INVESTIGATIVE AND TECHNICAL PLAN

Volume I

Of a Proposal to the

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

for

PROPORTIONAL COUNTER ARRAY

and

SCANNING SHADOW CAMERA

for the

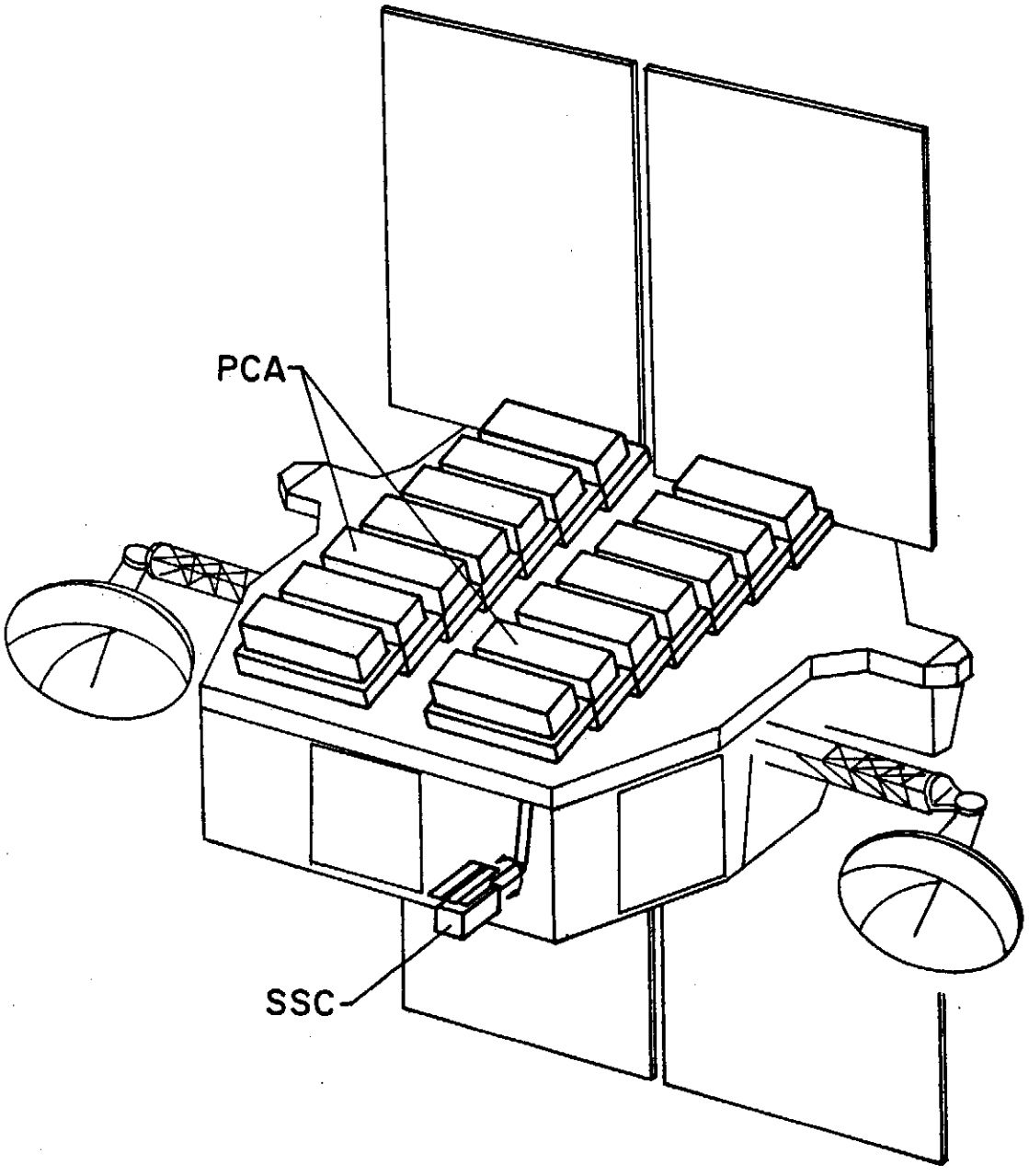
X-RAY TIMING EXPLORER

This Proposal is Submitted

by the

CENTER FOR SPACE RESEARCH OF THE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY



The Proportional Counter Array (PCA) and Scanning Shadow Camera (SSC) on the TIXTE Spacecraft.

APPENDIX A4: DESIGN CONCEPT FOR A U.S. SPACECRAFT

The modules of the PCA are mounted along the edge of the spacecraft, all pointing in the same direction, in the plane of the spacecraft. There are three SSC modules, each scanning through ~120°, also in the spacecraft frame. The solar panel is mounted on a rotating shaft. The shaft is perpendicular to the spacecracft plane, but the solar panel is tipped back so that its normal is 30° above the spacecraft plane.

The plane of the spacecraft is normally aligned roughly with the galactic plane. This allows the SSC's continuous coverage of the galactic plane. As the spacecraft is rotated about its Z-axis (the galactic pole) in order to put the PCA on a target, the solar panel is rotated to the azimuth of the sun. If the solar panels are sized to allow a ±30° sun offset then the sun can be tracked all year, leaving the S/C plane in the galactic plane. When the sun passes into the southern hemisphere, the spacecraft is inverted and the Z-axis aligned with the south galactic pole.

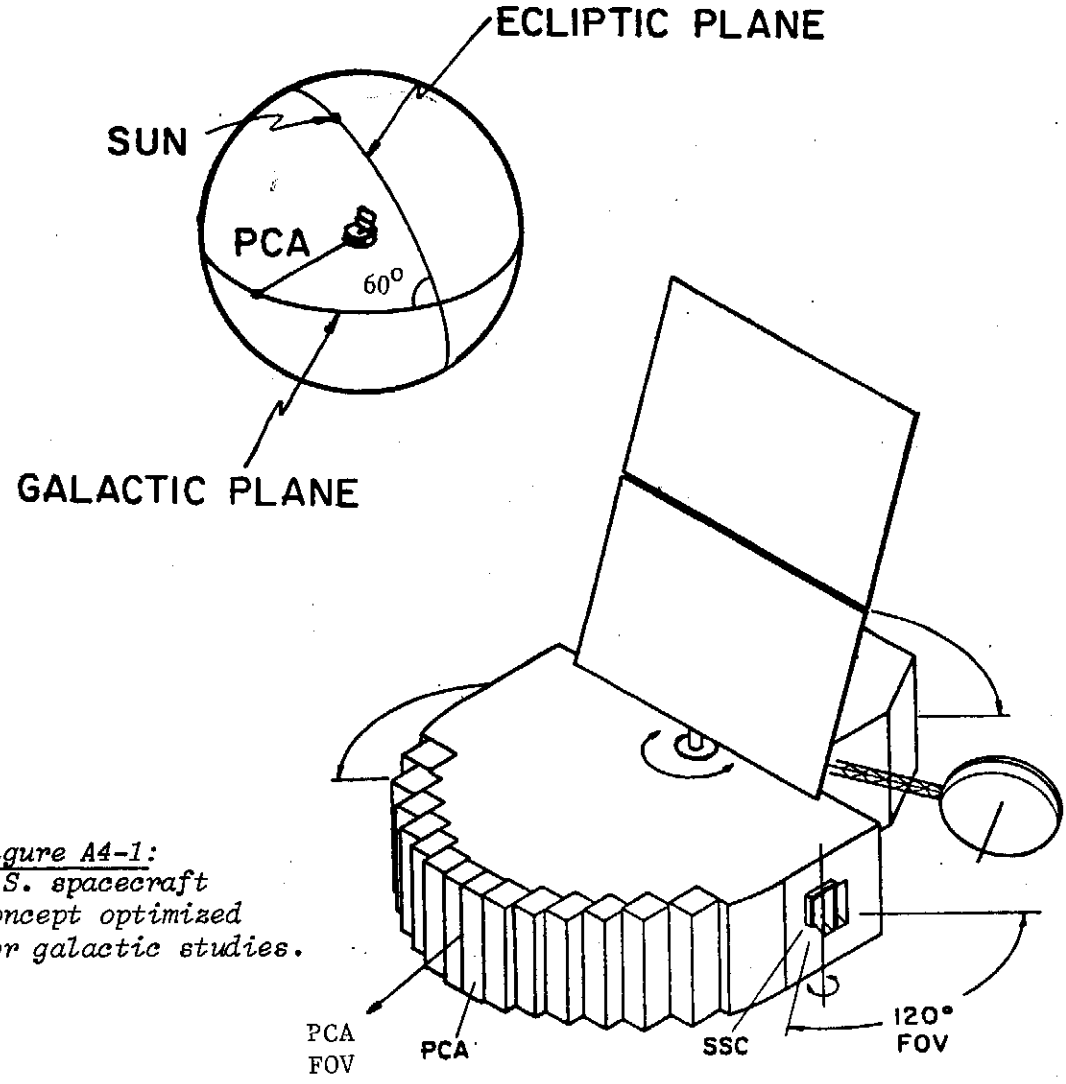


Figure A4-1: U.S. spacecraft concept optimized for galactic studies.

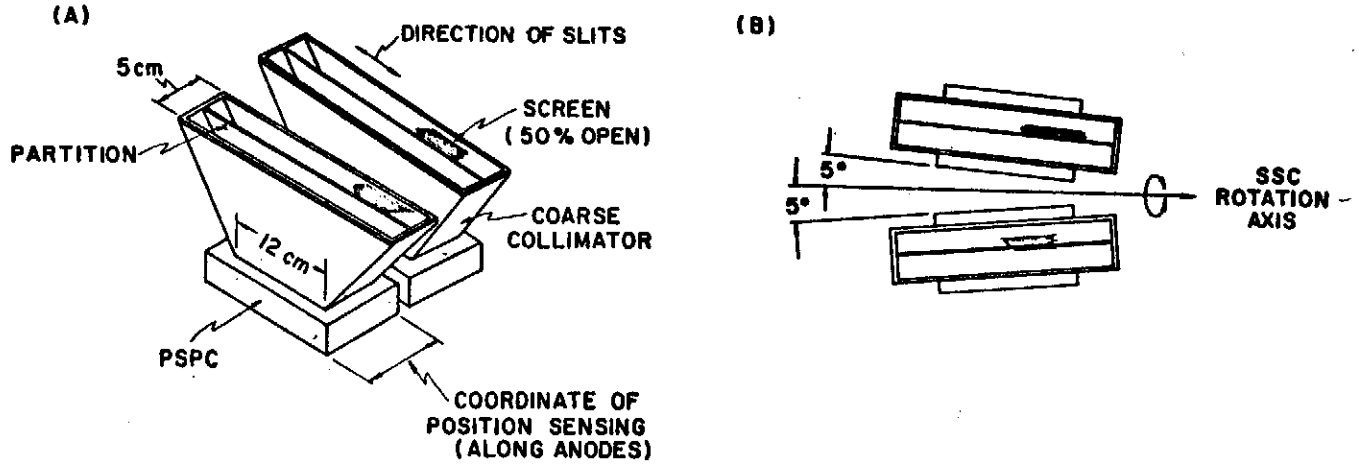


Figure 4-1: A) Both modules of the SSC are shown schematically. In each module, a screen, perforated with slits of varying widths, is held by a coarse collimator above a one dimensional position sensing proportional counter (PSPC). Each coarse collimator is partitioned into two halves to provide the 10° FOV. The screen pattern is repeated for each half. The direction of position sensing is parallel to the counter anodes, which run perpendicular to the slits in the screen.

B) The relative orientation of the 2 SSC modules as installed on the rotatable mount are shown schematically in this top view (i.e., the center of the field of view of each module is directly out of the plane of the drawing). Each module is canted 5° with respect to the SSC rotation axis so that the respective lines of position will intersect at a 10° angle.

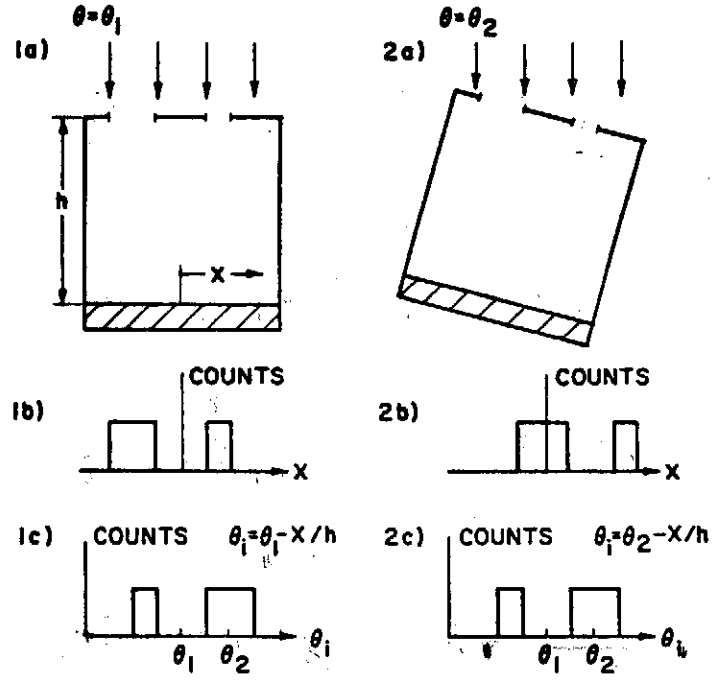
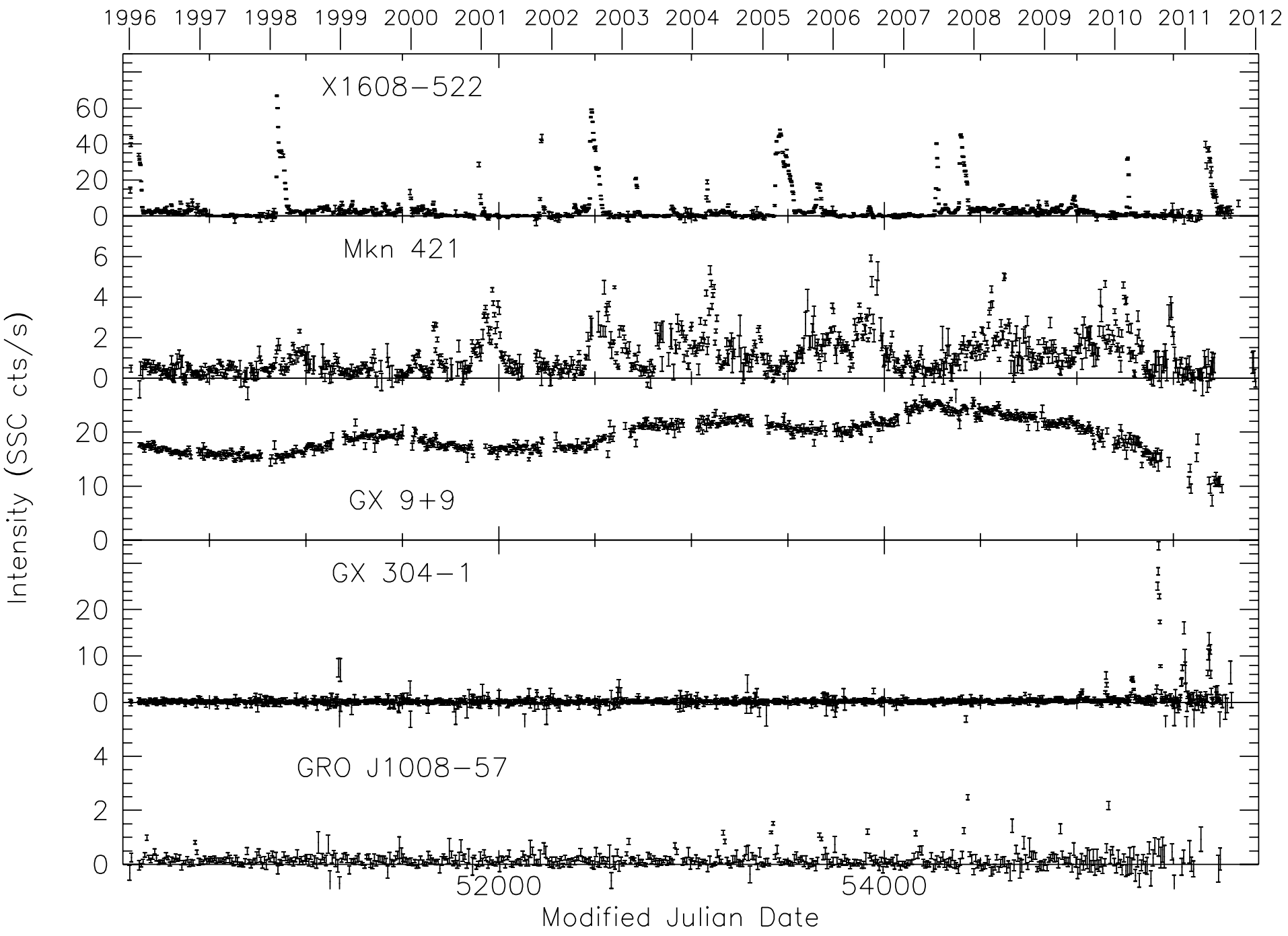


Figure 4-2: Illustration of the technique of azimuthal binning. When a source is centered in the field of view of an SSC module, at azimuth $\Theta = \Theta_1$, as shown in 1a, the screen pattern is replicated on the detector with no sideways shift, as in 1b. This position data is transformed to azimuth data with the formula $\Theta_i = \Theta_1 - X/h$ and is shown in azimuth bins in 1c. The same source will produce a shifted pattern on the detector when the SSC is oriented at a different angle, as in 2a and 2b. However, the shift is proportional to $\Theta_2 - \Theta_1$, and when this data is transformed to azimuth bins as in 2c, a pattern identical to 1c results.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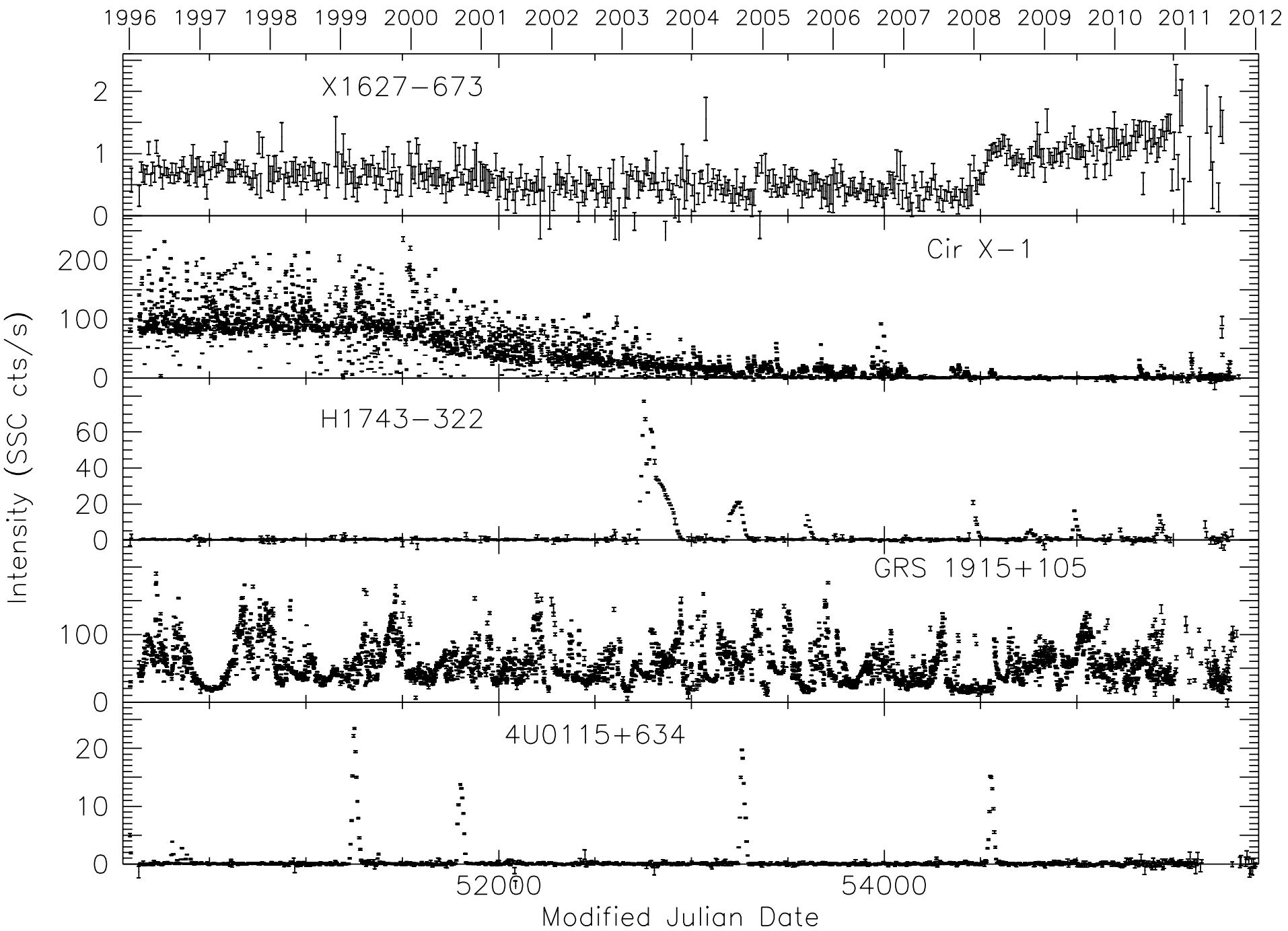
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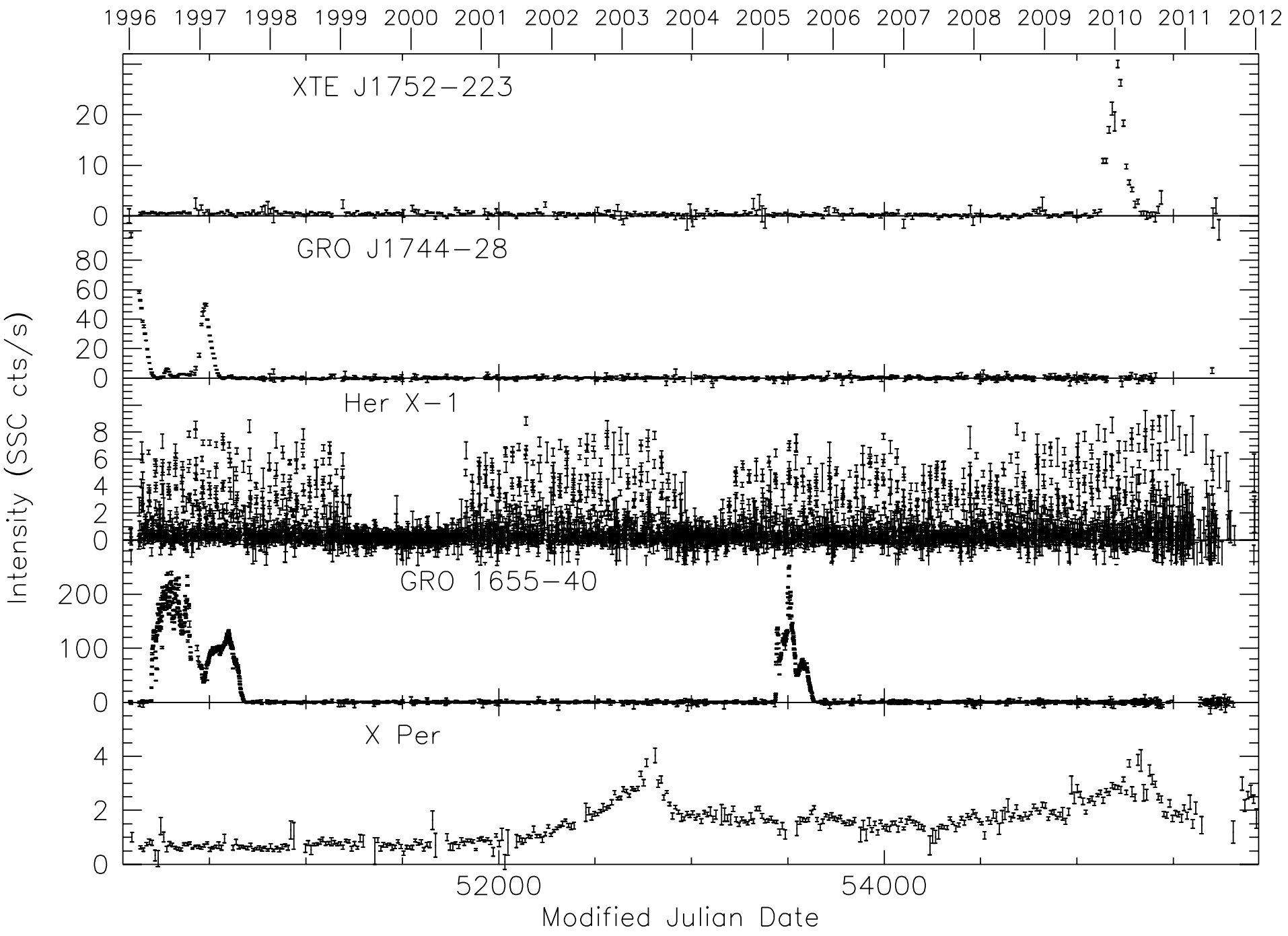
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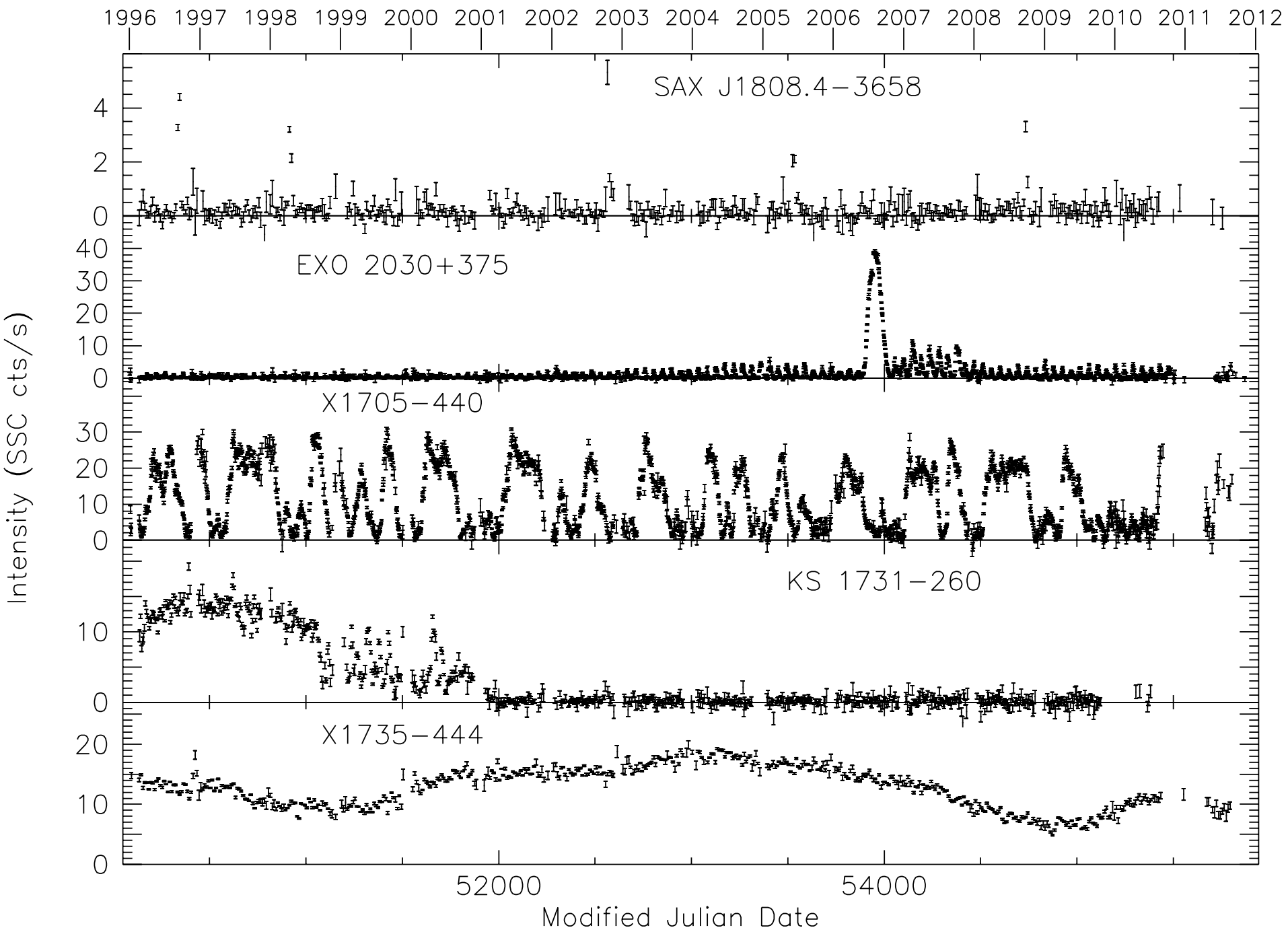
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