eROSITA - StarsWG Report

Jan Robrade

Hamburger Sternwarte

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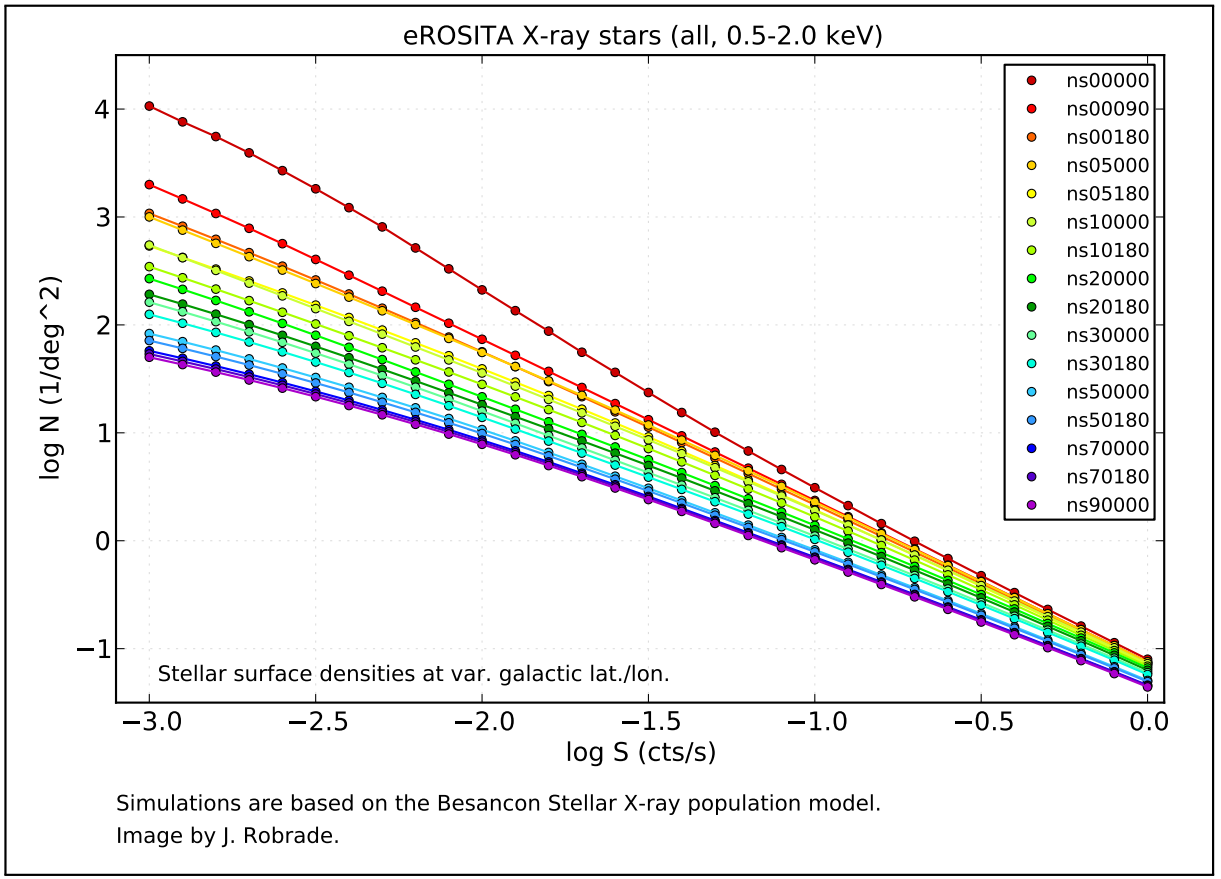
Detecting stars with eROSITA

Besancon model:
(RASS, Guillout+ 1996)

> 50 per deg^2 (disk), ~ 6 per deg^2 (poles)

lim. $F_X \sim 1 \times 10^{-14}$ erg cm^{-2} s^{-1}

(logS = -1.9 [cts/s], 20 cts/1600s



- **about 0.7 million X-ray stars in eRASS**
- detection limit: $L_X \approx 1 \times 10^{24} \times d^2(\mathrm{pc})$ [erg/s]

Finding X-ray stars

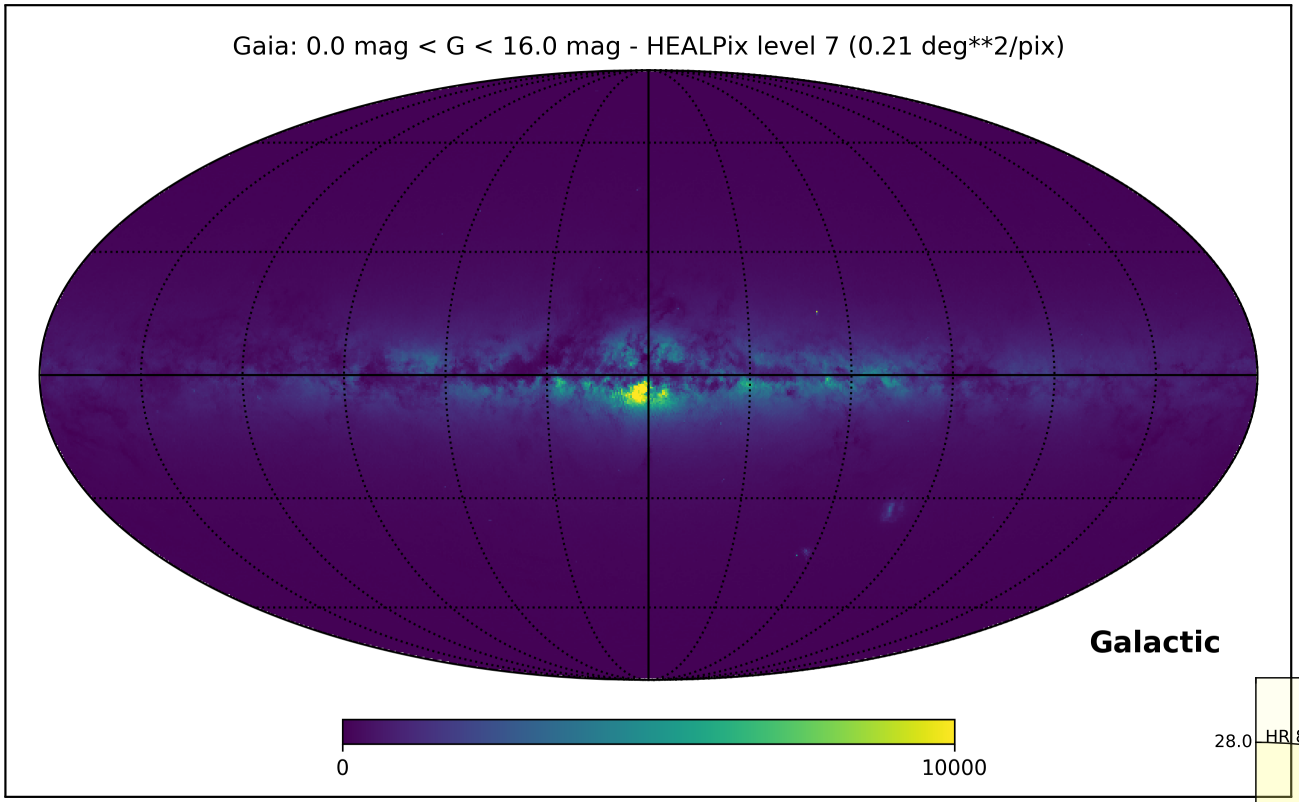
All-sky surveys for all-sky data

Main identifications:

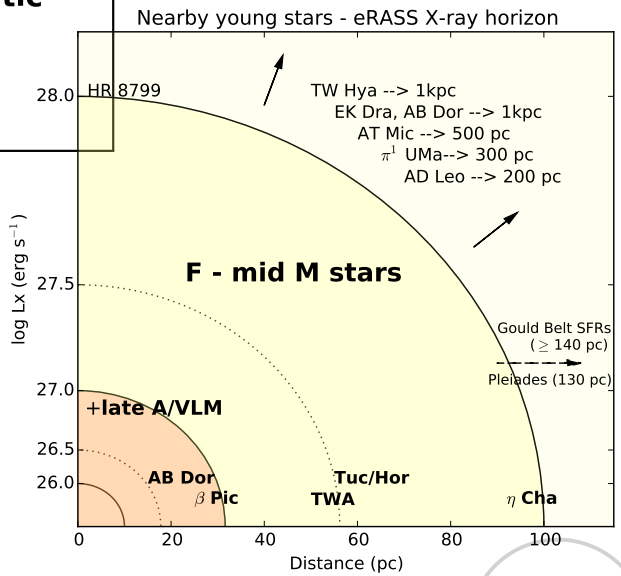
- Gaia – $\mathbf{1.3 \times 10^9}$ objects, G $\lesssim$ 20 mag (+ BP/RP & RVS spectra)
- 2MASS – $\mathbf{4.5 \times 10^8}$ objects, J/H/K ($\lesssim$ 16/15/14 mag)
- ALLWISE – $\mathbf{7.5 \times 10^8}$ objects, 3.4, 4.6, 12 and 22 μm (W1 $\lesssim$ 16 mag)
- TYCHO-2 – $\mathbf{2.5 \times 10^6}$ objects, B/V (V $\lesssim$ 11 mag)
- full eRASS coverage (completeness $\gtrsim$ 99 %)

- activity-age-rotation relation
- coronal sources: activity range $\log L_{\rm X}/L_{\rm bol} \approx -3 \ldots -7$
- lim. $F_{\rm X} \Longrightarrow$ lim. $F_{\rm opt}$ per spT/color/$T_{\rm eff}$ and phot. band
- ongoing X-ID project @HS (XMMSL, RASS...)

Stellar cross-matching



$\sim 10^8$ DR1 sources
moderate
counterpart
surface density
($\lesssim 1$ @ r $= 10''$)

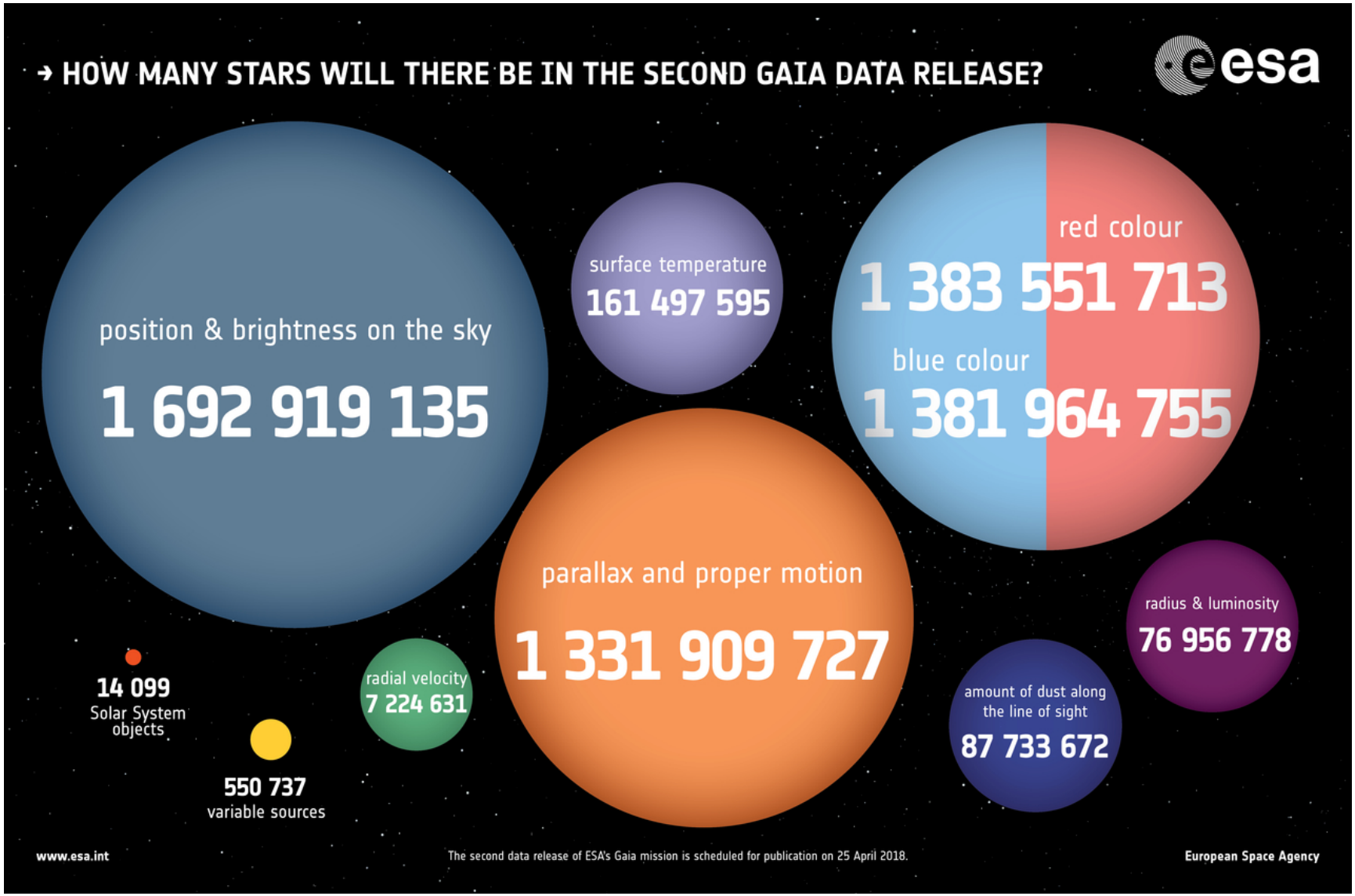


Gaia + 2MASS etc.

- accurate parallaxes for eRASS stars ($F \rightarrow L$)
- opt. fainter sources are nearby

ID-space: position, distance, colors

Stellar cross-matching



Stars in eRASS1+

Stellar science with eRASS1

sample size $\sim$ 50000 stars

- new + hard/absorbed sources (already better than RASS)
- comparison to RASS (and other X-ray surveys)
  - variability (long-term baseline of 25 years)
- more X-ray stars/photons in future eRASS releases
  - Gaia DR3/4, TESS (launched)...
  - MWL and follow up campaigns

eROStars & collaborations

Inter-National: several high-expertise groups expressed interest in eROSITA

Russian side: stellar working group scheme vague; collaborations very welcome

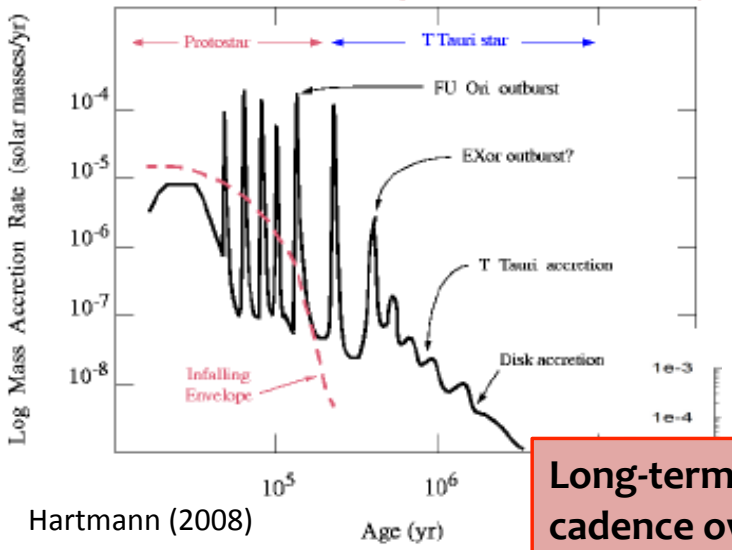
eROStars - CalPV program

η Cha (B8V) and field (DSS)

The η Cha cluster

- nearby (100 pc) star forming region, intermediate age (5−8 Myr)
- 150 ks field scan mode, 5 x 5 deg
- 5 ks depth: $\log L_{\mathrm{X\,lim}} \approx 6 \times 10^{27}$ erg s^{-1}

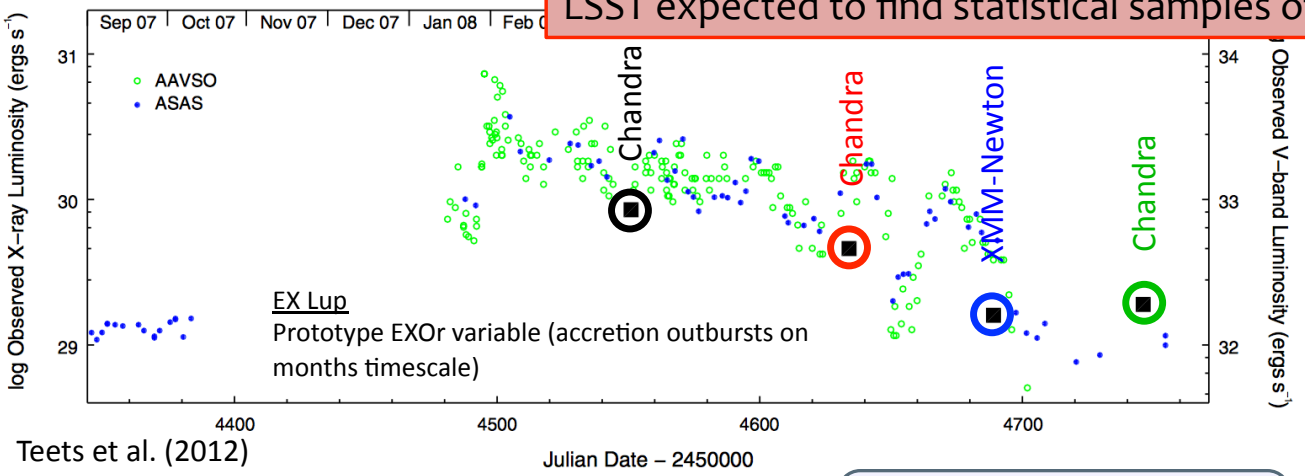
Variable X-rays in accretion bursts from Young Stellar Objects – FUOr, EXOr events



Hartmann (2008)

* FUor and EXOr events are strong transient brightenings of protostars ascribed to accretion bursts
* mass accretion rate increases by 3 orders of mag
* FUOr: duration – years to decades
  EXOr: duration – months to 1-year
* only about 2 dozens known
* **YSO accretion shocks known to produce X-rays, but X-ray counterparts rarely identified**

Long-term (months – years) monitoring with low-cadence over large sky area needed
→ eROSITA follow-up of LSST candidates
LSST expected to find statistical samples of EXOr events.



Teets et al. (2012)

slide from B. Stelzer