2022

Science Objectives of the XRISM Performance Verification phase target teams science plan

XRISM Science Team

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1. Priority A targets

1.1 Galactic Compact sources

4U 1916-054 / 4U 1624-490

Observation plan

1. 4U 1916-054 will be observed for 50 ks, from which we expect we expect in total 40 ks of persistent emission and ~10 ks of dipping emission. We ask the observation to to be split in two parts taken a few days aside to maximise the chances to obtain deep dips in at least one of the exposures. This is driven by the fact that XB 1916−053 has been occasionally observed at periods when the dips were very narrow and shallow, which are worse for the proposed studies, compared to periods of wide, deep dips.
2. 4U 1624-490 will be observed for a total of 50 ks. We also ask to divide this observation in two parts of 25 ks each. In this case, the purpose is to have each of the parts centred at one dip, since the orbital period is too long (21 hours or 76 ks) to get two full dips if the exposure is uninterrupted. The dip ephemeris (easily measurable with MAXI) will be provided to the planning team in due time. We will then get a total dip exposure of 30 ks (15 ks per dip), which result in a minimum of ~6 ks exposure per flux level within dips (considering 5 flux levels).

For both targets, we request the open filter for Resolve (expected count rates are 16.7 s^{-1} for 4U 1916-054 in persistent emission and 21.4 s^{-1} for 4U 1624-490 during shallow dipping). For Xtend we request the 1/8th Full Window Mode for both targets (expected count rates are 15.8 s^{-1} in persistent emission for 4U 1916−053 and ~24.6 s^{-1} during shallow dipping for 4U 1624−490).

Immediate objectives

[1] Measure the column density, ionization and velocity of the plasma or plasmas present during persistent emission to determine if a wind is present (and if so measure its mass outflow rate) or rather a static atmosphere or hot corona.

[2] Measure the column density, ionization and velocity of the plasma or plasmas present during dipping emission in a flux- and phase-resolved manner to constrain the geometry of the plasma or plasmas responsible for the obscuration during dipping. In particular, attempt to determine the precise location of the lines (e.g. low ionization lines could be on the stream of cold material towards the disc, at the zone of impact with the disc or even further inside the disc) to understand the relation between low and high ionization plasmas, e.g. whether they might result from a thermal instability.

[3] Attempt to detect emission lines (e.g. He-like triplets from O VII or Mg XI) during the deepest dipping episodes or absorption lines from meta-stable levels (e.g. Fe XXII) that can help constraining the density of the plasmas.

[4] For 4U 1916-054, measure the phase-dependence of absorption lines width and shift to locate the region in the disc where the plasma originates and confirm the presence of a gravitationally shifted atmosphere.

[5] Study the dependence of the presence of dips or of the detected plasmas as a function of changes in the continuum (luminosity and hardness) e.g. to constrain if radiation pressure may help launching a wind and to further understand potential shielding in the disc.

If X-ray bursts occur during the observations:

[6] Study the dependence of the presence of dips or of the detected plasmas following the X-ray burst to further constrain the effects of illumination on the existing plasmas (and the recombination timescales), the capability to launch a wind via radiation pressure, and the location of the plasmas.

[7] If the bursts show photospheric radius expansion, search for lines within the bursts that can be attributed to the spread of burst products in the corona or on the surface of the accretion disc. This could be the first detection of such products.

GX13+1

Observation plan

30ks neutral density filter and offset pointing to reduce count rate to 100c/s in Resolve. This observation – actually this will be 40ks due to the overlap in target with the Galactic Diffuse observation (GX 13+1 halo).

1/8 window mode for Xtend.

Immediate objectives

[1] measure the FeXXVI absorption line profile (this is the simplest, strong line seen) to distinguish between magnetic and thermal/radiative wind launch mechanisms (ion column along the line of sight as a function of velocity)
[2] measure the emission line contribution to FeXXVI to determine the solid angle of the wind.
[3] measure all ion columns as a function of velocity to determine the radial density profile of the wind to give an independent diagnostic of the wind launch mechanism. (paper 2)
[4] use the variability of the hard X-ray source on short timescales to explore the response of the wind and get an independent diagnostic of the wind density structure

Cyg X-1

Observation plan

We perform a continuous 100 ksec observation with no constraint on source state or orbital phase.

<Adopted filter/mode>
Resolve: Be filter (26um), placing the source in one quadrant of the array
Xtend: 1/8 burst mode

Immediate objectives

[1] establish a way of analyzing a bright point source
[2] precisely measure the iron emission/absorption lines and other narrow features, with the goals, as far as data quality due to the brightness of the source allows:
    [a] reveal warp of the accretion disk
    [b] study the Fe abundance in the system
    [c] Check for asymmetric line broadening to constrain weak relativistic Doppler and gravitational shifts
    [d] Discover whether or not winds are launched from the accretion disks in wind-fed HMXBs

SS 433

Observation plan

We perform a continuous 80 ksec observation around an eclipse: a 50 ksec exposure during an ingress or egress and a 30 ksec exposure before the start of the ingress or after the end of the egress.

<Adopted filter/mode>
Resolve: no filter
Xtend: full window mode

Immediate objectives

[1] measure the velocity dispersions of ionized metals in different regions of the jets, to investigate whether or not the jets are progressively collimated.

[2] compare the spectra taken in a non-eclipse phase and an eclipse phase (in which the innermost region of the jet is hidden) to study the distributions of temperature and ionization state in the jets.
[3] measure the metal abundance in the jets.

Cyg X-3

Observation plan

A single 40 ks observation, as nearly contiguous as possible in order to observe the spectrum around 2.3 orbits. The observation may need to use offset pointing if the source is in a historically bright state.

Immediate objectives

[1] We want to observe the emission and absorption spectrum at high resolution in order to characterize the gas. Under the assumption that the fluorescent Fe Kalpha line is associated with the compact object, we hope to refine the measurement of the Doppler shift due to the orbital motion. This will then allow a more accurate measurement of the mass of the compact object.
[2] We want to use the spectrum to infer what is the dominant ionization parameter, temperature, elemental composition (assumed to be constant) around the orbit. Of particular interest is the iron line, which shows absorption near ~6.5 keV, suggesting the presence of a disk wind or possibly a jet. If so, the line profiles of the trough may give some clues as to the origin.
[3] Depending on the spectral state of the source it may be possible to search for X-ray evidence for the jets seen in the radio band.

Cen X-3

Observation plan

We propose an entire coverage of the 2.08 day binary orbit of Cen X-3 to map the wind velocity fields around the O star by tracing the photo-ionized line profiles with Resolve.

If the observing efficiency is 50%, this is equivalent to 90 ks exposure. We request a continuous observation. One pointing with no time constraint. Open filter for Resolve. Full window for Xtend.

Immediate objectives

[1] Detect and measure the line profiles of major photo-ionized lines over an entire orbital period, and interpret the result based on X-ray Doppler tomography.
[2] Fe Ka fluorescence during the eclipse.

eta Carinae

Observation plan

1 pointing for 100 ksec centered at the central binary system. XRISM can observe the star anytime in the available observing window as the binary is near apastron of a 5.5-year, highly eccentric orbit in 2023 (phi ~0.6). Resolve uses no filter (open) option.

Immediate objectives

[1] Measure the hot plasma emission line profiles to understand the shock heating mechanism of the wind-wind colliding X-ray plasma
[2] Measure the fluorescent Fe emission line profile to understand the dynamics of the primary

star wind

[3] Measure the emission line profiles of the extended (~1') soft X-ray nebula surrounding eta Carinae to understand the origin of the soft diffuse X-ray nebula and its connection to the Great eruption in the 1840s, which produced the bipolar Homunculus nebula.

V834 Cen

Observation plan

100 ksec, single pointing, filter=OPEN, MXS=no preference,
Non-ToO observation (but prefer to observe in the high state if possible; see below)
No phase constraint (Spin period = 1.691 hr)
Visibility opens during 2 July --14 Sep and 2 Jan – 12 Mar

Immediate objectives

[1] To demonstrate the new plasma diagnostic using optically thick resonance photons under optically-thin Collisional-Ionization-Equilibrium (CIE) plasma column, by measuring the enhancement of Fe-K resonance line in the pole-on phase.

[2] To perform the benchmark test of the CIE-plasma code under the multi-temperature cooling-flow site on the magnetic cataclysmic variables (MCVs), using the plasma density derived from the method in [1] using the enhancement of the Fe-K resonance lines and comparing with the density diagnostic using Fe-K satellite lines.

[3] To probe the cooling flow structure of the accretion column on MCVs, by measuring the line intensities and energies (inc. Doppler shifts and widths) from multiple atomic lines (Fe and lighter elements).

GT Mus

Observation plan

The main purpose of the XRISM observations is to detect non-thermal signatures during stellar flares in a magnetically active star. GT Mus was chosen as a good candidate, although any other magnetically active star satisfying the triggering conditions may be observed instead.

To trigger the XRISM observation, we require that MAX will alert us of a giant flare in GT Mus or any other magnetically active star, and confirm the stellar nature of the source by NICER, onboard the International Space Station (OHMAN). These observations will also allow us to determine rapidly the flux level and confirm the long duration of the flare. ISAS has the capacity to trigger NICER observations based on MAXI results. Based on the MAXI and NICER information, the XRISM observation will be triggered.

XRISM will then make one single pointed observation of 90 ksec. The OPEN filter will be used with Resolve and the FULL window for Xtend.

Immediate objectives

[1] Measure Doppler shifts of multiple lines
[2] Detect deviations from collisional ionization equilibrium (CIE)
[3] Constrain flag geometry from neutral Fe I Kalpha

SS Cyg

Observation plan

We will trigger the outburst observation as a ToO when its visual magnitude becomes less than 10th (mV < 10), by monitoring SS Cyg using AAVSO data or by monitoring SS Cyg by ourselves. The outburst observation, again as a ToO, should be started at 1-4 days after the trigger is made.

We will trigger a quiescence observation after the outburst state finishes. The outburst normally continues 10-20 days. We will declare the end of the outburst state. The quiescence observation should be started within two weeks after our declaration.

SS Cyg is not extremely intense both in outburst and quiescence. We therefore do not need any filter for Resolve. Both observations are approved with the exposure time of 100 ks for each. We need just one pointing for each observation.

Immediate objectives

[1] Measure profiles of He-like and H-like iron emission lines to identify the location of X-ray-emitting hot plasma in outburst.

[2] Measure profile of a 6.4 keV emission line, resolving a narrow and a broad component, to understand the geometry of the X-ray-emitting hot plasma in relation to the white dwarf and the accretion disk in outburst.

[3] Measure profiles of He-like and H-like emission lines from oxygen to iron to elucidate radial profile of the X-ray-emitting hot plasma and to search for evidence of ionizing plasma at the entrance of the boundary layer in quiescence.

[4] Measure profile of a 6.4 keV emission line, resolving a narrow and a double-horn component, to understand the heating process and the radial profile of the X-ray-emitting hot plasma in quiescence.

[5] Measure gravitational redshift of the 6.4 keV emission line to evaluate the mass of the white dwarf in SS Cyg, using the data in quiescence. Outburst data may also be useful.

T CrB

Observation plan

- A single, 150 ks, TOO observation, to be triggered when the hard X-ray flux has recovered to the historical level.
- Trigger to be based on X-ray all sky monitors (Swift/BAT, MAXI) supplemented by pointed Swift/XRT observations. The estimated trigger probability is low (~0.2), based on its historical behavior.
- Once it returns to the X-ray bright state, T CrB is likely to stay bright for months or years; rapid reaction is not necessary.

Immediate objectives

To measure the gravitational redshift of the 6.4 keV line from the white dwarf surface, and hence to measure the white dwarf mass. The gravitational redshift is a steep function of mass near the Chandrasekhar limit, so the accuracy to which mass can be determined is excellent in the most interesting case of a near-Chandrasekhar mass white dwarf. On the other hand, we cannot specify the accuracy to which we will measure the mass without knowing what the mass is.

1.2 Galactic Diffuse sources

SN 1006

Observation plan

- Priority A: NW (60 ks), Center (20 ks)
- Priority C: SE (80 ks)

Immediate objectives

[1] Measure ion/electron temperatures at the immediate postshock region of the NW rim to constrain the efficiency of the collisionless electron heating.
[2] If the SE shock (where the shock velocity is different from that in the NW shock) is observed, we will compare the ion/electron temperatures to investigate the velocity dependence of the collisionless electron heating.
[3] We will measure Doppler shift of lines in the Center observation data to measure the expansion speed of the remnant. The line strength difference (emission measure difference) between red-shifted and blue-shifted components will show us the asymmetry in the direction of line-of-sight. We will also make a single shot image of the entire remnant with Xtend.

SN 1987A

Observation plan

We will perform a single observation with an exposure time of 100 ks. Resolve and Xtend will be operated with an open filter and normal full window mode, respectively.

Immediate objectives

[1] Spectroscopically characterize the ejecta component to constrain the progenitor and the explosion mechanism
[2] Spectroscopically characterize the CSM components to constrain the early phase evolution of the remnant and the progenitor's stellar wind structure
[3] Measure line broadenings to study collisionless shock heating
[4] Search for pulsation from the putative NS

Cygnus Loop

Observation plan

We are planning to observe three pointings in northeastern regions — the P7 and NE rims — of the Cygnus Loop. Two of the three pointings are used to derive a radial variation of the P7 rim (hereafter, P7out and P7in); the remaining single pointing is for an observation of the brightest position in the NE rim, where no CX is expected. To have good statistics, we will limit position angles so that the outermost edge of the Resolve FoV is along the shock fronts. The position P7in should be adjacent to that of P7out. Exposure times are 50, 30, and 20 ks for P7out, P7in, and NE, respectively.

Immediate objectives

[1] Search for evidence of charge exchange X-ray (CX) emission to understand the SNR shock physics.
[2] Search for evidence of resonance scattering (RS) to constrain a line-of-sight plasma depth and/or turbulent velocity.
[3] Measure absolute abundances of elements (C, N, …, and Fe) to reveal the metallicity of ISM (or CSM) around the Cygnus Loop particularly in relation to a so-called “low-abundance problem”.

Tycho’s Supernova Remnant

Observation plan

We plan to perform a 75-ks observation of the “Fe knot” located at the SE corner of the SNR. We will devote another 75 ks to the central part of the SNR. To map the whole remnant, we foresee a series of 20-ks observations (accepted as priority C) targeting the N, NW, SW, S, and NE regions. No roll angle constraints are necessary for all the pointings.

Immediate objectives

[1] Measure the ion temperatures of each element of the reverse-shocked ejecta.
[2] Constrain the progenitor of the Type Ia explosion based on metal abundances.
[3] Search for emission from forward-shocked ISM/CSM.
[4] Measure the bulk velocities of each ejecta species.
[5] Probe the spatial distribution of the ion temperature and ejecta elements by mapping the whole remnant.

W 49 B

Observation plan

Two observations covering the entire SNR of 4x3 arcmin2 with an overlap at the center, with a 100 ks effective exposure for each. The observations are not time critical and do not have roll-angle constraints. The open position of the filter wheel is chosen for Resolve and normal window/clocking mode for Xtend.

Immediate objectives

[1] Measure the electron temperature and Fe and Ca ionization temperatures (charge-state distributions) to determine the physical parameters characterizing the recombining plasma, such as the recombination timescale and initial ionization temperatures.
[2] Measure the Fe ion temperature and its ratio to the electron temperature to constrain the cooling mechanism that produced the recombining plasma.
[3] Measure the elemental abundances and mass ratios of the Fe-peak elements in the ejecta, such as Ti, Cr, Mn, Fe, and Ni, to identify the progenitor.
[4] Detect and study odd-Z elements with lower atomic numbers in the ejecta, such as Al, Na, and P, to probe the initial metallicity of the progenitor.

Cas A

Observation plan

A single 50 ks pointing in the SE region of Cas A centered at RA=23:23:36.7, Dec=+58:48:42.0. No time constraints. Once the observation is scheduled and the roll angle is known, it may be desirable to adjust the pointing. The open position of the filter wheel is chosen for Resolve and the normal window/clocking mode for Xtend.

Immediate objectives

[1] Detect emission from and measure the abundances of Na, Al, P, Cl, K, Ti, Mn, Cr & Ni.
[2] Detect and characterize spectral dust signatures.
[3] Measure Doppler shifts/broadening due to bulk motions and thermal broadening.
[4] Characterize plasma conditions: electron temperatures, ionization temperatures, ionization timescales, & abundances

Galactic Center

Observation plan

The PV observation will aim to three positions with 100 ks exposure for each pointing.

- the Galactic center (Sagittarius A*; GC-1)
- the ~6' eastern side (GC-2)
- the ~6' western side (GC-3)

No roll angle constraint is requested. The last one is priority C. Resolve will work with no filter. Xtend operating mode is full window with normal clocking.

Immediate objectives

[1] Measure the properties of the GC plasmas (electron/ion/ionization temperatures, metal abundances)
[2] Measure the dynamics of the GC plasma and X-ray emitting cold gas
[3] Probe the photoionization and scattered X-rays from Sgr A* (X-ray reflection nebulae)
[4] Probe the KaL1 and KaL2 lines associated with the Fe Kα lines produced by low energy cosmic-ray protons
[5] Clarify the origin of the recombination plasma of Sgr A East by plasma diagnostics
[6] Monitor Sgr A* flares

GX 13+1 Dust Scattering Halo

Observation plan

Pointing 1: 40 ks, on-axis observation of GX 13+1 with Neutral Density Filter (NDF), Xtend in ⅛ window + 0.1s burst mode.
Pointing 2: 50 ks, 3 arcmin off-axis observation of GX 13+1 with open filter, Xtend in full window mode (possibly with 0.1s burst mode).
Roll Angle for Pointing 2: We are attempting to orient the Resolve chips so that it stays in the shadow of the mirror support structures. A roll angle on the order of 45, 135, 225, or 315 (+/- 15 degrees) should be fine. We will finalize this decision in consultation with the XMA calibration team.
The final Xtend observational setup needs to be finalized by consultation with the Xtend team.

Immediate objectives

[1] Measure the intensity of the scattering halo relative to the point source in order to measure the abundance of large (0.5 micron scale) dust grains in the diffuse ISM.
[2] Apply laboratory templates of astrosilicate materials to the Si K shell X-ray Scattering Fine Structure (XSFS) features in the GX 13+1 scattering halo to identify the dust compounds responsible for X-ray scattering by the ISM.
[3] Search for XSFS from Mg K shell (1.3 keV, visible in Chandra HETG) to further constrain the mineralogical compound responsible for X-ray scattering by the ISM. A simultaneous fit to the Si K and Mg K shell XSFS will provide the best possible mineral identification.s

GX340+0

Observation plan

- 150 ks
- Resolve: Open filter; -0.4', -0.4' offset in detector coordinates*
- Expected count rate: 137 ct/s
- The pointing offset will be finalized in consultation with the Bright Sources Working Group.

The current offset reflects the latest work.

- Xtend mode: Planning for ⅛ window (CCD1 & CCD2) in 0.1s burst mode while CCD3 & CCD4 are in normal mode. However, the setup will be finalized in consultation with the Xtend team.
- Observation can be split as needed

Immediate objectives

[1] Identify foreground interstellar dust compounds from a simultaneous fit for the K-shell edges of Si (1.8 keV) and Fe (7.1 keV)
[2] Distinguish among solid compounds and gas phase in the K-shell edges of S (2.5 keV) and C (4.1 keV), for the first time
[3] Use observations of the Fe XXV triplet at 6.7 keV to distinguish between models of relativistic emission versus absorption from a high speed outflow

Comet

Observation plan

The comet target team recommends C/2021 S3 (PanSTARRS), a comet of approximately the peak optical magnitude (6-7) which meets the observing constraints for XRISM and will be available around March 2024. C/2021 S3 reaches closest approach of approximately 1.26 AU during the prime observing period, requiring repointing of XRISM once per hour during the observation time along a pre-defined path. This same operation was successfully performed during the PV comet observation for Suzaku. We will use the Resolve filter wheel in its OPEN position, and no special modes for XTEND are required.

Immediate objectives

[1] Measure detailed spectral signature of charge exchange from a solar system object
[2] Benchmark spectral synthesis codes (e.g., AtomDB and SPEX codes, and Kronos database)
[3] Measure chemical abundance of solar wind ions and cometary neutrals (will be challenging with the 100ks currently in the PV plan)

1.3 Extra-Galactic Compact sources

Cen A

Observation plan

A single 100 ks observation

Immediate objectives

[1] Measure a fluorescence Fe-Ka line profile to constrain the accretion geometry by Doppler/relativistic effects.
[2] 2. Detect ionized Fe-K absorption lines to measure a velocity, ionization, column density to constrain physical parameters of warm absorbers and/or UFO.
[3] 3. Detect flux variability of a 6.4 keV Fe-K line, photoelectric absorption (Fe-K edge, NH, ...), and ionized Fe-K abs lines.
[4] 4. Search for shock features caused by jet interaction in the soft thermal emission.

Circinus Galaxy

Observation plan

- We perform a 100 ksec continuous observation.
- Resolve: no filter
- Xtend: full window mode

Immediate objectives

[1] determine torus structure from the Fe-K line profile including Compton shoulder
[2] determine metal abundances in the torus region and detect signals from polar dusty outflow, using neutral fluorescence lines of multiple elements
[3] determine kinetics of photoionized plasma using emission lines from highly ionized ions

MCG—6-30-15

Observation plan

Our PV proposal for MCG6 was approved for a single 100-ks exposure at priority A. The observation is not a ToO, so it requires no trigger. We require no filter for Resolve and select 1/8 window mode for Xtend to avoid pile-up in case the source is caught in an historically high flux state.

Immediate objectives

[1] Determine whether relativistic reflection is seen in MCG6 using its time-averaged spectrum, time-resolved spectrum, RMS variability analysis and time lag analysis.
[2] If relativistic reflection from the inner disk is seen, determine whether the black hole spin derived by XRISM is consistent with previous measurements.
[3] Characterize the holistic properties of the warm absorber, including saturation and partial-covering effects, to determine the total energetic output of the outflowing wind; investigate the outflow energy and momentum transfer mechanism through the ISM by comparing the momentum rate of the X-ray warm absorber and that of the molecular outflow.
[4] Measure any differences between the inner and outer disk geometries.

NGC 1365

Observation plan

Our target was approved at Priority A for two 125 ks exposures taken several days to weeks apart. The observation is not a ToO, so it requires no trigger. We require no filter for Resolve and select full window mode for Xtend.

Immediate objectives

[1] **Resolve Fe XXV, Fe XXVI Kα, Kβ absorption lines and search for the corresponding emission (if found in Compton-thin state)**. Measuring P- Cygni profiles from winds would put unprecedented constraints on the covering fraction and launching radius of an extreme, ionised wind. With our ideal observation, we should observe variability in the wind on timescales of weeks/days.
[2] **Measure the broad iron K emission line to estimate BH spin, and search for the corresponding reverberation lag with Resolve + Xtend.** If both XRISM observations of NGC 1365 occur in NnH < 1 × 1023 cm−2 state, we will perform a high-frequency time lag search to probe reverberation time delayslags.
[3] **Search for comet-like broad line region clouds, and corresponding soft lags.** The signature

of eclipsing comet-like BLR clouds is a rapid increase in column density that slowly decreases over time (on timescales of ~ 50 ks). This may also produce low-frequency soft lags (measurable with Resolve + Xtend) that can place independent constraints on BLR location and structure.

[4] **Measure the temperature/velocity of collisionally-ionised emission and disentangle from photoionised component.** In archival RGS data, the photo-ionised emission contributes at the 5-15% level. We will search for variability in the photoioniszed component, and comparecomparing the collisionally-ionised emission to other star- forming galaxies, and the photo-ionised NLR emission to other AGN.

NGC 3783

Observation plan

A single 200 ks, continuous exposure (spanning about 4 days), using Resolve (open filter), Xtend (1/8 mode).

Immediate objectives

[1] Constrain the full Absorption measure Distribution (AMD) of the outflow
[2] Determine full dynamics of the highest ionized gas (outflow speed, turbulence)
[3] Determine the distance of the highest ionized gas directly using variability (or lack of) of the Fe XXV resonance line
[4] Constrain relative sizes of disk and/or outer corona using Fe XXIV lines in the K- and L-complex
[5] In case of obscuration, characterize the obscuration in the Fe-K band for the first time
[6] Search for Ultra-fast outflows (UFOs)
[7] Study the variability in the red wing of Fe-K
[8] Reflection studies, in particular by finding the Compton shoulder of the narrow Fe-K line

NGC 4151

Observation plan

NGC 4151 is approved as a Phase A target, for a total of 180 ks. Nominally, this exposure is to be taken in 4 segments of 45 ks, with the goal of catching the distinctive high-flux, low-obscuration and low-flux, higher-obscuration states of NGC 4151. The 4 segments can be scheduled almost at random; separating them by at least 2 weeks may be optimal.

If this scheduling proves impractical, longer exposures are preferred over short ones (e.g., 3 exposures of 60 ks, or 2 exposures of 90 ks). The chances of catching both states would then be reduced but it is important to obtain sensitive spectra in every instance.

Resolve should be run in its normal mode, with no filter.
Xtend should be run in 1/8 window mode (to prevent photon pile-up).

Immediate objectives

[1] Reveal the origin of the narrow Fe K line through a detailed study of its velocity broadening and shape, and variability within and across observations.
[2] Search for variable ultra-fast outflows and measure the gas properties with unprecedented sensitivity, to reveal the origins and driving mechanisms of UFOs. Optimally, the radius and/or gas density will be constrained to determine the mass flux and kinetic luminosity of the UFOs. Constraints on the UFO duty cycle may be possible.
[3] Measure slower ionized absorbing outflows in the Fe K band, and at low energy, to determine their launching radii, driving mechanisms, mass flux, kinetic luminosity, and connections to geometries that are also revealed in optical and IR bands.

[4] Search for relativistic disk reflection to reveal the inner accretion disk and its interaction with the compact component of a corona, and to potentially measure the spin of the black hole.
[5] Search for evidence of lags between the continuum and discrete line features, as an independent window on their physical origins.
[6] Understand the nature of the distinctive source states in NGC 4151, with the advantage of high-resolution, high-sensitivity X-ray data in the Fe K band, in concert with broad-band optical and UV data and complementary X-ray data

PDS 456

Observation plan

Given the dramatic spectral variability of PDS 456, we asked for a single long observation of the source to best characterize its Fe-K Ultra-Fast Outflow (UFO). Given recent publication of the UFO disappearing in the highest flux states, we will consider using Swift/XRT monitoring to avoid these periods, if it does not have a large impact on the satellite operation planning.

Immediate objectives

[1] Confirm the presence of the Fe-K UFO; measure its physical parameters via the line shift, width and equivalent width (interpreted as column density)
[2] Resolve the velocity structure of the trough for the first time
[3] Search for an Fe-K emission line, possibly a P-Cygni profile, to constrain the mass outflow rate
[4] Make a physical connection between the Fe-K UFO and soft X-ray absorption features

1.4 Extra-Galactic Diffuse sources

M82

Observation plan

M82 will be observed with the nucleus of the galaxy coincident with the optical axis for a single pointing of 50 ks. If the observation must be broken into smaller segments, we request similar roll angles (or additional exposure time on the order of 5 ks per angle to ensure the spectra from the outer ring of Resolve pixels are well exposed).

No filter is required, and we request full-frame Xtend data to achieve the best astrometric solution

Immediate objectives

[1] Determine whether the wind speed exceeds the escape velocity, its impact on the surrounding gas, and the partitioning of wind energy among hot, warm, and cool gas by measuring (and possibly mapping) the velocity of hot, nebular gas using soft X-ray lines.
[2] Confirm that hot gas pressure is the primary wind driver and constrain the mass-loading rate and thermalization efficiency by measuring the velocity of the superheated nuclear gas using Fe XXV and Fe XXVI lines. Constrain the role of cosmic rays in wind acceleration via comparison to predictions of the velocity profile.
[3] Determine the metal loss rate from the galaxy and confirm the Type II SNe enrichment scenario by measuring the chemical abundances in the extended hot wind.
[4] Quantify the contribution to soft X-rays from the wind nebula from (a) cooling wind material, (b) shocks of entrained cool clouds or with the surrounding medium, and (c) charge exchange by measuring the temperature structure from global fits and He-like triplets and by measuring the CX contribution to strong line complexes.
[5] Investigate the possibility that M82 X-1 is an IMBH by searching for a reported, but

ambiguous, broad Fe Ka line. We anticipate a combined analysis of M82 X-1 and X-2 due to the angular resolution, that will include both Resolve and (modestly piled-up) Xtend data.
[6] Determine the relationship between hot, warm, and cool wind gas by comparing the X-ray velocity structure to that of the warm and cool phases (from archival data and published papers).
[7] Search for an explanation of the extensive, diffuse hard X-ray nebula in M82.

NGC 4636

Observation plan

One standard mode 100 ks pointing centered on the nucleus of NGC 4636.

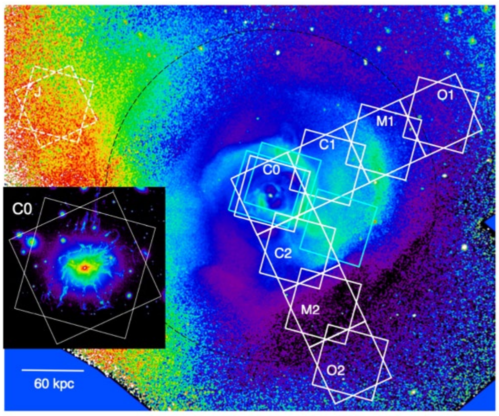
Immediate objectives

[1] Measure the velocity widths of emission lines to reveal the hot gas kinematics and details of AGN feedback.
[2] Measure the optical depth through resonance scattering of the ions with the strongest transitions. This also contributes to constraints on the turbulent velocities.
[3] Probe the star formation and chemical evolution by measuring the abundances of C, N, O, Ne, Mg, Al, Si, Ar, Fe, and Ni.
[4] Contribute to the calibration of atomic physics in sub-keV plasmas.
[5] Constrain the thermal structure of the interstellar plasma

Perseus Cluster

Observation plan

"A" pointings: 4 in total, 280 ks in total
C0: (RA, Dec) = (03 19 47.76, +41 30 46.8), 50 ks
C1: (RA, Dec) = (03 19 33.36, +41 32 02.4), 50 ks
M1: (RA, Dec) = (03 19 18.96, +41 33 14.4), 80 ks
O1: (RA, Dec) = (03 19 04.08, +41 34 33.6), 100 ks
"B" pointings: 1 in total, 220 ks in total
C0: (RA, Dec) = (03 19 47.76, +41 30 46.8), 200 ks
If the primary goal for Virgo/M87 is achieved without the SW pointing, the SW pointing exposure will be used to observe C0 for 200 ks as "A".
"C" pointings: 3 in total, 280 ks in total
C2: (RA, Dec) = (03 19 41.04, +41 28 01.2), 50 ks
M2: (RA, Dec) = (03 19 34.56, +41 25 19.2), 80 ks
O2: (RA, Dec) = (03 19 27.6, +41 22 37.2), 150 ks.



Immediate objectives

"A" pointings
[1] C0, C1: measure turbulent velocity broadening and line of sight velocity of gas motions in a region affected by the AGN feedback physics. Probe potential velocity gradient in the direction of the rising NW bubble.
[2] M1, O1: probe shear motions of the hot gas across a cold front
[3] C0, C1, M1, O1: measure radial profile of velocities of gas motions in ICM, probe a transition from feedback-dominated to merger-dominated regions, compare with predictions from cosmological simulations of large-scale structure
[4] C0, C1, M1, O1: measure radial metallicity profile and put tight constraints on enrichment mechanisms (SNcc vs. SNIa)

[5] C0, C1: detect rare elements (Na, Al)
[6] C0, C1, M1, O1: reveal the role of turbulence in accelerating cosmic rays by searching correlation between measured velocity amplitude and strength of radio emission
[7] C0: probe physics of central AGN, including its variability, constrain changes from Hitomi
[8] C0, C1, M1, O1: calibrate statistical relation between the amplitude of density fluctuations and velocity

"B" pointings

[1] C0: detection of charge exchange
[2] C0: resonant scattering studies, constraints on the anisotropy of gas motions
[3] C0: probe different temperature, density and velocity components of the gas resulting from cooling and mixing with ambient gas
[4] C0: explore non-gaussianity of the strong iron lines
[5] C0: search for unknown physics
[6] C0: probe physics of central AGN, including its variability, constrain changes from Hitomi (in case 50 ks is not enough, depends on the current flux and equivalent width of the Fe-Kα line)

"C" pointings

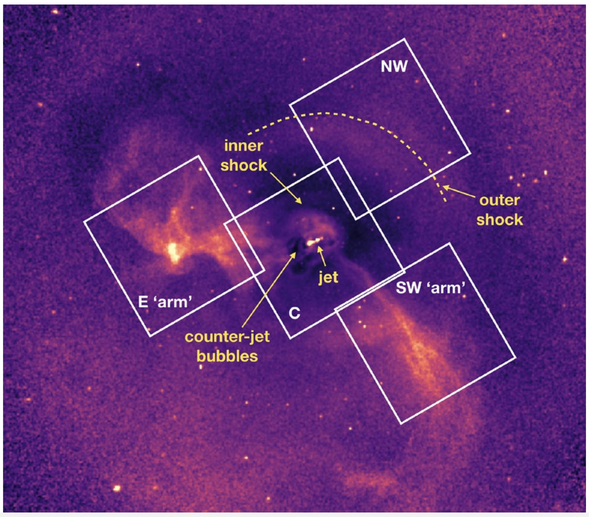
[1] C0-3, M1-2, O1-2: measure azimuthal variations of velocities and metallicities
[2] M2: probe velocities in a region with prominent eddies formed by Kelvin-Helmholtz instability, constrain gas viscosity
[3] C0-3, M1-2, O1-2: probe a signal at 3.5 keV line, distinguish between a narrow plasma line and a broad dark matter line

Virgo/M87

Observation plan

Three pointings will be performed first:
C (12:30:48.99,+12:23:22.57): 100 ks
E (12:31:02.09,+12:23:26.67): 150 ks
NW (12:30:42.87,+12:26:05.29):100 ks

An additional pointing to the SW will be performed if the immediate objectives regarding gas uplift physics (see (6) below) are not fulfilled with the E pointing, and if the relative positions of various lines within the Fe-L shell are demonstrated to be measured with sufficient accuracy from the existing data. Details of the additional observation:
SW (12:30:38.63,+12:21:25.45): 150 ks



Immediate objectives

Central pointing:

[1] Measure the turbulent motions in the hot ICM close to the SMBH, using line broadening and resonant scattering.
[2] Measure the chemical composition, including new detections of rare odd-Z elements (Na, Al).
[3] Probe the detailed multi-temperature structure in the cluster core.

Eastern pointing:

[4] Determine the turbulent velocity broadening and line of sight velocity in the hot ICM associated with the Eastern AGN lobe rising buoyantly through the M87 atmosphere.
[5] Measure the average chemical composition in the wake of the buoyant AGN bubble.

[6] Test the power of the data to constrain multi-temperature, multi-metallicity, multi-velocity models.

Southwestern pointing (conditional):

[4’,5’,6’] If the analysis in objective 6 demonstrates that multi-velocity fits (using the relative shifts of various lines in the Fe-L complex) are feasible with well controlled systematics, but fail to detect the expected velocity shift between the cool uplifted gas and hot spherically symmetric atmosphere, an additional observation of the SW arm will be performed. This will provide a full picture of the interaction between the radio lobes and the ICM along two ‘arms’ with very different X-ray and radio morphologies.

Northwestern pointing:

[7] Measure bulk characteristic turbulence in a relaxed control region located away from AGN lobes but at the same cluster-centric radius.

[8] Measure the undisturbed radial gradient of various metal abundances, and compare with the AGN lobe direction.

[9] Aid with atomic line database calibration for a quasi-isothermal plasma.

Coma Cluster

Observation plan

- Priority A: 1 pointing, 200 ks (RA=12:59:46.3, Dec=+27:56:45)
- Priority C: one offset pointing out of 4 below, 100 ks (which one is to be decided later):
    - West (12:59:19.2, +27:56:46)
    - North (12:59:46.3, +28:02:45)
    - East (13:00:13.5, +27:56:45)
    - South (12:59:46.3, +27:50:45).

Immediate objectives

The program will perform the first measurement of bulk and turbulent gas motions in a merging galaxy cluster. Turbulence is expected to be the dominant form of non-thermal energy in galaxy clusters, and characterizing it is crucial to determine the total energy budget, constrain deviations from hydrostatic equilibrium, and understand the origin of relativistic particles in the intracluster medium (ICM). The target of this observation, the Coma Cluster, is the nearest and brightest massive non-cool-core galaxy cluster undergoing merging activity.

Radio halos, i.e. diffuse, Mpc-scale radio sources associated with GeV electrons permeating the ICM, are believed to be powered by stochastic acceleration induced by the dissipation of turbulent motions in the ICM. The Coma Cluster is the only Priority A PV target hosting a Mpc-scale radio halo, thus the observation will provide the first direct estimate of turbulent velocities in a system hosting a radio halo.

The central pointing (Priority A) will yield 1000 counts in the He-like Fe line (6.7 keV) plus 700 counts in the H-like line (6.9 keV), providing an accurate measurement of the velocity dispersion of the line and detect any large asymmetries of the velocity distribution. The second, offset pointing (Priority C) will be located 200 kpc apart from the central pointing and will collect 500 counts in the Fe line complex. The addition of the offset pointing will constrain the power spectrum of velocity fluctuations across the cluster. Indeed, particle acceleration is expected to occur through the dissipation of small-scale turbulent motions. Although the scales over which particle acceleration occurs will not be directly measurable by XRISM, the normalization and the injection scale of the velocity power spectrum will allow us to probe how much of the dissipated turbulent energy will be channeled into particle acceleration. The offset pointing will be a downpayment toward a future raster scan of the cluster, which will measure the ICM turbulence spectrum.

While Resolve is collecting the line photons, Xtend will obtain a detailed temperature and abundance map of the entire cluster core. Comparing it with the Planck data, for example, will determine whether our understanding of the ICM energy budget is correct. Resolve should also detect an OVIII line, constraining the presence of cool gas in the cluster outskirts on the core line of sight.

Centaurus Cluster

Observation plan

We observe the central region of the cluster with a slightly offset pointing to discriminate dust depletion and SN Ia metal enrichment. We consider the contamination of the PSF scattering photons. The exposure time is 150 ks.

Immediate objectives

[1] Investigate multi-temperature structure of the ICM and its impact on the metal abundance.
[2] Measure detailed metal abundance of the ICM to study dust formation. The formation can be confirmed by comparing the abundance of metals that form the dusts with that of noble gas.
[3] Measure detailed metal abundance of the ICM to study SN Ia explosion mechanism. We also investigate the contribution of the metals from core collapse supernovae.
[4] Measure turbulent and bulk velocities around the AGN to study the efficiency of AGN feedback. The result are compared with those for other clusters.

Abell 2029

Observation plan

- Priority A: 3 pointings, 320 ks in total
  - North P3 (15:10:56.03, +05:50:39.3): 250 ks
  - North P2 (15:10:56.03, +05:47:39.3): 50 ks
  - Center P1 (15:10:56.03, +05:44:39.3): 20 ks
- Priority C: 2 pointings, 300 ks in total
  - West P3 (15:10:32.15, +05:44:39.3): 250 ks
  - West P2 (15:10:44.09, +05:44:39.3): 50 ks
- All observations use the open filter wheel position. Spacecraft roll angle will be optimized to reduce PSF scattering from inner to outer cluster regions once the observations are planned.

Immediate objectives

[1] Measure the turbulent and bulk motions of the intracluster medium and the contribution of non-thermal pressure support with ~1% accuracy in the outer regions (~R_{2500}) in a relaxed galaxy cluster, Abell 2029.
[2] Measure the velocity broadening and bulk motion in the center of a galaxy cluster with a significant sloshing signature.
[3] Study the multi-temperature gas in the center of a strong cool-core cluster.
[4] Measure thermodynamic profiles of temperature, density, and entropy out to R_{200} with Xtend to compare to previous results on this and other relaxed clusters with Suzaku.

2. Priority-C targets

2.1 Galactic Compact sources

2S 0921-630

Observation plan

- 80ks observation.

- Resolve with no filter and on axis
- Xtend in full window mode

Immediate objectives

[1] Measure the profiles of the wind emission lines to determine the velocity structure of the wind across the radii where each ion state is produced. The hydrogen like Lya lines from Si XIV at 2keV, S XVI at 2.6 keV and the He like FeXXV at 6.7 keV will trace lower ionization material than the FeXXVI at 6.9 keV.

[2] measure the OVII triplet emission to get a density diagnostic from even lower ionization material, and search for similar triplets from He-like Ne, Mg, Si and S.

[3] compare all these to the predictions of thermal-radiative wind models and magnetic wind models to determine the launching mechanism of the wind

[4] measure the profile of the Fe Kalpha line and determine its origin

Circinus X-1

Observation plan

Cir X-1 was selected as a Category-C target with 40 ks exposure. Since this is only 3% of the 16.7-days (=1,442 ks) entire orbital period, we cannot cover the entire orbital cycle. Therefore, as discussed at the proposals, we concentrate on the orbital phase around the periastron passage, where the prominent iron emission/absorption line features are predicted. In fact, based on the recent MAXI and NICER monitoring campaigns (Tominaga et al., in prep), the orbital X-ray light curves are stable and reproducible at each orbit. Furthermore, the H-like and He-like iron lines show the transition from emission lines to absorption features at around the orbital phase of 0.93-0.96 when the X-ray flux abruptly increases. The XRISM observation should cover this important orbital phase of 0.85-1.05 with four snapshots at 10 ks each. We plan to assign a longer exposure to the former of the low luminosity state than the latter (high luminosity state) to make the difference of X-ray photon statistics smaller between the two states. However, an over-optimized plan may fail to capture both desired states due to the actual accretion conditions. We can further adjust this when a realistic satellite operation plan is discussed. We will use filters (or windows) to the bright state, which reaches 2e-8 erg/s/cm2.

Immediate objectives

[1] At the low flux state before the transition (at the orbital phase of 0.85-0.93), we expect the emission lines at 6.4, 6.7 and 7.0 keV. We will perform the (photoionized) plasma diagnostics of stellar wind or disk (we could consider several scenarios of the line process).

[2] At the high flux state after the transition (at the orbital phase of 0.96-1.05), we expect the absorption features at the iron lines. We will try interpretation disk wind analyses.

[3] We will study the absorption edges at around 7 keV. (e.g., an XMM observation of Cir X-1 at the lowest flux before periastron in 2006.

[4] We will search iron and other line features for the P-Cygni profile to study the stellar wind physics.

[5] If we can coordinate multiwavelength campaign (e.g., optical and radio bands), we will try time lag analyses.

[6] If an outburst happens during the XRISM observations, we can further perform timing analysis, burst spectroscopies and so on.

Vela X-1

Observation plan

A 50 ksec observation of Vela X-1 around orbital phase 0.5 and two 10 ksec long observations

around phase 0.25 and phase 0.75, for a total of 70 ksec.
(Vela X-1 High Mass X-ray Binary has the orbital period of 8.964 days.)

Immediate objectives

Using XRISM Resolve observations of Vela X-1 we will study:

[1] The total mass budget in the wind and the average intensity of ionizing radiation.
[2] The properties of the primary wind.
[3] The interaction of the wind with the compact object gravity: A bow shock is expected, along with a wake structure associated with the gravitational focusing of the wind.
[4] Interaction of the wind with the X-rays: X-ray ionization will suppress the UV driving of the wind by ionizing the ions responsible for the UV opacity. This will lead to large scale wake structures trailing the X-ray source in its orbit.
[5] Interaction of the wind with the rotating beam of X-rays from the pulsar.
[6] The primary nucleosynthetic history by searching for iron peak trace elements such as Mn and Cr. And, the element abundance and the distribution of column densities of the near-neutral material in the wind by measuring the neutral fluorescence lines including Si, S, Ar, Ca and Ni.

The observation of Vela X-1 is virtually guaranteed to produce spectra which are of high statistical significance and rich in line features. It will provide prime material for highlighting the capabilities of XRISM and the Resolve instrument.

2.2 Galactic Diffuse sources

Kepler's SNR

Observation plan

We will perform a single pointing observation with an exposure time of 50 ks. The primary instrument is Resolve with an open filter.
We would like to make a slight shift of the aim point (~30" northward). We originally planned to aim at the very center of the remnant with an assumed roll angle of ~45 degrees measured north of east in case that we are awarded one pointing. Meanwhile, we realized that all Suzaku observations of Kepler's SNR were taken with roll angles of around zero degrees. This situation will be probably the same as XRISM (□ this needs to be checked). With this roll angle, outermost regions in both northern and southern rims will be out of the field of view of Resolve, making it difficult to achieve our minimal goals described in our proposal. Therefore, we would like to shift the originally-planned aim point toward the north by ~30" to make it easier to achieve minimal goals.

Immediate objectives

[1] Measure C/N/O abundances of the CSM to constrain the progenitor mass.
[2] Measure abundance ratios between unburned (C, O) and burned (Si, Fe) elements of SN ejecta to constrain the explosion physics.
[3] Measure odd-Z element abundances to constrain the progenitor metallicity.
[4] Measure line broadenings to study electron-ion temperature nonequilibration**.**

3C397

Observation plan

We perform two pointing observations with exposure time of 50 ksec each.
<Adopted filter/mode>
Resolve: Open filter

Xtend: Normal Full Window mode

Immediate objectives

[1] Measure flux and line ratios of L-shell Cr, Mn, Fe and Ni.
[2] Derive {Cr,Mn,Ni}/Fe mass ratios with above lines.
[3] Constrain central density of the progenitor.

RCW 86

Observation plan

The observation plan consists of two pointings targeting the eastern region (observation 50 ks) and a northeastern region (100 ks). The open position of the filter wheel is chosen for Resolve and the normal window/clocking mode for Xtend.

Immediate objectives

[1] Measure the electron/ion temperature ratios in a region with X-ray synchrotron emission (NE) and in a region without X-ray synchrotron (E)
[2] Use the ion temperatures to search for deviations from the standard Rankine-Hugoniot relations, expected for shock acceleration
[3] Measure in detail the peculiar Fe-K line at 6.4 keV, probably from shocked Fe-rich ejecta (i.e. reverse shock related): measure charge state, Doppler broadening search for related low-ionisation lines, and searching for other K-lines from ejecta (Si, S, Ar, Ca), as evidence to support that the Fe-K emission is due to an ejecta component, and determine abundances and supernova type (thought to be Type Ia).

Cyg X-2

Observation plan

Ideal Science Case: We will perform two paintings with the total exposure of 240 ks.

This is a Priority-C target and we can adjust the exposure time to be shorter to fill in any available gaps in scheduling. We have identified a minimal exposure time necessary to detect O K and Fe L scattering features from interstellar dust.

(1) 40 ks (ideal) or 10 ks (minimum); 1.6’ (close to on-axis) of Cyg X-2

- Resolve: Open filter (or Neutral Density filter)*
- Xtend: 1/8 window + 0.1-s burst

*An open filter configuration would be more idea, because the NDF has an O K shell absorption that will reduce the signal and add structure to our observation. We will consult with the Bright Sources Working Group to see if an open filter configuration can be used to achieve the same result.

(2) 200 ks (ideal) or 50 ks (minimum); 4.5’ (off-axis) of Cyg X-2

- Resolve: Open filter
- Xtend: 1/8 window + 0.1-s burst
- XMA: roll angle within +/- 15 degrees of 45, 135, 225 or 315 to keep Resolve within the shadow of the mirror support structure.

Immediate objectives

[1] Measure the position and depth of the scattering features from solid interstellar Oxygen.
[2] Compare Fe L shell XSFS against a library of lab-measured mineralogical templates to evaluate the composition of Iron bearing interstellar dust.
[3] Establish the analysis method for bright point sources. Observe Fe K emission/absorption lines to understand the plasma condition and constrain Doppler and gravitational shifts of a neutron star low-mass X-ray binary.

Jupiter

Observation plan

Jupiter is a moving target and the number of pointings to follow its orbital motion in the sky depends on when we observe it. Below is a summary of the observation plan.

1. Observable time and the number of pointings :

Observable time in 2023 and 2024	Total apparent angular rate in the sky [arcsec/min]	The number of pointings*	Distance to the target [AU]
2023 Jan 1 – Jan 24	0.3-0.4	6-8	5.0-5.4
2023 Jul 2 - Sept 8	0.5-0.04	10-1	5.3-4.4
2023 Dec 28 – Dec 31	0.03-0.02	1	4.4-4.5
2024 Jan 1- Mar 1	0.02-0.4	1-8	4.5-5.4
2024 Aug 8 – Oct 15	0.4-0.06	8-2	5.4

   * Assuming the exposure time of 100 ks and observation efficiency due to Earth occultation of 50 %. For example, when the angular rate of the target is 0.3 arcsec/min, the total angular distance of the target is 0.3 arcsec/min * 100 ks / 0.5 (efficiency) = 16 arcmin. Then, the required number of pointings becomes 16/2.9 = 5.7 where the FOV of the Resolve is 2.9 arcmin. So we need 6 pointings.
2. Exposure time : 100 ks
3. Filter option for the Resolve FW : Open
   Considering the filters in the dewar and the thermal filter of the telescope, optical loading effect will be negligible.
4. Coordinate observation : As an option, if the PV observation is approved (Jupiter is Pri.C) and the observation schedule is roughly fixed, we would like to coordinate observations with JUNO (NASA's Jupiter exploration, in-situ particle measurement), Chandra (X, high spatial resolution), XMM (X, high photon statistics), Hisaki (EUV, Io Plasma Torus), Hubble (IR, aurora) and ground observation sites.

Immediate objectives

[4] Measure the position and depth of the scattering features from solid interstellar Oxygen.
[5] Compare Fe L shell XSFS against a library of lab-measured mineralogical templates to evaluate the composition of Iron bearing interstellar dust.
[6] Establish the analysis method for bright point sources. Observe Fe K emission/absorption lines to understand the plasma condition and constrain Doppler and gravitational shifts of a neutron star low-mass X-ray binary.

Carina Nebula

Observation plan

The brightest region of the Carina nebula will be observed. The exposure time will be 30 ksec. No filter should be used for Resolve. This is not a ToO observation.

Immediate objectives

[1] Clarify the physical status of the hot plasma.
[2] Clarify the interaction of the hot plasma and molecular clouds.
[3] Measure the bulk motion or turbulence of the hot plasma.
[4] Measure the carbon abundance in the high-mass star forming region.

2.3 Extra-Galactic Compact sources

IRAS F05189-2524

Observation plan

We perform a normal continuous 100 ksec observation.

<Adopted filter/mode>

Resolve: no filter

Xtend: full window mode

Immediate objectives

The proposed observation aims to

[1] Explore binary super massive black bole with sub-pc separation.

[2] Detect blue-shifted absorption line features by ultra-fast outflows, and compare their properties to galactic molecular outflows.

[3] Study an accretion disk and obscuring matters of an AGN in the ULIRG, and compare their properties to those in Seyferts.

[4] Identify multi-temperature components and dynamics of starburst plasmas, and compare their properties to those without the AGN activity.

M 81*

Observation plan

name	RA	DEC	Exposure	Filter	MXS
M81* (Pri-C)	09 55 33.18	+69 03 55.3	100 ks	OBF filter	None

note:

OBF filter is required, and we request 1/8-frame Xtend data

Immediate objectives

[1] reveal the location of the neutral or low-ionization gas.

[2] measure the line shifts of H-like Fe XXVI and He-like Fe XXV

[3] measure their width of shifted lines

[4] reveal the geometry and dynamics of a radiatively inefficient accretion flow (RIAF) onto a black hole

Mrk 766

Observation plan

Mrk 766 is approved as a priority C target, to be observed for 80 ks. To investigate the behavior of spectral components in the highly accreting AGN, in particular its variable absorption features, we asked for a single observation of the source, to be possibly analyzed in several time bins, depending on the source state.

Resolve should be run in its normal mode, with no filter.

Xtend should be run in full window mode.

Immediate objectives

The proposed observation aims to:

[1] Disentangle the highly ionized gas and its connection with other ionized phases (i.e. the complex warm absorber and the ultra-fast outflow)

[2] Study the iron line emitting region; assess the presence and origin of a broad wing; use relativistic reflection models to constrain the black hole spin, iron abundance and inner disk inclination

[3] Investigate the flux-resolved variability of a source accreting in a high Eddington regime

NGC4388

Observation plan

We perform a 100 ksec continuous observation.
Resolve: no filter
Xtend: full window mode

Immediate objectives

[1] Unbiasedly determine matter distribution around the nucleus using the Fe-K line profile as well as absorption features

[2] Determine torus structure from multiple lines and broadband modelling

[3] reveal the origin of the extended soft X-ray component using emission lines from highly ionized ions

2.4 Extra-Galactic Diffuse sources

Abell 3667

Observation plan

name	RA	DEC	Exposure	Filter	MXS
ABELL 3667 CF IN (Pri-C)	20 12 57.50	-56 53 10.2	180 ks	Open filter	None

No filter is required, and we request full-frame Xtend data to achieve the best astrometric solution

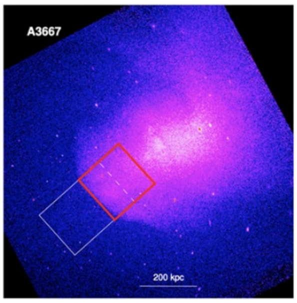
Immediate objectives

[1] Reveal the merger geometry (sloshing or stripping) of the system, by measuring the bulk velocity and turbulence within the cold front.

[2] Measure gas velocity distributions and/or gradient, to constrain the gas dynamics in the cold front.

[3] Measure the metal abundance to infer from which radii in the pre-merger subcluster gas came.

[4] Measure the ICM turbulence inside the front to investigate the origin of radio emission during cluster mergers.



M51

Observation plan

1 pointing, 160 ksec, (RA, DEC) = (13:29:57.90, +47:12:36.3)

Immediate objectives

[1] Measure the emission measure distribution (EMD) in at least two regions (nucleus and spiral arms) from $6.0 < \log T[K] < 7.0$ in $\Delta \log T[K] = 0.1$ bins, thereby obtaining the mass and energy budget.
[2] Search for NEI plasma and map its distribution.
[3] Map abundances (O, N, Ne, Fe, Mg, and Si) to trace enrichment history.
[4] Confirm CX in the nucleus from O vii and O viii and map its distribution..

NGC 5044

Observation plan

One standard mode 100 ks pointing centered on the nucleus of NGC 5044.

Immediate objectives

[1] Measure the velocity widths of emission lines to an accuracy of 30 km/sec to reveal the hot gas kinematics and details of AGN feedback.
[2] Probe the star formation and chemical evolution by measuring the abundances of N, O, Ne, Mg, Al, Si, Fe, and Ni.
[3] Search for evidence of charge exchange in a strongly multi-phase ISM.
[4] Constrain the temperature and metallicity structure of the interstellar plasma, and determine the cooling rate of the gas to understand the relationship between the hot and cold (e.g., CO) gas.
[5] Look for effects of resonancescattering, and utilize the results to help determine the 3-D distribution of the gas.