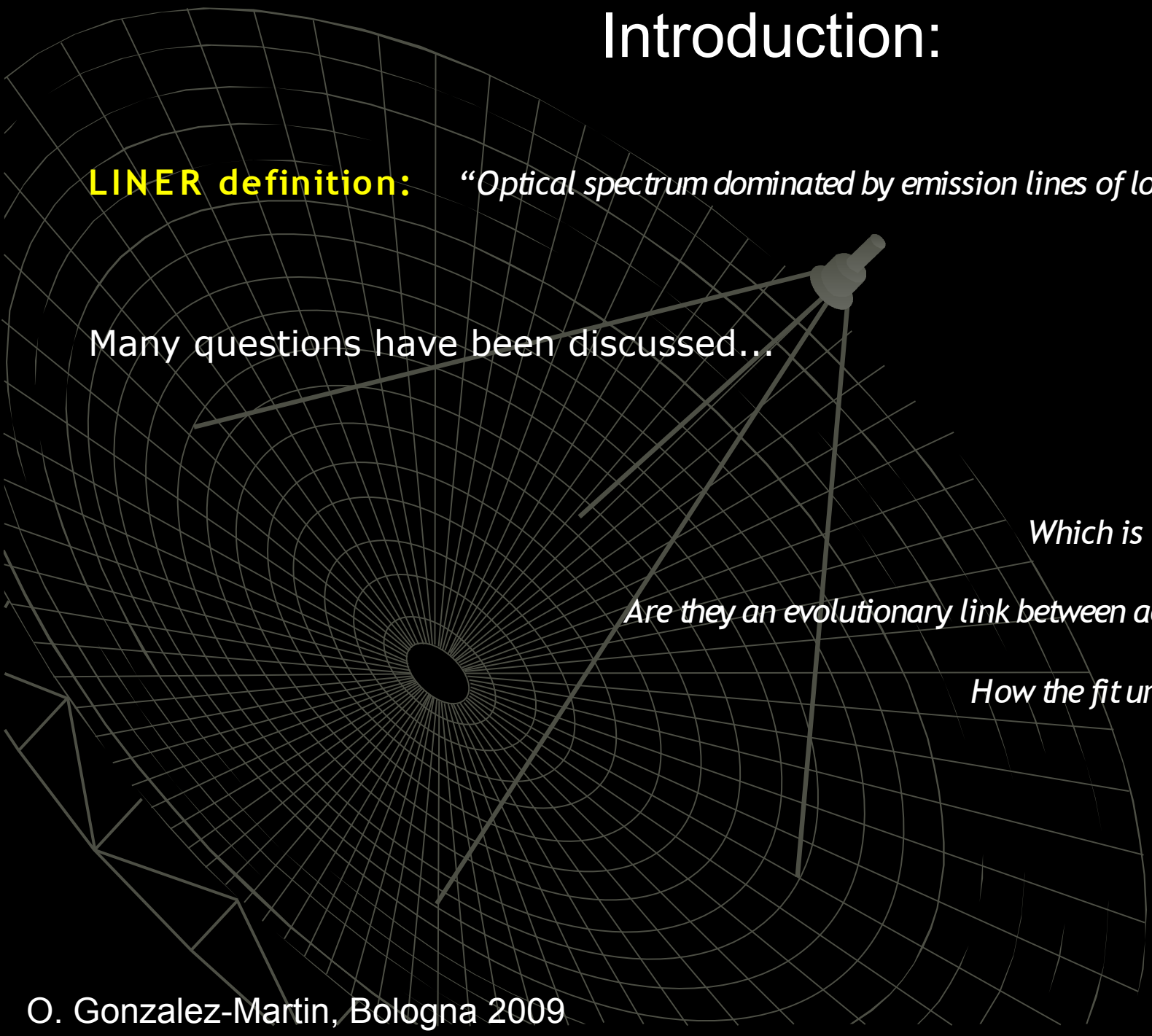
Nature of the soft X-ray emission found in LINERs

Omaira Gonzalez-Martin (1,2)

(1) FORTH/IESL, Crete, Greece; (2) University of Leicester, UK

J. Masegosa
I. Marquez
M. Guainazzi
S. Bianchi

Introduction:



LINER definition: *"Optical spectrum dominated by emission lines of low ionization states."*

Many questions have been discussed...

Which is the emission mechanism?

Are they an evolutionary link between active and inactive nuclei?

How the fit under de Unified scenario?

...

Sample:

Comprise **82** LINERs observed with XMM-Newton or/and Chandra comming from:

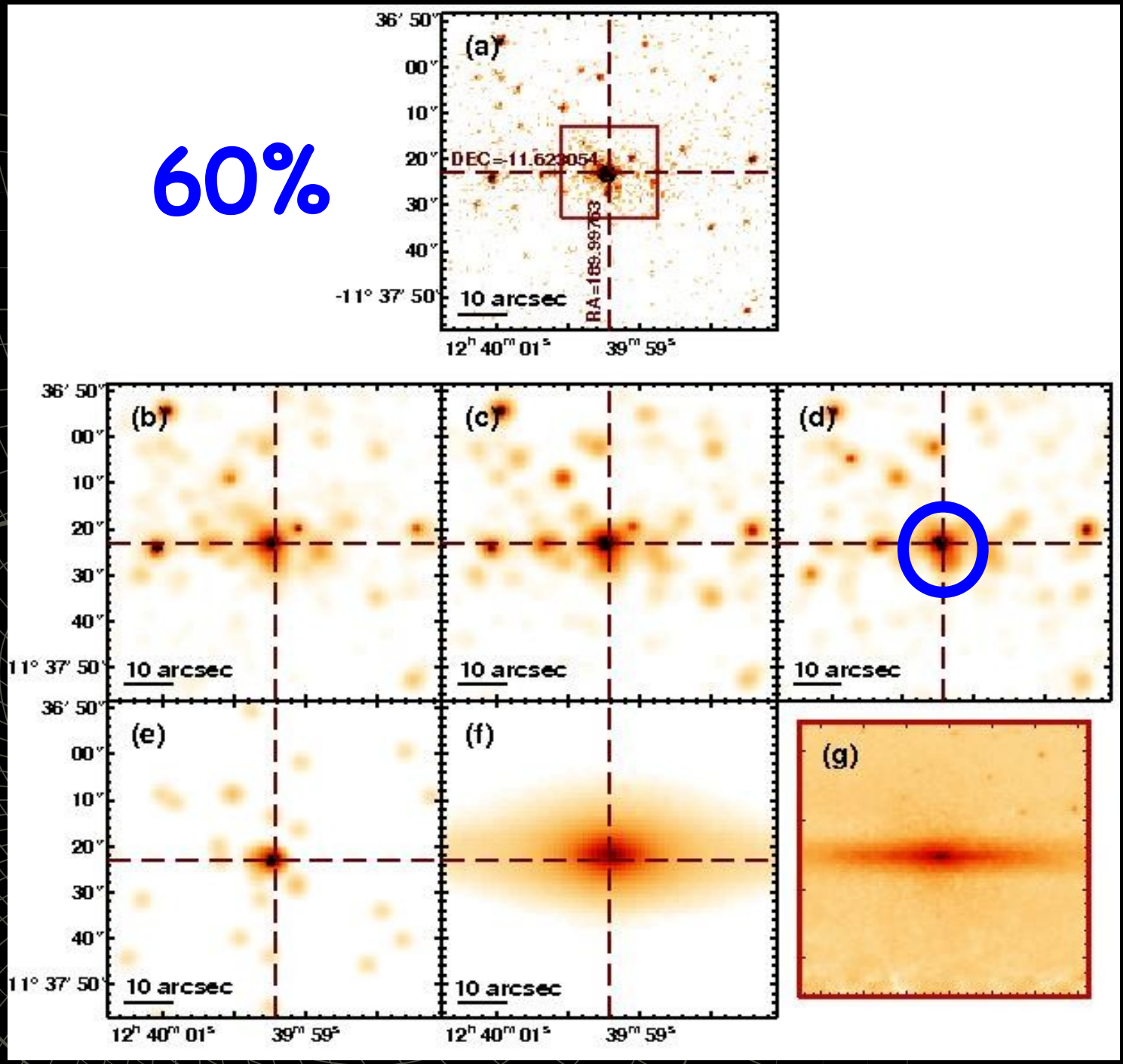
"All the LINERs compiled by Carrillo et al. 1999 identified in the literature as LINERs and reclassified following the BPT diagrams."

- We have extracted EPIC/pn and ACIS images (82) and low resolution spectra (60/82)

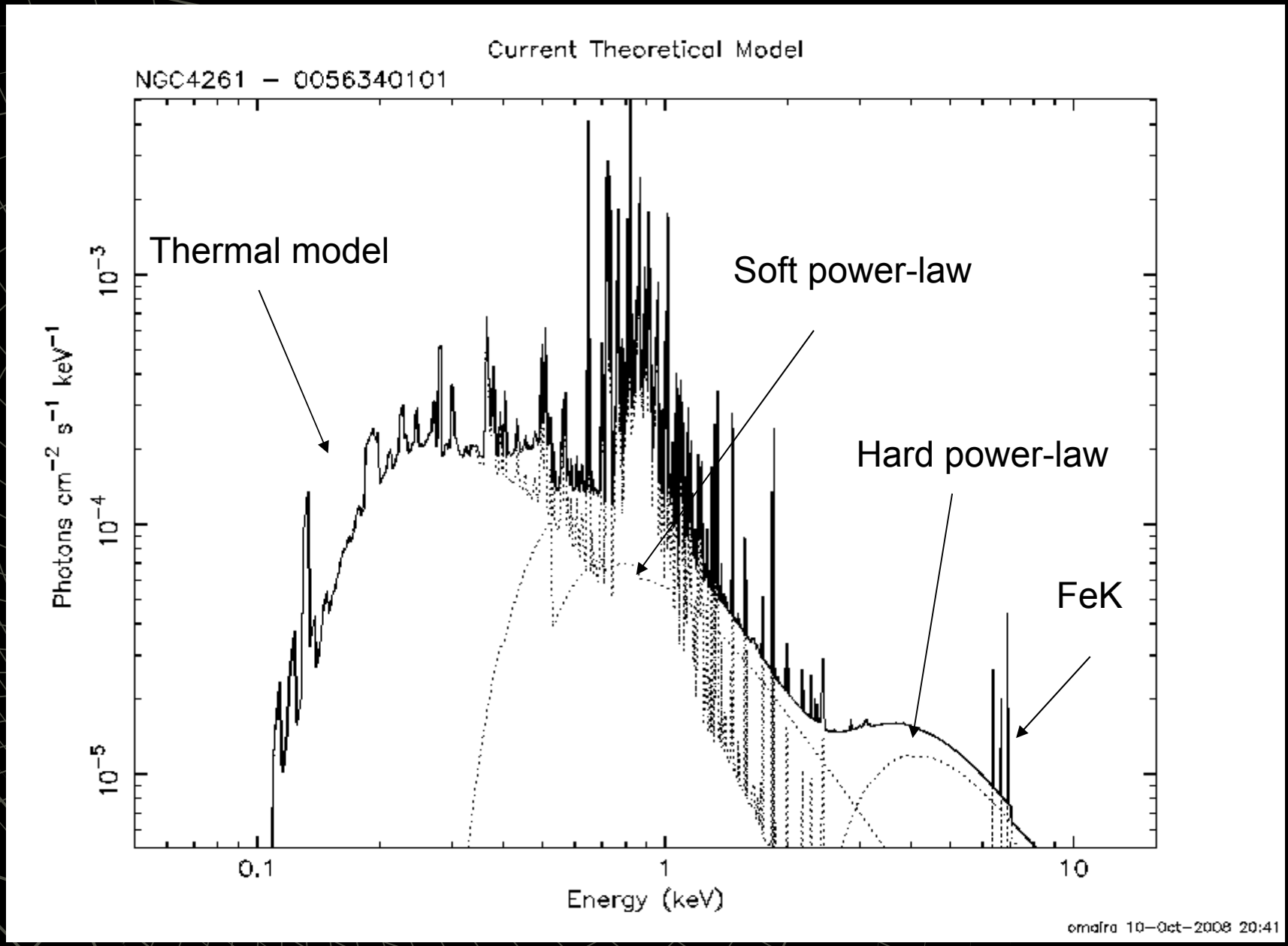
- We have extracted RGS spectra of LINERs (52/82)

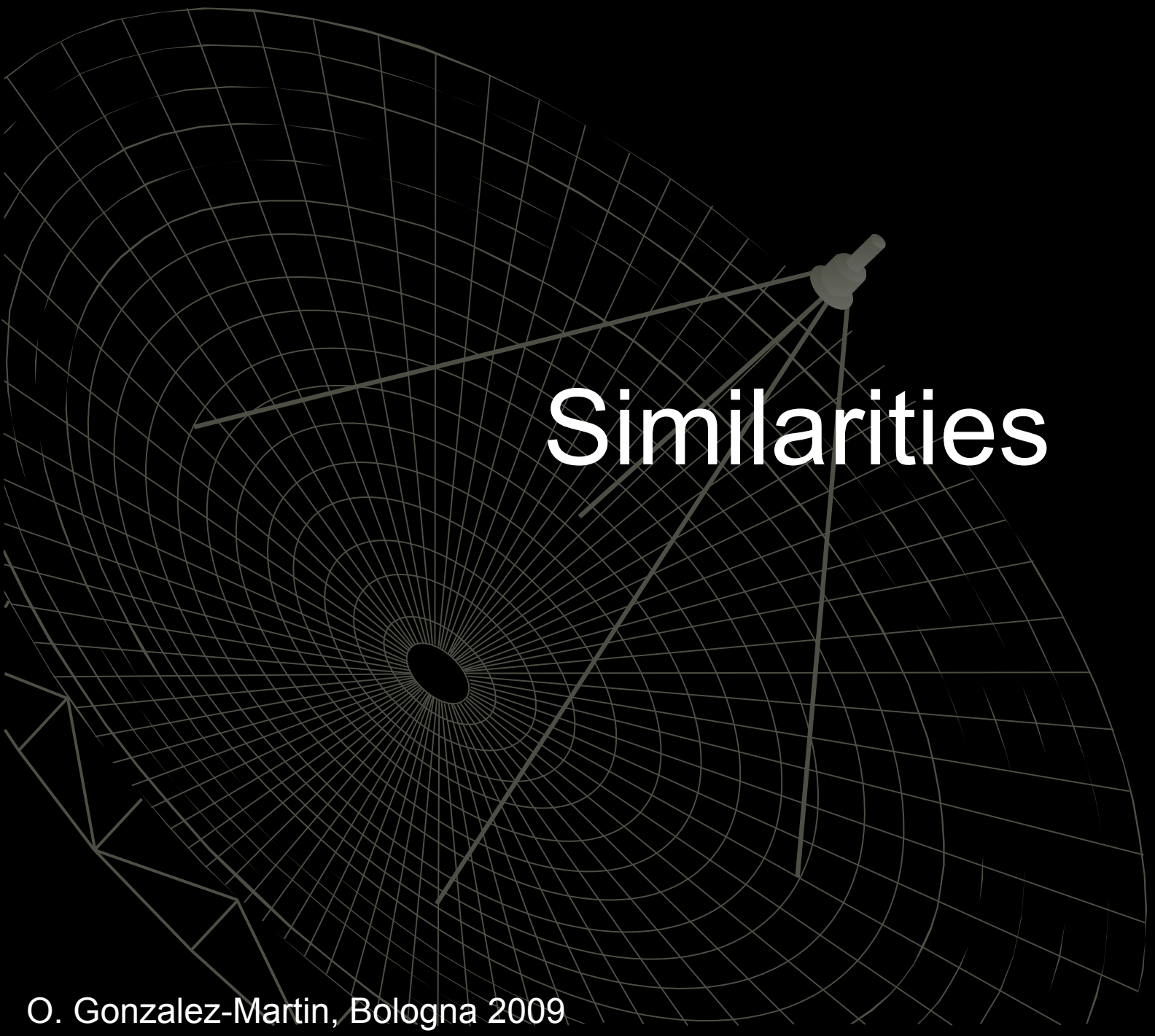
LINERs:
> 80% AGN
(adding multiwav.)

60%



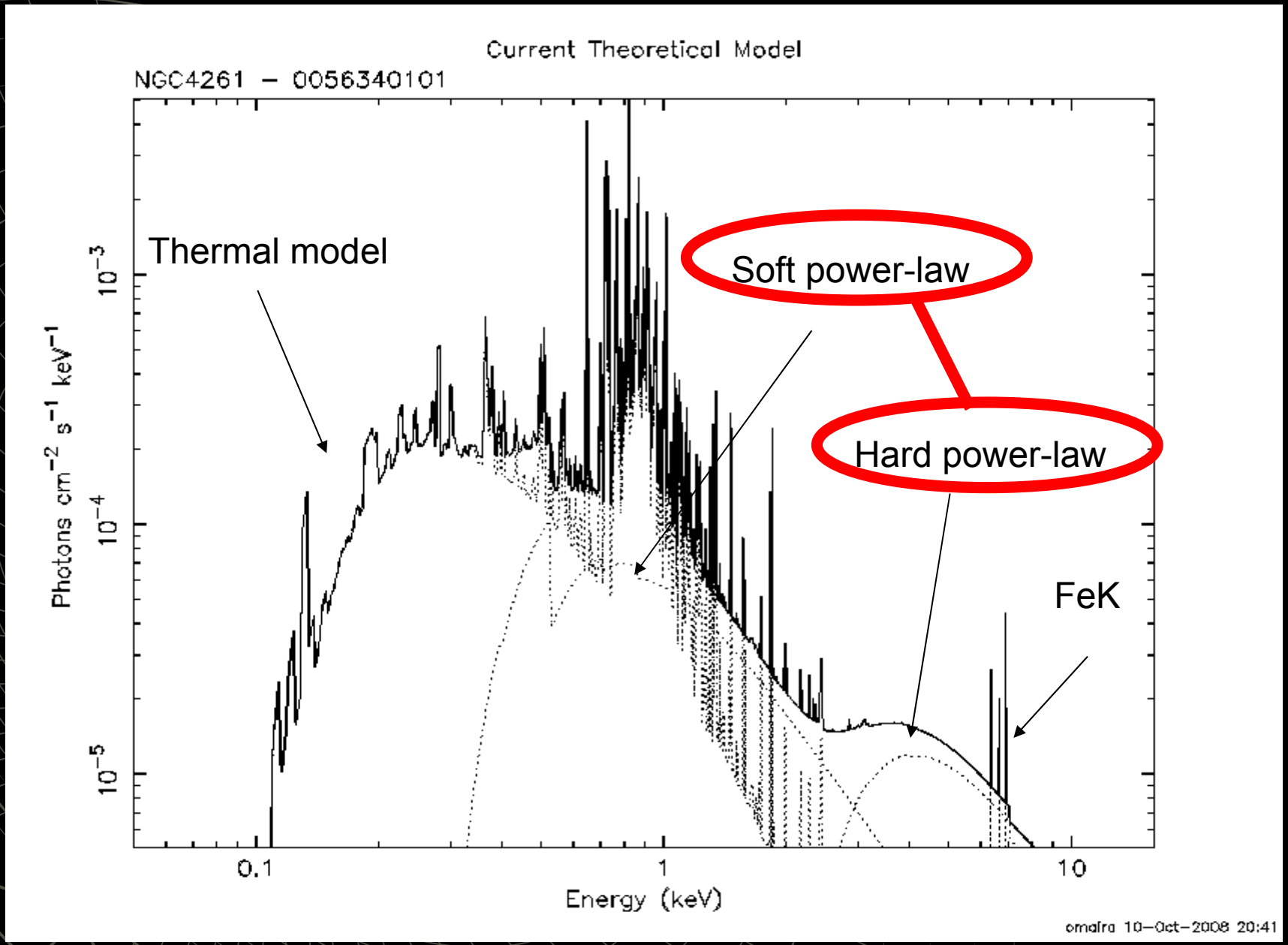
Gonzalez-Martin et al. 2009A, A&A accepted (arXiv:0905.2973)


Current Theoretical Model
NGC4261 – 0056340101
Thermal model
Soft power-law
Hard power-law
FeK
Photons cm^{-2} s^{-1} keV^{-1}
10^{-3}
10^{-4}
10^{-5}
0.1
1
10
Energy (keV)
omafra 10-Oct-2008 20:41



Similarities

Similar X-ray spectrum:



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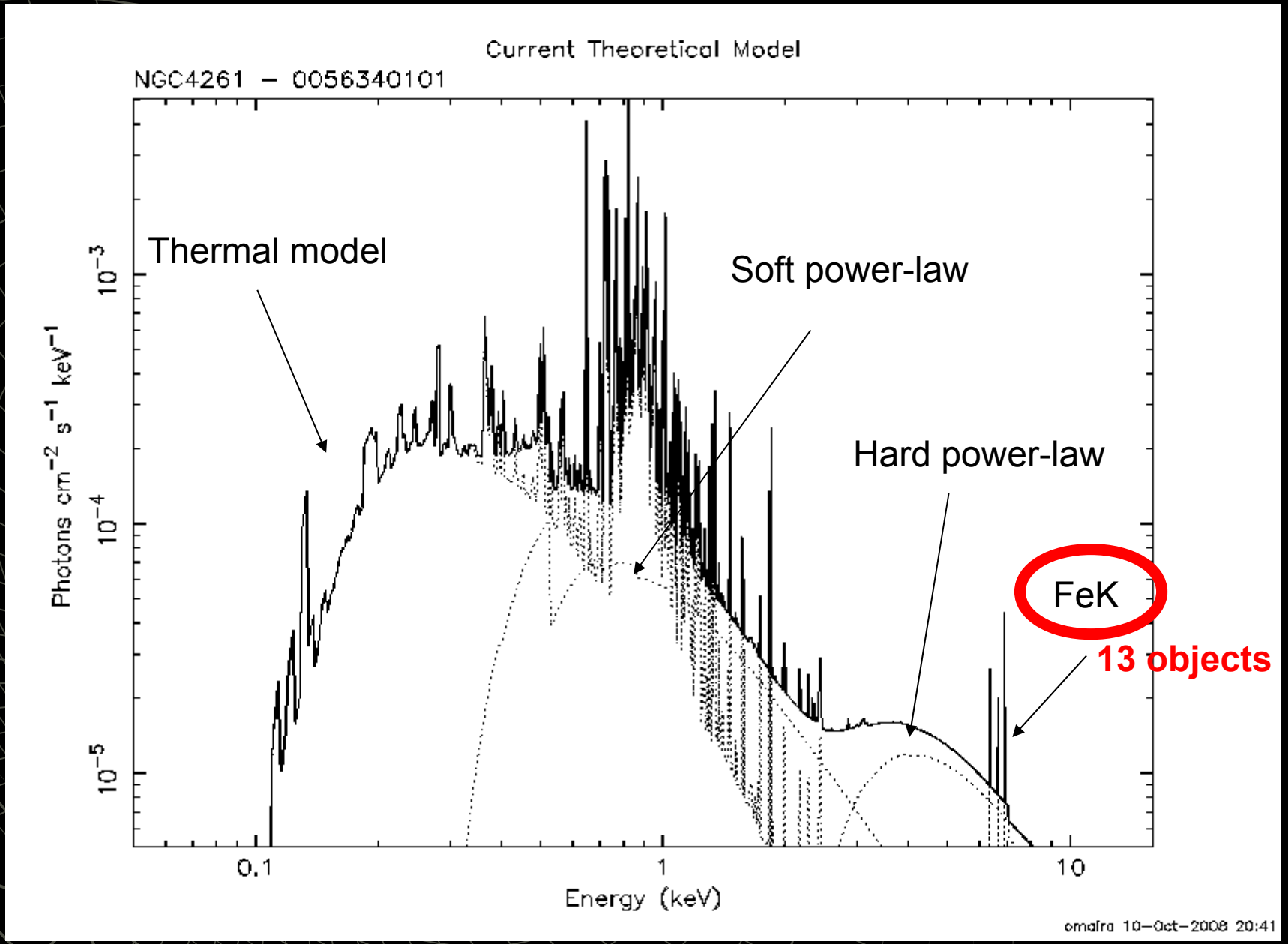
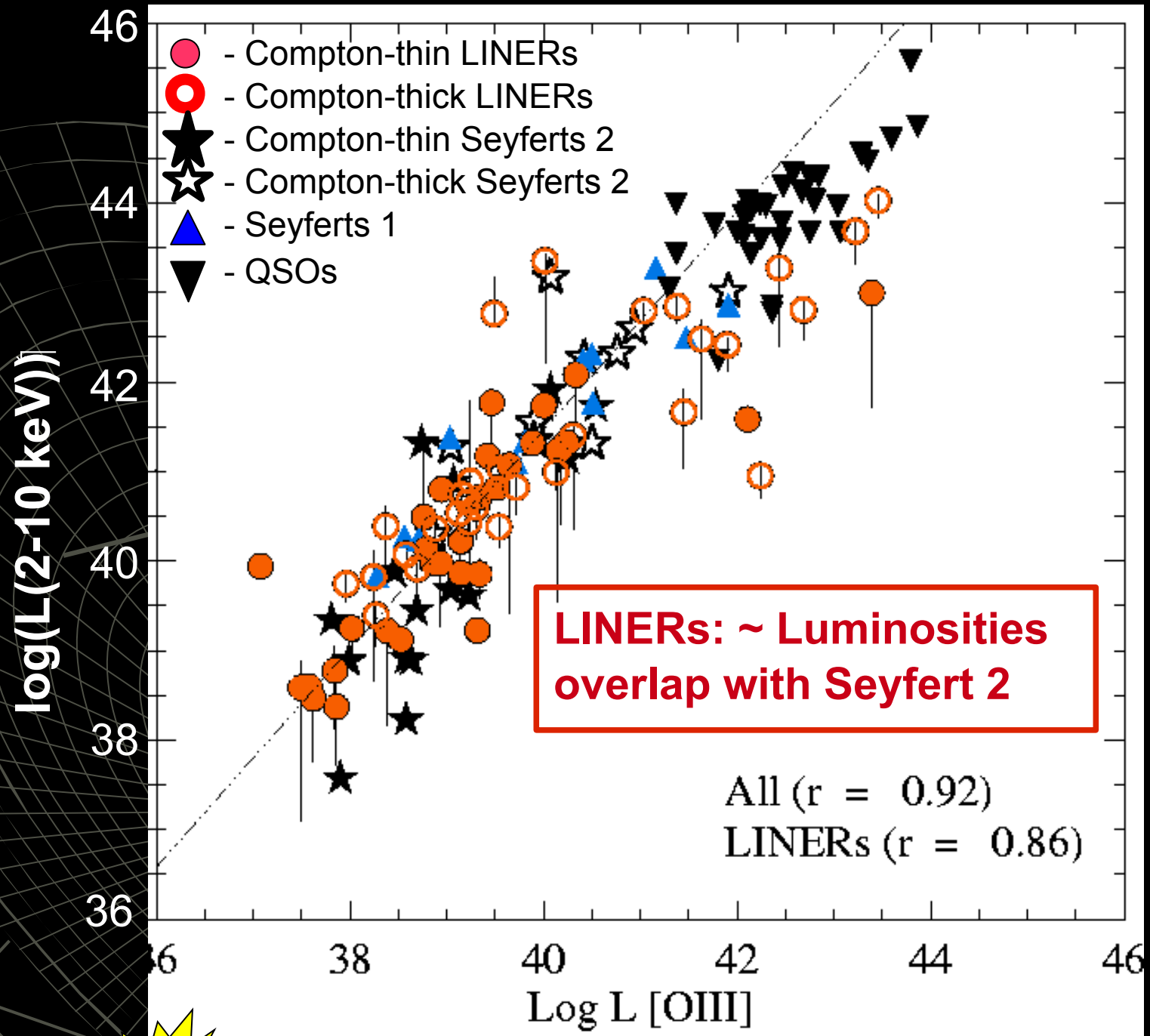
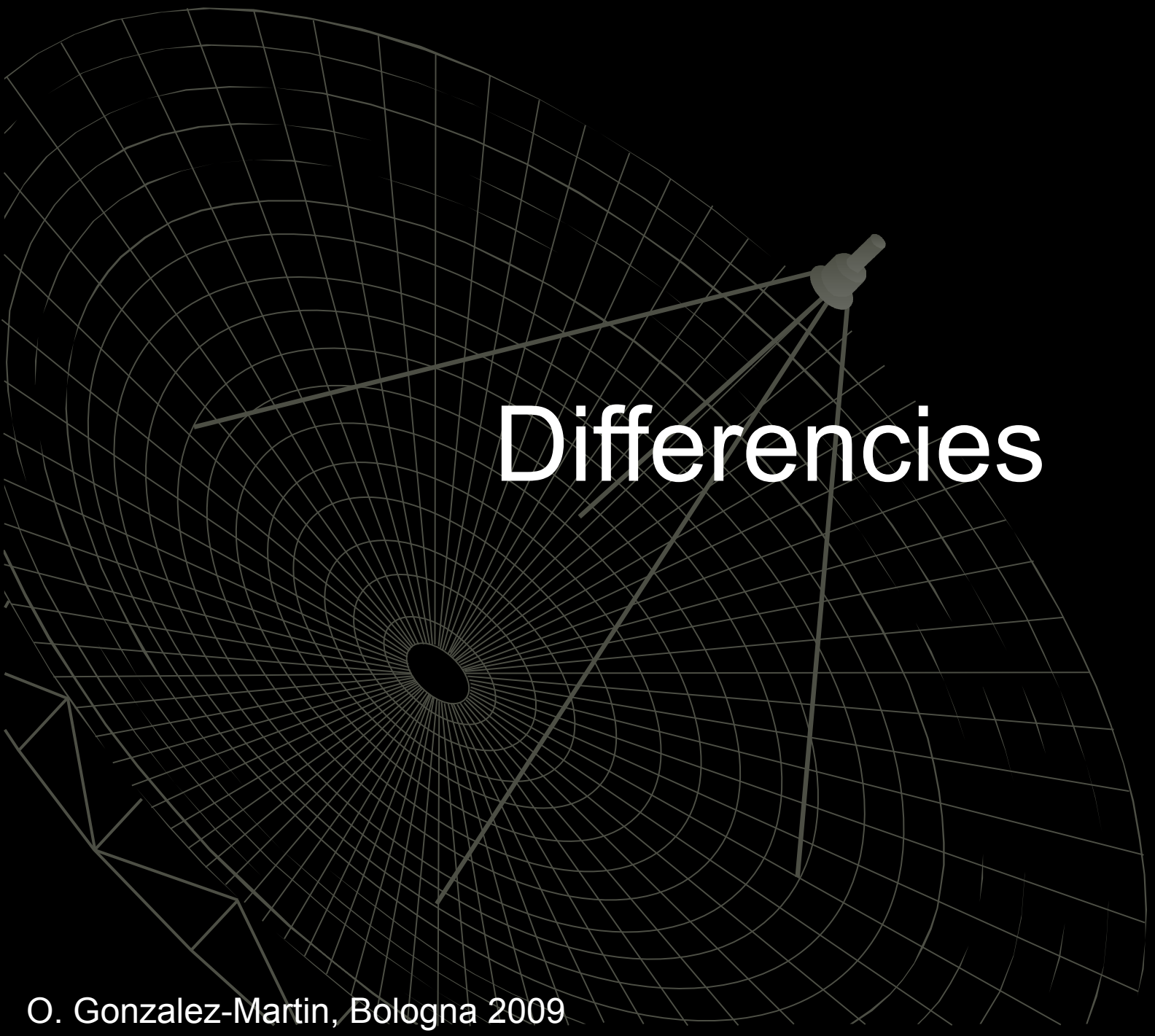


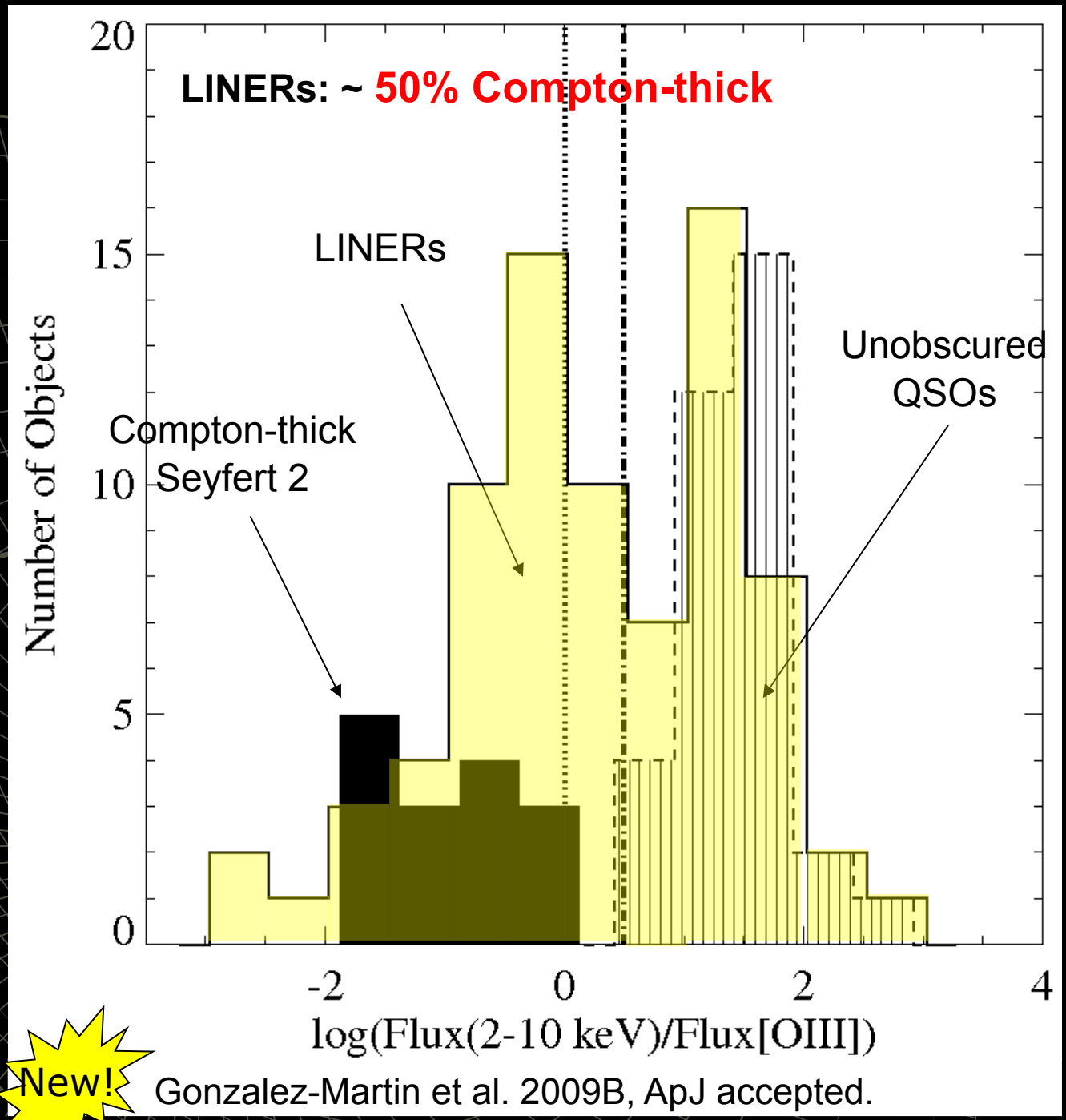


New!

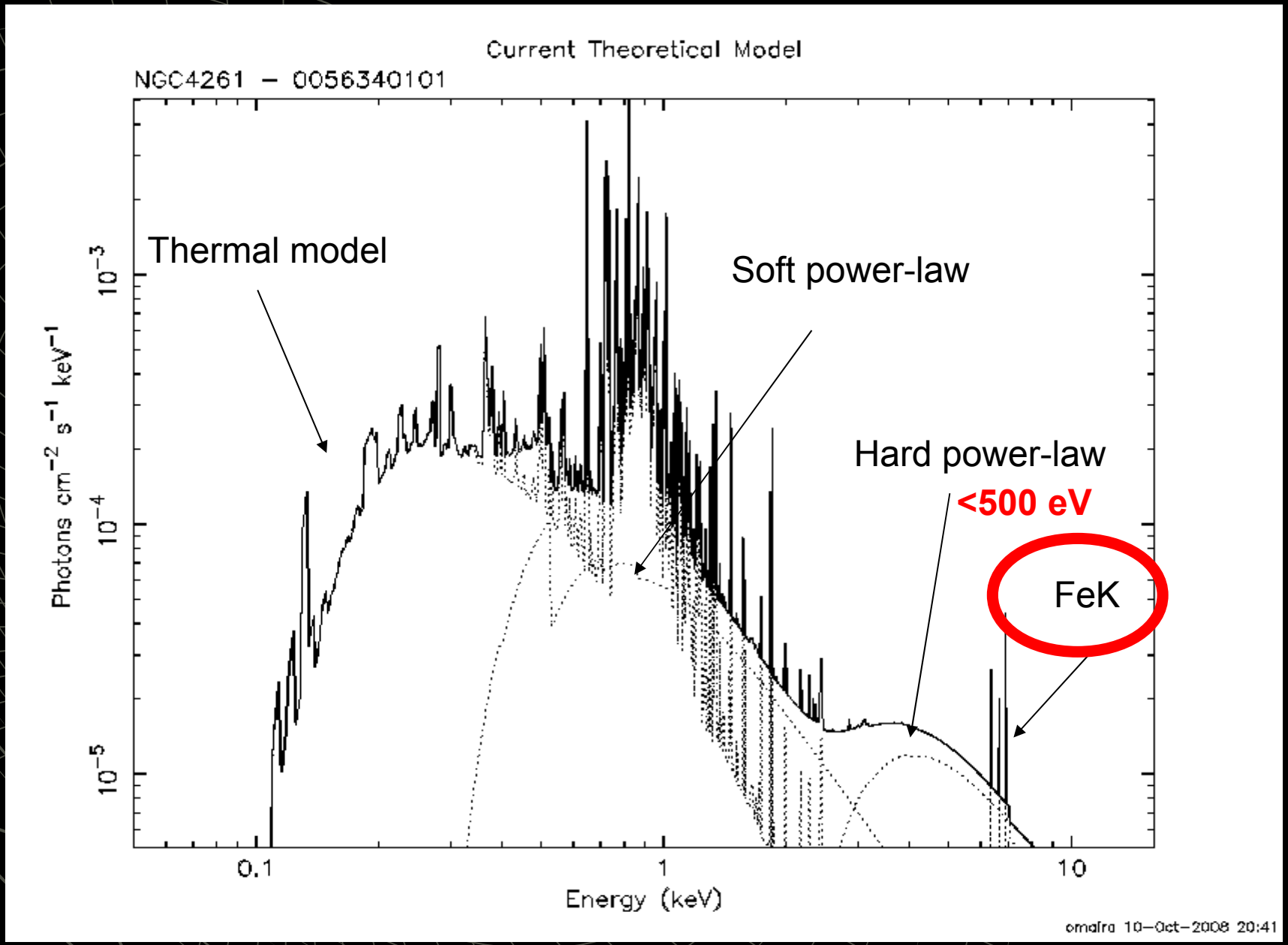
Gonzalez-Martin et al. 2009B, ApJ accepted.



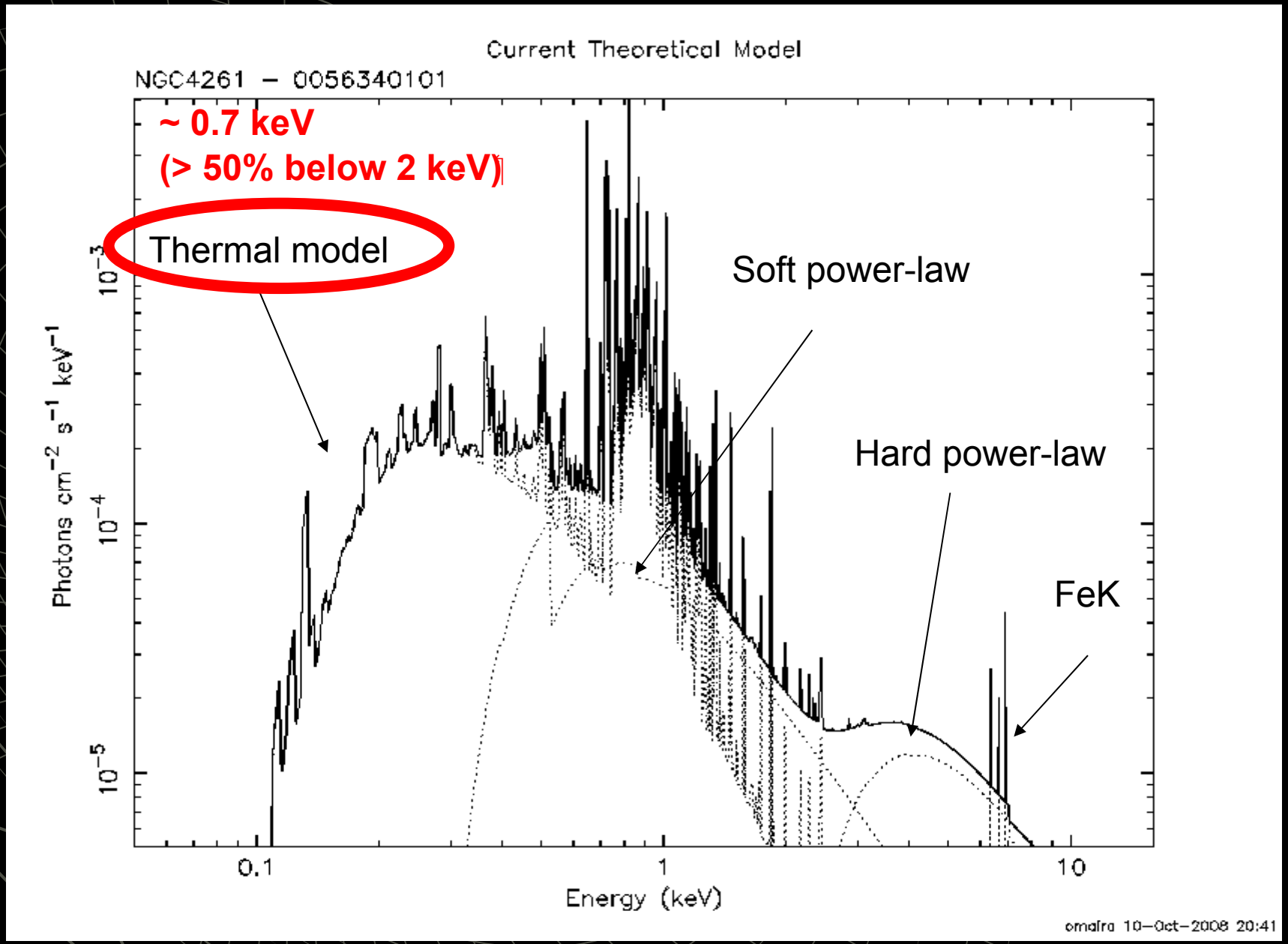
Differencies

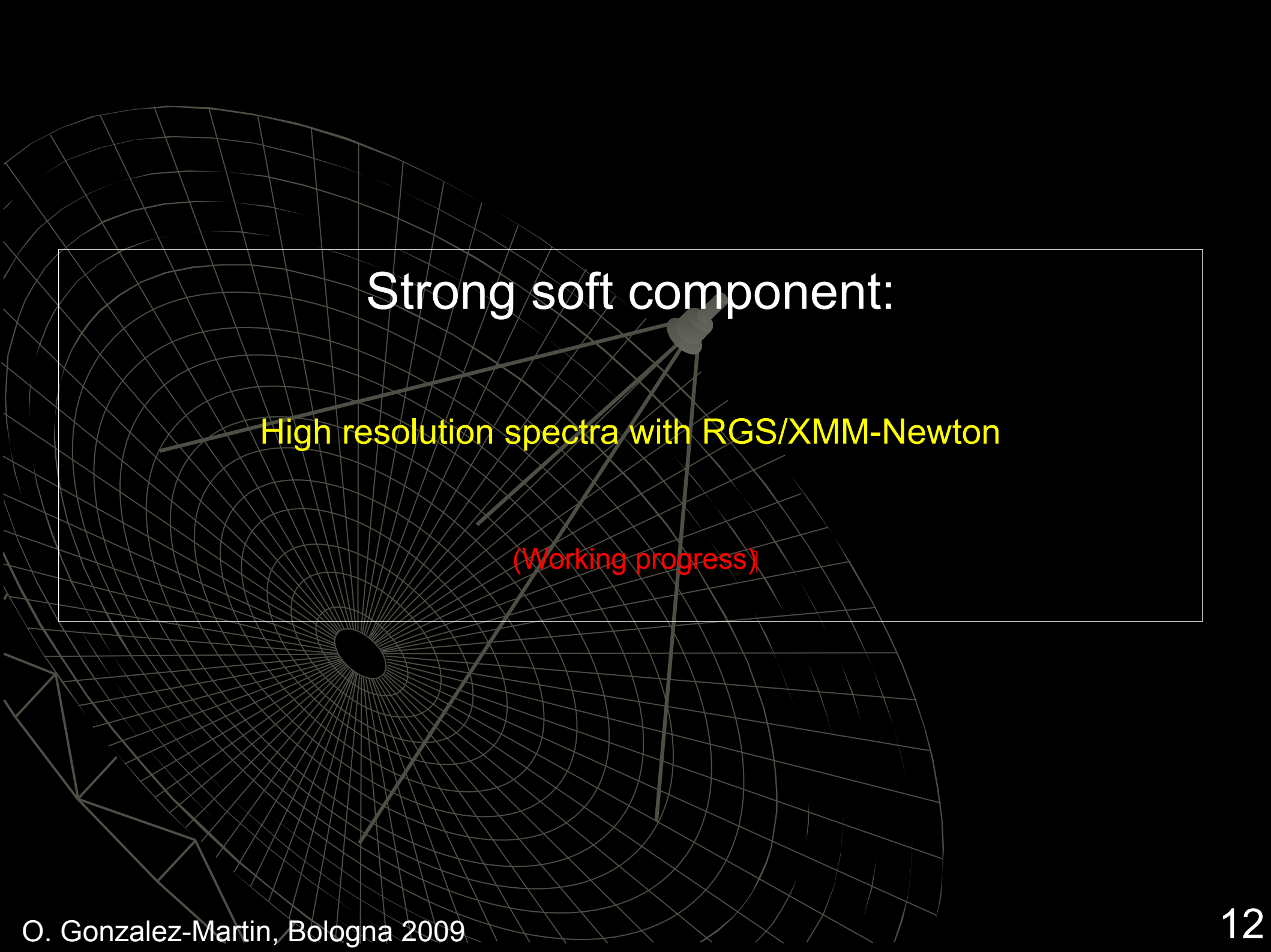

LINERs: ~ 50% Compton-thick
LINERs
Unobscured QSOs
Compton-thick Seyfert 2
Number of Objects
log(Flux(2-10 keV)/Flux[OIII])
20
15
10
5
0
-2
0
2
4
New!
Gonzalez-Martin et al. 2009B, ApJ accepted.

Compton-thick LINERs show low EW(FeKa)



Strong thermal component





Strong soft component:

High resolution spectra with RGS/XMM-Newton

(Working progress)

Soft X-ray emission in Seyferts:

The soft X-ray emission is identified as photoionization by the nucleus.

- **Morphology**: It overlaps with the [OIII] emission comming from the NLR.

(Bianchi et al. 2006)

- **Spectroscopy**: High resolution spectra of Seyferts shows that the photoionization by the nucleus is the responsible for the X-ray soft emission with a contribution of photoexcitation.

(Guainazzi & Bianchi 2007)

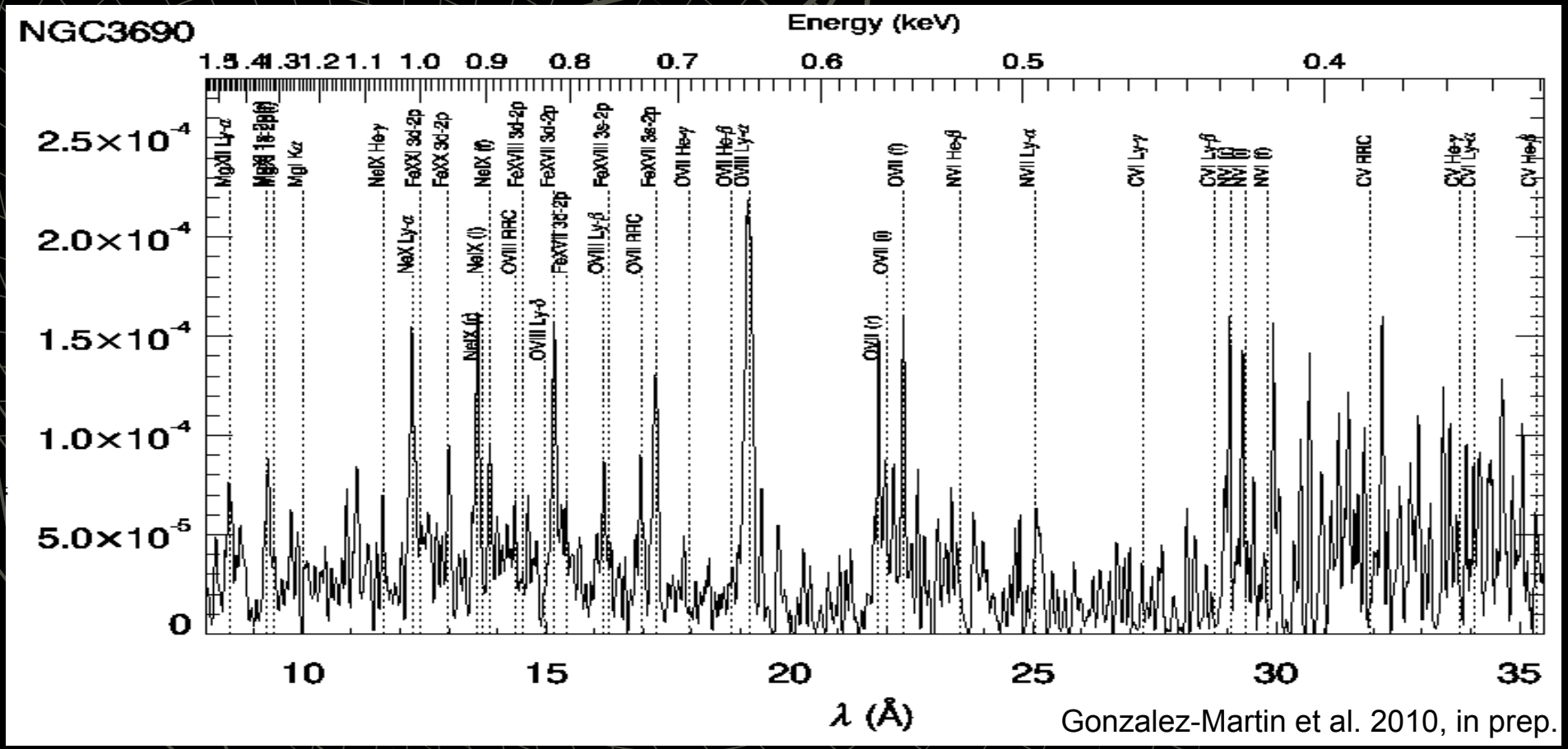
The spectral clues of the emission nature throught the high resolution spectroscopy are:

- Supporting photoionization by the nucleus, the spectrum presents narrow radiative recombination continua (RRC) features of OVIII, OVII and CV.
- The intensity of higher order transitions are enhanced with respect to the Ka than predicted for pure photoionization.

Soft X-ray emission in LINERs:

- **Morphology**: No [OIII] images with enough quality.

- **Spectroscopy**: 52 objects with RGS/*XMM-Newton* data.



Gonzalez-Martin et al. 2010, in prep.

Soft X-ray emission in LINERs:

- **Morphology**: No [OIII] images with enough quality.

- **Spectroscopy**: 52 objects with RGS/*XMM-Newton* data.

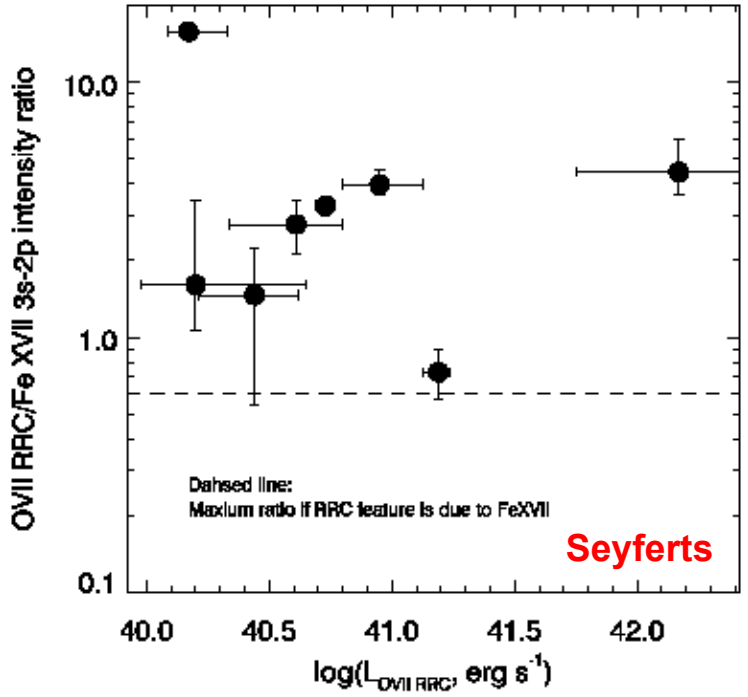
OVII RRC: 34 detected. Most of them compatible with FeXVII.

OVIII RRC: 31 detected.Most of them compatible with FeXVIII

CV RRC: **16 detected -> 31%**

We are studying new diagnostics comparing Starburst, Seyferts and LINERs

FeXVII triplet can contaminate the OVII RRC:



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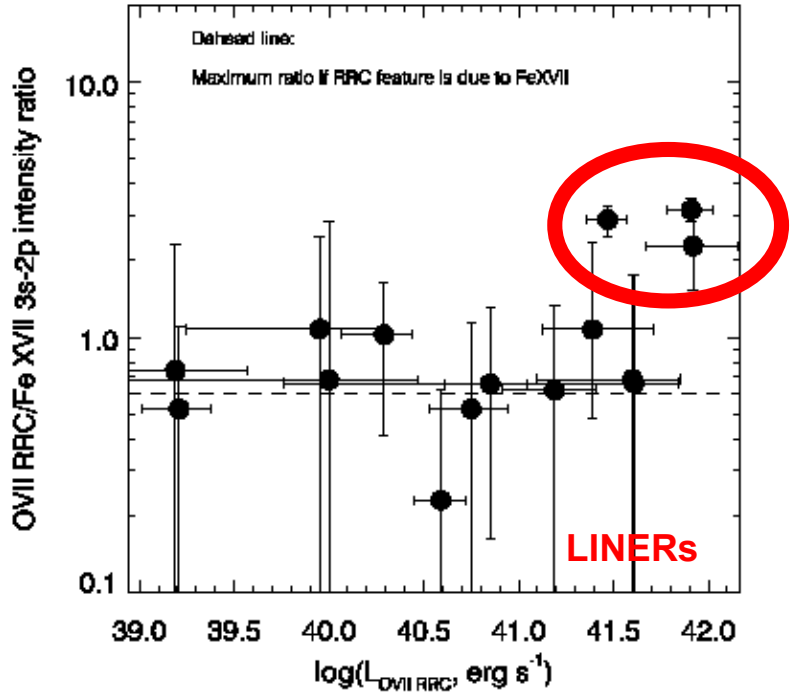
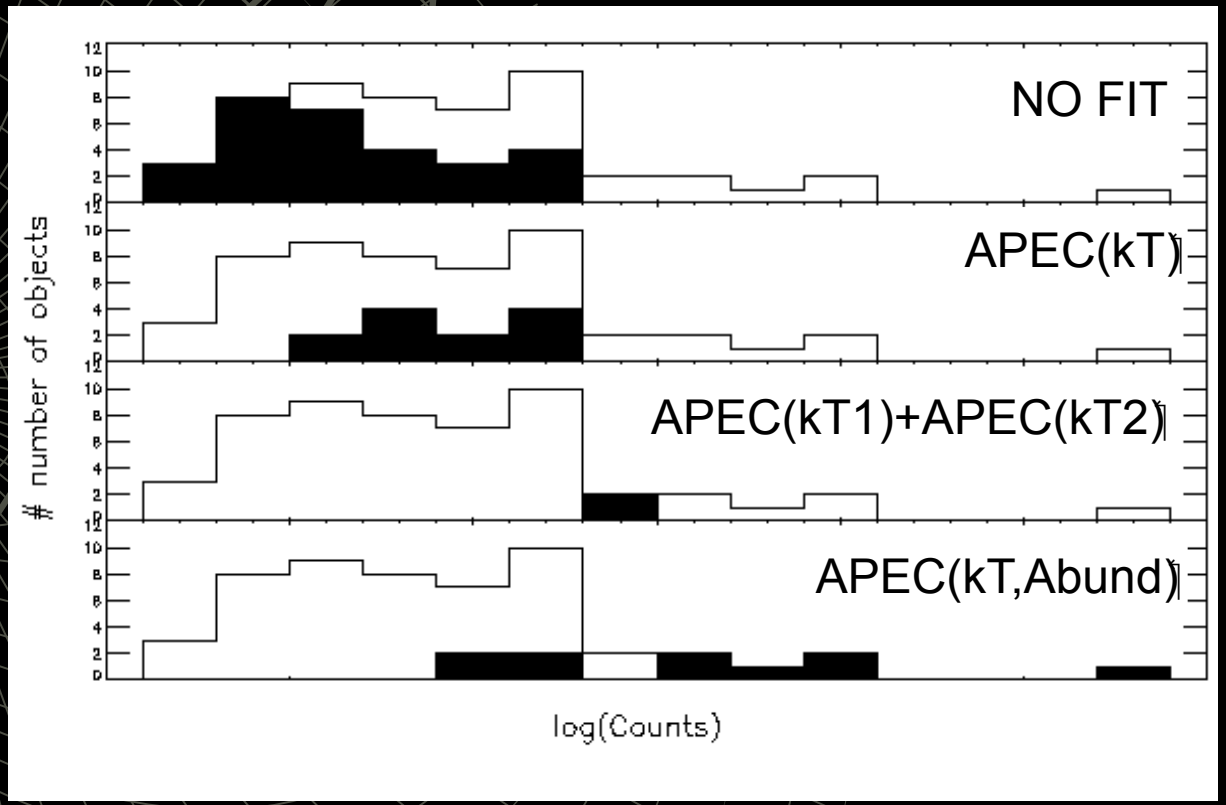


Soft X-ray emission related to star-formation?

- wabs(apec{kT}) 12
- wabs(apec{kT1}+apec{kT2}) 2
- wabs(apec{kT1}+apec{kT2}+apec{kT3}) 0
- wabs(apec{kT1}+apec{kT2}+apec{kT3}+apec{kT4}).....0
- wabs(apec{kT, Abundance}).....10

We are now testing CLOUDY models to simulate the pure photoionization scenario.



Summary

- LINERs are similar to type 2 Seyferts: (1) same range of luminosities and (2) same overall X-ray spectrum.
- LINERs are different to type 2 Seyferts: (1) The strong soft component; (2) higher proportion of Compton-thick sources and (3) the low EW(FeKa) of Compton-thick LINERs.
- The soft X-ray emission in LINERs seems to be associated with photoionization by the nucleus, as type 2 Seyferts. However, the lack of enough statistics prevent us to make any strong conclusion.
- Although the low statistic is affecting the results, this soft X-ray spectrum can be fitted with an APEC, letting free the temperature and the abundance in 22 out of the 52 objects (42%). We are testing CLOUDY models.

To be continued...