17245 - Unveiling the UV pulse emission mechanism in the accreting millisecond X-ray pulsar SAX J1808.4-3658 during its 2022 outburst

Cycle: 29, Proposal Category: GO/DD

(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) SAXJ1808.4-3658	STIS/CCD STIS/NUV-MAMA	1	31-Aug-2022 19:00:13.0	yes

1 Total Orbits Used

ABSTRACT

Millisecond pulsars (MSPs) are the fastest spinning compact stars known to date. They can appear as radio pulsars powered by the rotation of the NS magnetic field or accreting X-ray pulsars powered by the accretion of mass transferred by a companion star. The accreting millisecond X-ray pulsar

SAX J1808.4-3658 has revealed an abrupt increase in intensity beginning in 19 August 2022, indicating the onset of a new outburst. This activity has never been observed since the last outburst in 2019. During the outburst this source emits X-ray pulsations at the neutron star spin period, which have been already detected with NICER. Ultraviolet millisecond pulsations have also been detected from SAX J1808.4-3658 during its 2019 outburst with HST/STIS, representing the first discovery of this kind in accreting MSPs. For the first time in forty years of pulsar studies, we might have witnessed that electrons are accelerated to relativistic energies by the rotation of the neutron star magnetosphere even during the accretion phase. To probe the nature of this new phenomenon, we require disruptive activation time to observe SAX J1808.4-3658 with HST STIS/NUV-MAMA instrument combination to study UV pulses during the 2022 outburst. The detection of UV pulsations close to the peak of the outburst, when the mass accretion rate is maximum, would allow us to probe the UV pulse emission mechanism over a range of mass accretion rates spanning 2-3 orders of magnitude.

OBSERVING DESCRIPTION

We ask to observe SAX J1808.4-3658 with HST during its 2022 outburst. This visit will consist in one HST orbits 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 \AA setting for this observation to achieve continuous wavelength coverage between 1570 \AA and 3180 \AA, with the 52X0.2 slit. The TIME-TAG mode of STIS will provide a maximum time resolution of 125 μs, fast enough to resolve pulsations at 2.5 ms (NS pulse period) in the Near-UV band. We will use precise and updated ephemeris of the 2022 outburst measured by the timing analysis of X-ray NICER data to study the pulses in NUV band.

Visit

Proposal 17245, Visit 01, implementation

Wed Aug 31 23:00:14 GMT 2022

Diagnostic Status: No Diagnostics

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

Special Requirements: (none)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	SAXJ1808.4-3658	RA: 18 08 27.6200 (272.1150833d) Dec: -36 58 43.30 (-36.97869d) Equinox: J2000		V=18	Reference Frame: ICRS

Comments:
Category=STAR
Description=[ACCRETION DISK, BINARY PULSAR, LMXB, 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		(1) SAXJ1808.4-3658	STIS/CCD, ACQ, 50CCD	MIRROR				5 Secs (5 Secs) *[==>]*	 ***[1]***
2	(STIS.sp.18 19126)	(1) SAXJ1808.4-3658	STIS/NUV-MAMA, TIME-TAG, 52X0.2	G230L 2376 A	BUFFER-TIME=685			2240 Secs (2240 Secs) *[==>]*	 ***[1]***

Orbit Structure