The eROSITA all-sky survey - Stars in X-rays

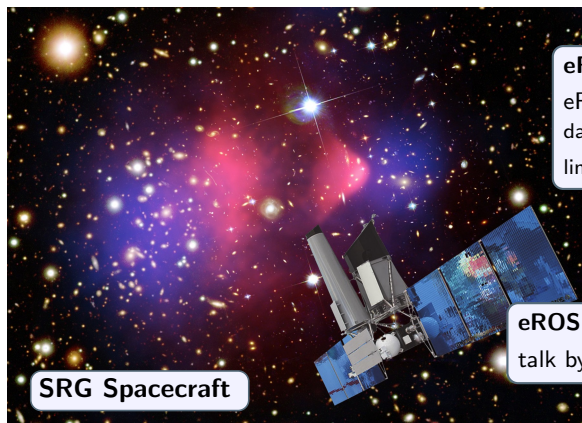...

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Hamburger Sternwarte

The X-ray Universe 2017
Rome, 6 - 9 June

eROSITA (extended Roentgen Survey with an Imaging Telescope Array)

eRASS:

eROSITA All-Sky Survey
data acquisition: $2019 - 2022$
lim. $F_{\mathrm{X}} \approx 1 \times 10^{-14}$ erg cm^{-2} s^{-1}

SRG Spacecraft

eROSITA on SRG
talk by P. Predehl (Thursday morning)

- eROSITA/SRG – launch 2018, L2 halo orbit
- all-sky survey (4 yr, sky-split D/Ru) + pointed phase (3.5 yr)
- 7 co-aligned X-ray telescopes, FOV 1.03° Ø
- $0.3 - 10.0$ keV, HEW 15/28 ″, eff. area@1keV 2400/1400 cm^2

eRASS and stars

'The X-ray HRD' (Güdel 2004)

'eRASS sensitivity with two Suns'

(adapted from Wright et al. 2010)

eRASS (black line) vs.

ROSAT: survey+pointings (dots)

Chandra: CDF-N, ChaMP, COSMOS (crosses)
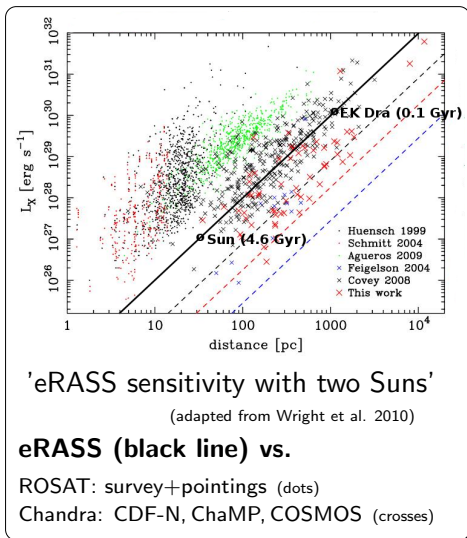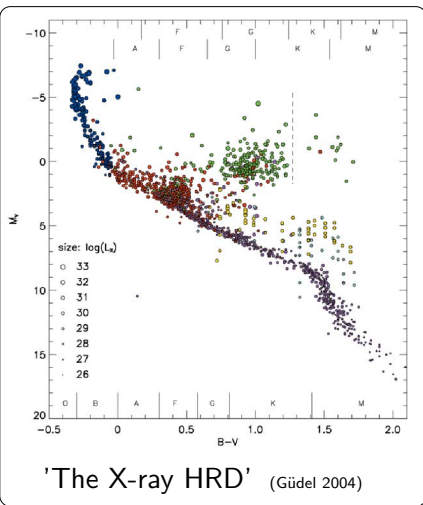
eRASS detection limit:

$L_{\mathrm{X}} \approx 1.0 \times 10^{24} \times d^2(\mathrm{pc}) \; [\mathrm{erg\,s}^{-1}]$

Besancon model:

(RASS, Guillout+ 1996)

$\sim$ **0.7 million X-ray stars**

> 50 per deg^2 (disk),

~ 6 per deg^2 (poles)

(lim. $\log S = -1.9$ [cts/s], 20 cts/1650s)

eROSITA X-ray stars (all, 0.5-2.0 keV)

Stellar surface densities at var. galactic lat./lon.

Simulations are based on the Besancon Stellar X-ray population model.
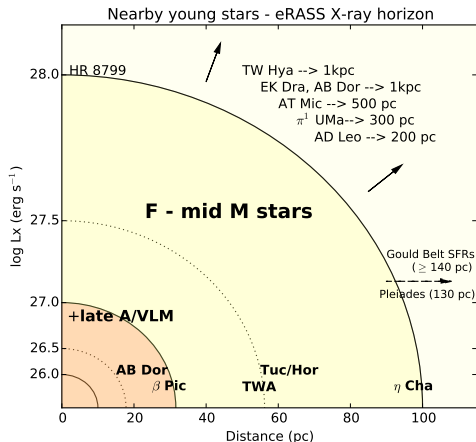Image by J. Robrade.
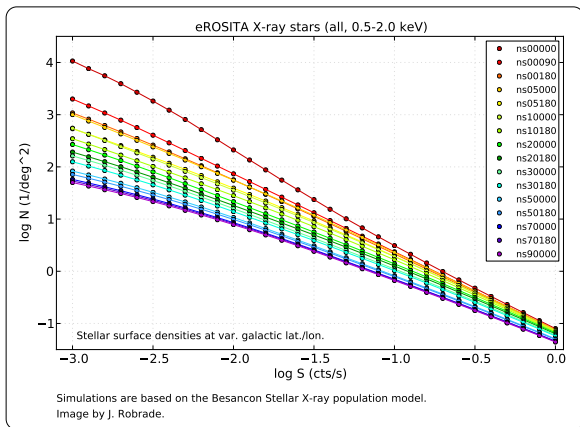
- 3 age x 6 star groups (0.15/1.0/10 Gyr, A to late M, 'standard' coronal sources)
- strong overall contribution from young stars ($\sim$ 250000)

Detecting nearby stars with eROSITA

Sensitivity at 100 pc (MS):
early F (5 $L_\odot$) $\rightarrow$ log L_X/L_{bol} = -6.3
mid M (0.005 $L_\odot$) $\rightarrow$ log L_X/L_{bol} = -3.3

Nearby young stars - eRASS X-ray horizon

- young+nearby (100 pc, 200 Myr) $\rightarrow$ virtually all F to mid M stars
- closer X-ray horizon for late A, VLM stars and older populations
- very nearby - RECONS 10 pc sample :: > 300 stars (4-6-20-44-248, A-F-G-K-M)

CTTS - WTTS - ZAMS

- **strong X-ray emission in all YSOs**
- all-sky & harder energy range ideal
- SFRs at $100 - 500$ pc (Gould belt)
- CTTS: accretors
- WTTS: weak/no accretion or disks
- post TTs/ZAMS
- Massive SFRs in Milky Way, collective X-ray emission

Nearby SFRs and Gould Belt
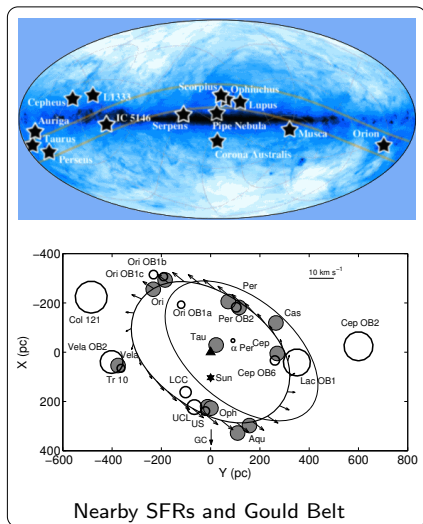
More rare stars

Massive + Intermediate mass stars

- O + early B stars, Lx/Lbol relations
- WR, LBV, magn. massive stars
- HAeBe stars : coronae, jets, MCWS, (companions)
- ApBp stars : MCWS, magnetic disks, (companions)

Ultracool dwarfs (M7+)

- X-ray bright UCD population in solar vicinity ($\lesssim$ 30 pc)
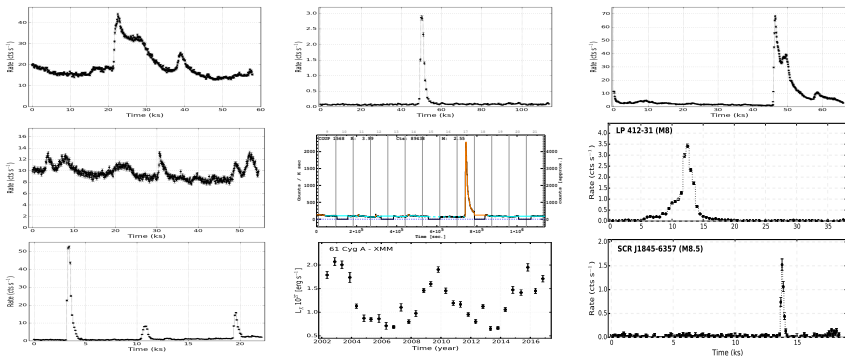- VLM stars (fully convective)
- young or massive/hot BDs

Stelzer et al. (2009)

Williams et al. (2014)
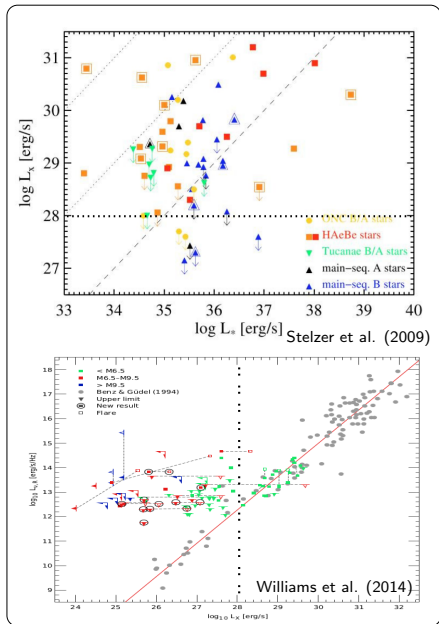
Beyond detections - spectral properties
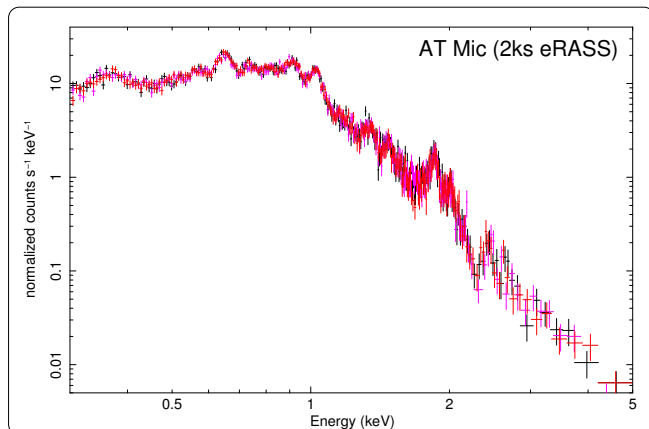
AT Mic - simulated eRASS spectrum (27000 counts)

- about 50000 (5000) stars with $\gtrsim$ 200 (1000) counts
- coronal properties of X-ray brighter targets
- multi-band HR classification for many other sources

X-ray light curves – **left**: nearby young stars; **middle**: A0p star, CTTS, K dwarf; **right**: M dwarfs, UCDs

- light curves on multiple timescales + transient sources
  - 4 yr survey: 8 sky-scans (0.5 yr) with 6 scans/day (40 s each)
- X-ray variability, flare statistics, activity cycles...

Summary and synergies

> The **eROSITA all-sky survey** - an unprecedented view of the X-ray sky

- RASS $\implies$ eRASS: about factor 20 higher sensitivity
- plus variability, higher spatial resolution, X-ray spectral characteristics...

- volume complete samples, full stellar populations, large object numbers

  Synergies: most eROSITA stars are optically bright (V $\lesssim$ 15 mag)

- Gaia :: distances, 3-D space motions, identifications etc.
- MWL data and aux. catalogs :: stellar properties, activity+age indicators, planet hosts etc.

  Interested in collaborating? Give us a note...