17587 - Fast Variability of the Inner Accretion Flow in Transitional Millisecond Pulsars: a Multi-Wavelength Campaign to Unveil Mode Switching

Cycle: 31, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) 3FGLJ1544.6-1125	STIS/CCD STIS/NUV-MAMA	1	23-Jan-2024 11:00:42.0	yes

1 Total Orbits Used

ABSTRACT

Transitional millisecond pulsars exhibit a peculiar X-ray sub-luminous disk state that features characteristics of both rotation-powered radio pulsars and accretion-powered X-ray pulsars. In this state, switching between two distinct intensity levels, dubbed high and low modes, is observed in both X-rays and optical/UV bands. For the prototype PSR J1023+0038, it was suggested that fast variations of the inner accretion flow might be at the origin of the observed mode-switching phenomenon. To better understand the physical mechanisms driving these transitions, we are organizing the first high-time resolution multi-wavelength campaign on the robust candidate transitional millisecond pulsar 3FGL J1544.6-1125, exploiting recently approved high-time resolution observations with the quintuple-beam imager HiPERCAM, at the 10.4m GTC, and ToO observing programs with XMM-Newton and NuSTAR. High-time resolution UV observations have never been performed on this source, but we expect, given its brightness, to allow a similar study as performed for PSR J1023+0038. We will investigate the timescales of mode-switching in 3FGL J1544.6-1125, assessing their compatibility with the proposed model for PSR J1023+0038. We will model broadband spectral energy distributions, separately extracted during the high and low modes. Such analyses are pivotal in refining and constraining the considered model, enhancing our efforts to understand this intriguing phenomenon. We found a candidate pulsed signal with the fast optical photometer TNG/SiFAP2. The proposed observing campaign also aims at confirming the hint of detection or put stringent upper limits on the fractional amplitude.

OBSERVING DESCRIPTION

We ask to observe 3FGL J1544.6-1125 in the time interval:

2024-02-08, 04:30-06:30 UTC (60348.18750000 - 60348.27083333 MJD)

This visit will consist in one HST orbit during which we will carry out time-resolved NUV TIME-TAG spectroscopy with the STIS/NUV-MAMA/G230L instrument/grating combination. We will use the 2376 A setting for this observation to achieve continuous wavelength coverage between 1570 A and 3180 A, with the 52X0.2 slit. The TIME-TAG mode of STIS will provide a maximum time resolution of 125 micro-s, fast enough to resolve high/low mode transitions and to search for pulsations at millisecond periods in the Near-UV band.

We will observe simultaneously with 10.4m Gran Telescopio Canarias and X-ray telescopes.

Visit

Proposal 17587, Visit 01, implementation

Tue Jan 23 16:00:42 GMT 2024

Diagnostic Status: No Diagnostics

Scientific Instruments: STIS/NUV-MAMA, STIS/CCD

Special Requirements: BETWEEN 08-FEB-2024:04:30:00 AND 08-FEB-2024:06:30:00

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	3FGLJ1544.6-1125	RA: 15 44 39.3674 (236.1640308d) Dec: -11 28 4.68 (-11.46797d) Equinox: J2000	Proper Motion RA: 19.754 mas/yr Proper Motion Dec: -12.541 mas/yr Epoch of Position: 2000.0	V=19	Reference Frame: ICRS

Comments:
Category=STAR
Description=[ACCRETION DISK, BINARY PULSAR, NEUTRON STAR, PULSAR]

Exposures

#	Label (ETC Run)	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	(1900528)	(1) 3FGLJ1544.6-1125	STIS/CCD, ACQ, 50CCD	MIRROR				7 Secs (7 Secs) *[==>]*	*[1]*
2	(1900400)	(1) 3FGLJ1544.6-1125	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=1165			2130 Secs (2121 Secs) *[==>2121.0 Secs]*	*[1]*

Orbit Structure