# LONG-TERM VARIABILITY IN ACTIVE GALACTIC NUCLEI

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# AIM OF THE PROJECT

- Brightness of AGNs appears to change very little over the years.
- Compare the soft X-ray (0.2 to 2 keV) of 2000 AGNs detected by XMM-Newton with the same objects seen by Rosat 15 years earlier.
- Find the true X-ray variability of those AGNs and investigate whether they depends on the luminosity or the redshift, or depends upon other properties such as the optical and the infra-red brigthness.
- The project also involve the use of different techniques (Unix scripts, catalogues...).

# **INTRODUCTION: AGNs**

- An Active Galactic Nuclei is a compact region at the centre of a galaxy which has a much higher luminosity than normally.
- They are the most luminosity sources in the Universe.
- The different parts of an AGN are:
  - A super-massive black hole in the center.
  - An accretion disk of matter near the hole.
  - A huge torus of gas around the black hole.
  - Sometimes two relativistic jets.



# **INTRODUCTION: AGNs**

Then, the way to understand the <u>high luminosity</u> emitted by an AGN is that:

- The black hole is surrounded by a rotating disk or torus of accreting matter (gas and dust).
- The radiated energy would come from the kinetic energy gained by the fall of the matter towards the black hole.
- The interaction between the disk and the black hole would produce two relativistic jets.

X-ray studies help us to understand what happens in an AGN, because X-rays can penetrate from far within the center of a galaxy.

# **INTRODUCTION: XMM-Newton**

- XMM : X-ray Multi-Mirrow Mission.
- Launch: Ariane 504 10<sup>th</sup> Dec 1999.
- 3 high throughput X-ray telescopes
  + Optical monitor.
- Research: Ranging from black holes to the origins of the Universe.
- XMM-Newton Science Operations Centre (SOC), located at ESAC → proposals.



# INTRODUCTION: ROSAT

- German X-ray satellite telescope.
- Life: 1<sup>st</sup> June 1990  $\rightarrow$  12<sup>th</sup> February 1999.
- Joint German, US and British X-ray astrophysics project.
- Two phases:
  - An all-sky survey performed for six months in scan mode.
  - Pointed observations of selected astrophysical sources performed for the rest of the mission.



# TECHNIQUES

#### <u>SQL scripts</u>

Used to obtain the specific sample from two different databases (XMM slew survey, RASS).

#### IDL scripts

Used to generate all the plots from the data, in order to obtain the results.

Astronomical catalogues

Used in order to find some properties of our AGNs such as the infra-red flux and the optical magnitude.

#### **RESULTS : AGNs and upper limits**



Complete sample of Rosat rates against XMM-Newton rates.

\* The mean count rates ratio is 7 which correspond to a slope of 1.7.

## **RESULTS : Spectral factors**



The XMM/ROSAT ratio has a dependency on the spectral shape.

## **RESULTS : Variability vs luminosity**



Sometimes ROSAT has higher flux than XMM-Newton and vice versa.

## **RESULTS : Variability vs luminosity**



Low-luminosity sources do not show a higher variability than high-luminosity sources.

# **RESULTS : Variability vs redshift**



Variability also independent of redshift.

## RESULTS : Variability vs Fx/(Fopt,Fk)



Here we have the variability against infra-red flux (K-band) and optical flux for our AGNs.

#### RESULTS : Variability vs Fx/(Fopt,Fk) in binning



The variability also appear to be independent of Xray to optical and X-ray to infra-red ratios.

#### **RESULTS : Variability vs classes of AGNs**



Bigger variability in Sy1.8, Sy1.9 and Sy2.



- Comparation of the brightness of AGNs from XMM-Newton with the same objects observed by Rosat 15 years earlier.
- Optimization of the sample along the study from around 16000 sources to 1454 AGNs.
- Contrary to the expectation, no relationship between XMM/Rosat ratio and luminosity, neither with the redshift.
- The variability also appear to be independent of Xray to optical and X-ray to infra-red ratios
- The AGNs with a bigger variability are Sy1.8, Sy1.9 and Sy2.

# DESIRED OUTPUTS

- Scientific paper (in progress).
- Master Thesis for the:

"Master Interuniversitario de Astrofísica UCM-UAM"

 Proposal for XMM-Newton with the AGNs with the bigger variability during these 15 years

SO, THE FUTURE IS OPEN!!!!!

# THANK YOU VERY MUCH

# QUESTIONS ???