

ART-XC data analysis and simulations

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ART-XC model

- ray tracing is used to put the photons from sources and background onto the detector — off-axis single reflection are taken in account
- particle background is simulated
- realistic detector model is used to “detect” photons and particles
- auxiliary information is simulated — housekeeping, star sensors data, etc.
- realistic telescope telemetry data are produced

ART-XC near real time data analysis

- inspection of telescope health information
- inspection of science data quality
- transient and variable sources detection

ART-XC data analysis pipeline

Sky is divided into 5839 equal area $\sim 3^\circ \times 3^\circ$ field, similar to eROSITA.

Newly developed code.

Compilers: C++, F90 (Python and Perl are also used).

CFITSIO, CALDB, ZHTOOLS, SLA, NAG, . . .

The data are processed for all seven telescopes separately.

ART-XC data analysis pipeline

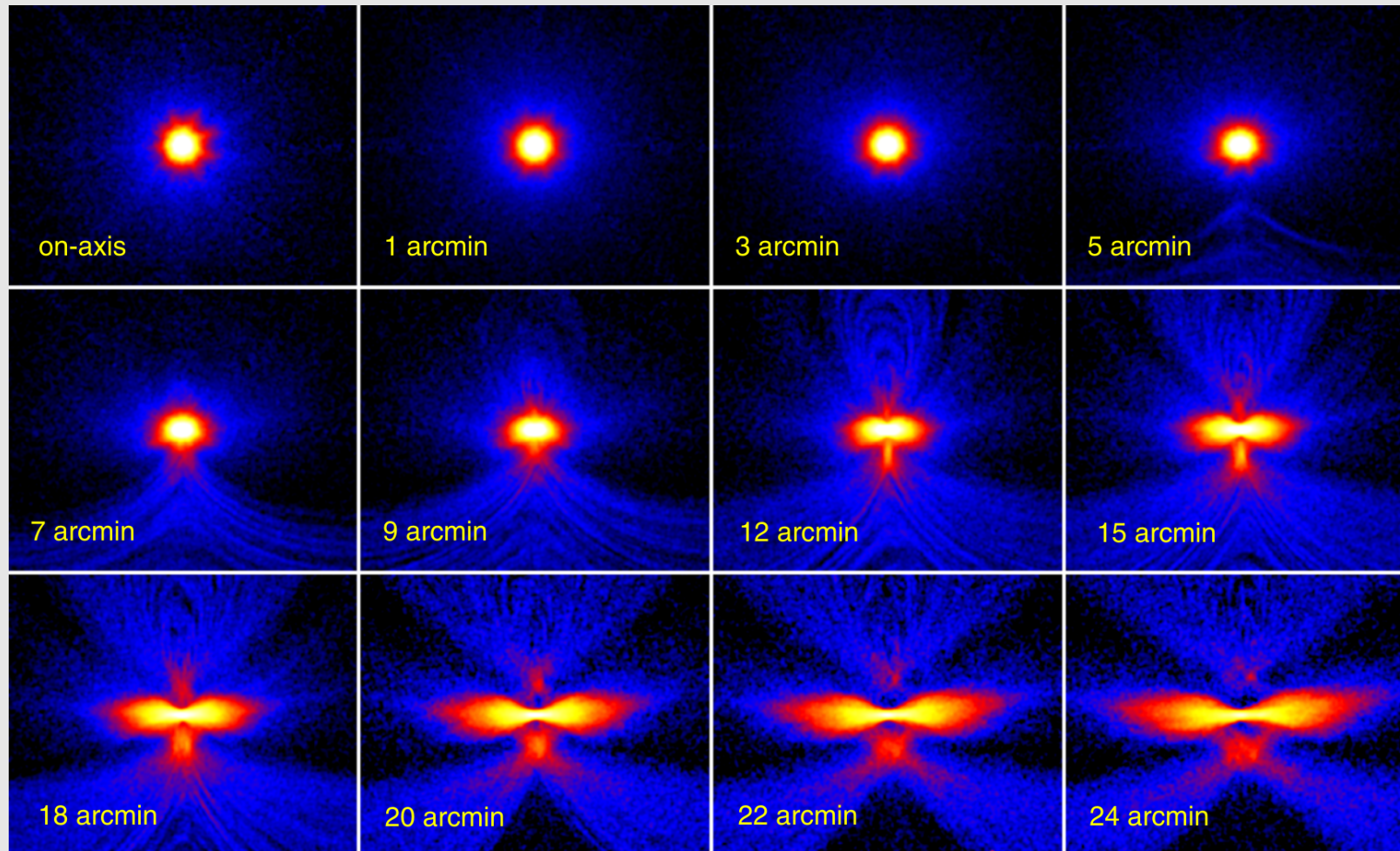
list of tasks, not complete:

- **artpreproc, artrawproc** — raw telemetry processing, data flow split, completeness tests, FITS conversions
- **artdetmask** — creation of detector mask
- **artephacalc** — calculation of PHA channels
- **artattitude** — telescope attitude from star sensor data
- **artskycoords** — calculation of sky coordinates for events
- **arthealthflag, artdataflag, artscreen** — GTI from telescope HK data and science data quality information

ART-XC data analysis pipeline

- **artexpmap** — exposure map
- **artpartbg** — particle background map, made using count rate in unexposed detector regions
- **artmkgb** — background map, wvdecomp from ZHTOOLS
- **artimg, artsrcdet** — image creation, source detection:
 - sliding box
 - matched filter with average and time-dependent PSF
 - maximum likelihood with average and time-dependent PSF (todo)
- **artsrcforced** — forced photometry (todo)
- **artsrc** — source light curve, cpectra, etc. (todo)
- energy bands — 4–6 keV, 6–11 keV, 11–30 keV, 4–30 keV (?)

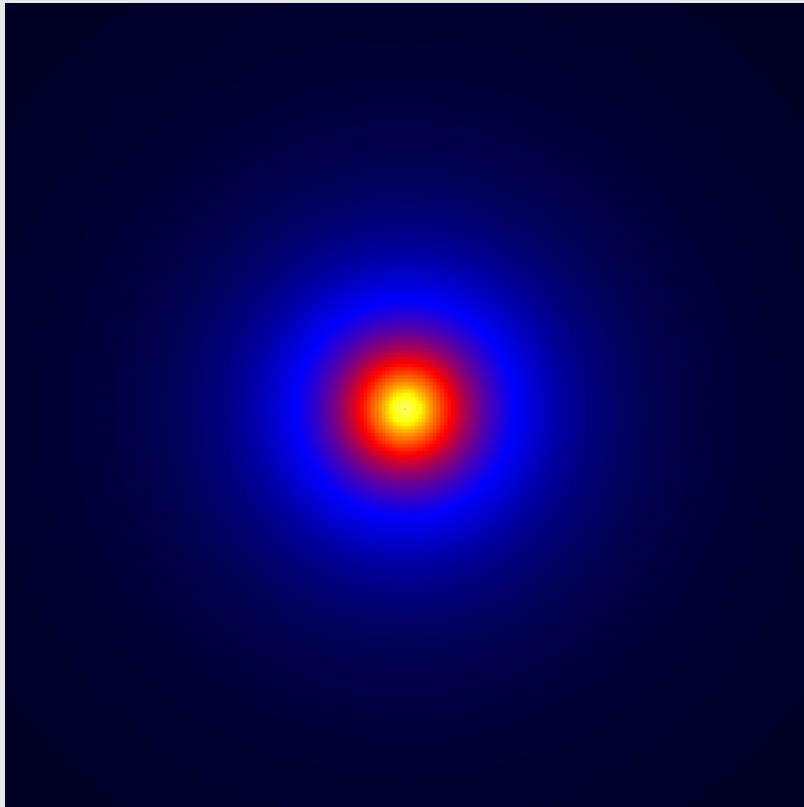
ART-XC mirrors calibrations at MSFC



on-axis PSF HPD — 30''

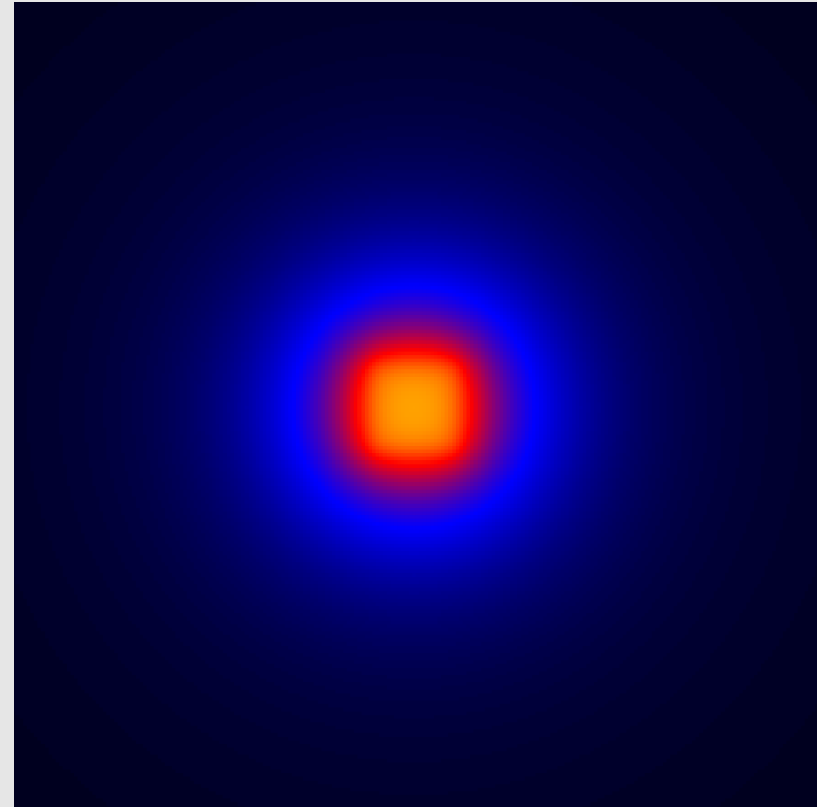
ART-XC effective PSF in survey

weighted average



HPD: 55.4''

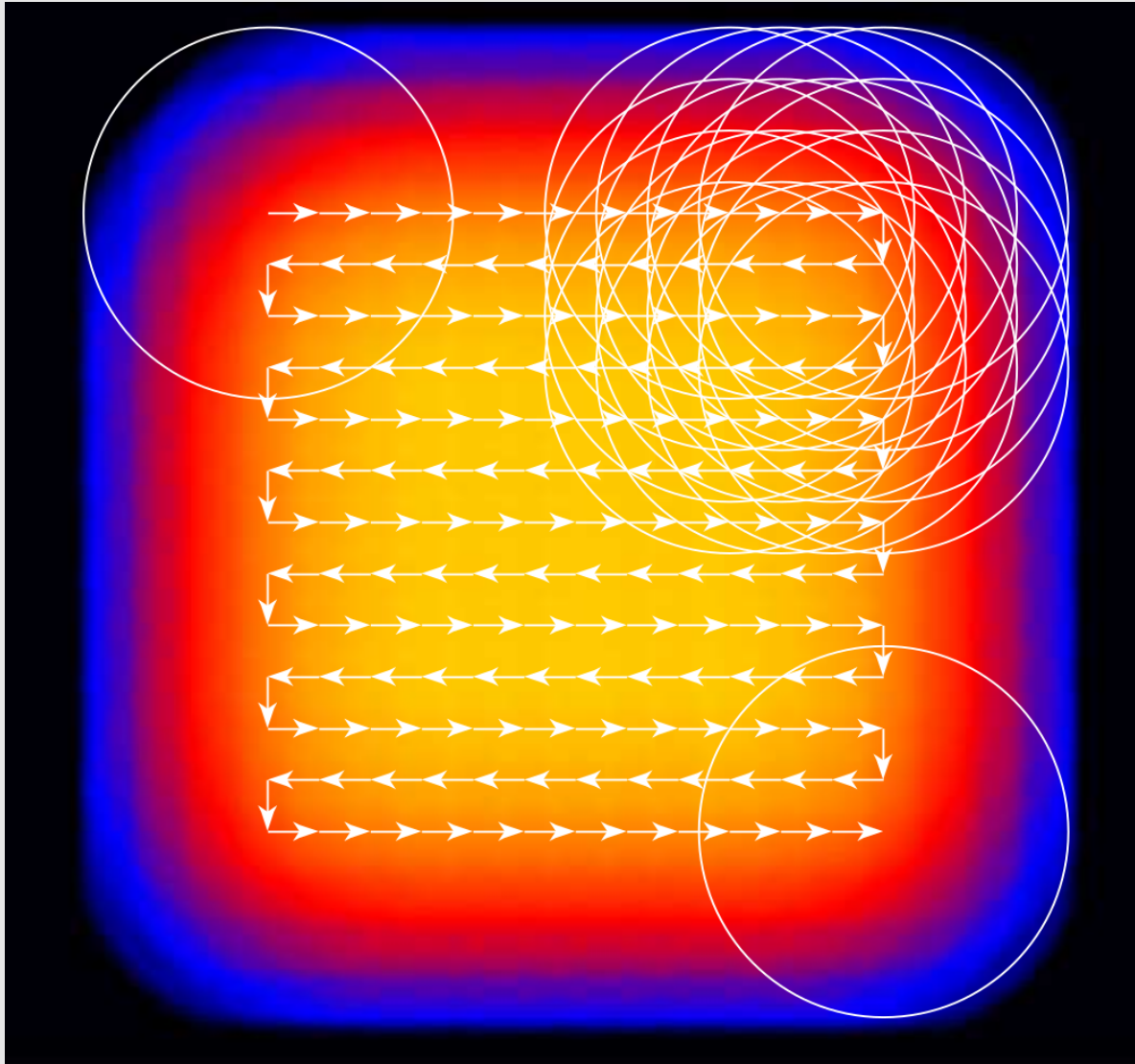
convolved with detector pixel



70.3'' (26% larger)

FWHM — $\approx 51''$

ART-XC deep survey simulation

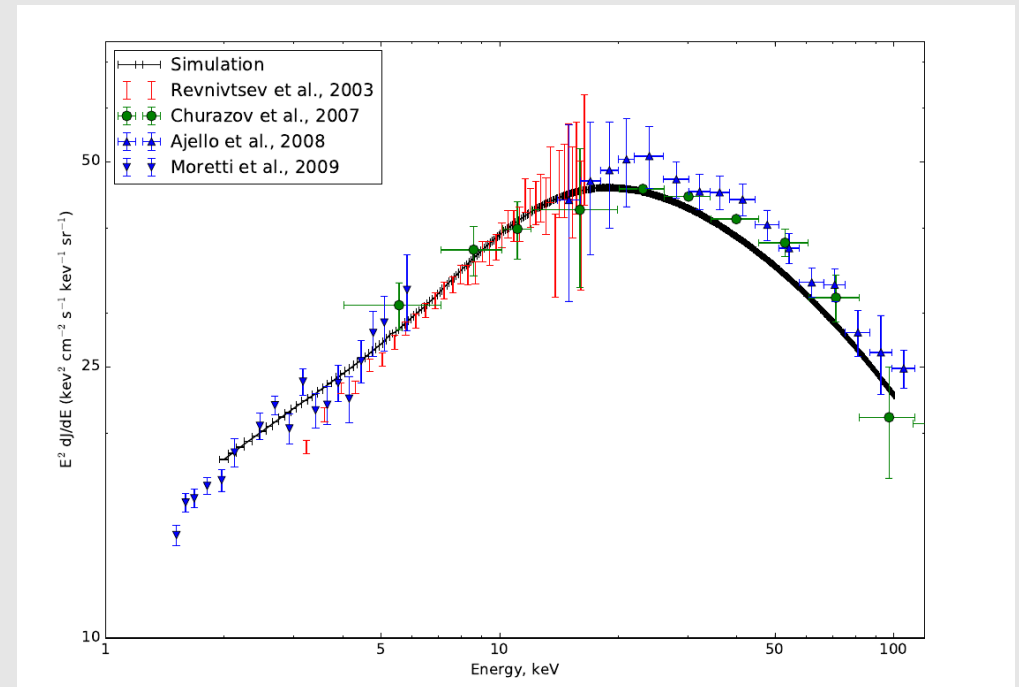
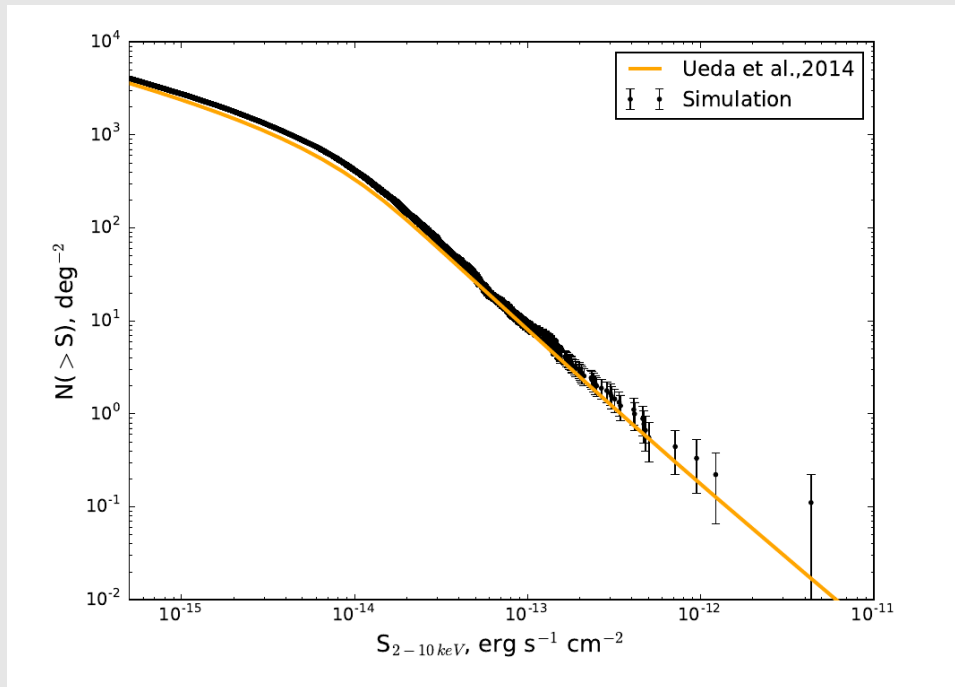


≈ 1 sq. deg

100 ks per FOV area

Mereminsky et al., 2017

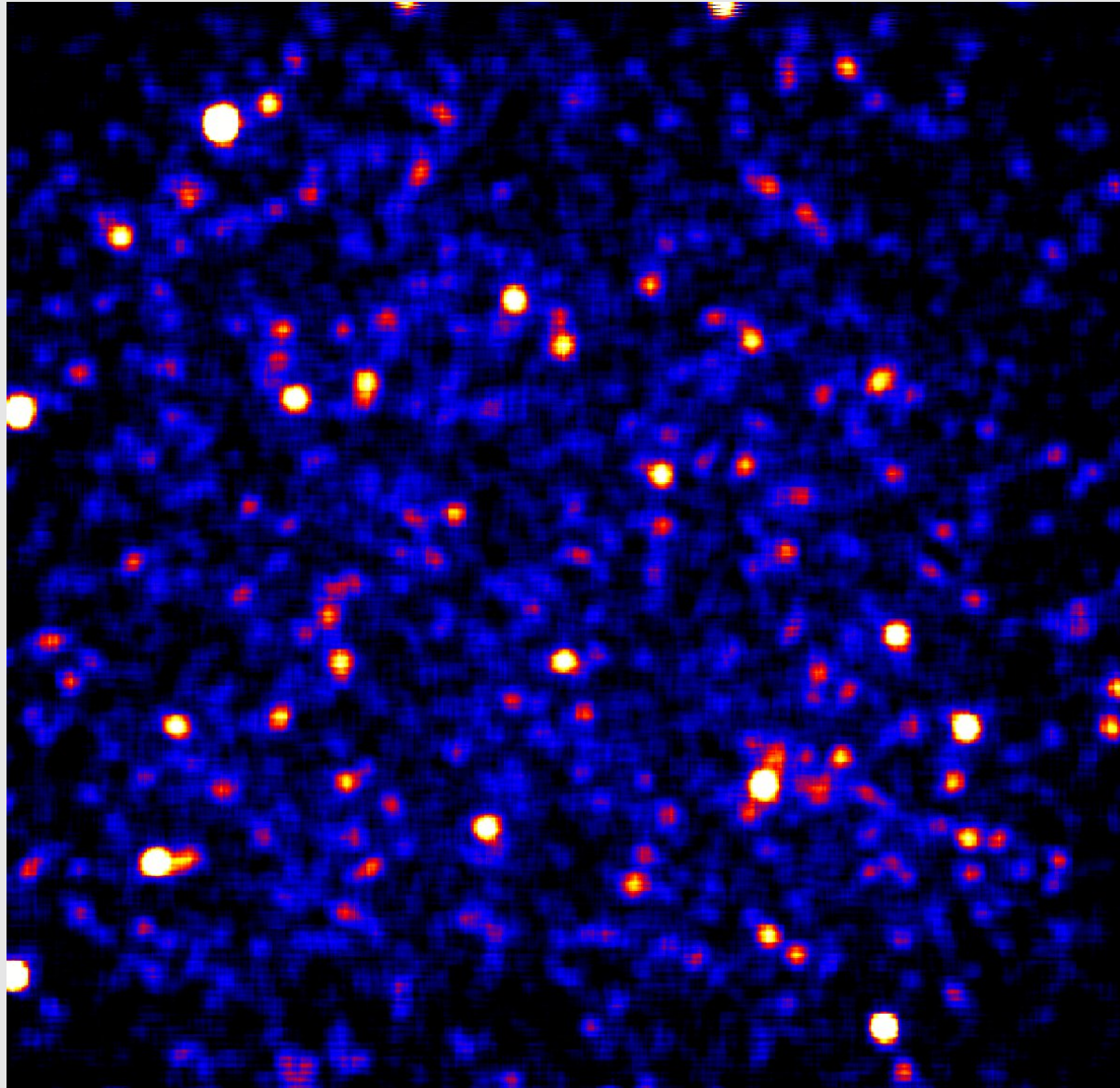
ART-XC deep survey simulation



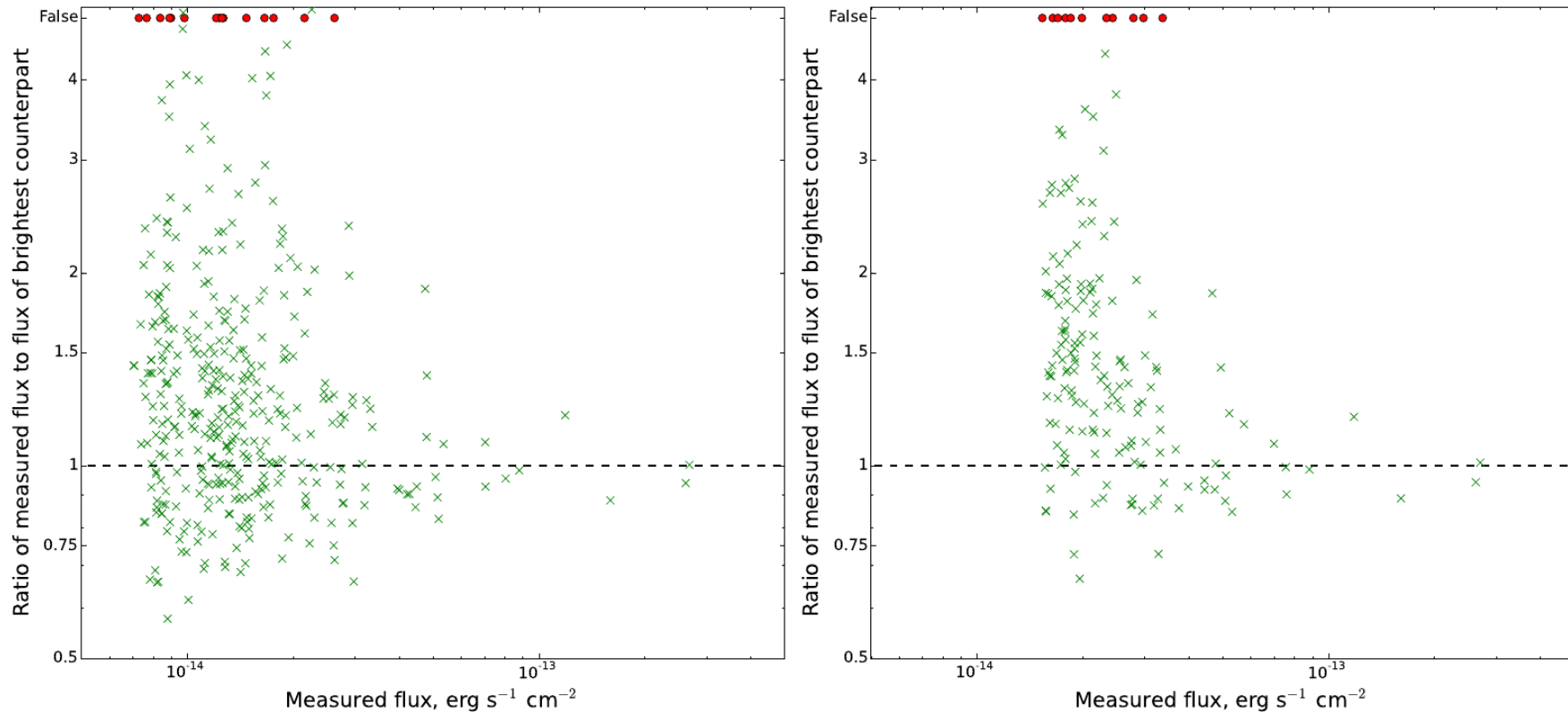
self-consistent AGN population model

Mereminsky et al., 2017

ART-XC deep survey simulation



ART-XC deep survey simulation

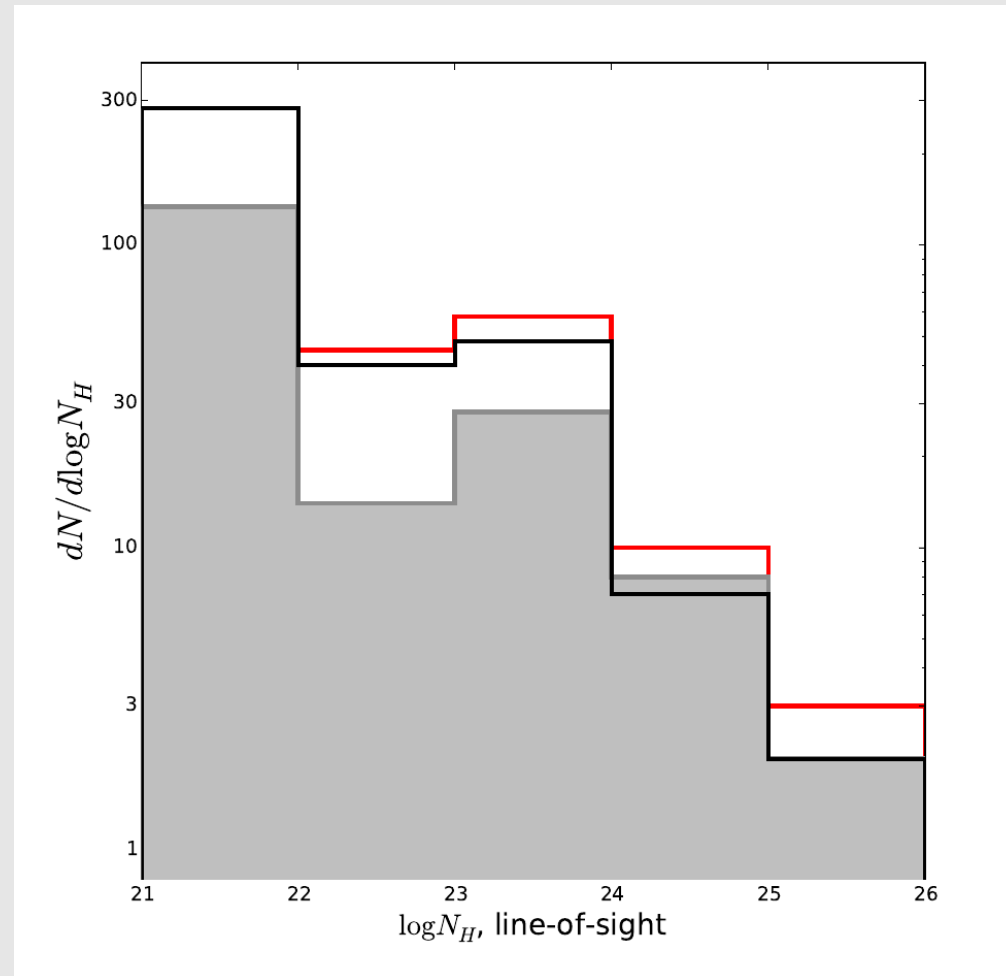


“low” and “high” particle background (0.001 and $0.01 \text{ s}^{-1} \text{ cm}^{-2} \text{ keV}^{-1}$)

5–11 keV, confusion at $\approx 2 \times 10^{-14} \text{ erg s}^{-1} \text{ cm}^{-2}$

in all-sky survey: $f_x > \sim 6 \times 10^{-13} \text{ erg s}^{-1} \text{ cm}^{-2}$, ~ 20000 sources

ART-XC deep survey simulation



a significant part of sources (up to 10%) will not be detected by eROSITA due to absorption

Conclusions

- ART-XC data analysis pipeline is almost ready
- effective PSF in survey — $\approx 50''$ FWHM
- all-sky survey flux limit — $f_x > \sim 6 \times 10^{-13} \text{ erg s}^{-1} \text{ cm}^{-2}$ (5–11 keV)
- ~ 20000 sources will be detected
- more detailed simulations are planned