UNIVERSITY OF AMSTERDAM

MSc Physics and Astronomy
Track: Astronomy & Astrophysics

Master Thesis

A Cosmic Cannibal Seen Through the Eyes of a New X-Ray Telescope:

Probing the Ionized Disk Atmosphere of 4U 1916–053

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by

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Abstract

4U 1916–053 is an ultra-compact neutron-star low-mass X-ray binary (LMXB) with an orbital period of about 50 minutes and is one of the best-studied “dipper” systems, showing periodic intensity drops caused by variable absorption in the accretion-disk atmosphere.This thesis presents a high-resolution spectroscopic study of 4U 1916–053, leveraging newly obtained XRISM observations and archival XMM-Newton data. The primary goals of this work are to systematically investigate the structure, ionization state, and dynamics of the disk atmosphere, and to explore their evolution with orbital phase and dipping activity. A central part of our analysis will be to search for signatures of ionized outflows and to evaluate the influence of transient thermonuclear bursts on the local accretion environment. By constructing phase- and time-resolved spectra, this study aims to characterize the physical conditions of the absorbing plasma and its variability during both dips and bursts. We will pay particular attention to higher-energy spectral features to trace the motion and ionization of inner-disk material, which may elucidate potential wind launching mechanisms. The combination of XRISM’s unprecedented spectral resolution with XMM-Newton’s complementary coverage is expected to provide new constraints on the geometry, composition, and variability of ionized plasma around neutron stars. This work will contribute to a broader understanding of the interactions between accretion, ejection, and nuclear burning in compact X-ray binaries.

Keywords: Neutron Stars, X-ray Binaries, 4U 1916–053, XRISM, XMM-Newton, Accretion Disks, Bursts, High-resolution Spectroscopy.