
# INVESTIGATION OF COMPTON-THICK SOURCES

By

**Reham Mostafa Ayoub**

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Faculty of Science
Fayoum University

**Under the supervision of**

Prof. Dr. Naglaa Rashid Said
Professor of Nuclear Physics, Physics department
Faculty of Science, Fayoum University
Signature:

Prof. Dr. Alaa Ibrahim Hussein
Professor of space astrophysics, Physics Department
Zewail University in Cairo
Signature:

Prof. Dr. Matteo Guainazzi
Professor of space astrophysics
European Space Agency- ESA
Signature:

# Approval Sheet

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This thesis for Ph.D degree has been by:

Prof. Dr. Naglaa Rashid Said
Professor of Nuclear Physics, Physics department
Faculty of Science, Fayoum University
Signature:

Prof. Dr. Alaa Ibrahim Hussein
Professor of space astrophysics, Physics Department
Zewail University in Cairo
Signature:

Prof. Dr. Tarek Hussien
Professor of Physics, Physics department
Faculty of Science, Cairo University
Signature:

Prof. Dr. Francisco J. Carrera
Professor of space astrophysics
IFCA, Department of astrophysics, Santander, Spain
Signature:

## ABSTRACT

Most Active galactic nuclei (AGNs) are obscured by large column densities of cold and neutral gas. If the X-ray obscuring matter has a column density equal to or larger than the inverse of the Thomson cross-section ($N_H \geq \sigma_T \approx 1.5 \times 10^{24}$ $cm^{-2}$), then the source is identified as a Compton-thick AGN. If the X-ray obscuring matter has a column density $N_H < 1.5 \times 10^{24}$ $cm^{-2}$ the dominant X-ray absorption mechanism is photoelectric absorption, and hard X-rays (2-10 keV) can still be detected through the obscuring matter. However, for column densities above $10^{24}$ $cm^{-2}$ the attenuation of X-rays is dominated by Compton scattering on electrons rather than photoelectric absorption. If the column density does not exceed a value of order $10^{25}$ $cm^{-2}$, then the nuclear radiation is still visible above 10 keV, and the source is called mildly Compton thick. For higher column densities (heavily Compton thick), the entire high energy spectrum is down-scattered by Compton recoil and hence depressed over the entire X-ray energy range

One of the characteristics of Compton-thick AGN is the presence of Fe Kα emission line in their spectra with a large equivalent width. Using this criterion with XMM-Newton observations we identified Compton-thick AGNs by following a selection method, the FLEX algorithm, to search for X-ray line emitting objects (XLEOs). This technique detects the sources having significant excess of photons resulting from the iron emission line. Here we present the results from applying this method on the 28 highly absorbed AGNs. Of these 28 AGN, 15 are candidate Compton-thick AGN. We applied the detection algorithm on a pilot sample of 40 XMM-Newton observations. Our results confirm the Compton-thick nature of 14 of Compton-thick AGN, based on the observed properties of the Fe Kα emission line. We use the characteristics of the observed lines to diagnose the AGNs and their environments.

We present a selection technique to detect Compton-thick AGNs (CT) in the 3XMM/SDSS-DR7 cross-correlation. A subsample of 3481 X-ray sources that are detected in the hard band (2-8 keV) and have photometric redshifts constitute our parent sample. We first applied an automated spectral-fitting procedure to select highly absorbed sources ($N_H > 10^{23}$ $cm^{-2}$). We found 184 highly absorbed candidates. Then, we performed the Bayesian Monte Carlo Markov Chains (MCMC) selection technique to find Compton-thick AGNs. We also tested the MCMC selection technique by applying Monto-Carlo simulations. We found that the method is accurate at 90 per cent independently of the nature of the underlying source. Our sample contains 52 *bona fide* Compton-thick AGNs. The CT AGNs were selected to have a range > 0.75 of probability of being CT when either fitting with the two models Torus and MYTorus. About 75 per cent of Compton-thick AGNs in our sample had probabilities > 90 per cent. From the spectral analysis, we significantly found an anti-correlation between the equivalent width (EW) of the neutral Fe kα line and the X-ray luminosity at 2-10 keV, the so-called X-ray Baldwin effect.