The Multi-INstrument Burst ARchive – MINBAR

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Large thermonuclear burst samples

- Catalogues from large samples of bursts analysed with uniform data analysis procedures have proven a valuable resource for investigations of burst energetics, thermonuclear processes, and burst oscillations
  - Van Paradijs, Penninx & Lewin 1988 (although combined data from bursters with different accreted compositions)
  - Cornelisse et al. 2003 study of BeppoSAX data
  - Muno et al. 2001, 2002a,b 2003, 2004 studies of burst oscillations
  - RXTE burst catalog (Galloway et al. 2008)
The RXTE burst catalog

- An almost decade-long effort led to the 2008 release of the first multi-source burst catalogue (Galloway et al. 2008; hereafter G08), that included analysis results for almost 1200 events, from 40 burst sources observed by RXTE.

- Amongst other things, analysis of this data established the need to distinguish between different source classes (mixed H/He and ~pure He accretors).

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Some improvements can be made

- This catalogue has become a useful reference for observers and theorists, but is not without its shortcomings:
  - Reliance on RXTE pointed observations resulted in little exposure for many sources. Wide-field instruments (e.g. BeppoSAX) gave much more exposure, particularly in the Galactic centre.
  - RXTE data consequently had a poor detection rate for rare events like intermediate-duration bursts.
  - RXTE has no imaging capability so localising bursts, particularly in crowded regions such as the Galactic centre, is a challenge.

- RXTE has continued observations of burst sources, so there are additional bursts in new public data -> need to keep updating

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MINBAR seeks to address these issues

- Assembly of the Multi-INstrument Burst ARchive (MINBAR) is under way. The complete catalogue will have the following additional benefits over G08:
  - updated analysis procedures, better suited to comparisons of bursts between different instruments
  - analysis with latest RXTE response matrices, and improved treatment of column densities
  - first public release of re-analysed BeppoSAX/WFC burst data
  - first public release of companion RXTE observation database (not released as part of the G08 catalogue)

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Additional minor benefits

• Better measurement of burst rates etc. thanks to “interleaving” of burst observations
• Practically this is rather limited, due to low duty cycles for individual instruments. For example, the overlap between the BeppoSAX and G08 samples (2200/1200) bursts was such that only 15 bursts were observed by both instruments
• But such overlap can be critical for recurrence time studies (e.g. KS 1731-26, & 4U 1728-34 with Chandra)

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MINBAR current version (0.51)

- Total of 4175 bursts from 72 sources (from RXTE PCA and BeppoSAX WFC data)
- Some verification has already taken place, but more to do
- Currently (at Monash) working on identifying long H/He bursts and matching to model results (with Lampe, Keek & Heger)
- Also produced a preliminary list of long bursts from MINBAR and the literature for our deliverable from this meeting (ask me for a copy!)

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Results so far

- Pre-release versions including RXTE and BeppoSAX data have already been the subject of detailed analysis.
- Keek et al. (2010) presented an analysis of 136 bursts from the combined RXTE and BeppoSAX data with recurrence times <1 hr.
- Such short-wait time (SWT) bursts are seen in groups of up to four from 15 sources, but notably from none of the confirmed or candidate ultracompact binaries in the Galaxy, and restricted to the “hard” (island) spectral state.
Results #2

- in ‘t Zand & Weinberg (2010) presented analysis of “superexpansion” bursts which showed significant spectral fit residuals compared to a blackbody model
- Suggested to arise from absorption edges from material ejected during the RE

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Results #3

- in ‘t Zand &c presented analysis of another strong RE burst that showed remarkable variability late in the burst
- Possible this arises from the interaction of the expanded shell and the accretion disk

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Result #4

- Combined study of the bursting behaviour of the new transient IGR J17473-2721

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Issues

• Still have some work to do to get all the data we need (e.g. lightcurves) for the data in hand
• Switch to XSpec 12 revealed an issue with the spectral fits for RXTE bins with zero counts. Fixed with different choice of weighting for chi^2, but some exceptions noted
• No JEM-X bursts yet
• No strategy yet (nor personnel) for adding bursts from other instruments. We are personnel limited in general
The future

- I’ll spend two weeks in Denmark working on JEM-X burst analysis, and the focus this year will be getting those bursts in the catalog in some form
- Hoping for some contributions from the ESTEC group (Sanchez, Kuulkers)
- Likely spend another 2-3 weeks in June
- Once the catalog is complete (with bursts from all three instruments) we will have a “proprietary” period of not less than 6 months and then release the catalog publicly
- In the meantime, science work will continue on the preliminary versions

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