



UvA-DARE (Digital Academic Repository)

Different manifestations of accretion onto compact objects

Altamirano, D.

[Link to publication](#)

Citation for published version (APA):

Altamirano, D. (2008). Different manifestations of accretion onto compact objects

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <http://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

Contents

1	Introduction	1
1.1	Low-Mass X-ray binaries	1
1.2	Instrumentation and techniques	2
1.2.1	The Rossi X-ray Timing Explorer	2
1.2.2	Timing analysis	5
1.2.3	Spectral analysis: Colors	7
1.3	Long term X-ray variability of LMXBs	8
1.4	Black hole states	10
1.5	Neutron star phenomenology	11
1.5.1	States and power spectra	11
1.5.2	Thermonuclear burning on the neutron star surface	14
1.5.3	Millisecond pulsars	16
1.6	Outline	19
2	Millihertz Oscillation Frequency Drift Predicts the Occurrence of Type I X-ray Bursts	21
2.1	Introduction	22
2.2	Data analysis & results	23
2.3	Discussion	28
3	Discovery of coherent millisecond X-ray pulsations in Aql X-1	31
3.1	Introduction	32
3.2	Data Analysis	33
3.3	Discussion	35
3.3.1	Permanent pulsation	37
3.3.2	Transient pulsation	39

4	Intermittent millisecond X-ray pulsations from the neutron-star X-ray transient SAX J1748.9–2021 in the globular cluster NGC 6440	41
4.1	Introduction	42
4.2	The neutron-star transient SAX J1748.9–2021 in NGC 6440 . . .	43
4.3	Observations, data analysis and results	43
4.3.1	Colors, light curves and states	44
4.3.2	Pulsations	45
4.4	Discussion	47
5	The Island state of the Atoll Source 4U 1820–30	51
5.1	Introduction	52
5.2	Observations and data analysis	54
5.3	Results	57
5.4	Discussion	64
6	X-ray time variability across the atoll source states of 4U 1636–53	69
6.1	Introduction	70
6.2	Observations and data analysis	72
6.3	Results	78
6.4	Discussion	90
6.4.1	The broad components in 4U 1636–53 and Z-source LFN .	91
6.4.2	The low frequency QPO	94
6.4.3	The X-ray luminosity dependence of rms	95
6.4.4	The nature of the hectohertz QPOs	96
6.5	Summary	98
6.6	Appendix	99
7	Discovery of kilohertz quasi-periodic oscillations and state transitions in the LMXB 1E 1724–3045 (Terzan 2)	103
7.1	Introduction	104
7.2	Observations and data analysis	106
7.2.1	Light curves and color diagrams	106
7.2.2	Fourier timing analysis and fitting models.	107

7.2.3	Energy spectra	110
7.2.4	Search for long term periodicities	110
7.3	Results	111
7.3.1	The light curve	111
7.3.2	Color diagrams; identification of states	114
7.3.3	kHz QPOs	114
7.3.4	Averaged power spectrum	118
7.3.5	Integrated power	121
7.3.6	Comparing Terzan 2 with other LMXBs	123
7.3.7	Spectral fitting	126
7.3.8	Lomb Scargle Periodograms	127
7.4	Discussion	127
7.4.1	Contamination by a second source in the same field of view? 127	
7.4.2	The kilohertz QPOs, different states and their transitions .	129
7.4.3	On the ~ 90 days flare recurrence	130
7.4.4	Energy dependence as a tool for kHz QPO identification .	133
7.5	Summary	134

8 The transient black hole candidate XTE J1550–564 as seen by RXTE 139

8.1	Introduction	140
8.2	Black hole states	141
8.3	Identification and evolution of power spectral components	145
8.4	The black hole XTE J1550–56	147
8.5	Observations and data analysis	148
8.6	General description of the main figures used in this work	151
8.6.1	Fractional rms amplitude as a function of spectral state . .	151
8.6.2	Power spectral characteristics as a function of time, color and fractional rms amplitude	152
8.6.3	Power spectra	152
8.7	Results	169
8.7.1	The light curves	169
8.7.2	Hardness–intensity diagram and colors as a function of time	174
8.7.3	Time variability during outbursts D, E and F	178
8.7.4	Timing variability during Outburst C	180

Contents

8.7.5	Time variability during Outburst A	183
8.7.6	Time variability during Outburst B	189
8.8	Discussion	193
8.8.1	Low frequency QPO identification	194
8.8.2	Broad components identification	194
8.8.3	XTE J1550–564 and the PBK relation	204
8.8.4	XTE J1550–564 and the WK relation	206
8.8.5	Power spectra that do not fit the previous classifications	206
8.9	Summary and Conclusions	208
8.10	Appendix I: on the $< 3\sigma$ fitted components	210
8.11	Appendix II: observing modes	211
8.12	Appendix III	213
	Samenvatting	219
	Glossary	223
	Bibliography	227
	Publication list	237
	Accepted observing proposals	239
	To all of you, and nobody else	241