The Upper Limit Server (ULS)

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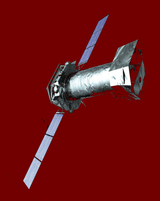
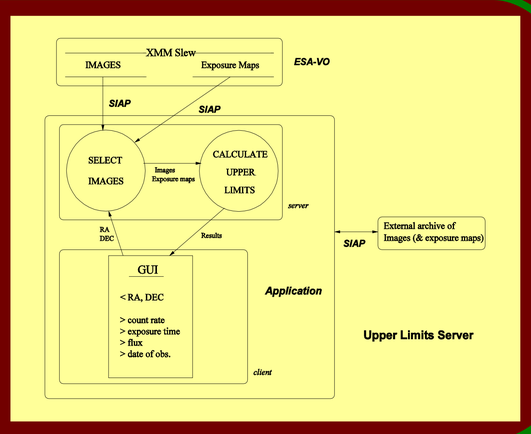


Catalogues of sources discovered in high-energy, X-ray and Gamma-ray, observations exist for all the major observatories and are well supported by the Virtual Observatory (VO) and specific sites such as HEASARC and LEDAS. It is much more difficult for an astronomer to find the upper limit to the flux at a position where no source was detected. Here, we present a web-based tool, which performs an on-the-fly calculation of the upper-limit, using images extracted from archives that support the Simple Image Access Protocol (SIAP). It is designed to work in a mission-independent manner on any photon counts image. Currently, XMM-Newton slew and XMM-Newton pointed data are supported. Extensions to other missions such as ROSAT and INTEGRAL are planned.

What it does

- Returns the count rate or upper limit from archived high-energy observations of an input sky position.
- Converts the count rate to a flux assuming a standard spectral model.
- Traces the flux history of a source

Top Level Design

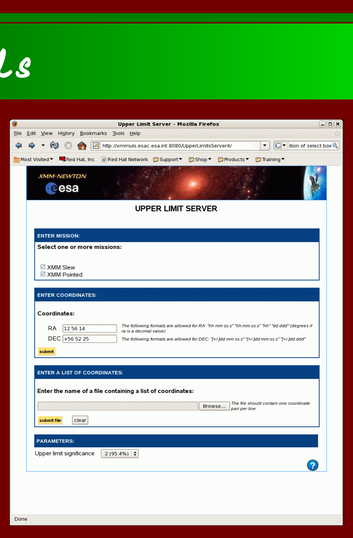


How it does it

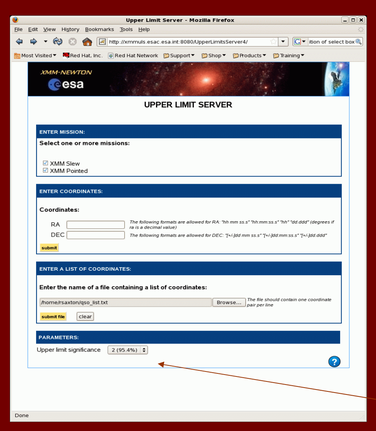
- Runs as a Java applet.
- Gets sky positions from a client-side, web-based form.
- Sends a SIAP request to supported servers, asking for information about images containing this source position.
- Retrieves images and exposure maps from the SIAP servers which have responded positively.
- Calls C++ code to analyse the images and calculate the count rate or upper limit at the sky position.
- Converts count rates to in-band fluxes, using the PIMMS program and a default absorbed power-law spectral model (NH=3E20 cm^{-2}, Gamma=1.7)
- Formats and displays the results in a browser window.

Input Panels

Standard access from the XMM-Newton Archive page



Enter single set of coordinates



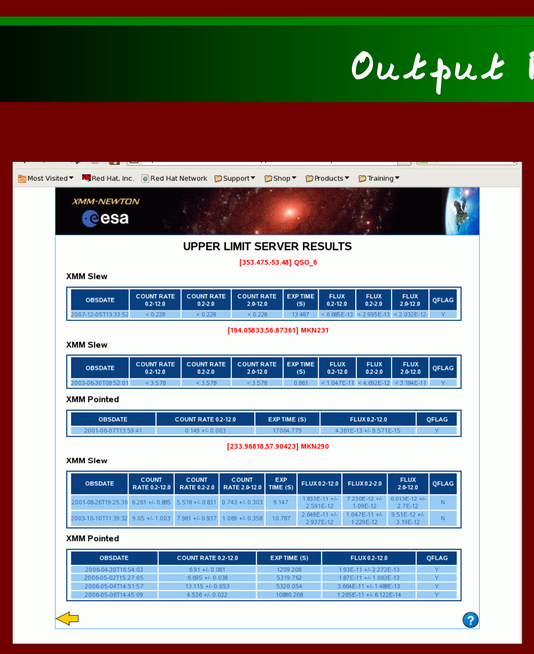
User choice of upper limit significance

Enter list of source positions with name

URL

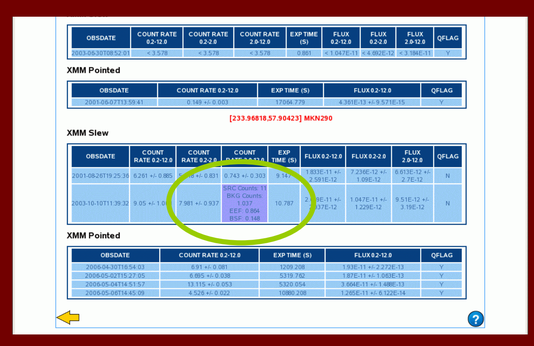
http://xmm.esac.esa.int/external/xmm_products/slew_survey/upper_limits/uls.shtml

Output Panels



The output screen is ordered by source, by mission and then by observation in chronological order.

If a count rate is found which is > than twice the error then It is shown as a detection. Otherwise an upper limit is returned.



A mouseover on a count rate shows the number of counts used in the calculation.

Issues and the Future

- **SIAP limitations**: SIAP is simple indeed and implementation specific configuration is needed in the application to support each server. Therre is a need to define an X-ray / Gamma-ray specific extension so that metadata, e.g. the energy range of each image, is stored in a standard way.
- **Standardisation of calibration files**: The application needs to know the form of the Point Spread Function (PSF) in order to calculate the total count rate of the source. Currently each mission has its own algorithm and storage mechanism for the PSF. A common form should be evolved (cf redistribution matrices) so that ad hoc translations into the application don't need to be made.
- **Support for other missions**: There is great benefit in including missions which performed large area surveys such as ROSAT and INTEGRAL. Images from these missions, *in units of counts,* need to be made available within a SIAP server. If you have data that could usefully be supported by the ULS please contact the author.
- **Calculate upper limit with JAVA code**: Recoding the image analysis code inside the applet would improve performance.

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