The Ground Segment data processing system of the SuperAGILE instrument

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Abstract

The SuperAGILE instrument is a X-ray detector for Astrophysics measurements, part of the Italian satellite AGILE launched on 23/04/2007 from India. SuperAGILE is studying the sky in the 18 - 60 KeV energy band and can detect sources with good imaging, spectral and timing capabilities. The data processing scientific software performing at the AGILE Ground Segment is divided in modules, grouped in a processing pipeline named SASOA. The processing steps can be summarized in data reduction, photonlist building, sources extraction and single source refined analysis.

Figure 1: launch of the AGILE satellite: India, 23/04/2007

1 Introduction

The SuperAGILE (SA) instrument is a X-ray detector for Astrophysics measurements, part of the Italian satellite for X-Ray and Gamma-Ray Astronomy AGILE. AGILE was launched on 23/04/2007 by the Indian PSLV rocket from the ISRO base of Shriarikota (Chennai - Madras), India. The India-made Polar Satellite Launch Vehicle put the astronomical satellite into its intended orbit about 550 kilometres above the earth 20 minutes after blast-off. It was India's first commercial space mission and the rocket's 11th flight. SuperAGILE is now studying the sky in the 18 - 60 KeV energy band and can detect sources with advanced imaging and timing capabilities and good spectral capabilities. First scientific results are reported in Pacciani et al, 2007 [2]. Details regarding the technology of the instrument can be read in Feroci et al, 2007 ([3]).

2 Fixed & transient sources detection

The Science Verification Phase (SVP) of the functional life of the instrument, was started in July 2007 and ended in November 2007. During this preliminary phase the detecting capabilities of the instrument were tested and all parameters able to modify the instrument performances were tuned. Several astrophysical sources has been detected and localized, including Crab, Vela X-1 and GX 301-2. We can confirm that the instrument has the skill to resolve correctly sources in a field of view of [-45, +45] x [-30, +30] degrees interval, with the angular resolution of 6 arcmin, and can perform a spectral analysis with the resolution of 8 KeV. Transient events are currently detected, with confirmation from other observatories (see Del Monte et al, 2007 [1]) with the rate of 1 event every two months. Transient sources can be detected by SA with the aid of its temporal resolution (2 microseconds) and using signals coincidence on different portions of the collecting area to optimise the signal to noise ratio.

3 The Data Processing System

Data transmitted to Malindi Ground Station (Kenya) are forwarded to Telespazio Control Centre (Fucino, Italy) and then to INAF institutes and to the ASDC Data Centre (Frascati, Italy).
The ASDC centre is the official access door of SuperAGILE results to the sci-

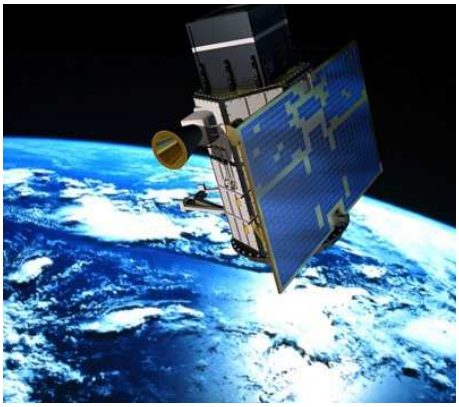

Figure 2: AGILE will remain detecting sources in orbit hopefully until 2011

entific community. During the SVP INAF institutes were using but also testing and improving the data processing system that was consolidated at IASF INAF institute and at ASDC during the last months.
The SA data processing scientific software performing at the AGILE Ground Segment is divided in modules, grouped in a processing pipeline named SASOA. The SA pipeline consists on a large set of routines, organized in an automatically installable system (the "*build*"). The core of these routines is contained in a C++ object oriented library named *sas*. The software system is also based on standard science software libraries, mostly *HEADAS* package, *RSI IDL Astrolib* and *CERN ROOT* and works on a *SUSE Linux* (9.x - 10.x) standard Operating System. Processing steps use also a Relational Database Management System (RDBMS) to read data and save science results. The RDBMS is implemented on a mysql system and is accessed by data processing servers through the network.

The mysql database server is hotly redunded by a mirror database server updated in near real-time. Data processing servers can access the second RDBMS in case of service interruption of the primary. The routines for science results extraction were often updated during last months, a software repository saves the updated version of software with the aid of an automatic system to control the software versions (CVS). The CVS based repository allows also to coordinate software changes among developers of the SuperAGILE Software Team (SAST). Also the software repository is saved daily in a back-up area located in a different building.
The SA data processing can be simply described by the following steps:

1. data reduction;
2. photonlist building;
3. sources extraction;
4. single source refined analysis.

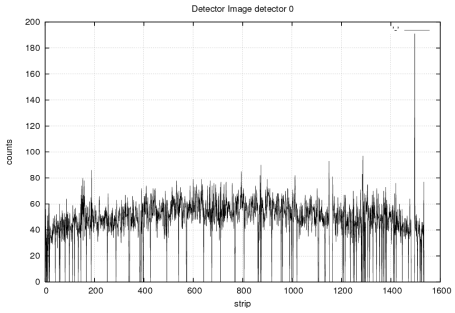

Figure 3: Detector Image Monitor

The software provides electronic noise filtering, attitude correction and cosmic background subtraction. A quick

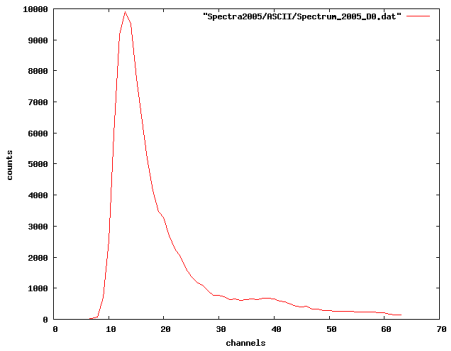

Figure 4: Spectrum Monitor

and easy web-based access to the data, reports the state of the detector and the detected sky signals (see figures 3-7). The data processing chain is triggered by satellite contact with the Ground Station, each time a new data set transmitted from space is delivered by the Data Transfer Utilities (DTU), automatic procedures handle and elaborate the data (with no human action) from the telemetry translation to the final sky images and histograms.
The data are integrated on an orbital timescale and also on a daily timescale. A summary of the updated results can be read from any network connected computer, browsing a dedicated web page (team use only). A public access web page will be usable connecting to the ASDC web site.

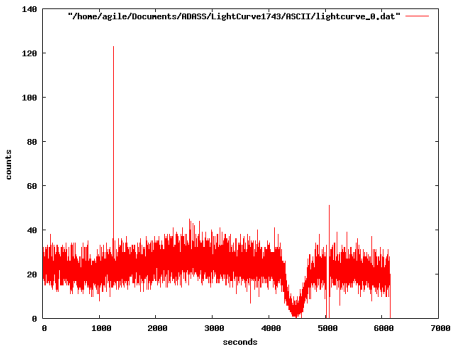

Figure 5: Lightcurve Monitor: the spike is GRB 070824

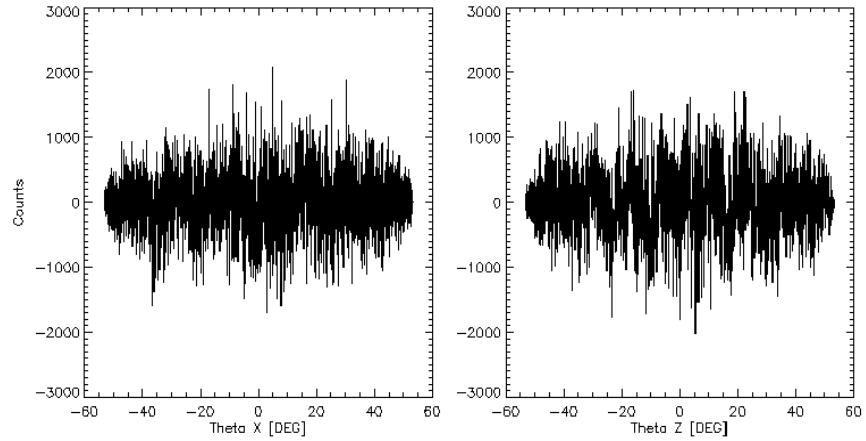

Figure 6: Sky Image: Background

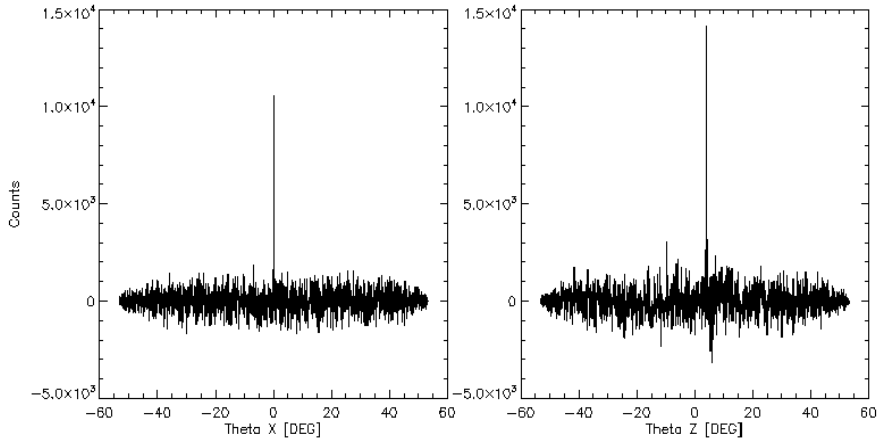

Figure 7: Sky Image: Crab Nebula source signal

References

[1] Del Monte E. et al, "The First Gamma Ray Burst localized by SuperAGILE on board the AGILE mission and its Swift X-Ray afterglow", submitted to Astronomy & Astrophysics, 2007.

[2] Pacciani L. et al, "SuperAGILE Ground Calibrations and first in orbit observations", proc. of SPIE conf. 6686 "UV, X-Ray, and Gamma-Ray Space Instrumentation for Astronomy XV", 2007.

[3] Feroci M. et al, "SuperAGILE: The Hard X-Ray Imager for the AGILE space mission", Nuclear Instruments and Methods, 2007 [arxiv:0708.0123]