X-ray sources in the Magellanic Clouds: Analysis of 15 years of XMM-Newton and Chandra observations

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Introduction to the library of pulsars in the Magellanic Clouds

- Why study pulsars in Magellanic Clouds:
  NSs hold unsolved problems
  low absorption, known distance (->categorize luminosity of the Pulsars)

- Known pulsars with combination of 3 satellites
  e.g. SXP 348, SXP 1323

- Pulse profile modeling
  e.g. SXP 504
Library of pulsars in the Magellanic Clouds

XMM-Newton
116+42 Obs: 2000-2014

Chandra
155+30 Obs: 2000-2014

RXTE
Weekly Obs: 1997-2012
Observation overview

Propeller line in Magellanic high mass X-ray binaries; Did not find the pulsations below the P-line

\[ L_{X,\text{min}} = L_0 \left( \frac{2.0 \times 10^{37} \text{ erg/s}}{\mu \left( \frac{\text{G cm}^3}{\text{s}} \right)^2} \right) P^{-7/3} \]
SMC Pulsar library with 3 satellite combination

- **SXP 348**
- **Spin up**: 0.00102 s/day
- **RXTE** does not have Pulse Frac info
- **Spin up/down**
- **Pulse profile model**
- **Intro Library**
- **Pulsars in SMC & Model**

### Luminosity
- \(10^{33}\) erg/s
- \(10^{34}\) erg/s
- \(10^{35}\) erg/s
- \(10^{36}\) erg/s
- \(10^{37}\) erg/s

### Pulse fraction
- Amplitude (Counts/s)
- 0.0
- 0.1
- 0.2
- 0.3
- 0.4
- 0.5
- 0.6
- 0.7
- 0.8
- 0.9

### Spin Period (s)
- 335
- 340
- 345
- P dot = -0.000248 s/day

### Significance (%)
- 0
- 20
- 40
- 60
- 80
- 100

### MJD
- 51000
- 52000
- 53000
- 54000
- 55000

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**Jun Yang**

**Chandra**

**XMM-Newton**

**RXTE**
SMC Pulsar library products

Pulsars In SMC & Model

Intro

Pulsars spin up/down

Pulse profile model

In sum

**e.g. SXP 1323**

Spin up: 0.016932 s/day

**P_{orbit} = 12.0656 \ (days) \ast P_{spin}^{-0.4251}**

16 spin up

14 spin down
Model: Off-center magnetic axis with GR effect

Photon Pulsar Magnetic axis Hot spot Rotation axis Cone of emission

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Pulsar in SMC & Model

Intro Library

Pulsars spin up/down

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In sum

SXP 504 2003-12-14 Observation

The reduced χ2

Lomb-Scargle Power Amplitude (counts/s)

Phase

β (deg)

Period (s)

Best fitting angle: \( \theta = 28^\circ \) and \( \beta = 52^\circ \)

\( \theta \) : angle between spinning axis and B

\( \beta \) : angle between spinning axis and light of sight
Library of 3 satellites combination:

- Known pulsars in SMC & LMC  No pulsations found below Propeller line

- 16 spin up and 14 spin down

Modeling

More phenomenon into current model. Eg., flow column geometry including physics of accretion shock, accretion rate and photo energy

Astrosat

Investigate the hard X-ray sources; bright galactic pulsars, expand the period range of the pulsars
Thank you!

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