X-ray Studies of Canadian Galactic Plane Survey SNRs
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Motivation:
- Low-surface brightness supernova remnants are important in shaping our understanding of pulsar and supernova evolution, since the population of SNRs in our Galaxy is likely to be dominated by faint objects.
- 80-90% of Galactic SNRs are expected to be of type Ib/c or II--explosions of massive stars, most of which create stellar wind bubbles around them, and thus form low-surface brightness SNRs.
- The Canadian Galactic Plane Survey (CGPS) (Taylor et al. 2003) is a high-resolution radio survey that incorporates single-antenna data to retain sensitivity to the largest structures (such as filamentary non-thermal radio emission from SNRs).
- So far a handful SNRs have been discovered with the CGPS (Kothes et al. 2005).
- We have started a program to search for their X-ray counterparts with XMM-Newton, which is best for the study of low-surface brightness SNRs in the X-ray. We also used Chandra to resolve X-ray point sources in their field and search for the putative neutron star associated with the SNR.
- The 3 SNRs presented here (G85.4+0.7, G85.9-0.9, G107.5-1.5) were discovered in CGPS data. No X-ray studies of these objects have been performed earlier.

Radio Images (CGPS):
- G85.4+0.7 has a 0.4" non-thermal shell surrounded by a 0.8" thermal shell, located within an H I bubble.
- G85.9-0.6 has no discernible H I features, possibly a remnant of a Type Ia SN between the local and Perseus arms.
- Central X-ray emission was detected with ROSAT (contours). No sufficient counts for a spectral analysis.

Observations:

<table>
<thead>
<tr>
<th>SNR G.</th>
<th>XMM (ks) T(tot) T(ef)</th>
<th>CXO (ks) T(tot) T(ef)</th>
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<tbody>
<tr>
<td>85.4+0.7</td>
<td>26.7 15.2 14.5 20.2</td>
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<tr>
<td>85.9-0.6</td>
<td>29 26 14.3 19.9</td>
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<tr>
<td>107.5-1.5</td>
<td>35 15 ---</td>
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Total and effective (after filtering the data for high bkg flares) exposure times with XMM and Chandra. Proton flares in XMM data have severely reduced the exposure times.

Summary:
- We detected thermal emission from G85.4 and G85.9. The SNRs appear centrally bright in soft X-rays with a thermal spectrum, and are thus classified as new Mixed-Morphology SNRs.
- G85.4 is most likely a core-collapse SN explosion but G85.9 is more likely a Type Ia explosion (enhanced Fe abundance).
- We did not detect any diffuse emission from G107.5, likely because our observation was reduced significantly by proton flares. Two soft point sources were detected near the SNR center, and coincide with an unidentified ROSAT source, that is likely the neutron star.
- Further observations are needed to better constrain the spectral parameters of the point sources, perform timing analysis of neutron star candidates, and detect diffuse emission from G107.

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