N° PROYECTO : 1080603  DURACIÓN : 4 años  AÑO ETAPA : 2011
TÍTULO PROYECTO : THE CENTRAL ENGINE OF ACTIVE GALACTIC NUCLEI

DISCIPLINA PRINCIPAL : ASTRONOMIA
GRUPO DE ESTUDIO : ASTRON., COSMOL. Y PAR
INVESTIGADOR(A) RESPONSABLE : PAULINA M. LIRA TEILLERY
CIUDAD : Santiago
REGIÓN : METROPOLITANA
OBJETIVOS
Cumplimiento de los Objetivos planteados en la etapa final, o pendientes de cumplir. Recuerde que en esta sección debe referirse a objetivos desarrollados, NO listar actividades desarrolladas.

<table>
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<tr>
<th>Nº</th>
<th>OBJETIVOS</th>
<th>CUMPLIMIENTO</th>
<th>FUNDAMENTO</th>
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<tr>
<td>1</td>
<td>Results from the Reverberation Campaign of High-z Quasars should be emerging and a publication should be in preparation.</td>
<td>PARCIAL</td>
<td>The Reverberation Campaign is in full gear. We have had the full support of the Chilean Telescope Allocation Committee and the amount of observing time has been increasing systematically to cover the number of sources that are being followed up spectroscopically. However, the results are still not significant enough to produce an ISI publication.</td>
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<td>2</td>
<td>Optical, IR and X-ray observations of nearby Seyfert galaxies.</td>
<td>TOTAL</td>
<td>The monitoring campaign obtained light curves for 4 Seyfert 1 galaxies during several years. One paper was published last year (Lira et al., 2011) while a second ISI paper is in preparation. We have also submitted two papers on the determination and modeling of the IR spectral energy distribution of a large sample of Seyfert 2 galaxies (Lira et al., 2012; Videla et al., 2012).</td>
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<td>3</td>
<td>Results should be published for the study of the Black Hole growth in the early Universe.</td>
<td>TOTAL</td>
<td>The main results from this study were published last year by Trakhtenbrot et al. (2011). However, far-IR follow up of these sources has yielded new results that have now been accepted for publication in the ApJ Letters journal (Mor et al., 2012).</td>
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<td>4</td>
<td>Publishing of results from our spectropolarimetric observations.</td>
<td>PARCIAL</td>
<td>This is still pending. Time constraints has not allowed us to finish with the code development to test our results and finish the pending article. I could send the draft paper to show the advanced state of the publication.</td>
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Otro(s) aspecto(s) que Ud. considere importante(s) en la evaluación del cumplimiento de objetivos planteados en la propuesta original o en las modificaciones autorizadas por los Consejos.
RESULTS OBTAINED:
For each specific goal, describe or summarize the results obtained. Relate each one to work already published and/or manuscripts submitted. In the Annex section include additional information deemed pertinent and relevant to the evaluation process. The maximum length for this section is 5 pages. (Arial or Verdana, font size 10).

Reverberation Mapping of high-$z$ QSOs

We are continuing the acquisition and analysis of the data from the monitoring campaign of high-$z$ QSOs. We are allocated about 10-12 nights per year to conduct the imaging and follow up spectroscopy using the 0.9m SMARTS and 2.5m du Pont telescopes. Paula López, PhD student under my supervision, is in charge of the data reduction. See Figure below. Results from this project were presented as a poster contribution at the Sochias/AAA conference in San Juan, Argentina.

Figure 1: Continuum and emission line light curves for one of the QSOs in the Reverberation Mapping program.
The statistical analysis that would allow to determine the lag between the continuum and the emission lines variations from the QSOs still does not give results robust enough for publication just yet, but there are clear hints of a measurable lag. Therefore, in the very near future we will be able to report on these results.

**Optical, IR and X-ray observations of nearby Seyfert galaxies**

The monitoring campaign produced light curves for 4 Seyfert 1 galaxies during several years. Results for 2 of the sources were already published last year (Lira et al., 2011) while the the quality of the acquired data for the remaining sources had to be assessed. Now we have conducted the analysis of these 2 sources and the preliminary results are excellent. Therefore a second ISI paper is now in preparation. Example of the light curves for MCG-6-30-15 and the cross-correlation analysis are shown in Figure 2.

![Light Curves](image)

**Figure 2:** Left: Optical and IR light curves for of MCG-6-30-15 showing the correlated variability of this source. Right: Cross-correlation analysis between the B and K band showing a clear and significant peak for a lag of around 20 days.
We have also submitted two papers on the determination and modelling of the IR spectral energy distribution of a large sample of Seyfert 2 galaxies. We are currently waiting for the referee report on this work. The modelling has allowed us to constrain the physical parameters of the dusty material found around local AGN (see Figure 3).

**Early Black Hole Growth**

We have continued the exploration of AGN in the early Universe. The most promising sample in our study is that found at $z=4.8$. This sample clearly shows a significant evolution from those seen at higher and lower redshifts and therefore defines an epoch for fast Black Hole growth (Trakhtenbrot et al., 2011). We have conducted a Herschel follow up of these source and found that they also harbour some of the most actively forming stars ever seen. The results are reported in a Letter recently accepted for publication (Mor et al., 2012). Results from this project were presented as an oral contributions at the Sochias/AAA conference in San Juan, Argentina.

Finally, we are the study of a sample of radio selected sources in the Hubble Deep Field South, which is composed of a mix of AGN and starburst galaxies. However, our multiwavelength data and radio indices is allowing us to distinguish these two populations and characterize parent galaxies. In Figure 4 we show our derived
Figure 4: Luminosity Function of radio sources divided by the properties of their parent galaxies. Four samples are defined: E/S0, Sb/Sc, Sc/Sd and starburst galaxies (SB).

Luminosity Functions for the radio sources.
DESTAQUE OTROS LOGROS DEL PROYECTO TALES COMO:
- Estadías de investigación.
- Actividades de difusión y/o extensión en la temática del proyecto.
- Cualquier otro logro no contemplado en los ítem anteriores y que Ud. quiera destacar.

La extensión máxima de esta sección es de 1 página (letra tamaño 10, Arial o Verdana).

Cabe destacar que durante el año 2011 se redactó junto a la Dra. Patricia Arévalo y el Dr. Nelson Padilla, un libro de divulgación sobre la temática de los Agujeros Negros. Actualmente estamos en discusión con una editorial para completar la impresión del libro.
PRODUCTOS

ARTÍCULOS
Para trabajos en Prensa/ Aceptados/Enviados adjunte copia de carta de aceptación o de recepción.

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ANEXOS

A continuación se detallan los anexos físicos/papel que no se incluyen en el informe en formato PDF.