pc^2);(3) area of ionized hydrogen (in pc^2); (4) mass of hot molecular gas (in solar masses);(5) mass of cold molecular gas (in solar masses); (6) mass of ionized gas (in solar masses); (7) average mass surface density of hot molecular gas (in solar masses per pc^2); (8) average mass surface density of cold molecular gas (in solar masses per pc^2); (9) average mass surface density of the ionized gas (in solar masses per pc^2).

Galaxies	A (H_2)	A (HII)	M $(H_2)_h$	M $(H_2)_c$	M (HII)	μ $(H_2)_h$	μ $(H_2)_c$	μ (HII)
MRK 1157	2.8×10^5	1.8×10^5	2.3×10^3	1.6×10^9	5.4×10^6	8.2×10^{-3}	5714	45
NGC 1068	5.2×10^4	1.5×10^4	29	2×10^7	2.2×10^4	5.6×10^{-4}	384	1.4
MRK 1066	2.5×10^5	1.9×10^5	3.3×10^3	2.4×10^9	1.7×10^7	1.3×10^{-2}	9600	89
NGC 2110	1.1×10^5	7×10^4	1.4×10^3	9.9×10^8	1.7×10^6	1.3×10^{-2}	9000	24
MRK 79	9.8×10^5	7.8×10^5	3×10^3	2.2×10^9	7×10^6	3.1×10^{-3}	2245	9
NGC4051	1.3×10^4	1.4×10^4	66	4.7×10^7	1.4×10^5	5.3×10^{-3}	3760	9.8
NGC4151	2.4×10^4	1.9×10^4	240	1.7×10^8	2.4×10^6	1.8×10^{-2}	7083	125
MRK766	3×10^5	2.7×10^5	1.3×10^3	9.8×10^8	7.6×10^6	4.3×10^{-3}	3266	29
NGC5548	1.7×10^5	6.7×10^5	2.3×10^2	1.7×10^8	2.2×10^6	6.6×10^{-3}	3473	7.2
NGC5929	1.2×10^5	7×10^4	471	3.5×10^8	1.3×10^6	3.9×10^{-3}	2966	18
NGC5506	1.4×10^5	1.2×10^5	1.4×10^3	1×10^9	3.2×10^7	9.7×10^{-3}	7951	244
NGC3516	8×10^4	6×10^4	517	3.7×10^8	3×10^5	6.4×10^{-3}	6168	5

NGC788	6.2×10^5	5.5×10^5	1012	7.3×10^8	4.8×10^6	1.6×10^{-3}	1319	8.8
NGC3227	8.8×10^4	4.4×10^4	1274	9.2×10^8	1.7×10^6	1.4×10^{-2}	20682	39
NGC5899	1.9×10^5	8.7×10^4	559	4×10^8	4.2×10^5	2.9×10^{-3}	4624	4.8
MRK607	5.9×10^4	2.3×10^4	182	1.3×10^8	1.1×10^6	3×10^{-3}	5710	48

4. Overall status

We are now in the fifth semester of the LLP (2017A), but we got no data during 2016B and ~60% of the data for semesters 2015A, 2015B and 2016A.

The efficiency of data collection has been ~ 50%: we should have by now 12 galaxies observed, but we have only 6 observed so far, or actually 5 in both bands plus the J-band for NGC2110.

We have contacted Gemini about this, and learned that LLPs should have rollover status, and we thank the TAC for giving us this status, that we hope will warrant that we obtain the data we need for a successful conclusion of our project.

We have also received the information that it is important that the proposal is highly ranked as compared with GMOS proposals, for example. This is again due to the fact that NIFS+ATAIR is at the telescope usually only twice per semester, while GMOS is always in the telescope. A proposal similarly ranked (and even ranked lower) for GMOS has much higher chance of being executed than a proposal for NIFS+ALTAIR.

We presently have 4 PhD students working in the project: (1) Astor Schönell is in charge of the analysis of the gas flux and mass distributions, excitation and kinematics; (2) Marlon Diniz is in charge of the analysis of the stellar population; (3) Natacha Dametto is so far using additional data in the comparison of stellar population synthesis results between the optical and near-infrared and investigation of the best stellar population templates for the synthesis and (4) Luis D. Hahn is working in the analysis of the calibration between the J and K bands, using cross-dispersed data from IRTF and Blanco, helping with the development of the Megacube tasks and now beginning to perform also panchromatic spectral synthesis using combined data cubes GMOS-IFU + NIFS.

Reduction of data is complete, as well as the fits of the emission lines. Most "protocols" for data analysis and reduction are ready, including MEGACUBE.

5. Observing plan and data release

With our LLP we aim at completing NIFS+ALTAIR observations of a distance-limited sample of 26 Active Galaxies: 10 already observed via previous proposals plus 16 to be observed in this LLP. As already discussed in the initial part of this report, we have J and K-band data for 6 galaxies so far: NGC788, NGC 2110, NGC 3227, NGC 3516, NGC 4235 and NGC 5506. We thus still need to observe 10 more galaxies in order to reach the goals of our project.

For the present semester (2017A) we hope to get observations of NGC 3393, NGC 3786 and NGC 5728. Although Altair will not have the Laser, we verified that all three galaxies can be observed with NGS after the previously mentioned change in SB conditions (from Any to SB=80%). We have changed the Phase II accordingly as requested by Marie Lemoine-Busserole, from Gemini.

For 2017B, as we did not get any observations in 2016B, and our proposal has rollover status, the galaxies requested for 2016B should be observed: NGC 2992, NGC 3081 and NGC 1125. We have checked that NGC 2992 and NGC 3081 can be observed with NGS, but not NGC 1125. We will request that NGC 1125 be replaced by NGC 3035.

We are entitled to another 15hs of time in 2017B, because the observations above are "rollover". We opt not to use this time in 2017B and ask instead for time in 2018A to observe two galaxies, NGC 4939 and NGC 4388. We will then ask for 10hs in 2018B (5hs remaining for our entitled 15hs in 2018A + 5 additional hours) to observe NGC 1125 and NGC 1194.

Our effort with the MEGACUBE has the goal of storing the reduced data, together with the measurements of flux distributions and kinematic maps in each emission line, as well as the results of the spectral synthesis as extensions of the same cube. In the case of the spectral synthesis we plan to save maps of the percent contribution of each stellar population template, featureless continuum and black body (torus) contribution, as well as the reddening map. The MEGACUBE will then be made available in a data release by the end of our analysis of the data, that we estimate to happen during 2018.

Table 2 shows our progress as well as the planned semesters for the forthcoming observations.

Galaxy	Activity	FWHM	Semester	Status
NGC788	Sy2	done	15B	Observed and reduced, analysis on-going.
NGC1125	Sy2	0.56"	18B	
NGC1194	Sy1	Sy1	18B	
NGC2110	Sy2	done	15B	Observed, reduced, partial results in Diniz+2015.
NGC2992	Sy2	0.64"	17B	Not observed in 16B-> rollover 2017B
NGC3035	Sy1	Sy1	17B	Not observed in 16B-> rollover 2017B
NGC3081	Sy2	0.55"	17B	Not observed in 16B-> rollover 2017B
NGC3227	Sy1.5	Sy1	16A	Observed and reduced, analysis on-going
NGC3393	Sy2	0.72"	17A	Current semester
NGC3516	Sy1.5	done	15A	Observed, data reduced, analysis on-going.
NGC3786	Sy1.8	0.70"	17A	Current semester
NGC4235	Sy1	0.47"	16A	Observed, reduced, analysis on-going
NGC4388	Sy2	partial	18A	Only 800s in 15A -> 2018A
NGC4939	Sy1	0.68"	18A	Not observed in 16A -> 2018A
NGC5506	Sy1.9	done	15A	Observed, data reduced, analysis on-going.
NGC5728	Sy2	-	17A	Current semester

6. Publications

During the years 2015, 2016 and beginning of 2017, we have finalized and published the following papers using data from the galaxies of the BAT-AGN sample - the first 4 contain data from the LLP while the others are from the same project but based on data that have been obtained in previous runs:

Riffel, Rogemar et al., submitted, being revised according to referee's suggestions: Gemini NIFS survey of feeding and feedback processes in nearby Active Galaxies: I - Stellar kinematics

Diniz, M. R. et al., submitted: Disentangling the near infrared continuum spectral components of the inner 500 pc of Mrk 573: two-dimensional maps.

Schoenell et al., being finalized: Gemini NIFS survey of feeding and feedback processes in 6 nearby Active Galaxies: surface mass density distributions and gradients and gas excitation

Riffel et al., in preparation: Gemini NIFS survey of feeding and feedback processes in nearby Active Galaxies: II - Definition and general properties of the sample

Schönell, A. J., Storchi-Bergmann, T., Riffel, R. A. & Riffel, R. 2017, MNRAS, 464, 1771: Feeding versus feedback in AGN from near-infrared integral-field spectroscopy XII: NGC5548

Diniz, Marlon R.; Riffel, Rogemar A.; Storchi-Bergmann, Thaisa; Winge, Claudia, 2015, MNRAS, 453, 1727: Feeding versus feedback in AGN from near-infrared IFU observations XI: NGC 2110

Riffel, Rogemar A., Storchi-Bergmann, T., Riffel, R. 2015, MNRAS, 451, 3587: Feeding versus feedback in active galactic nuclei from near-infrared integral field spectroscopy - X. NGC 5929

Storchi Bergmann, Thaisa, IAU General Assembly, Meeting #29, #2286157: Active Galactic Nuclei in 3D: feeding and feedback processes

Colina, Luis; Piqueras López, Javier; Arribas, Santiago; Riffel, Rogério; Riffel, Rogemar A.; Rodriguez-Ardila, Alberto; Pastoriza, Miriani; Storchi-Bergmann, Thaisa; Alonso-Herrero, Almudena; Sales, Dinalva 2015, A&A, 578, 48: Understanding the two-dimensional ionization structure in luminous infrared galaxies. A near-IR integral field spectroscopy perspective

Riffel, Rogemar A.; Storchi-Bergmann, Thaisa; Riffel, Rogério, 2015, IAU Symp. 309, 339: Near-IR Integral Field Spectroscopy of the central region of NGC 5929

Riffel, R.; Pastoriza, M. G.; Rodríguez-Ardila, A.; Dametto, N. Z.; Ruschel-Dutra, D.; Riffel, R. A.; Storchi-Bergmann, T.; Martins, L. P.; Mason, R.; Ho, L. C., 2015, ASPC, 497, 459: Models Constraints from Observations of Active Galaxies

Alf Drehmer, Daniel; Storchi-Bergmann, Thaisa; Ferrari, Fabricio; Cappellari, Michele; Riffel, Rogemar A. 2015, MNRAS, 450, 128: The benchmark black hole in NGC 4258: dynamical models from high-resolution two-dimensional stellar kinematics

PhD exam and Thesis: The student Astor Schönell presented his PhD exam in 2015B, where he collected relevant measurements for all the galaxies of the BAT sample such as: gas masses and surface mass densities - ionized and molecular, mass outflow and inflow rates, geometry, extent, velocities and power of the outflows. He will continue to collect these measurements to present a joint analysis and investigate correlations among these properties and between these properties and the power of the active nucleus. His Thesis should be presented in 2017A.

Porto Alegre, Março de 2017

Thaisa Storchi Bergmann