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Published in:
 Galaxy Evolution and Feedback across Different Environments

DOI:
[10.1017/S1743921320002057](https://doi.org/10.1017/S1743921320002057)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
 Publisher's PDF, also known as Version of record

Publication date:
 2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Reynaldi, V., Guainazzi, M., Bianchi, S., Andruchow, I., García, F., López, I., & Salerno, N. (2021). The excitation mechanisms of X-ray oxygen emission-lines. In T. Storchi-Bergmann, W. Forman, R. Overzier, & R. Riffel (Eds.), *Galaxy Evolution and Feedback across Different Environments: Proceedings IAU Symposium No. 359, 2020* (pp. 360-361). (Proceedings IAU Symposium ; Vol. 15, No. S359). International Astronomical Union. <https://doi.org/10.1017/S1743921320002057>

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The excitation mechanisms of X-ray oxygen emission-lines

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Abstract. We present the Catalogue of High REsolution Spectra of Obscured Sources (CHRESOS) from the *XMM-Newton* Science Archive. It comprises soft X-ray emission-lines from C to Si and the Fe 3C and Fe 3G L-shell transitions. Here, we concentrate on the oxygen emission-lines O VII(f) and O VIII Ly α to shed light onto the physical processes with which their formation can be related to: active galactic nucleus vs. star-forming regions. We are analysing the relationships between the oxygen lines and the luminosities of: [OIII] λ 5007, [OIV]25.89 μ m, MIR-12 μ m, FIR-60 μ m, FIR-100 μ m, and hard X-rays continuum bands.

Keywords. line: formation, plasmas, galaxies: active, galaxies: Seyfert

1. The data and the astrophysical question

The Catalogue of High REsolution Spectra of Obscured Sources (CHRESOS) arises from RGS (Reflection Grating Spectrometer onboard *XMM-Newton*; [den Herder et al. 2001](#)) data of 62 nearby ($z < 0.07$), Seyfert-type active galactic nuclei (AGNs). The data were obtained from the *XMM-Newton* Science Archive (XSA). CHRESOS gathers for the first time the soft X-ray emission-line luminosities of H-like and He-like transitions from C to Si, and the Fe 3C and Fe 3G L-shell transitions. We focus our analysis on two important oxygen emission-lines: O VII(f) (0.561 keV) and O VIII Ly α (0.654 keV). We are currently analysing them with multiwavelength (MW) nuclear data: Continuum Fluxes in 14-195 keV, 2-10 keV, Mid-Infrared (MIR)-12 μ m, Far Infrared (FIR)-60 μ m, and FIR-100 μ m continua, and fluxes of two other important oxygen lines: [OIII] λ 5007 in the optical, and [OIV]25.89 μ m in the IR. Since we are probing into the formation mechanism of O VII(f) and O VIII Ly α , the MW data were chosen because of their known relationships with the two scenarios from where these emission-lines can emerge: the AGN and the (nuclear/near nuclear) star-forming regions, or starbursts (SB).

We show some preliminary results in Figure 1. The two diagrams represent the luminosity of O VII(f) and O VIII Ly α against that of [OIII] λ 5007 and FIR-100 μ m, respectively. The former as a proxy of the AGN ionizing power in the Narrow-Line Region (NLR; e.g. [Bassani et al. 1999](#); [Schmitt et al. 2003](#); [Heckman et al. 2005](#); [LaMassa et al. 2010](#);

Figure 1. *Left:* diagram of O VII(f) luminosity vs. [OIII] λ 5007 (NLR, AGN ionizing power). *Right:* luminosity of O VIII Ly α vs. FIR-100 μ m continuum (star formation indicator). Seyfert 1-1.2 sources are plotted as empty (red) circles; Seyfert 1.5-1.9 as (blue) asterisks, and Seyfert 2 as filled (black) squares; unclassified sources were drawn as empty (orange) diamonds.

Zhang & Feng 2017), and the the latter as that of star-forming regions (Rodríguez-Espinosa *et al.* 1986, 1987; Mouri & Taniguchi 1992; Hatziminaoglou *et al.* 2010). The sources are described in Fig 1. The continuous line in each diagram represents the best linear fitting (in log space). The data of [OIII] λ 5007 were collected from Schmitt *et al.* (2003); Heckman *et al.* (2005) and Panessa *et al.* (2006); and that from FIR-100 μ m continuum was obtained from Sanders *et al.* (1989, IRAS).

So far, we have found that O VII(f) and O VIII Ly α luminosities are strongly related to [OIII] λ 5007, [OIV]25.89 μ m, MIR-12 μ m, and the two primary continuum X-ray bands. However, the relationships that point to an origin from the star-forming regions are also meaningful. The two relationships shown in Fig. 1 are statistically significant (90% confidence level) in spite of the small sample size in each diagram (28 and 17 data points, respectively). We continue analysing these relationships and their statistical significance, in order to disentangle the main ionizing mechanisms taking place in the soft X-ray emitting gas.

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