LOFT WIDE FIELD MONITOR
Guide to prospective LOFT WFM response

	Name	**Date**
Prepared by	LOFT WFM Team	2011-10-08 issue 1.0 2012-06-27 issue 2.0

Document Change Record

Issue	Date	Changed Section	Description of Change
1	2011-10-08	All	First issue
2	2012-06-27	All	Major revision due to significant changes in the WFM design.

Table of contents

1 Introduction 4

2 WFM data modes and spectral response files 4

2.1 Recipe for spectral simulations 5

3 Expected WFM long-term sensitivity and 1-year exposure map 5

4 WFM field of view 6

5 Help, questions, suggestions 8

1 Introduction

The current baseline for the WFM comprises 5 identical units each composed of 2 orthogonal cameras endowed with a coded mask and sensitive between 2 and 80 keV. Each of the 2 cameras in a unit has a refined positional capability in one direction (few arcmin) and a coarse position resolution in the orthogonal direction (few degrees). The combination of two orthogonal cameras thus gives a fully 2D capable WFM unit, with angular resolution <5 arcmin and a positional accuracy of ~1 arcmin. The maximum achievable spectral resolution is of <500 eV over the entire energy range.
The 5 units together reach a very wide field of view (180° x 90° + 90°x90° toward the anti-solar direction).
We refer the reader to our webpage below for further details on the WFM:
http://www.isdc.unige.ch/loft/index.php/instruments-on-board-loft

2 WFM data modes and spectral response files

Data collected from the WFM will be of two types:

- ***triggered data***: these are provided when the instrument is automatically triggered by the detection on board of some bright events (sources in outbursts, GRBs, etc..). In this mode, event-by-event data are made available on the ground within 3 hours from the detection on the best effort basis. Event-by-event data are endowed with the full spectral (<500 eV) and timing resolution (~1 μs). The brightest triggered events are also alerted on the ground through the so-called LOFT Burst Alert System (see the web-page above for details).
- ***data in normal operating conditions***: when no automatic trigger occurs, the WFM will collect only a limited amount of data, which details depend on the available telemetry during each observations (the WFM has to share the available telemetry with the LAD). The minimum available data from the WFM at any time will consist of images and spectra integrated every 300 s in 8 energy bands (16 is the very likely achievable goal), together with the detector rate meter data.

Due to the two different operating modes described above, two different sets of response files are provided on the LOFT repository to perform simulations with the WFM. In both cases, the response matrices correspond to the case in which the source is observed along the LAD pointing direction (i.e. the source falls within the FOV of 2 units -4 cameras- and at 15 deg off-axis in each of them; please see the web-page mentioned in Sect. 1 for a schematic representation of the geometrical WFM configuration).

Scientists carrying out simulations of bright objects in outburst or bright impulsive events that are expected to be able to trigger the WFM (see the sensitivity table reported in the above mentioned web-page) can safely use the *response files having the full instrument resolutions*. For long term monitoring of faint objects, we recommend to use the *response files with 16 energy channels* and take into account the *limited timing resolution*. *At present the 16 energy channels are optimized for the detection of iron lines, an ubiquitous feature in several Galactic and extra-Galactic sources. This might change in a future release, and should be only considered as an example.*

During normal operating conditions, it is expected that in the final design the WFM will be able to provide more than the limited resolution data discussed here. The latter are thus considered at present as the results of a very conservative approach in terms of mission final capabilities.
For both triggered and limited resolution response files, a *background model* is provided in fits format (integration time 10 ks). This is obtained through a very preliminary GEANT simulation of the WFM instrument. As for the response matrices, also the background is derived from a conservative approach. The final instrument background will likely be lower due to a number of effects not yet included in the present version.

2.1 Recipe for spectral simulations

Simulations need to be performed with the HEASARC tool XSPEC[1]. A simple way to do it is:

- Open Xspec
- Define your spectral model. E.g., an absorbed power-law model:
  `XSPEC12> model phabs*pow`
- Run[2]: "fakeit backgroundfilename" to include explicitly the background in the simulation (e.g., one of the provided WFM_full.bkg or WFM_16ch.bkg).
- When asked for the RMF and ARF file, give to Xspec one of the sets of files defined above according to your needs (full resolutions or 16 channels).
- Define, when asked, the total exposure time for the source and background (usually the "correction nor" parameter can be kept equal to 1). Following this command, Xspec will create for you the simulated spectrum (e.g., `test.pha`) and the corresponding background file (e.g. `background.bkg`). If you are using the full resolution matrices, then you need to group the spectrum to have at least 20-25 photons per energy bin by using the tool grppha[3]. Example:
  `grppha infile=test.pha outfile=test_grp.pha backfile=background.bkg comm="group min 20 & exit"`
  Here, `test.pha` is your simulated spectrum, `test_grp.pha` is the output file after grouping has been applied, 20 is the minimum number of photons per energy bin and `background.bkg` is the background file created by Xspec (see above).
- Load the grouped spectrum in Xspec and check your result (you might need to rearrange the model normalization and perform a second simulation depending on the flux that you want to obtain).

3 Expected WFM long-term sensitivity and 1-year exposure map

In order to allow scientists to perform sensitivity simulations, **a 1-year integrated exposure map** *of the WFM in fits format is also provided among the other response files*.
The sky coverage that the WFM will be able to achieve for every year of observation is expected to be non-uniform because of the combination of solar angle constraints and a specific observational program.

1 See URL http://heasarc.gsfc.nasa.gov/docs/xanadu/xspec/

2 http://heasarc.nasa.gov/docs/swift/proposals/swift_xspec_sim.html

3 http://heasarc.gsfc.nasa.gov/ftools/fhelp/grppha.txt

Fig. 1 (upper panel) shows a plot of the provided exposure map (the fits format is available for download from the website). It is assumed that:

- LOFT will perform 3 observations per day;
- scientific observations are performed for 95% of the total mission available time (5% instruments off)
- the satellite orbit has a height of 600 km and a 0 degrees inclination (Earth Occultation are accounted for in the final exposure time) and the limiting solar aspect angle is +30°deg/-90 °deg;
- the observational program is focused on the most popular RXTE targets in the categories of LMXBs and AGNs (no SGRs, pulsars and HMXBs have been included);

Note that, even though the assumed observational program is at present only indicative, given the wide field of view (FOV) of the instrument and the main science goals of the mission, the provided example exposure map is expected to be a good approximation of the future final one and thus suitable to perform simulations.

4 WFM field of view

As the WFM field of view is exceptionally large, a fits file representing it is also provided among the other response files. Fig. 1 (lower panel) shows a plot of the field of view obtained from the fits file (Aitoff projection).
The fits file for the FOV is given assuming a sample pointing targeted at the Galactic center for a solar position corresponding to April 1st. Color code represents the total net instrument area in each position (units of cm^2).

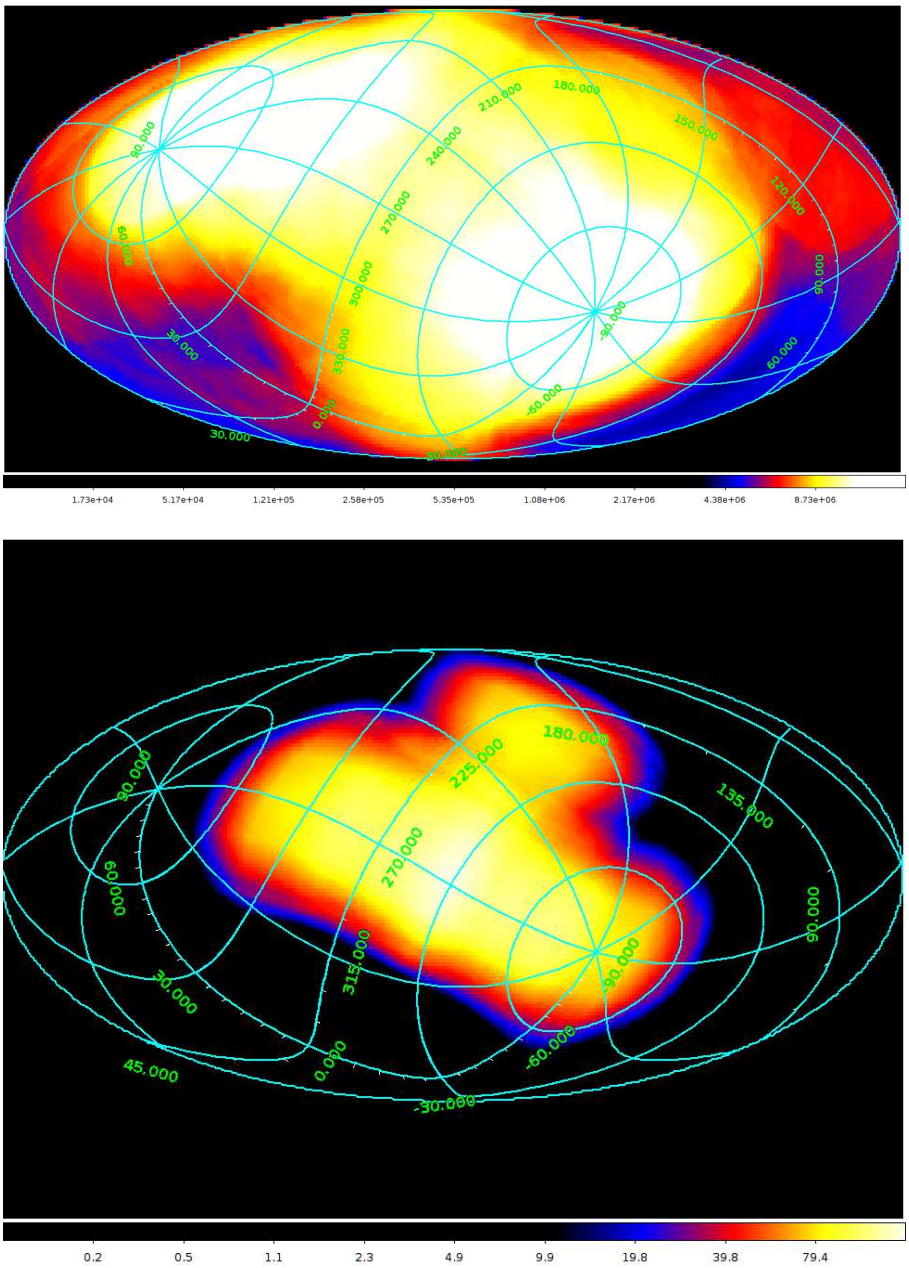

Figure1. *Upper panel:* expected 1-year WFM exposure time in seconds as a function of the sky position (Galactic coordinates - Aitoff projection-). Only locations covered with at least 10 cm^2 of total net detector area are considered. *Lower panel*: an example of the WFM FOV in Galactic coordinates. In this case the pointing direction is toward the Galactic center taking into account the solar constraints on the 1st of April. The color code represents the effective area in each position in units of cm^2.

5 Help, questions, suggestions

Requests for help, questions or suggestions are welcome at loft.webmaster@gmail.com