The ChaMPS Extended Stellar Survey (ChESS)

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Abstract

We present 348 X-ray emitting stars identified from correlating the Extended Chandra Multispectral Project (ChAMP) with the Sloan Digital Sky Survey (SDSS). 42 catalog members have spectroscopic classifications available in the literature. We present new spectral classifications and its measurements for an additional 79 stars. The catalog is dominated by main sequence stars; we estimate the fraction of giants in ChESS to be no more than 10%.

These stars lie in a unique space in the L, distance plane, filling the gap between the nearby stars identified as counterparts to sources in the ROSAT All Sky Survey and the more distant stars detected in deep Chandra and XMM surveys.

For 36 newly identified X-ray emitting M stars we calculate \( L_{x}/L_{bol} \) and \( L_{x}/L_{bol} \) are linearly related below \( L_{x}/L_{bol} \) \( \approx 3 \times 10^{-6} \) and \( L_{x}/L_{bol} \) appears to turn over at larger \( L_{x}/L_{bol} \) values.

Stars with reliable SDSS photometry have an \( -0.1 \) mag blue excess in u-g, likely due to increased chromospheric continuum emission. Photometric metallicity estimates suggest that the sample is split evenly between the young and old disk populations of the Galaxy; the lowest activity sources belong to the old disk population, a clear signature of the decay of magnetic activity with age.

M. Agüeros is supported by an NSF Astronomy and Astrophysics Postdoctoral Fellowship under award AST-0602298. I thank the Ministry of Education and Science of Spain and ESA XMM-Newton for their financial support.

Table 1 Stages in catalog construction. Columns 3 and 4 give the number of spectroscopically confirmed stars and galaxies present in the catalog at each stage. The numbers in parentheses correspond to the fraction of the original number of these objects that is retained.

<table>
<thead>
<tr>
<th>Matched ChAMP/SDSS catalog</th>
<th>Spectroscopic Objects</th>
<th>Spectroscopic Stars</th>
<th>Spectroscopic Galaxies</th>
</tr>
</thead>
<tbody>
<tr>
<td>... point sources</td>
<td>2121</td>
<td>69 (100%)</td>
<td>684 (100%)</td>
</tr>
<tr>
<td>... in DSS QSO catalog</td>
<td>3373</td>
<td>57 (100%)</td>
<td>388 (100%)</td>
</tr>
<tr>
<td>... with ( i &lt; 18.2 + 0.7 \times (g-i) )</td>
<td>546</td>
<td>86 (100%)</td>
<td>47 (100%)</td>
</tr>
<tr>
<td>... with clean X-ray properties</td>
<td>362</td>
<td>92 (98%)</td>
<td>3 (95%)</td>
</tr>
</tbody>
</table>

Final catalog

348\(^{a}\) 81 (91%) 0 (0%)

\(^{a}\) Includes 27 saturated stars that do not meet this color-magnitude cut.

\(^{b}\) Three spectroscopically confirmed QSOs and 11 sources with sub-standard X-ray detections are removed manually.

II. Identifying Stellar Sources

We use morphological star/galaxy separation, matching to an SDSS quasar catalog, an optical color-magnitude cut, and X-ray data quality tests to create the ChaMPS Extended Stellar Survey (ChESS) from a sample of 2121 matched ChAMP/SDSS sources.

Our cuts retain 92% of the spectroscopically confirmed stars in the original sample and excludes 99.6% of the confirmed extragalactic sources.

By comparing the distribution of the ChESS sample to that of simulated SDSS/2MASS observations generated by TRILEGAL, we estimate that the total fraction of giants in the catalog is \( \approx 10\% \).

In addition to seven confirmed giants, we identify three cataclysmic variables.

< 3\% of the sources in our final catalog are previously identified stellar X-ray emitters.

III. Some Results

Fig. 1 The Extended ChaMP footprint in Galactic coordinates. Open circles are fields observed with ACIS-I, filled circles observed with ACIS-S. The symbol size is proportional to \( \log L_{x} \), the symbol in the upper left corner corresponds to 100 ksec. The shaded region is the SDSS footprint.

Fig. 2 L\(_{x}/L_{bol} \) as a function of distance for several samples of X-ray emitting stars. ChESS stars with unsaturated SDSS photometry and clean X-ray detections are shown as filled circles, those with saturated SDSS photometry and/or X-ray detections are shown as open circles, and stars selected on the basis of Hα emission are shown as squares. Also shown are the samples of Schmitt & Liebke (2004, red circles), Hünsch et al. (1998, yellow circles), Feigelson et al. (2004, blue diamonds), and López-Santiago (2007, cyan asterisks).


Future papers will present analyses of source variability and comparisons of this catalog to models of stellar activity in the Galactic disk.

Also see D.-W. Kim’s poster: “Extended Chandra Multi-wavelength Project (ChAMP)” (I.7)