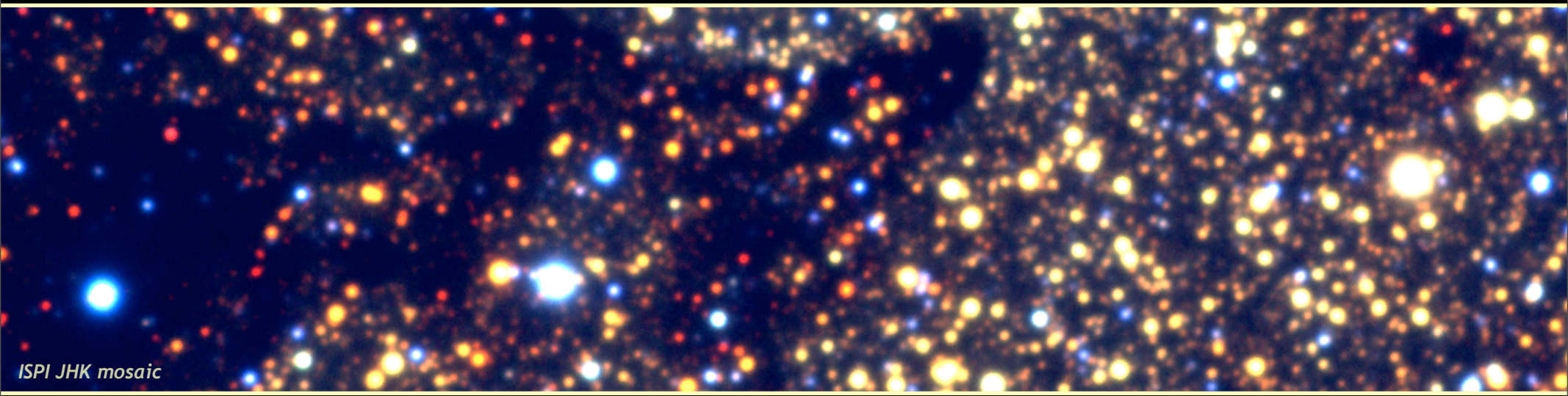
ChaMPlane's

Bulge Latitude Survey - status report



Maureen van den Berg JaeSub Hong Josh Grindlay Silas Laycock Ping Zhao
CfA, Gemini Observatory

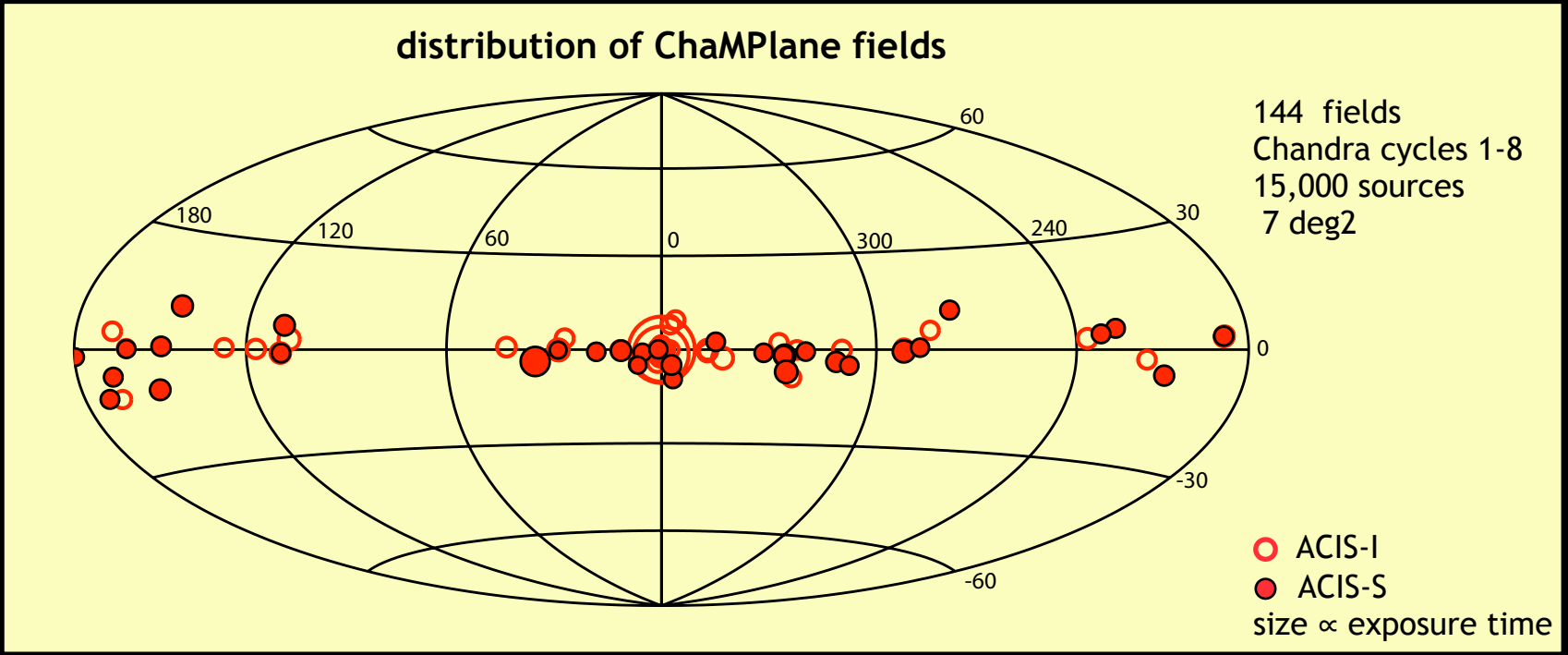
213th AAS meeting, Long Beach, Jan 5 2009

ChaMPlane
= Chandra Multiwavelength Plane Survey

Grindlay et al. 2005

goal : study faint Galactic X-ray point source population (Lx<~10^34 ergs/s);
mainly interested in accreting binaries (CVs, quiescent NS&BH XRBs), also coronal sources

method: analyze archival and targeted Chandra/ACIS observations in the plane (|b| < 12 deg),
follow-up optical and infrared imaging and spectroscopy for source classification



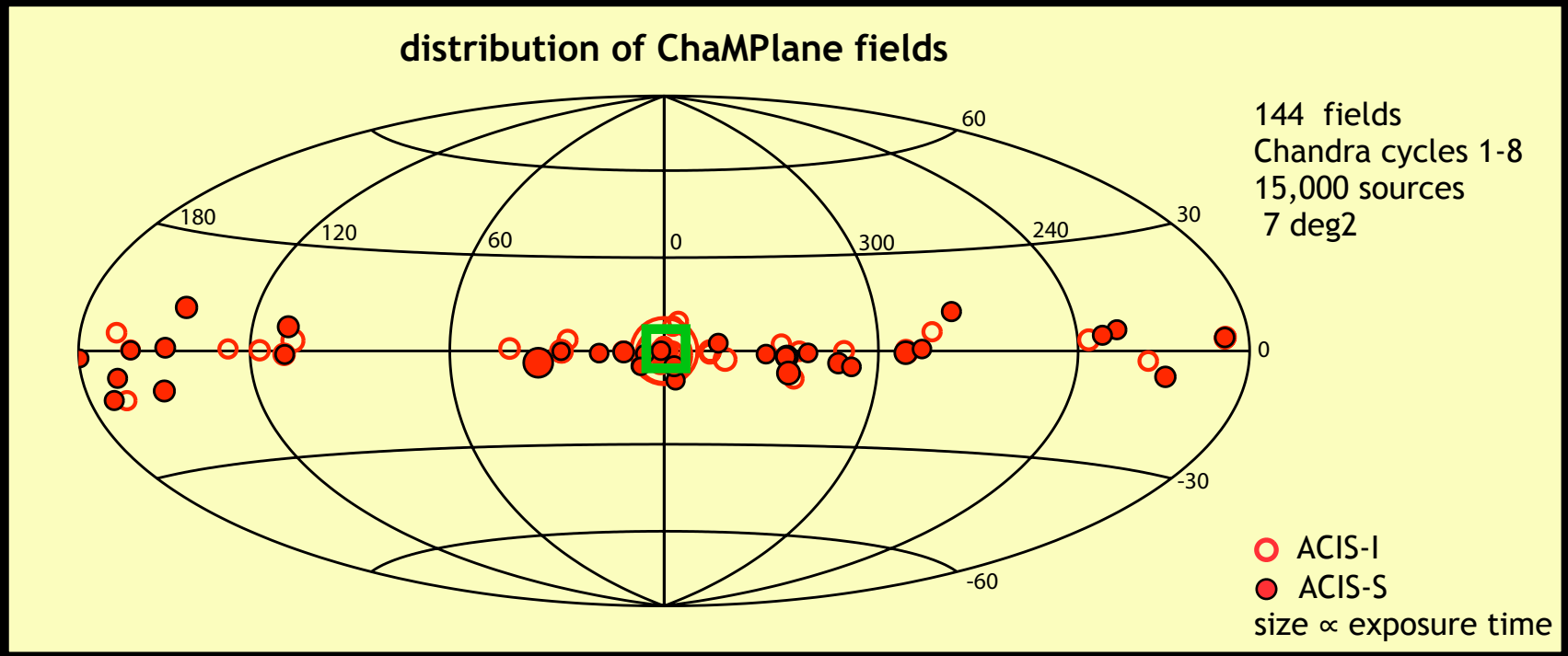
other ChaMPlane presentations:
- next talk by Ping Zhao on foreground sources towards Galactic Center
- Allen Rogel's Poster #470.01 on CVs in anti-Center fields (Wednesday)

ChaMPlane
= Chandra Multiwavelength Plane Survey

Grindlay et al. 2005

goal : study faint Galactic X-ray point source population (Lx<~10^34 ergs/s);
mainly interested in accreting binaries (CVs, quiescent NS&BH XRBs), also coronal sources

method: analyze archival and targeted Chandra/ACIS observations in the plane (|b| < 12 deg),
follow-up optical and infrared imaging and spectroscopy for source classification



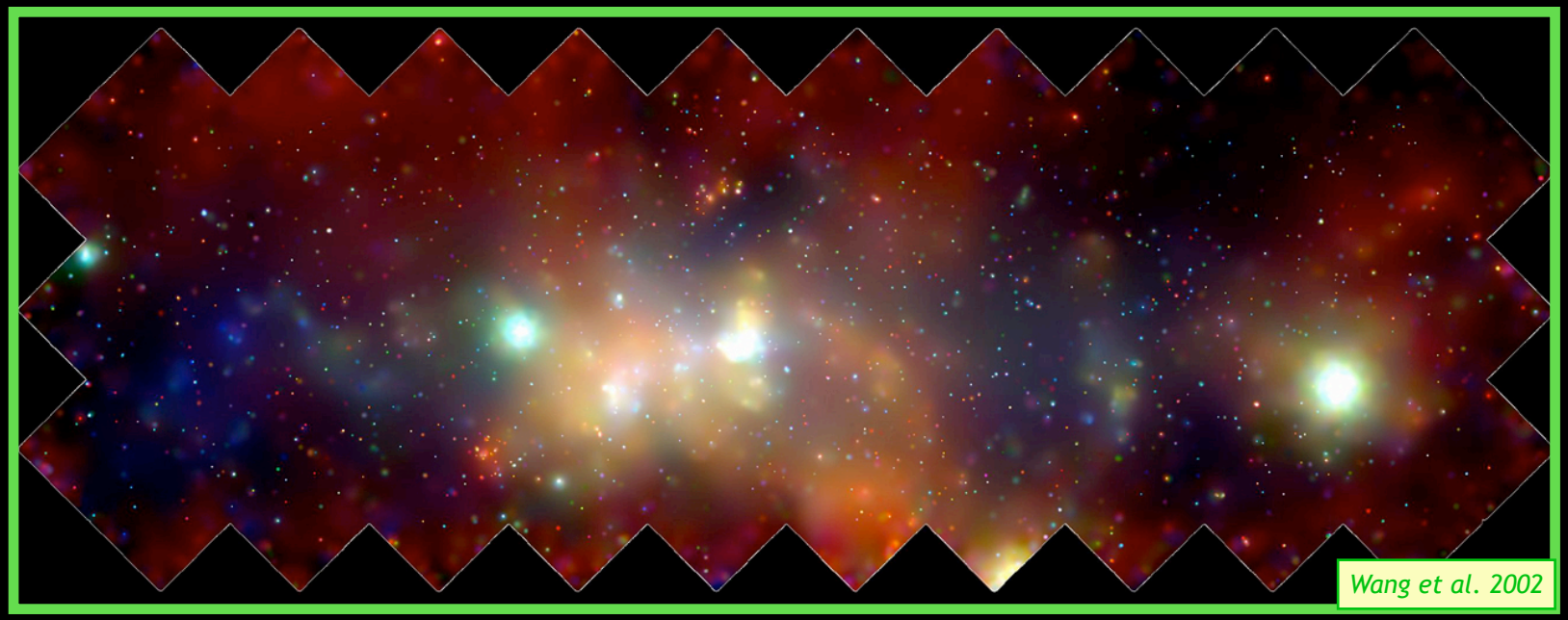
other ChaMPlane presentations:
- next talk by Ping Zhao on foreground sources towards Galactic Center
- Allen Rogel's Poster #470.01 on CVs in anti-Center fields (Wednesday)

ChaMPlane
= Chandra Multiwavelength Plane Survey

Grindlay et al. 2005

goal : study faint Galactic X-ray point source population (Lx<~10^34 ergs/s);
mainly interested in accreting binaries (CVs, quiescent NS&BH XRBs), also coronal sources

method: analyze archival and targeted Chandra/ACIS observations in the plane (|b| < 12 deg),
follow-up optical and infrared imaging and spectroscopy for source classification

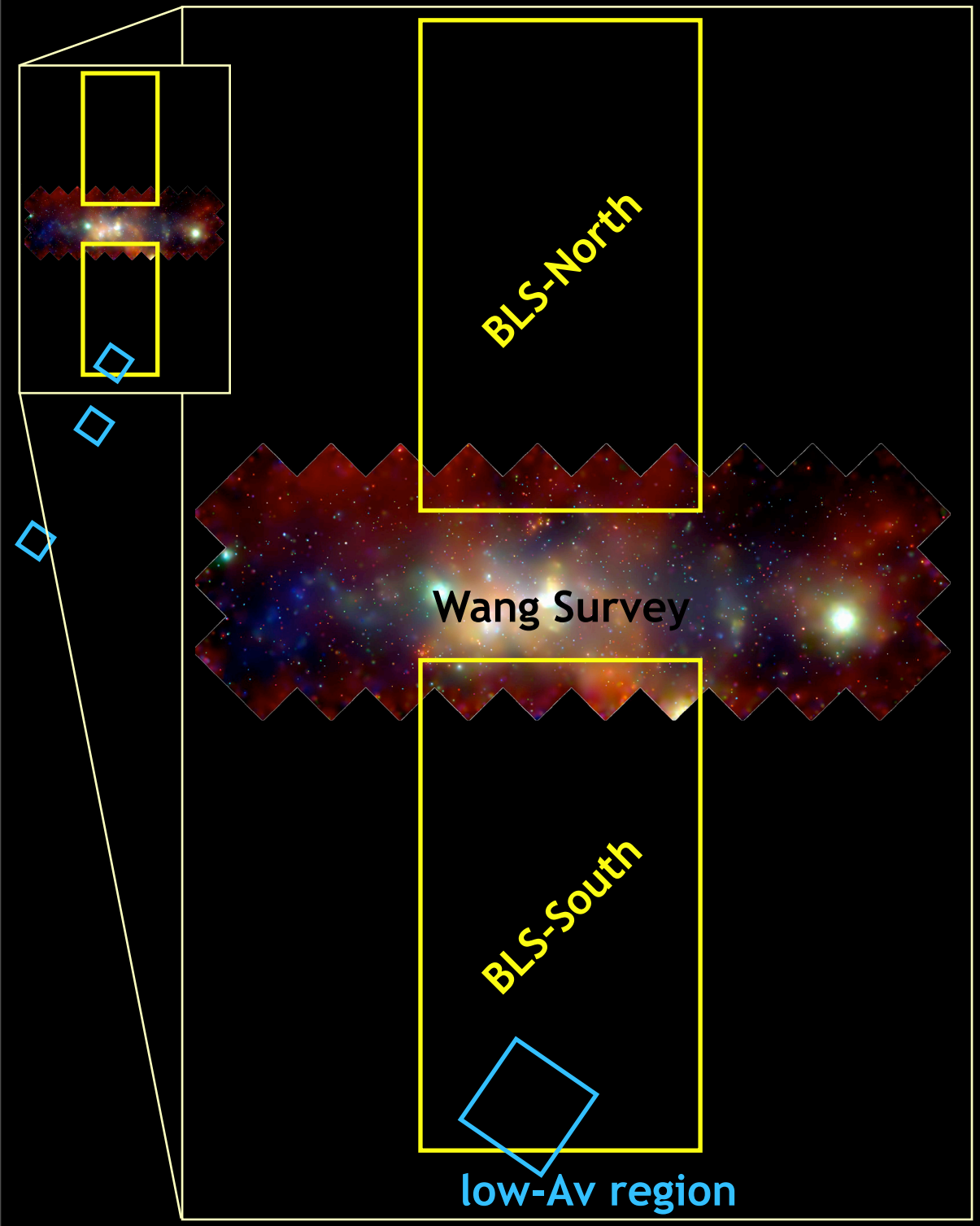


focus on Galactic-bulge and Galactic-center region:

- >9000 point sources (e.g. Muno et al. 2008, Hong et al. 2009)
- properties consistent with CVs & quiescent XRBs
- most are heavily absorbed (i.e. in bulge) => difficult to find optical/IR counterparts

other ChaMPlane presentations:

- next talk by Ping Zhao on foreground sources towards Galactic Center
- Allen Rogel's Poster #470.01 on CVs in anti-Center fields (Wednesday)



Bulge Latitude Survey (BLS)

X-ray:
- 36 Chandra/ACIS-I overlapping pointings, 15ks each, Chandra cycles 7-10
- sensitivity: Lx~9e31 ergs/s for d=8kpc

near-infrared (nIR):
- JHK imaging with NOAO CTIO-4m/ISPI
- search for candidate counterparts and extinction map

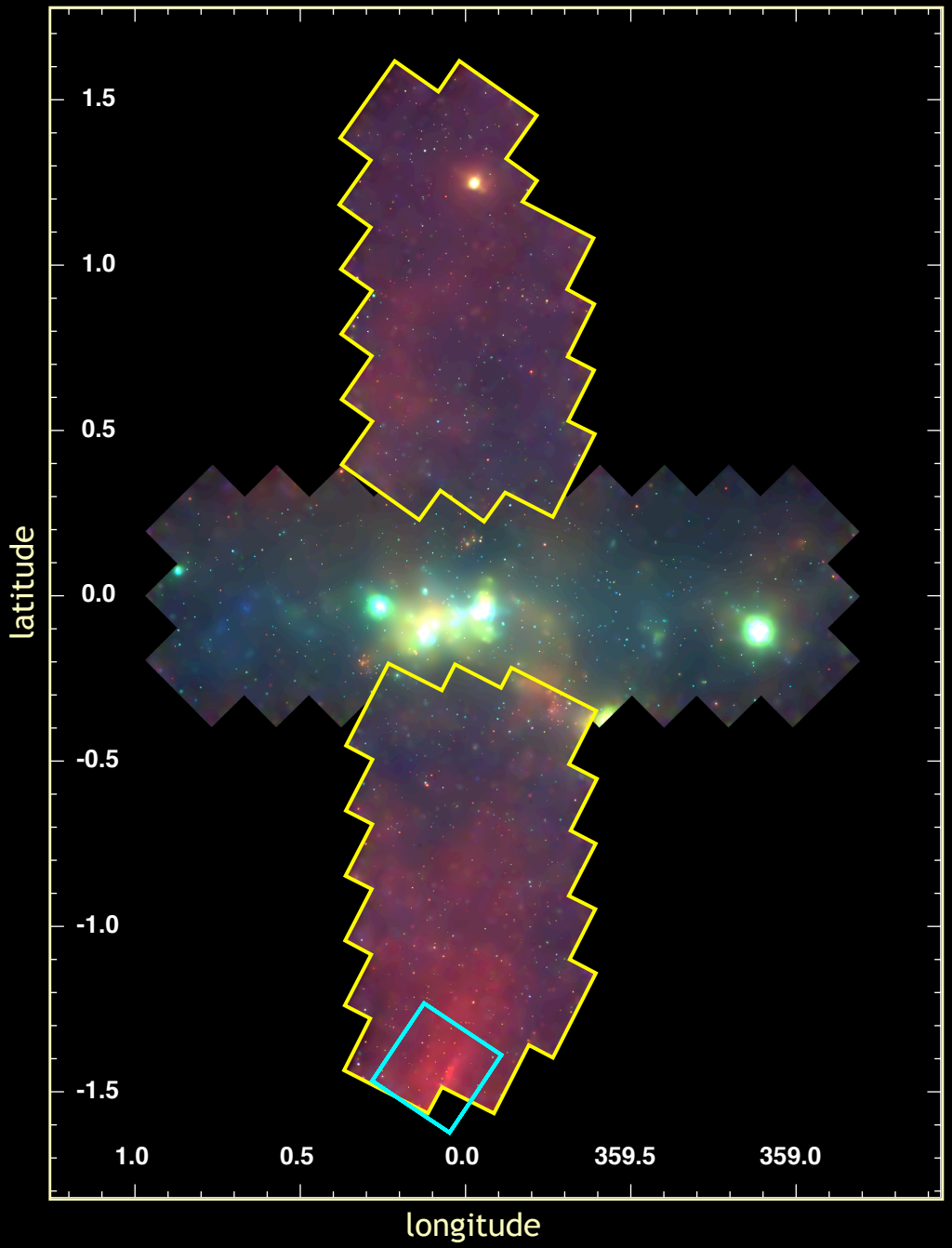
2 regions of 0.8 x 1.4 deg2, centered on SgrA*, lines up with our deep Chandra/HST survey of low-extinction Windows in the south

started '06, to be completed in summer '09

main goals:
study nature/origin of inner bulge & Galactic-Center region X-ray population by tracing the radial distribution

observe larger area needed to study the distribution of relativey bright sources in the bulge

use IR imaging to find candidate counterparts and make extinction map



Chandra/ACIS-I mosaic R=1-3 keV G=3-5 keV B=5-8 keV

BLS X-ray mosaic (33 pointings)

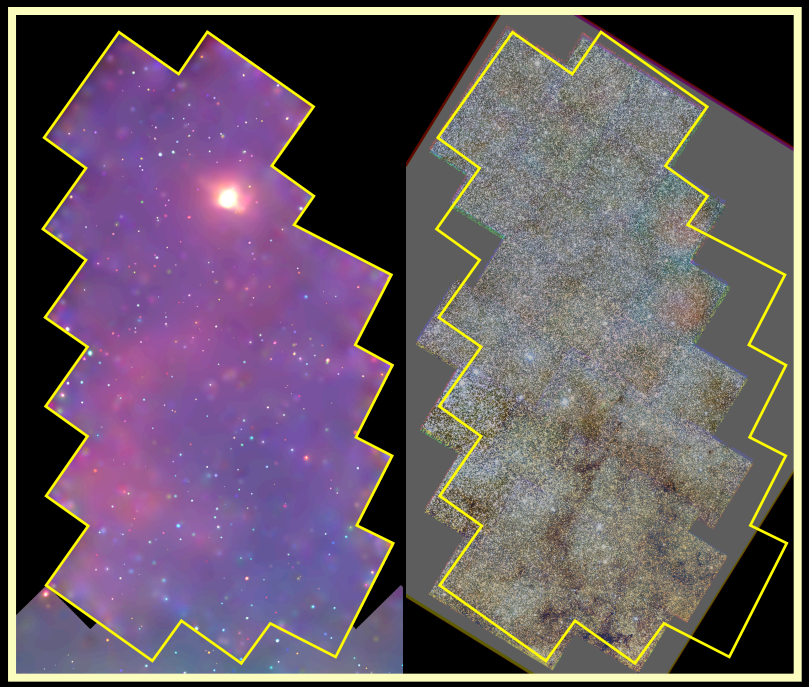
- 2347 unique sources
  only 13 sources with net counts > 250
  have to rely on X-ray colors for classification

- based on X-ray colors: 2/3 of bright sources (SNR>3) lie in bulge

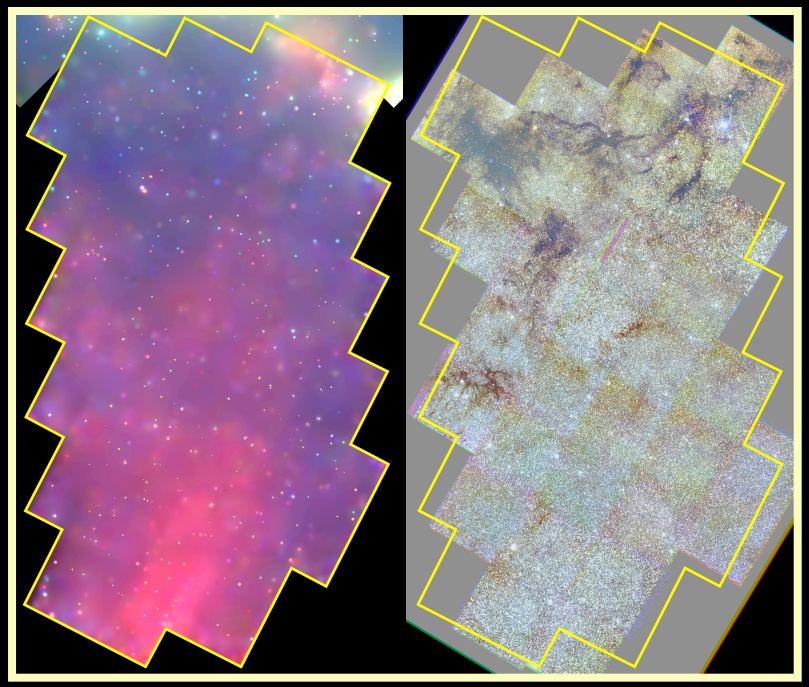
- median 95% positional error r95=1.7”
  based on K-band source density (with SNR>3):
  expect 0.2-1.2 chance alignments in a typical X-ray error circle

Looking for near-IR counterparts is challenging!
Identification cannot be based on astrometry alone

BLS-North



BLS-South



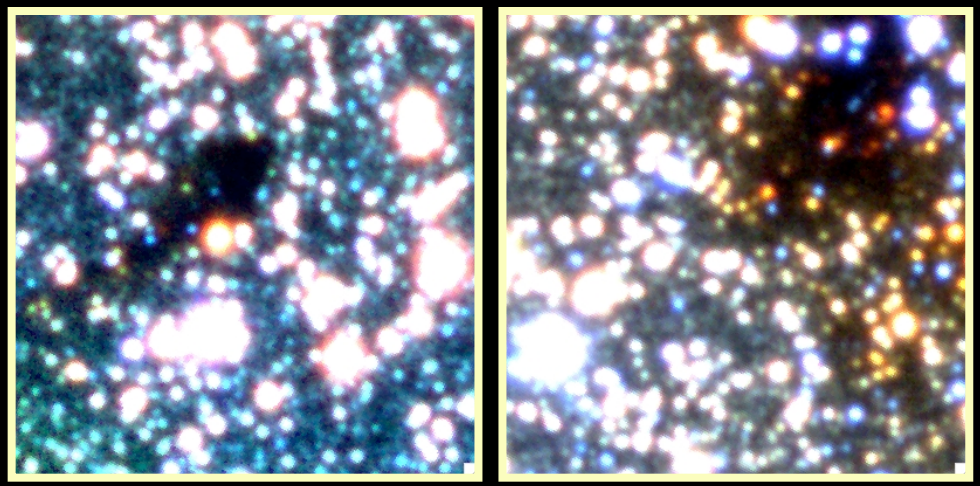
Chandra/ACIS-I mosaic
R=1-3 keV G=3-5 keV B=5-8 keV

ISPI JHK mosaic

BLS infrared mosaic

- sensitivity (3-band detection, SNR>3): K≈16.3 limited by crowding
- in BLS region: 4 ≤ A_V ≤ 20-30 or 0.4 ≤ A_K ≤ 2-3 sensitive to foreground CVs (M_K≈6) and HMXBs (M_K≈ -4) up to Galactic-Center distances
- goals: source identification & extinction map

crowding & small-scale extinction variations



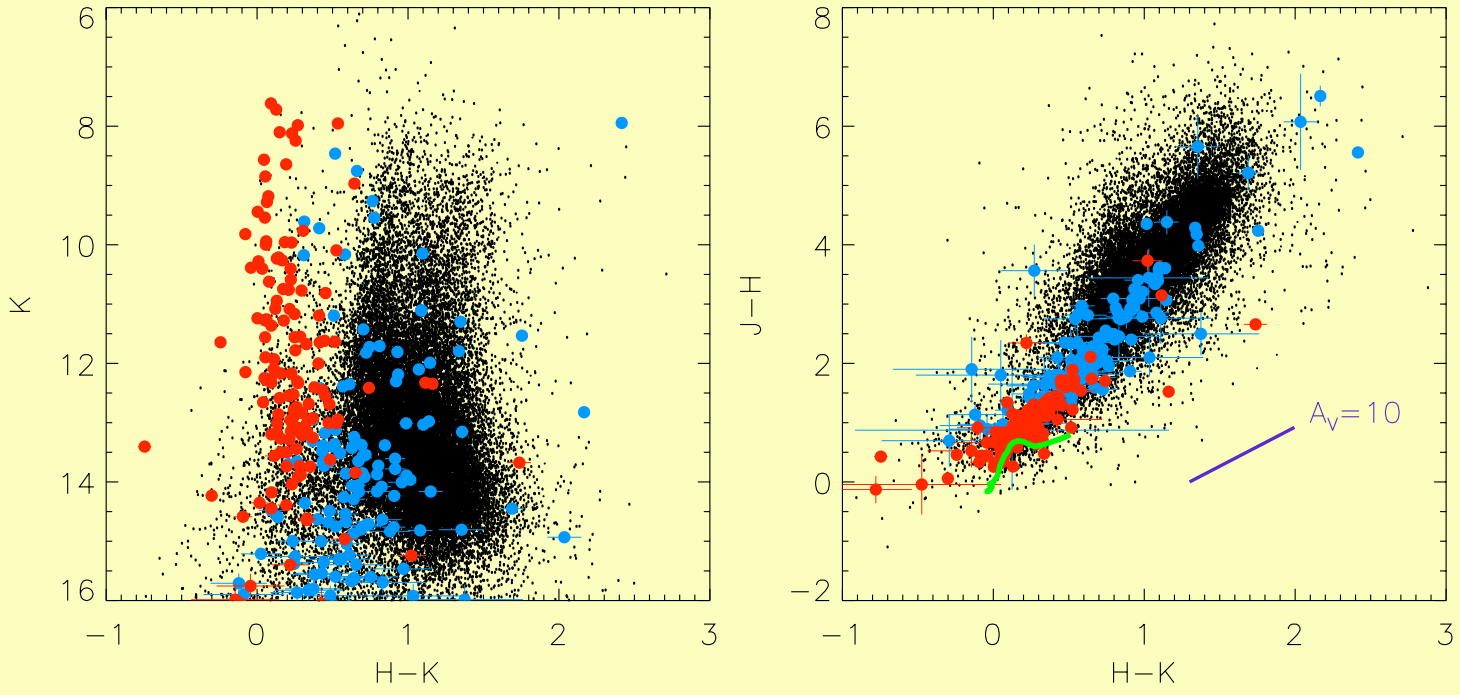
1 arcmin x 1 arcmin

X-ray/infrared matching

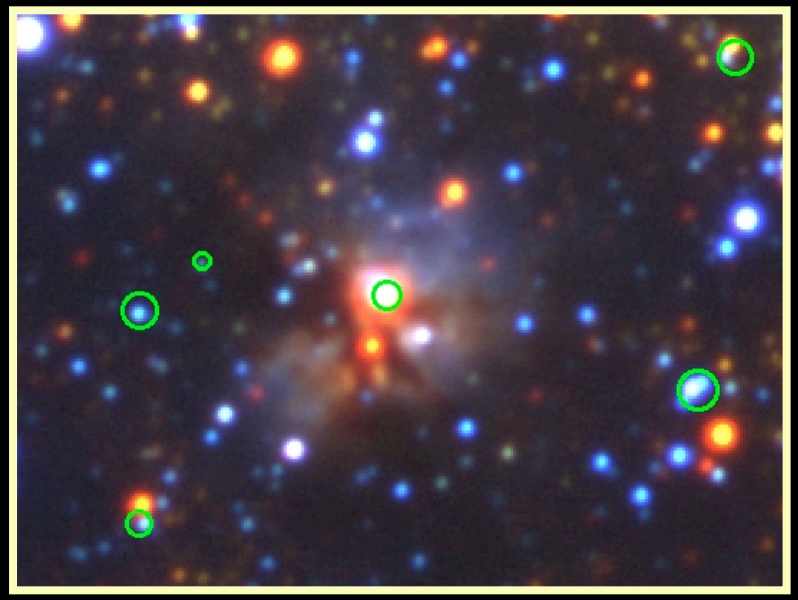
- for X-ray sources included in infrared survey
  74% with candidate counterparts
  51% with multiple candidate counterparts

- soft sources mainly match with foreground sources
  hard sources mainly match with reddened sources

- soft sources: Nmatch ≈ 2 Nrandom (excess ≈ 16 sigma)
  hard sources: Nmatch ≈ Nrandom (excess ≈ 2.3 sigma)



soft sources SNR(soft)>3 & SNR(hard)<3, r95< 2”
hard sources SNR(hard)>3 & SNR(soft)<3, r95<2”



1 arcmin

1.4 arcmin

Example of likely identification

absorbed X-ray point source aligned with absorbed and bright IR source, embedded in compact HII region (age < few million years)

=> probably young star, e.g. massive OB star or colliding-wind binary

Future IR work:

- follow-up IR spectroscopy (can only be done for brightest ones)
- consider variability, e.g. compare with UKIDSS Galactic-Plane Survey
- construct extinction map