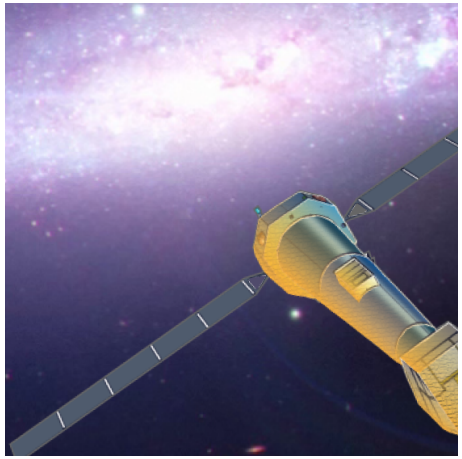
ATHENA

The Spanish scientific contribution to Athena



Giovanni Miniutti

Centro de Astrobiología (CSIC-INTA)

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SXA17, IAA, Granada, 23 November 2017

The Athena scientific community

ESA Athena Science Study Team (ASST)

M. Guainazzi (Chair), K. Nandra (Science Lead & WFI), D. Barret (X-IFU), A. Decourchelle, J.W. den Herder, A.C. Fabian, H. Matsumoto (JAXA), L. Piro, R. Smith (NASA), R. Willingale.

ESA has appointed an Athena Science Study Team (ASST) to scientifically guide/advise during the Assessment Phase

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ESA has appointed an Athena Science Study Team (ASST) to scientifically guide/advise during the Assessment Phase. Among other tasks:

- Continuous review/update of the scientific requirements
- Assist in any trade-offs
- Assess performance scientific aspects
- Support observation/calibration plans
- Requirements for Ground Segment
- Engage the broad community

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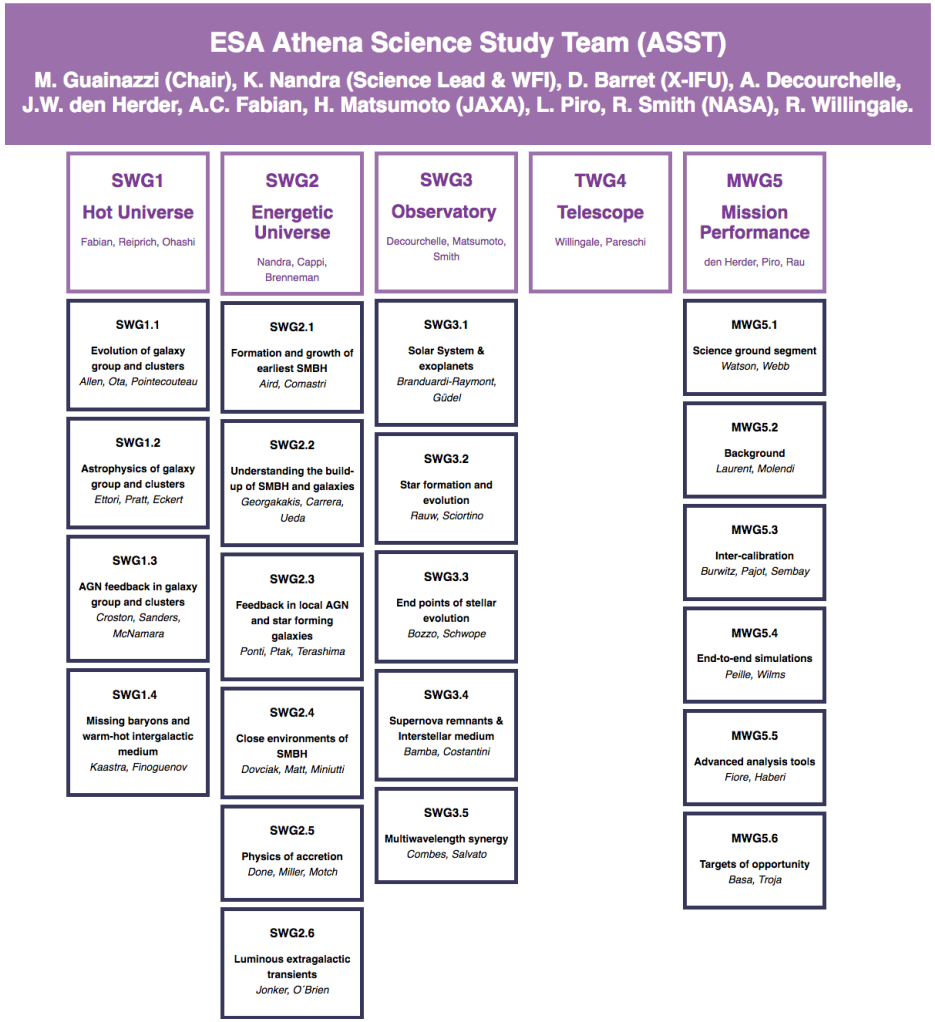
The Athena scientific community



The ASST has set-up a Science Working Group structure to achieve all their tasks and goals

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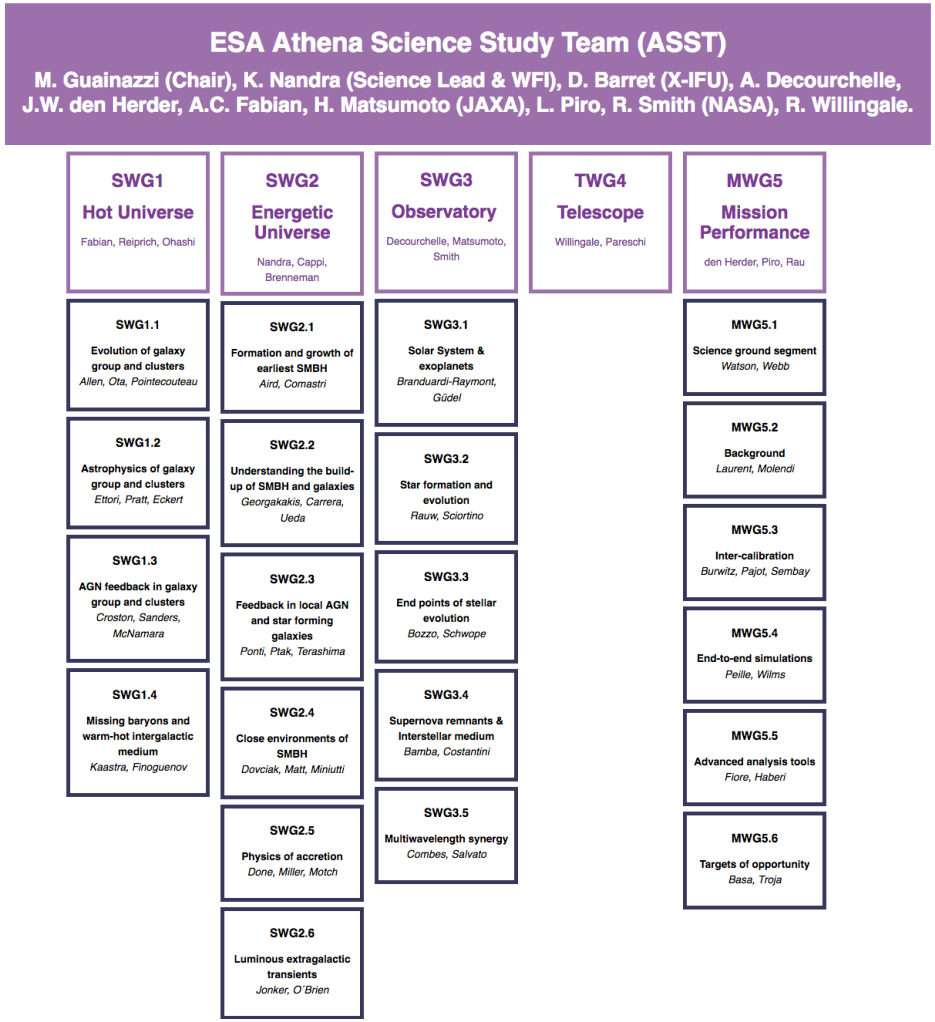
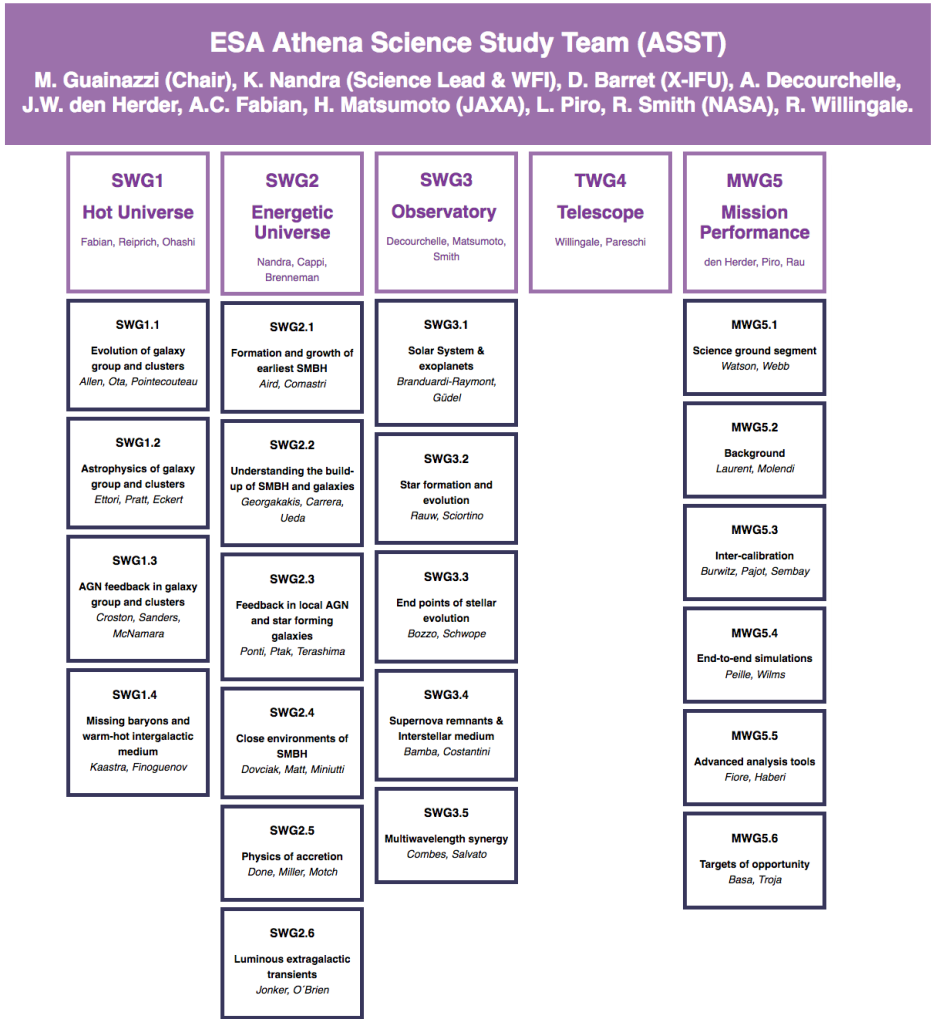
The Athena scientific community



The ASST has set-up a Science Working Group structure to achieve all their tasks and goals. The SWGs must

- Conduct studies (either scientific or technical) that are needed to support the mission
- Advise the ASST on any necessary revision/update of scientific requirements
- Advise the ASST on any scientific impact of possible trade-offs
- Promote the mission to the wider astronomical community

The Athena scientific community: Spanish contribution



- Spanish representatives co-chairing

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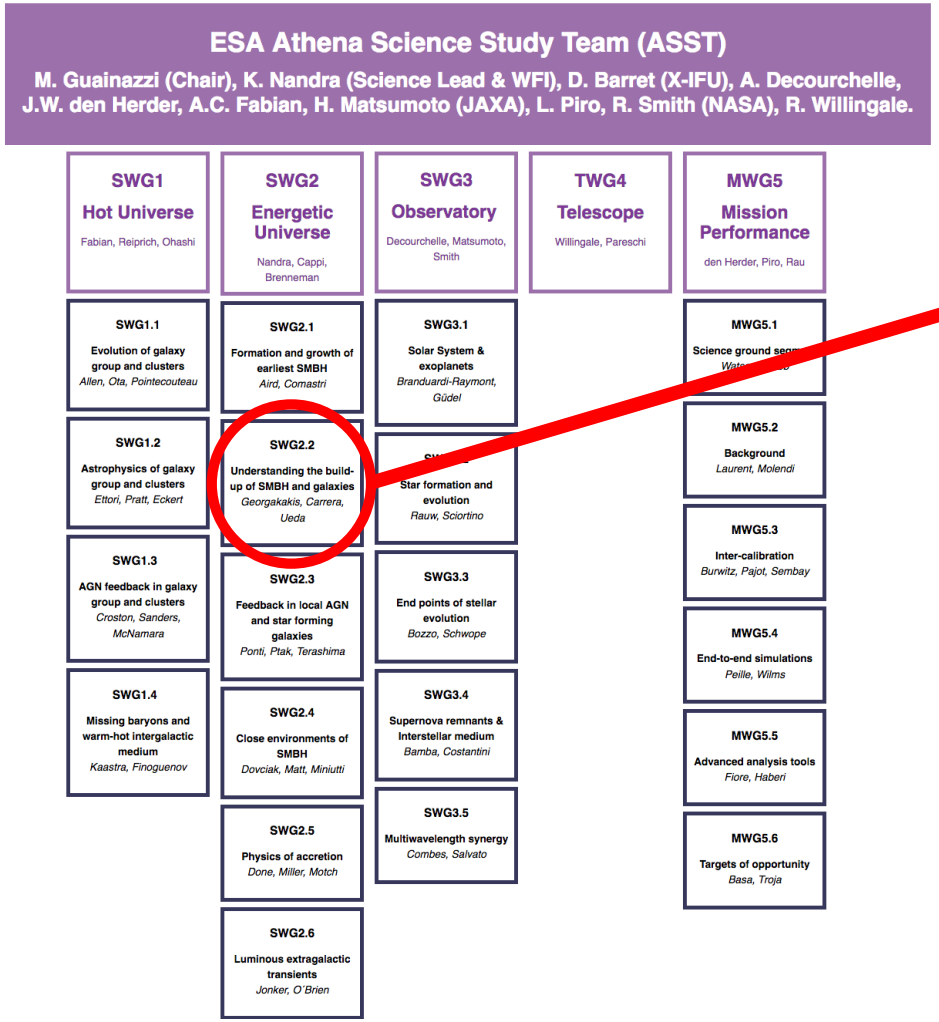
The Athena scientific community: Spanish contribution



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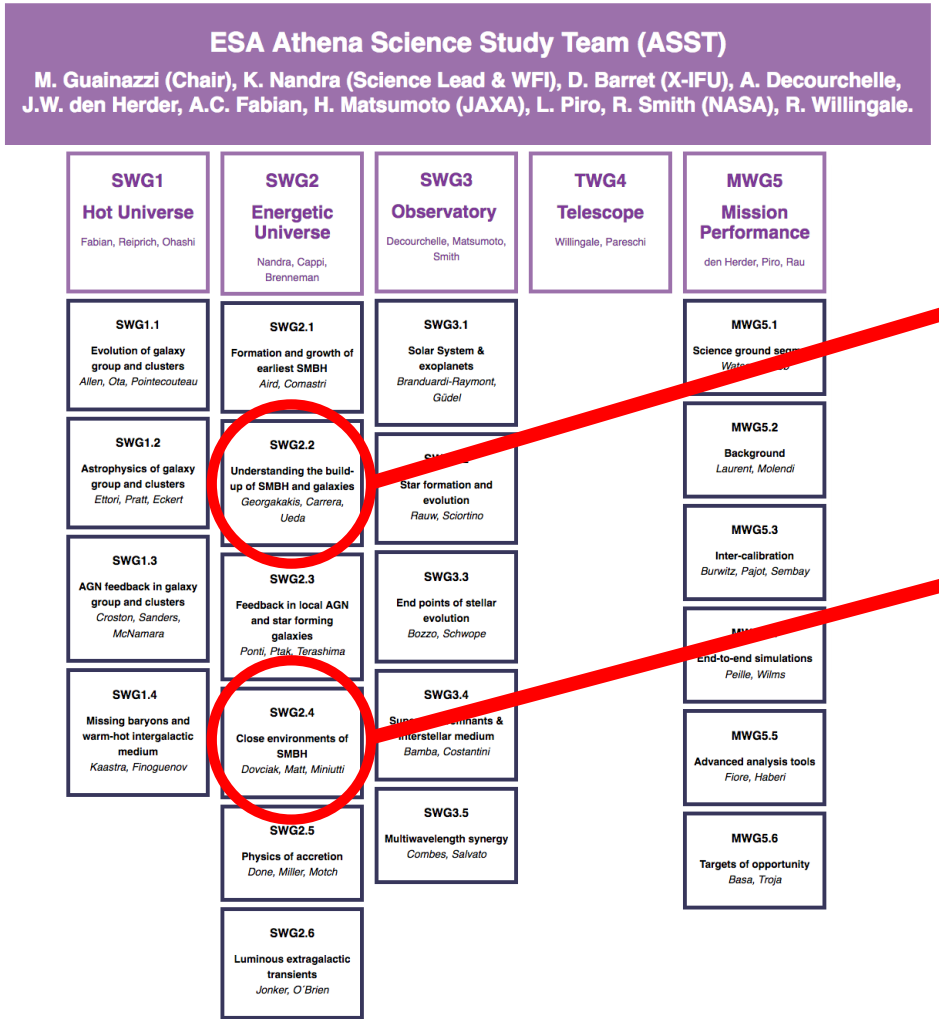
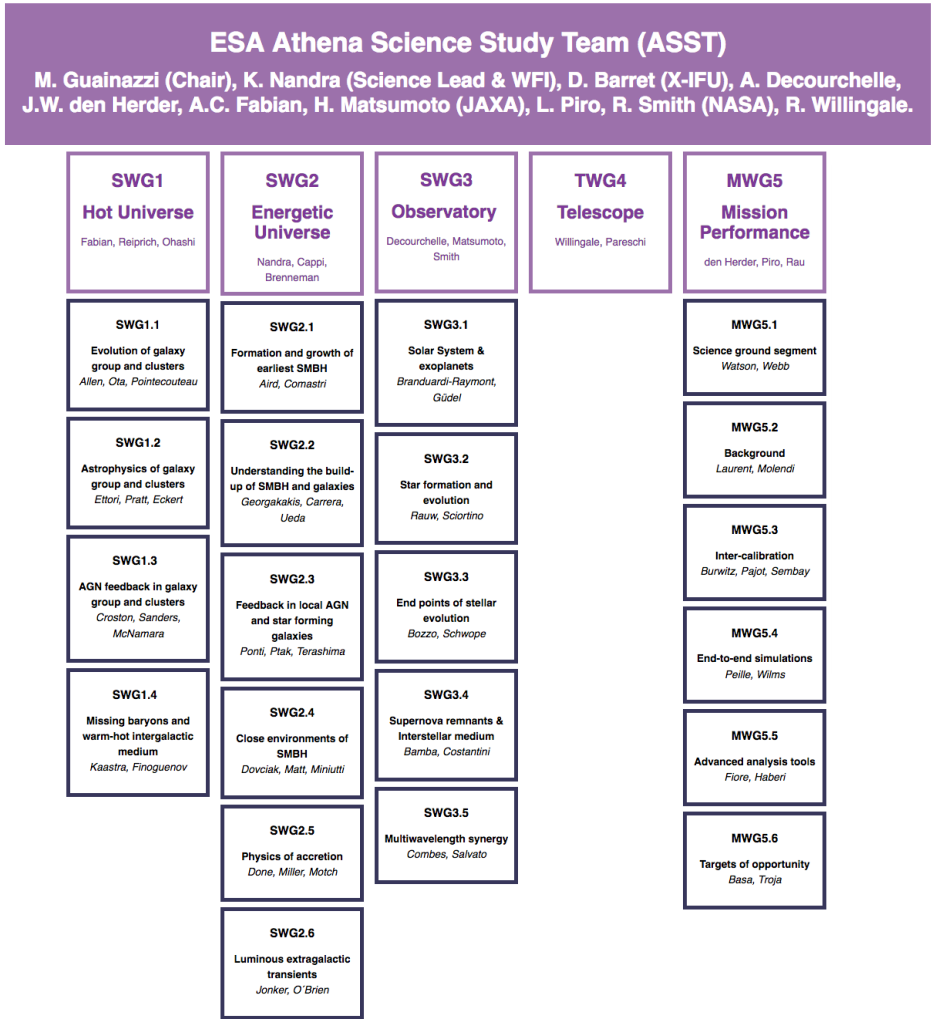
    - Understanding the build-up of SMBHs and galaxies (Francisco J. Carrera)

The Athena scientific community: Spanish contribution



- Spanish representatives co-chairing
  - SWG 2.2
    - Understanding the build-up of SMBHs and galaxies (Francisco J. Carrera)
  - SWG 2.4
    - Close environments of SMBH (Giovanni Miniutti)

The Athena scientific community: Spanish contribution



- "Spanish" researchers collaborating in
  - SWG 1 (TP 1.1, 1.2, 1.4)
  - SWG 2 (all TPs from 2.1 to 2.6)
  - SWG 3 (all TPs from 3.1 to 3.5)
  - TWG 4
  - MWG 5 (TP 5.1, 5.4, 5.5, 5.6)
- For a total of
  - ~ 50 Spain-based researchers
  - ~ 12 Spanish Institutions

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The Athena Community Office

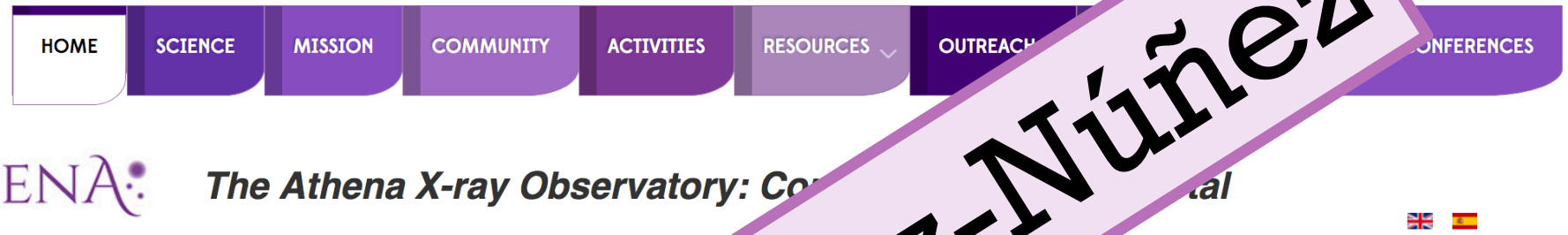
ATHENA *The Athena X-ray Observatory: Community Support Portal*

The ACO was set-up by the ASST with the main goal of being the interface between the broad community supporting the mission (~ 800 scientists) and the ASST

More info:
http://www.the-athena-x-ray-observatory.eu

The Athena Community Office (ACO)
Instituto de Física de Cantabria (CSIC-UC)
aco@ifca.unican.es

The Athena Community Office



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Mo
hena-x-ray-observatory.eu

a Community Office (ACO)
to de Física de Cantabria (CSIC-UC)
co@ifca.unican.es

The Spanish scientific participation to X-IFU

- X-IFU Consortium
  - 13 X-IFU Consortium members
    - 1 Consortium Board member (J.M. Mas-Hesse)
    - 1 Science Center Management Board member (J.M. Torrejón)
    - 2 X-IFU instrument Co-Is (M.T. Ceballos, J.M. Mas-Hesse)
    - 1 X-IFU science Co-I (X. Barcons)
    - 2 X-IFU Science Advisory Team members (J.M. Torrejón, G. Miniutti)
    - 2 X-IFU end-to-end simulation team members (M.T. Ceballos, B. Cobo)

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    -

Didier Barret and Javier Gómez-Elvira

M. Torrejón, G. Miniutti)

mbers (M.T. Ceballos, B. Cobo)

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The X-IFU Instrument Science Center (X-ISC) is one aspect of the Athena Science Ground Segment

- It is responsible for all activities related to the X-IFU Ground Segment such as
  - on-board software as well as X-IFU monitoring and calibration
  - data reduction/analysis software for X-IFU
  - automated pipeline and data products validation
- Currently a common framework, scripting language … are being discussed within the overall SOC

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The X-SAT has been set-up in 2014 and comprises ~20 scientists with expertise in the one or more of the key scientific objectives of the X-IFU from AGNs and binaries to clusters and active stars. Its main goal is to advise and support the PI and

- assess the scientific impact of any X-IFU instrument or design change
- help defining X-IFU related tasks for SWGs and evaluating results
- assist the X-IFU system teams in translating scientific requirements in instrument specifications
- advise in the definition of the X-IFU observing program

In summary: help to maximize the X-IFU scientific return

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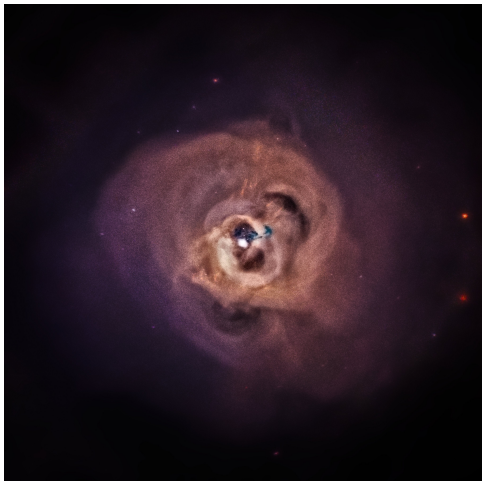
e2e simulations actually mean: simulation of the full detection chain i.e.



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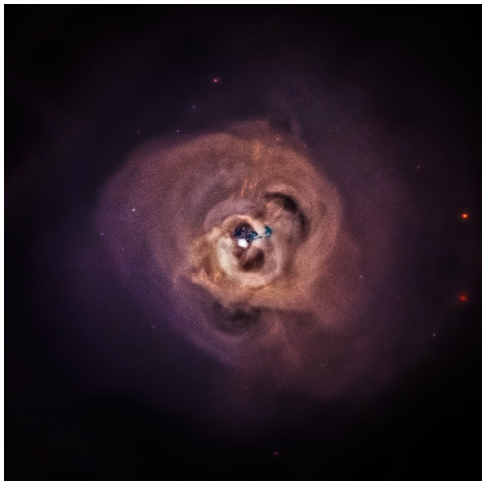

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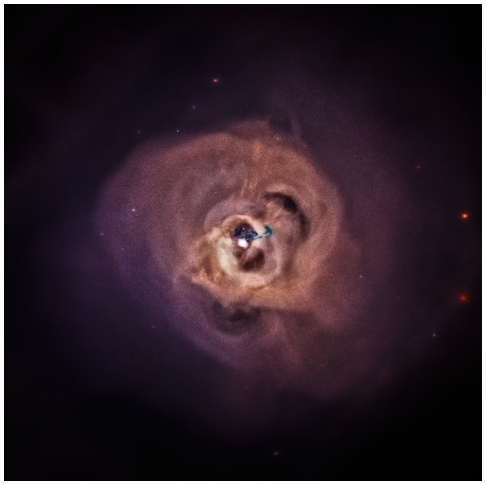

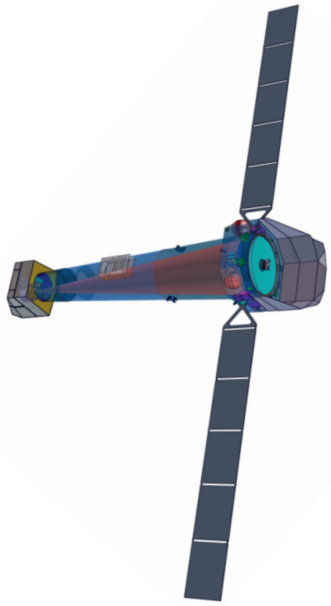

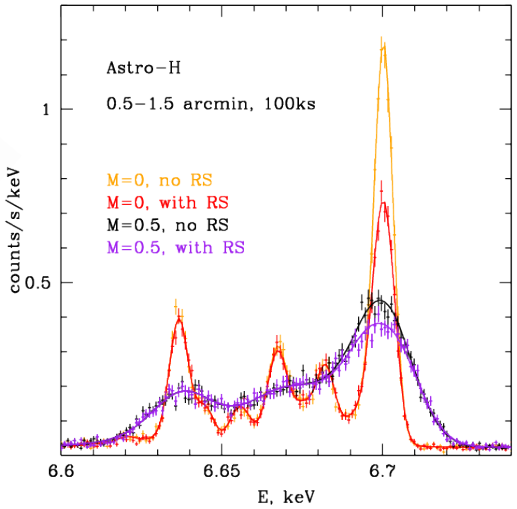

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This is fundamental from both the scientific and the engineering side of things

- Scientists can gauge the effects of mission/instrument design onto science, use e2e to help translating science requirements into instrument specifications or to plan observation programs
- Engineers can use science case studies to optimize design, estimate and better understand instrument performances

It is a most useful tool to maximize the permeability of the membrane between the two sides (scientists and system teams), which is actually the main goal of most of the X-IFU teams

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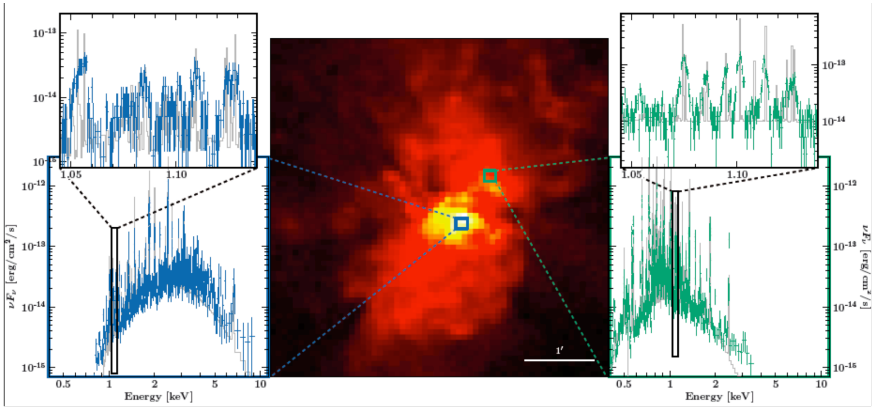
More info and downloads:
http://www.sternwarte.uni-erlangen.de/research/sixte

and the Athena-specific web interface:
http://hydrus.sternwarte.uni-erlangen.de/~athenasim



Abell 2146 with X-IFU
(Dauser/Pointecouteau)

The Spanish scientific contribution

SWG2

Energetic Universe

Nandra, Cappi, Brenneman

Main scientific topics of interest

- First SMBHs and build-up of SMBHs and galaxies
- AGNs in the local Universe
- BH accretion physics
- Extragalactic transients

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SWG3

Observatory

Decourchelle, Matsumoto, Smith

Main scientific topics of interest

- Solar System - Exoplanets
- SNR & ISM
- Star formation and evolution
- NSs, Pulsars, X-ray binaries …
- Multi-λ sinergies

The Spanish scientific contribution

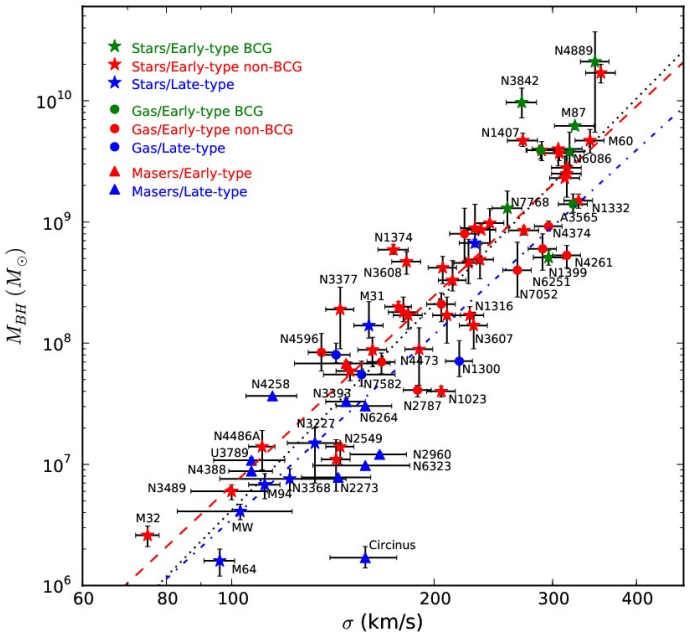
SWG2

Energetic Universe

Nandra, Cappi, Brenneman

- AGNs in the local Universe
  - winds and outflows

$$M_{BH} = \left(0.31^{+0.04}_{-0.03}\right) \times \sigma^{4.4 \pm 0.3}$$



A few % of L_{Bol} are needed in mechanical power

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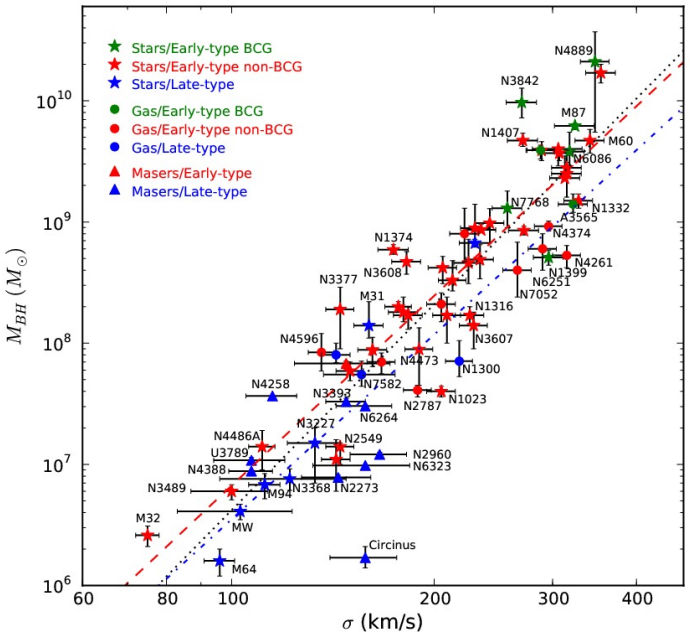

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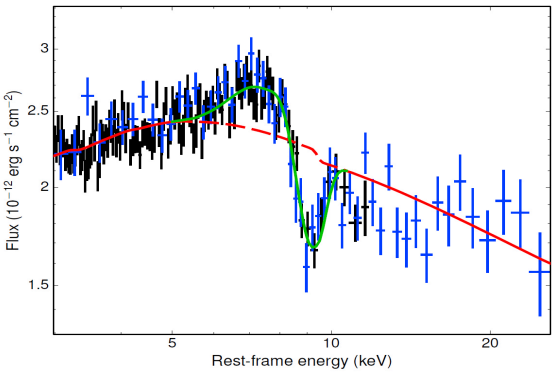

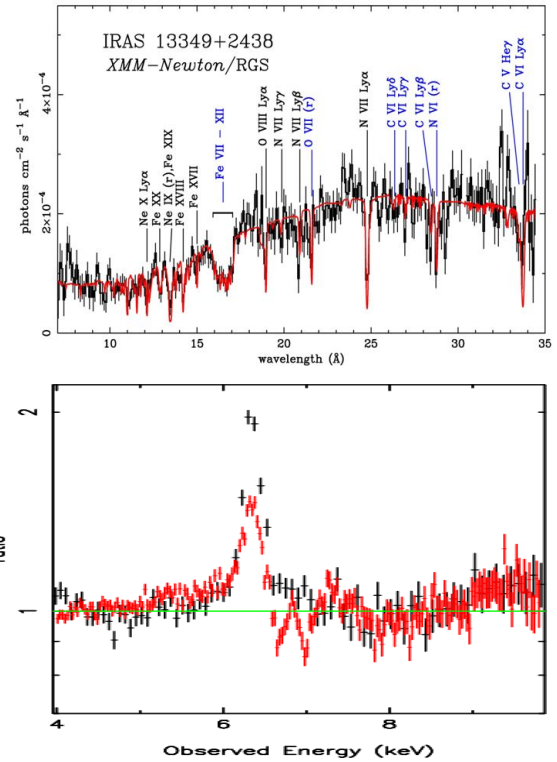

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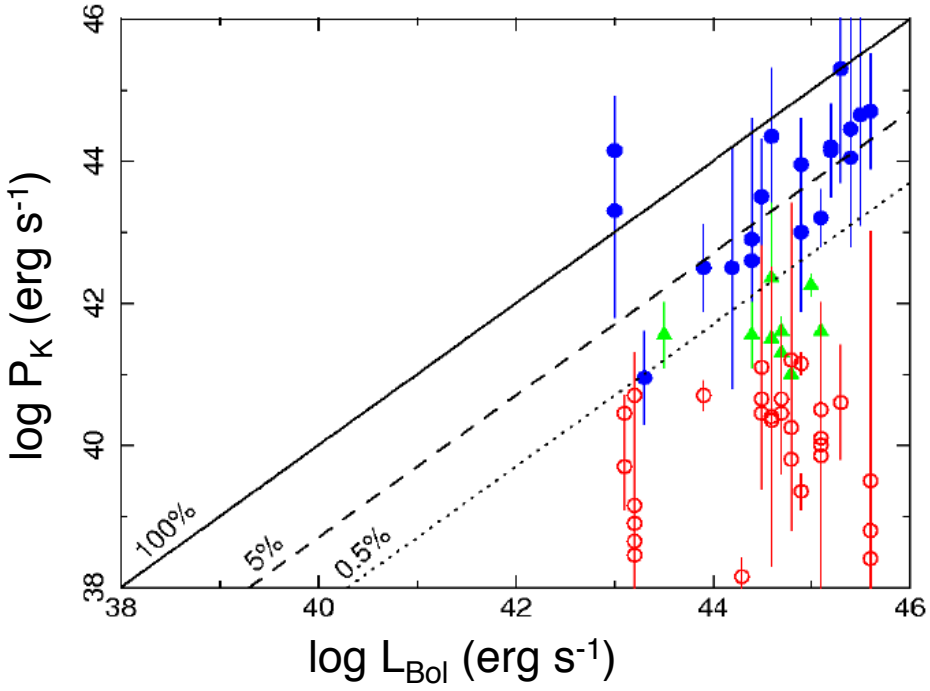

Ultra Fast Outflows (UFOs)

Fe xxv and xxvi outflows

AGN warm absorbers

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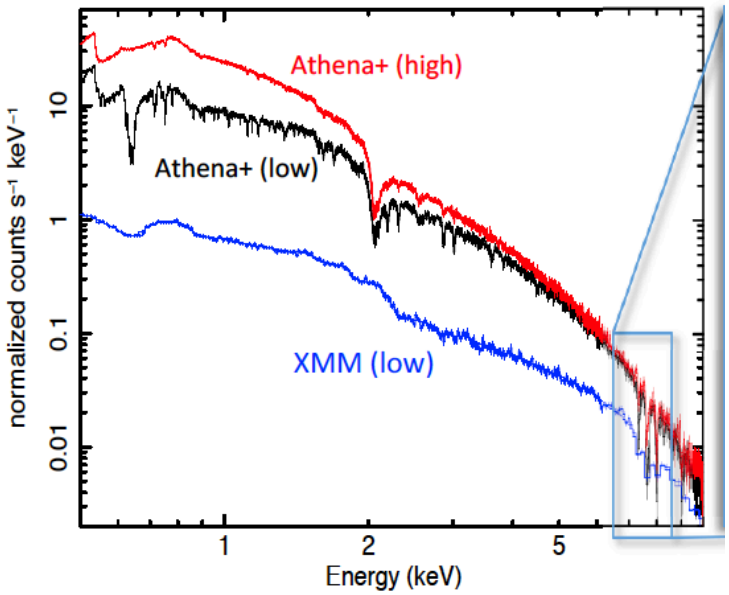

Cappi, Done et al. 2013

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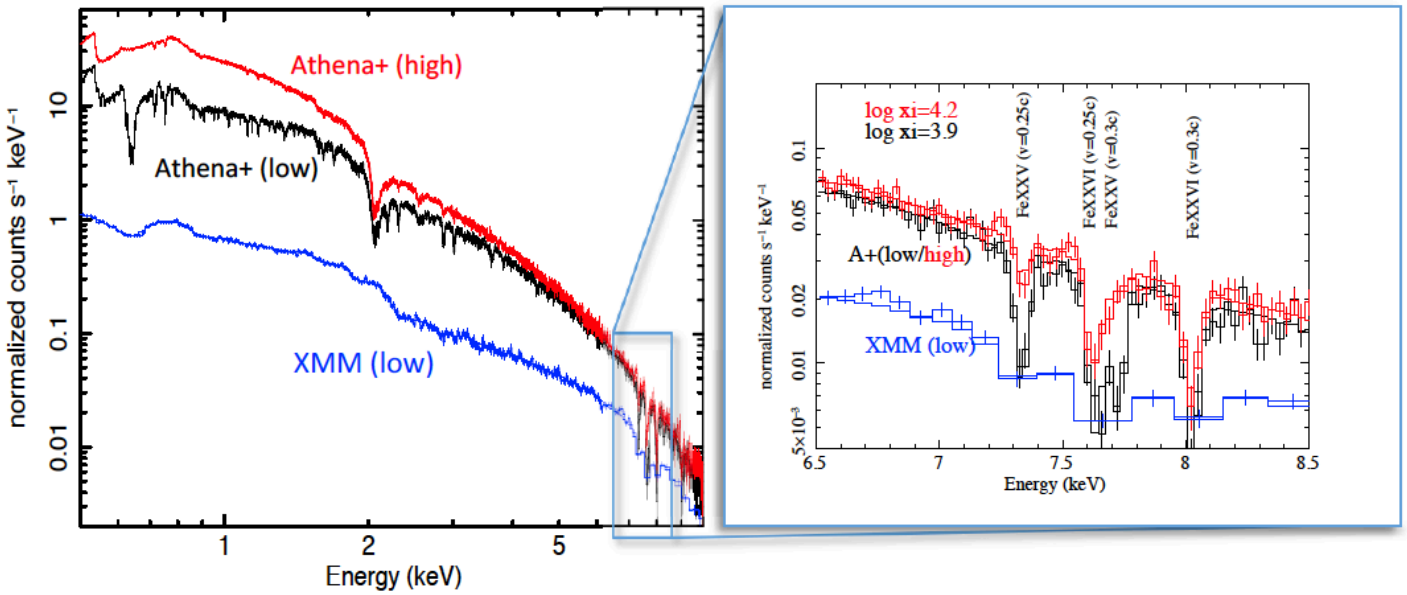

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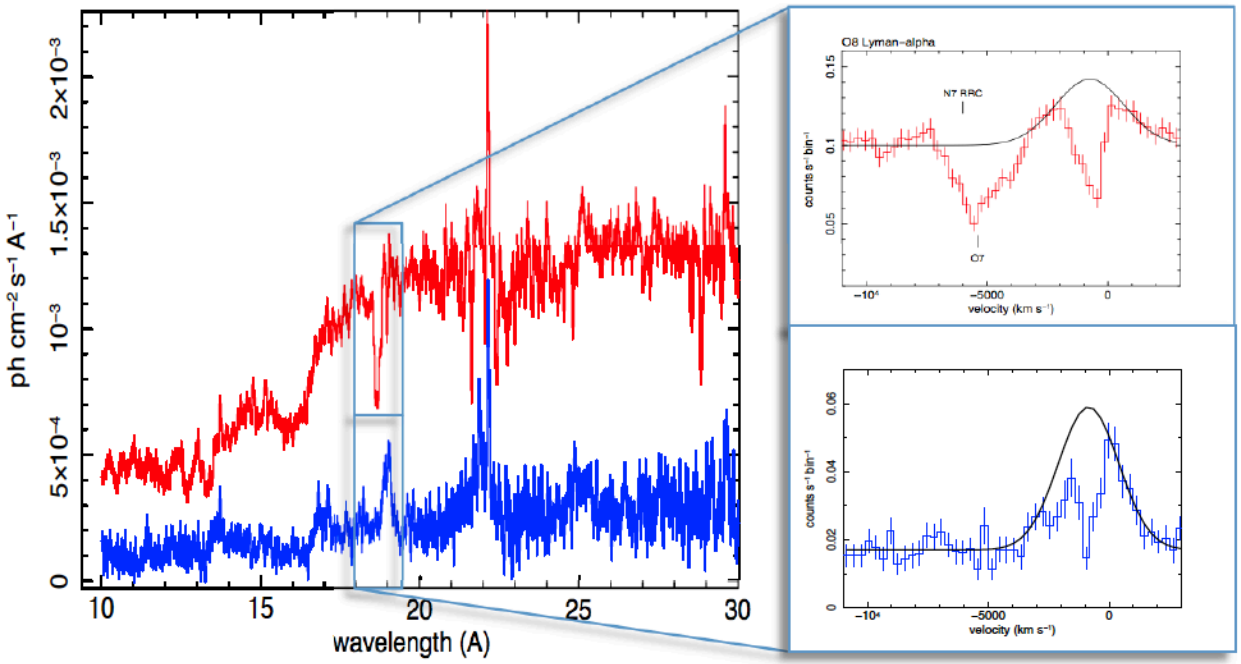

Cappi, Done et al. 2013

Wind-ISM interaction

Red: emission-dominated state (NGC 4051)

Blue: absorption-dominated state (NGC 4051)

Probing broad, blue-shifted emission + absorption and others with enough detail to probe deceleration

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Energetic Universe

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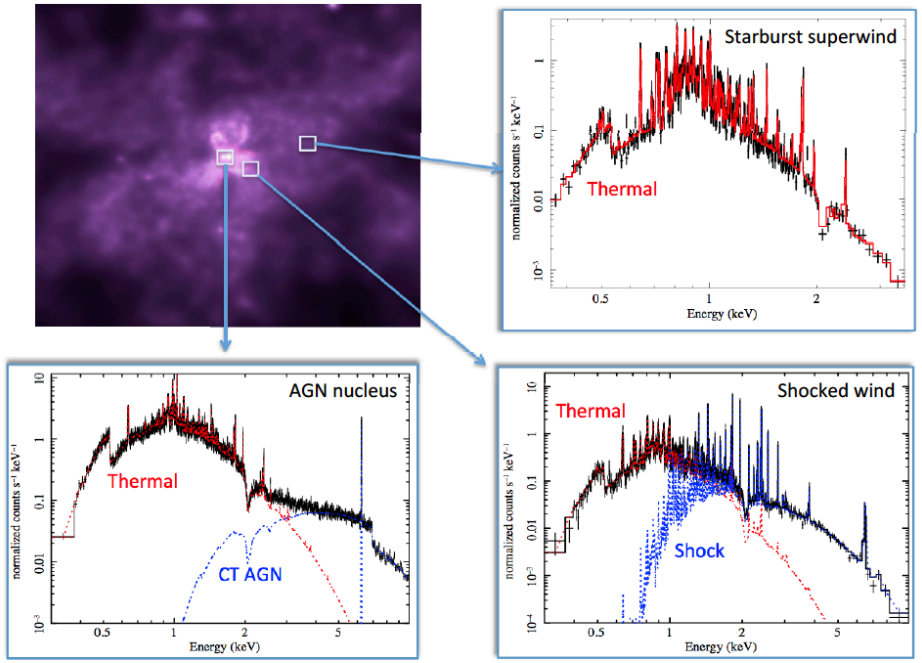
- AGNs in the local Universe
  - winds and outflows
  - AGN/starburst



Cappi, Done et al. 2013

Disentangling the different contribution in nearby star-forming galaxies

Taking to the next step feedback studies in nearby Seyfert galaxies and LIRGs/ULIRGs (here NGC 6240)

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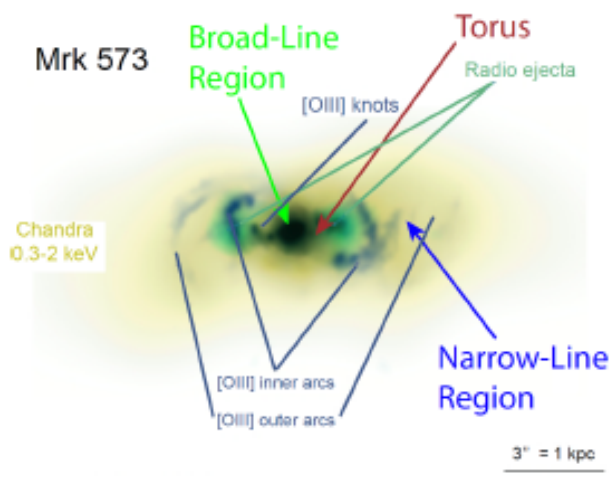
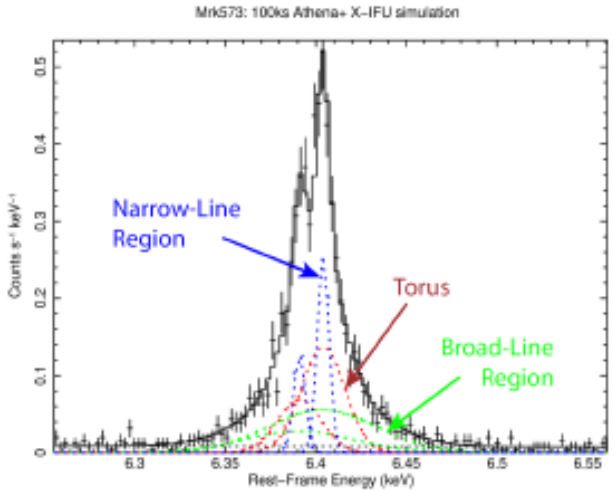




Mapping spatially distinct components in (obscured) AGN thanks to the superb energy-resolution and sensitivity of the X-IFU

Cappi, Done et al. 2013

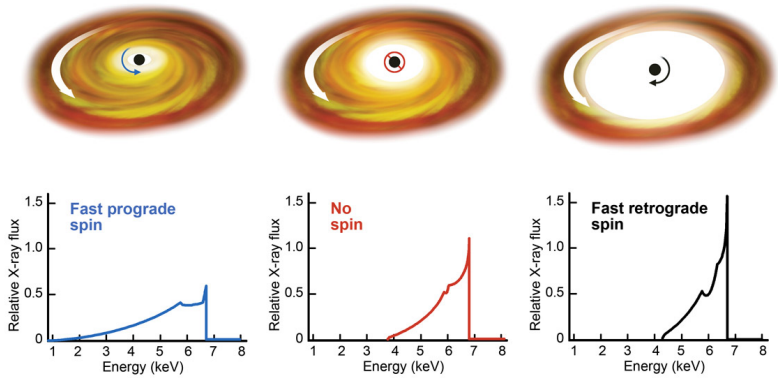
The Spanish scientific contribution

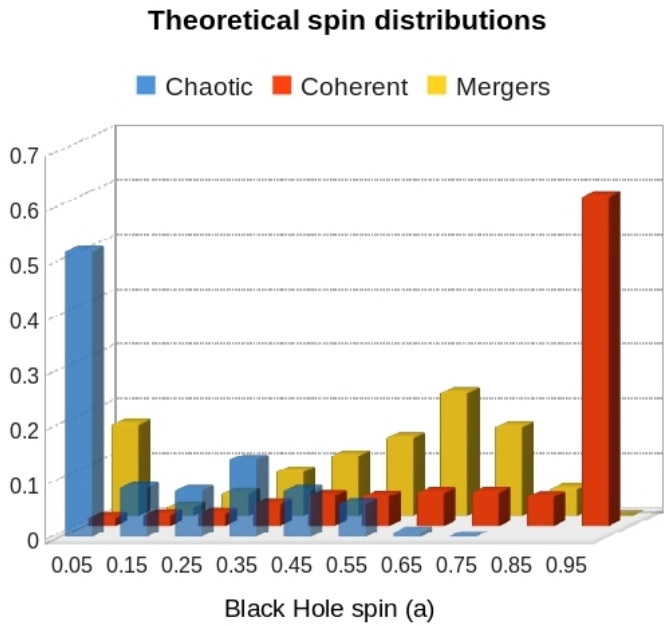
SWG2

Energetic Universe

Nandra, Cappi, Brenneman

- AGNs in the local Universe
  - winds and outflows
  - AGN/starburst
  - BH spin





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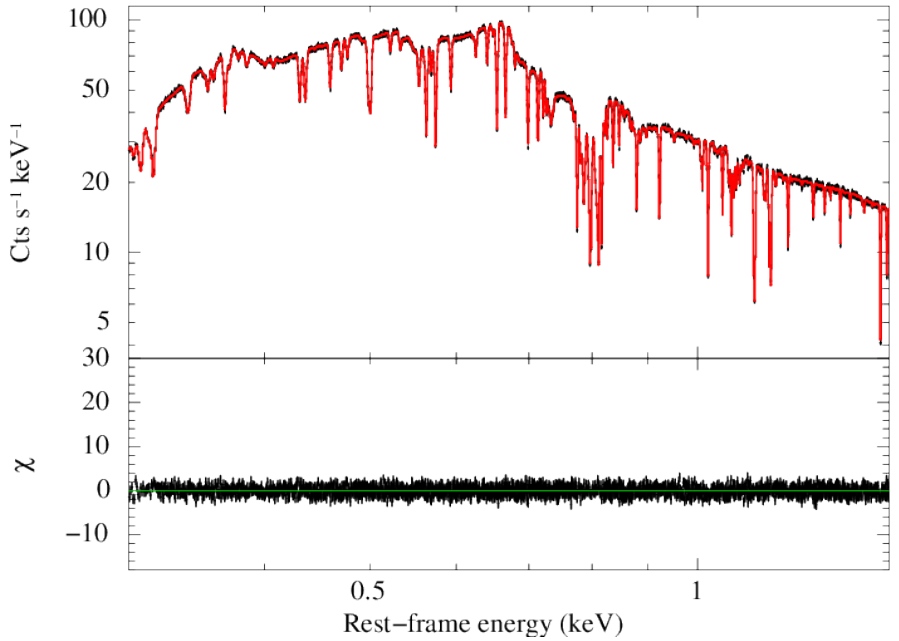

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Energetic Universe

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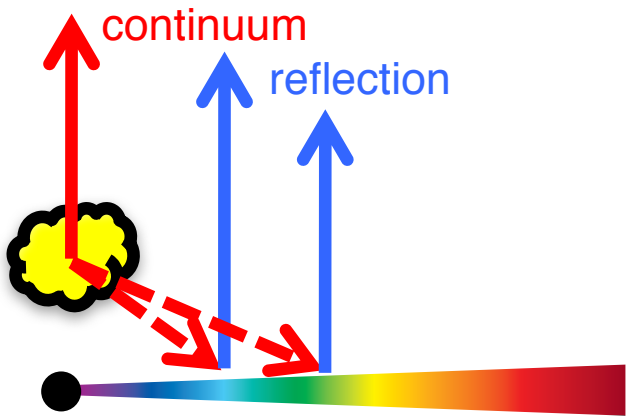
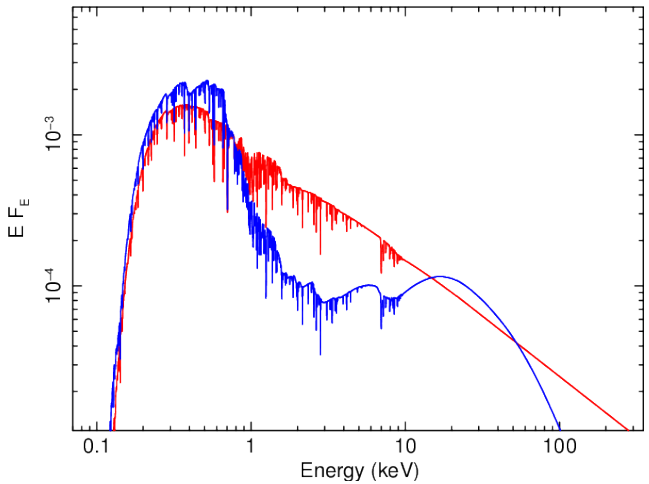
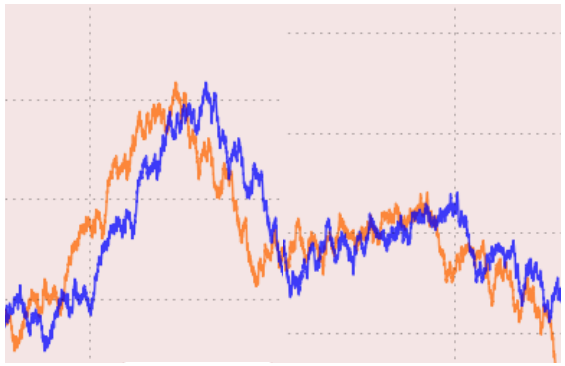
  - Reverberation







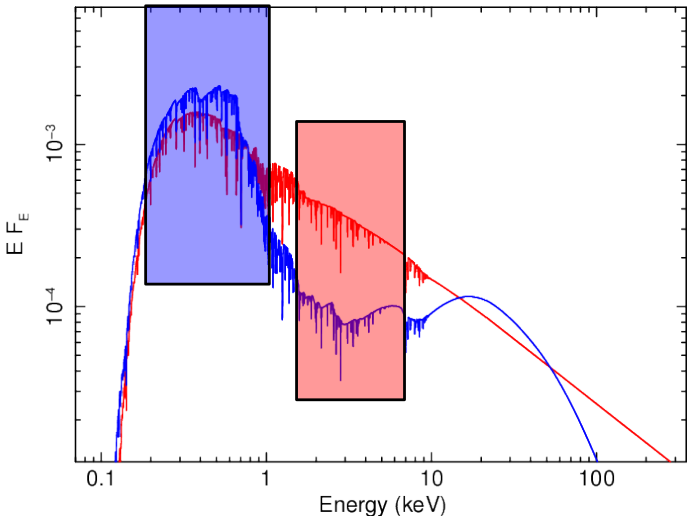
The Spanish scientific contribution

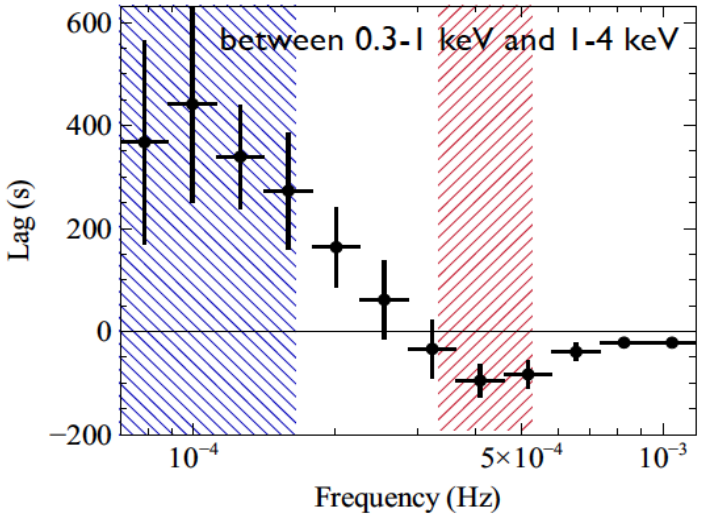
SWG2

Energetic Universe

Nandra, Cappi, Brenneman

- AGNs in the local Universe
  - winds and outflows
  - AGN/starburst
  - BH spin
  - Reverberation





The Spanish scientific contribution

SWG2

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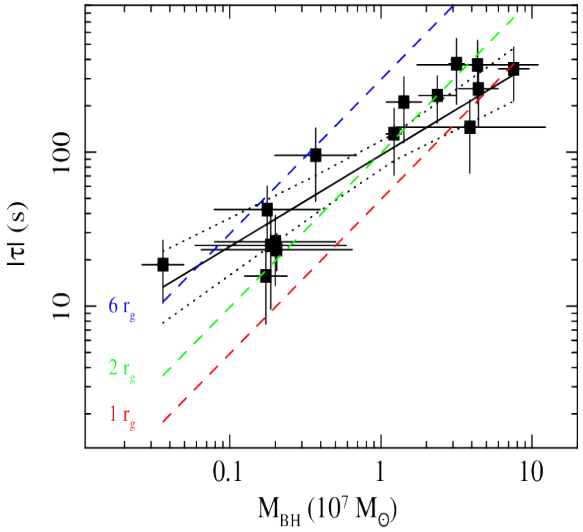

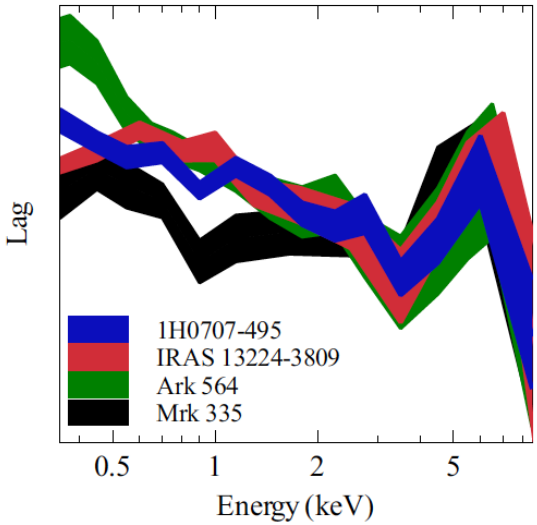

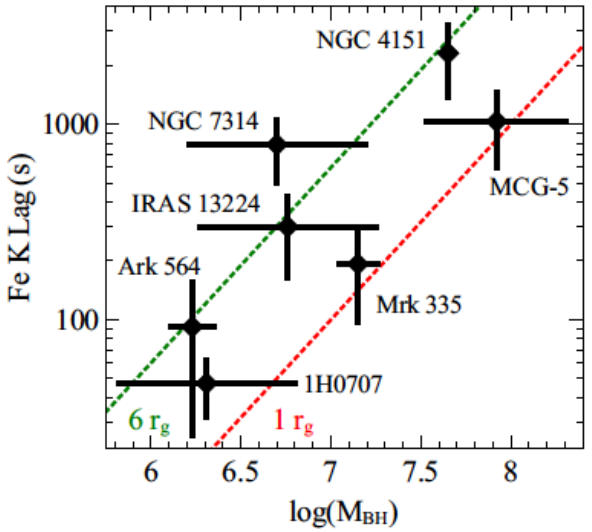

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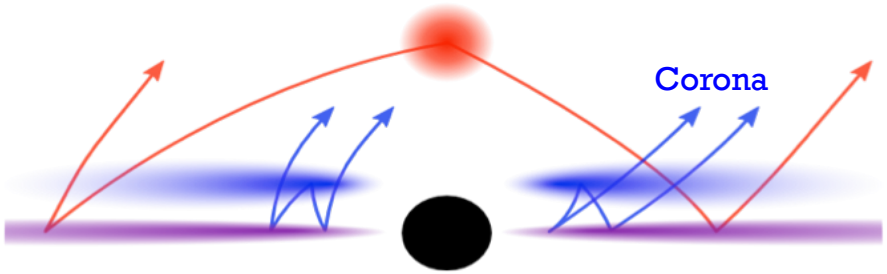
The Spanish scientific contribution

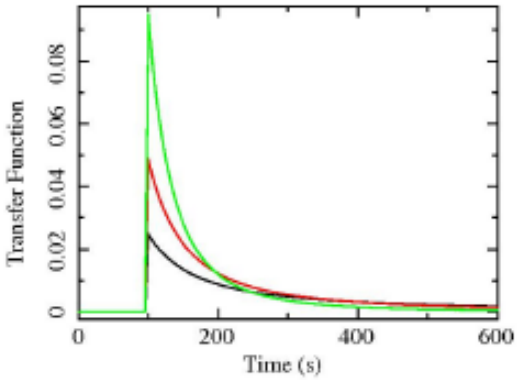
SWG2

Energetic Universe

Nandra, Cappi, Brenneman

Base of jet





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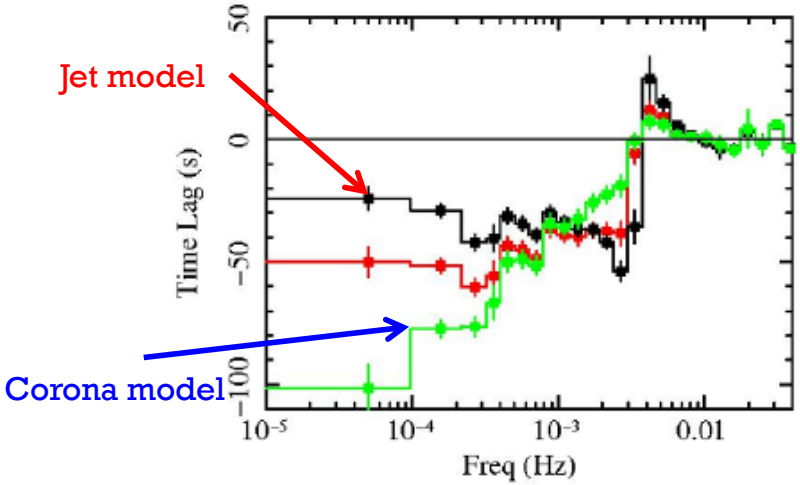


Dovciak, Matt et al. 2013

The Spanish scientific contribution

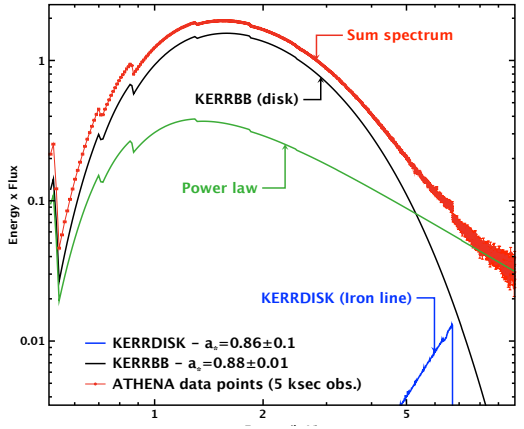
SWG3

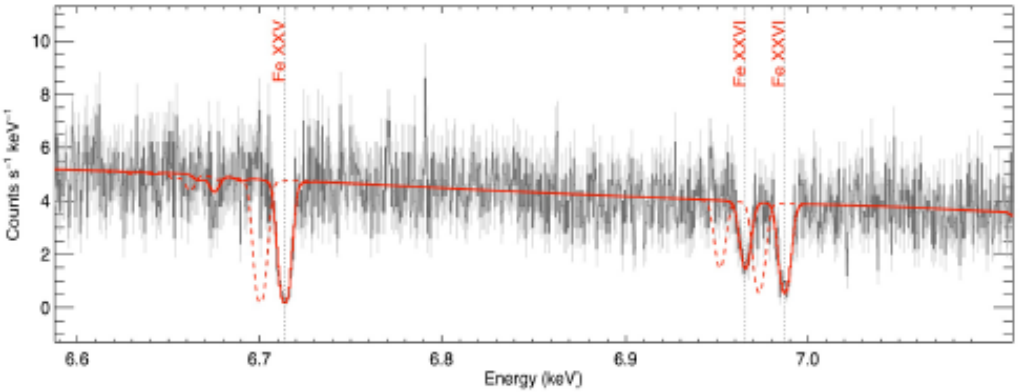
Observatory

Decourchelle, Matsumoto, Smith

- A few examples
  - Measure BH spin (SN origin)
  - Disc truncation
  - Winds as diagnostics of the accretion flow
  - …

- Observatory Science
  - BH accretion and XRBs





Motch, Wilms et al. 2013

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The Spanish scientific contribution

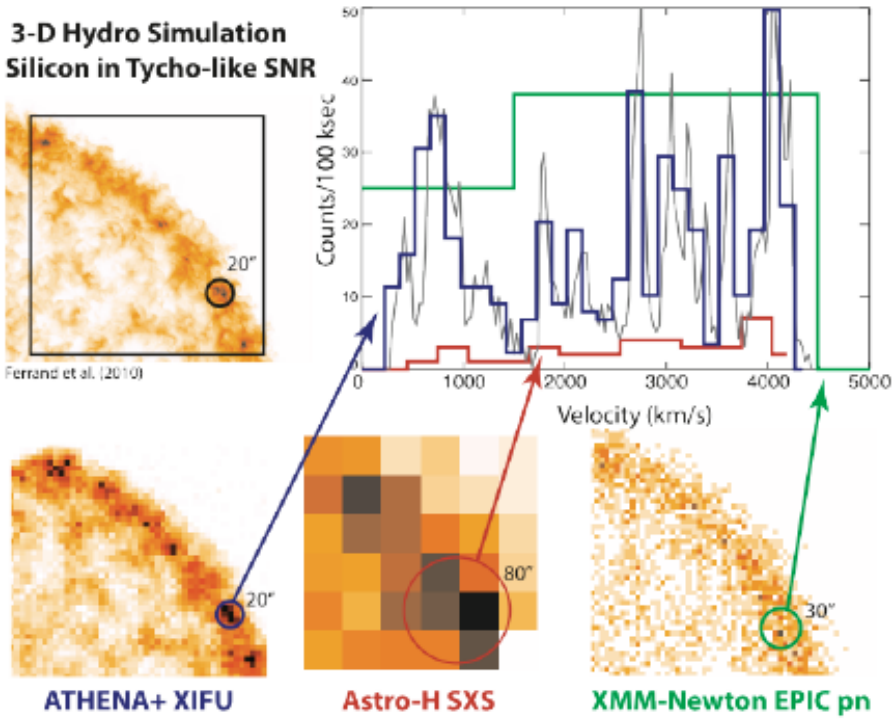
SWG3

Observatory

Decourchelle, Matsumoto, Smith

- Spatially resolved X-IFU high-E resolution
  - v, T, ionization, composition of different LOS enabling 3D decomposition
  - Shock physics and particle acceleration
  - …

- Observatory Science
  - BH accretion and XRBs
  - SNR & ISM



Decourchelle, Costantini et al. 2013

The Spanish scientific contribution

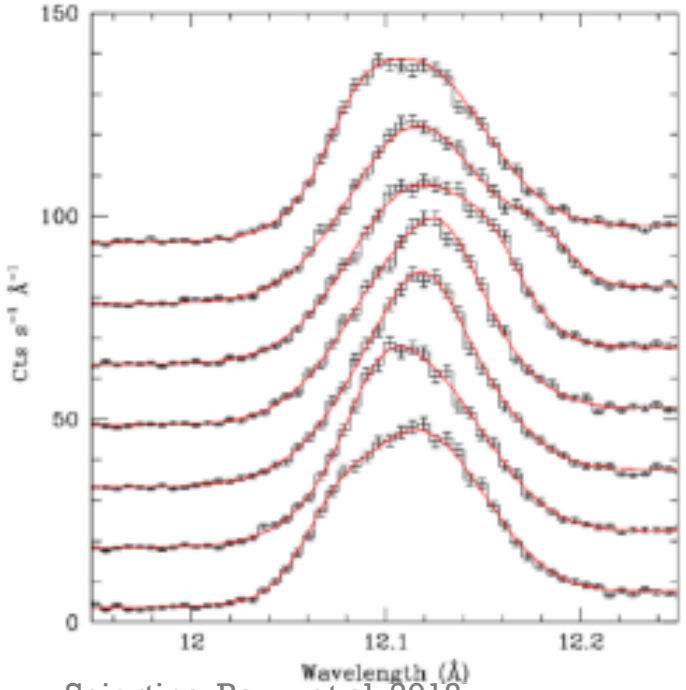
SWG3

Observatory

Decourchelle, Matsumoto, Smith

- Line profile variations in stellar winds on timescales ~ rotation (wind dynamics) – Here Ne X, few ks exp.
- Wind-wind interaction in binaries
- PNe, accretion in YSOs
- Cas-like X-ray sources
- …

- Observatory Science
  - BH accretion and XRBs
  - SNR & ISM
  - Stars, winds, B-fields …



Sciortino, Rauw et al. 2013

Summary

- Athena will be a transformational X-ray observatory
  - Designed to address the Hot and Energetic Universe science theme
  - Will impact virtually every corner of astronomy
- The Spanish community contributes with 2 SWG co-chairs, ~ 50 scientists as members of SWGs (~12 institutions), and runs the community portal ACO (thanks IFCA)
- Spanish researchers and institutions also participate to the scientific activities of the X-IFU instrument through a series of teams (XSAT, e2e …)
- Most science themes -especially on the "energetic" side of things and on observatory science - are covered by local expertise that has helped and is helping shaping the best possible mission

- **Follow Athena on**
  - **Web: www.the-athena-x-ray-observatory.eu**
  - **Twitter: @athena2028**
  - **Facebook: The Athena X-ray Observatory**
  - **Athena Community Office email: aco@ifca.unican.es**