IXO Science with Planned Future Missions

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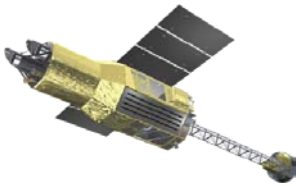
(NASA/MSFC) on behalf of the X-ray Community science team

Astro-H

Launch: 2014

uCalorimeter: 0.3 – 8 keV
ΔE = 7 eV, 0.02 m^2@1 keV
100'' PSF, 2.8' FOV

Hard Imager: 4-80 keV
200 cm^2 @ 20 keV



Science	Measurement	Method
Strong-field GR	Strong gravity predicts effects on X-ray spectra	Measure broad Fe K line with high spectral resolution; shape of broad band continuum
Growing SMBH	BH spin distribution over range of redshifts	Measure Fe K line width for brightest AGN
Large Scale Structure		
Cosmic Feedback	First measurements of cluster turbulence; Warm absorbers may transport AGN energy to galaxy/cluster	Measure velocity broadening in clusters; Measure density and velocity of warm absorbers, therefore determining kinetic energy outflow
NS Eq. of State		

GEMS

Launch: 2014

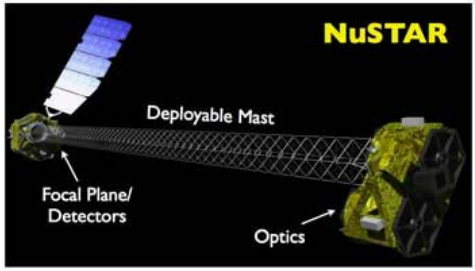
Polarimeter: 2 – 10 keV
1% MDP for 1 mCrab
14’ FOV; ΔE ~ 1keV

Science	Measurement	Method
Strong-field GR	Strong gravity predicts energy dependent polarization angle	Measure polarization intensity and angle in four bands
Growing SMBH		
Large Scale Structure		
Cosmic Feedback		
NS Eq. of State		

NuSTAR

Launch: 2012

Hard Imager: 6 – 80 keV
ΔE = 0.9 keV, 0.06 m^2@20 keV
50'' PSF, 13' FOV



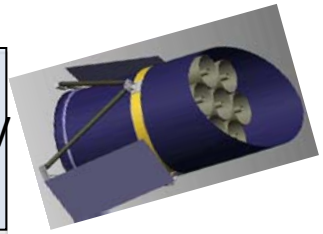
Science	Measurement	Method
Strong-field GR	Strong gravity predicts effects on X-ray spectra	Detection of Compton reflection above 10 keV in AGN and BHC
Growing SMBH	Survey of obscured AGN	Detection of ~ 100 obscured AGN in planned and serendipitous source surveys
Large Scale Structure	Get more accurate cluster masses by taking non-thermal emission into account	Will help constrain cosmic rays and magnetic fields in several clusters which would improve mass calibration
Cosmic Feedback		
NS Eq. of State	Neutron star Equation of State can be mapped by measuring R, M for a range of NS	Detect cyclotron lines in accreting pulsars; absorption edges from thermonuclear NS LMXB bursts

Spektrum R-G

Launch: 2013

eRosita: 0.2 – 12 keV
ΔE = 130 eV, 0.23 m^2@1 keV
28'' PSF, 41' FOV

ART: 6 – 30 keV
ΔE=1.4 eV, 0.05 m^2 @6 keV
60'' PSF, 30' FOV



Science	Measurement	Method
Strong-field GR	Strong gravity predicts effects on X-ray spectra	Detection of Fe-K lines (eRosita) + Compton reflection (ART) in bright AGN and BHC
Growing SMBH	(i) Number counts and spectra at moderate to high z can probe growth of SMBH (ii) spin measurements	(i) Detect ~ 10^4 AGN in all-sky survey (ii) Detect broad Fe-K and Compton reflection from eRosita and ART data.
Large Scale Structure	Detect the growth of cosmic structure and the evolution of the elements	Detect up to 10^5 clusters, many with enough counts for spectral analysis, mass determination
Cosmic Feedback		
NS Eq. of State		

Astrosat

Launch: 2012

LAXPC: 3 – 80 keV
$\Delta E/E$ = 9%, 0.6 m^2@10 keV
1-5’ PSF, 1° FOV

Hard Imager: 10 – 150 keV
$\Delta E/E$~5%, 0.1 m^2 @ 20 keV
8’ PSF, 10° FOV

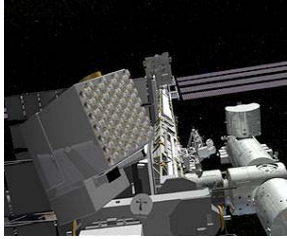
Science	Measurement	Method
Strong-field GR	Observe reflection component of inner accretion disk	Measurement of the high frequency QPOs at high energies (peaking ~30 keV) in black hole binaries
Growing SMBH	———	———
Large Scale Structure	———	———
Cosmic Feedback	———	———
NS Eq. of State	Spectral evolution during the thermonuclear X-ray bursts and the flame propagation	Bolometric measurements of the thermonuclear X-ray bursts (more capably than RXTE)

(Thanks to Biswajit Paul for help with Astrosat goals)

NICER

Launch: 20xx

Detector: 0.4 – 10.0 keV
ΔE=300 eV, 0.06 m^2 @6 keV
Timing: 100 ns absolute; 3’ psf



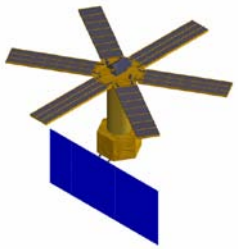
Science	Measurement	Method
Strong-field GR		
Growing SMBH		
Large Scale Structure		
Cosmic Feedback		
NS Eq. of State	Neutron star Equation of State can be mapped by measuring R, M for ~20 NS	Precision timing studies of ms pulsars

LOFT

Launch: 20xx

LAD: 2-50 keV
ΔE=200 eV, 10 m^2 @6 keV
Timing: 10 μs; 1° fov

WFM: 2-50 keV
ΔE=<300 eV, >80 cm^2 @6 keV
Timing: 10 μs ; 5' psf



Science	Measurement	Method
Strong-field GR	(i) Strong gravity predicts effects on X-ray spectra. (ii) Strong gravity effects via high frequency QPO modeling	(i) Low resolution Fe-K line fitting and continuum fitting (ii) Timing studies, harmonic content, at high count rates with high throughput
Growing SMBH	———	———
Large Scale Structure	———	———
Cosmic Feedback	———	———
NS Eq. of State	Neutron star Equation of State can be mapped by measuring R, M	Precision timing studies of ms pulsars

Summary

- 5 missions in progress (Astro-H, NuSTAR, Spektrum R-G, Astrosat)
- 2 missions under study (NICER, LOFT)