Web-tool for online test of cooling curves of compact stars

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Preamble

Main idea
Online web-tool for population synthesis of isolated cooling neutron stars (ICoNS) allows one to additionaly test equation of state (EoS) confronting synthesised population of ICoNS with observations made during ROSAT All-Sky Survey.

Report plan
1. General introduction
2. Population synthesis of isolated cooling neutron stars
3. Web-tool description
Population synthesis is a method for direct modeling of various populations of weakly interacting objects with complicated evolution.

Applicable:
- from isolated stars to binaries,
- from HR diagram of clusters to radiopulsars,
- from accreting stars to AGN.

For review see astro-ph/0411792.
Isolated cooling neutron star

- Isolated cooling near-by compact stars,
- Pure thermal spectrum, $T \sim 100$ eV,
- Perfect to use in cooling curves tests.

RX J1856, discovered by F.M. Walter

Well-defined model with following ingredients:

- Supernovae rate,
- Spatial distribution and velocity distribution,
- Gravitational potential of the Galaxy,
- Absorption of X-rays by ISM,
- ROSAT effective area,
- Mass distribution of compact stars*,
- Mass-radius relation*,
- Cooling curves*.

* specified by user in on-line tool.
Supernovae rate is assumed to be $1/30 \text{ yr}^{-1}$,

Local ICoNS population dominated by Gould Belt, which contains 10\% of all young NS (Popov et al. 2003, 2005).

90\% of young NS are outside nearest 500 pc, 18\% of this from Galaxy disc and rest from globular clusters.
Birth velocity distribution

- Velocity distribution from pulsar observations (Arzoumanian et al., 2002.)
- Two components: $\sigma_1 = 90 \text{ km sec}^{-1}$ and $\sigma_2 = 500 \text{ km sec}^{-1}$, $w_1 = 40\%$, where $\sigma_{1,2}$ is the 1D dispersion and $w_1$ — fraction of the first component in distribution.

Absorption of X-rays and distribution of the ISM

B. Posselt et al., 2008.

Wilms et al., 2000.

Mass distribution

- From HIPPARCOS500 catalog, obtained by direct counting with age-corrections.

![Mass distribution graph](http://www.astro.uni-jena.de/Net-PSICoNS/)

Does it work?

- Along with cooling curves for different initial magnetic fields used to fit initial magnetic field distribution. (Popov et al., 2010)
- Population synthesis of DA WDs is in good agreement with data from Liebert et al. (2004); Wolff et al. (1996). (Boldin et al., 2010)
- Can be applied to make prediction of a future survey’s properties: eROSITA, ART-XC.
LogN-LogS simulation

Parameter Input

- **Number of stars:**
  - 5000

- **Masses and cooling curves:**
  - Use default mass distribution
  - Specify mass fraction
    - Mass [M_Sun]
    - Specify mass fraction
      - 1.1
      - 1.25
      - 1.32
      - 1.4
      - 1.48
      - 1.6
      - 1.7
      - 1.76
    - Radius [cm]
    - Cooling curve for that mass
      - O6Iop...

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Code: S. Popov (SAI MSU), P. Boldin (MEPhI), B. Posselt (CfA-Harvard)
Created: N. Tetzlaff (AIU Jena), 2008-10-20 — Last mod.: N. Tetzlaff, 2010-09-08

Cooling curves from Pons et al., 2008.

**LogN-LogS simulation**

**Progress**

Download your results (will be available for one week from now)
Thank you!