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A comprehensive library of X-ray pulsars in the Small Magellanic Cloud: time evolution of their luminosities and spin periods

We have collected and analyzed the complete archive of XMM-Newton (116), Chandra (151), and RXTE\/ (952) observations of the Small Magellanic Cloud (SMC), spanning 1997-2014. The resulting observational library provides a comprehensive view of the physical, temporal and statistical properties of the SMC pulsar population across the luminosity range of $L_X = 10^{31.2}$–10^{38}~erg~s^{-1}. From a sample of 67 pulsars we report ∼1599 individual pulsar detections, yielding ∼1256 pulse period measurements. Our pipeline generates a suite of products for each pulsar detection: spin period, flux, event list, high time-resolution light-curve, pulse-profile, periodogram, and X-ray spectrum. Upper-limits are estimated for all non-detections bringing the combined database to ∼37,000 entries. Combining all three satellites, we generated complete histories of the spin periods, pulse amplitudes, pulsed fractions and X-ray luminosities. Many of the pulsars show variations in pulse period due to the combination of orbital motion and accretion torques. Long-term spin-up/down trends are seen in 11/7 pulsars respectively, pointing to sustained transfer of mass and angular momentum to the neutron star on decadal timescales. Of the sample 35 pulsars have relatively very small spin period derivative and may be close to equilibrium spin. The distributions of pulse-detection and flux as functions of spin-period provide interesting findings: mapping boundaries of accretion-driven X-ray luminosity, and showing that fast pulsars (P <10 s) are rarely detected, yet are more prone to giant outbursts. Accompanying this paper is an initial public release of the library so that it can be used by other researchers. We intend the database and pulse profile library to be useful in driving improved models of neutron star magnetospheres and accretion physics.

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