

# TARANIS – a Satellite for the Study of TLEs and TGFs

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**ABSTRACT:** TARANIS is a French satellite dedicated to the study of Transient Luminous Events (TLEs) and Terrestrial Gamma-ray Flashes (TGFs). By the end of 2016, TARANIS will be operating in space and will provide: combined Nadir observations of TLEs and TGFs, high resolution measurements of energetic electron beams, and high resolution wave field measurements from DC up to 35 MHz. The measured data will be distributed to the atmospheric electricity community through the TARANIS Scientific Mission Center (CMST). The TARANIS payload, the strategy adopted to maximize the scientific return of the mission, and the main functionalities of the future CMST are presented.

## INTRODUCTION

In Celtic mythology Taranis is the god of thunder. The mission TARANIS is funded and operated by the French space agency CNES. This is a low altitude satellite project dedicated to the study of impulsive transfers of energy between the Earth atmosphere and the space environment (Figure 1). Such phenomena, evidenced by the observation at ground and on satellite (FORMOSAT 2) of Transient Luminous Events (TLEs) and the detection on satellites (CGRO, RHESSI, Fermi, AGILE) of Terrestrial Gamma ray Flashes (TGFs), are observed above active thunderstorms and appear to be correlated to lightning activity. To answer the numerous remaining questions about the physics of TLEs and TGFs, the TARANIS mission will provide a set of unprecedented and complementary measurements.

## TARANIS SCIENTIFIC OBJECTIVES

The scientific objectives of the TARANIS mission are distributed among three broad categories:

To improve the physical understanding of the links between TLEs and TGFs, in their source regions and the environmental conditions.

To identify the generation mechanisms for TLEs and TGFs and, in particular, the particle and wave field events which are involved in the generation processes or which are produced by the generation processes.

To evaluate the potential effects of TLEs, TGFs, and bursts of precipitated and accelerated electrons (in particular lightning induced electron precipitation and runaway electron beams) on the Earth atmosphere and/or on the radiation belts.

## TARANIS SCIENTIFIC PAYLOAD

TARANIS aims at providing a sufficiently complete package of novel instrumentation to answer

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specific questions raised by the available observations of TLEs and TGFs. To achieve the scientific objectives of the TARANIS mission, the instruments of the scientific payload are:

- The MCP experiment. A set of four photometers (150-280 nm, 337 nm, 762 nm, and 600-900 nm) sampling at 20 kHz associated with two micro cameras (at 762 nm and 777 nm) at 10 fps for the detection and characterization of TLEs and lightning.
- The XGRE experiment. A 850 cm<sup>2</sup> LaBr<sub>3</sub> detector (20 keV – 10 MeV photons and 1 MeV – 10 MeV electrons) associated with very fast electronics for the detection and characterization of TGFs.
- The IDEE experiment. A set of two energetic electron detectors (70 keV – 4 MeV) to detect and characterize runaway electrons associated with TGFs as well as Lightning-induced Electron Precipitation.
- The IME-BF experiment. An electric field sensor (8 m tip to tip) to measure the electric field in the low frequency range [DC – 1 MHz] for the detection and characterization of radio signatures associated with TLEs and TGFs. IME-BF also includes an Ion Probe (SI) to measure the thermal ion plasma density.
- The IME-HF experiment. An electric field dipole antennae to measure electric fields in the high frequency range [100 kHz – 35 MHz] for the detection and characterization of HF signatures associated with TGFs and TLEs.
- The IMM experiment. A tri-axial search-coil magnetometer to measure the 3 magnetic field components in the frequency range [5 Hz – 1MHz] for the detection and characterization of radio signatures associated with TLEs and TGFs. IMM also includes a 0<sup>+</sup> whistler detector to perform on board characterization of 0<sup>+</sup> whistlers.

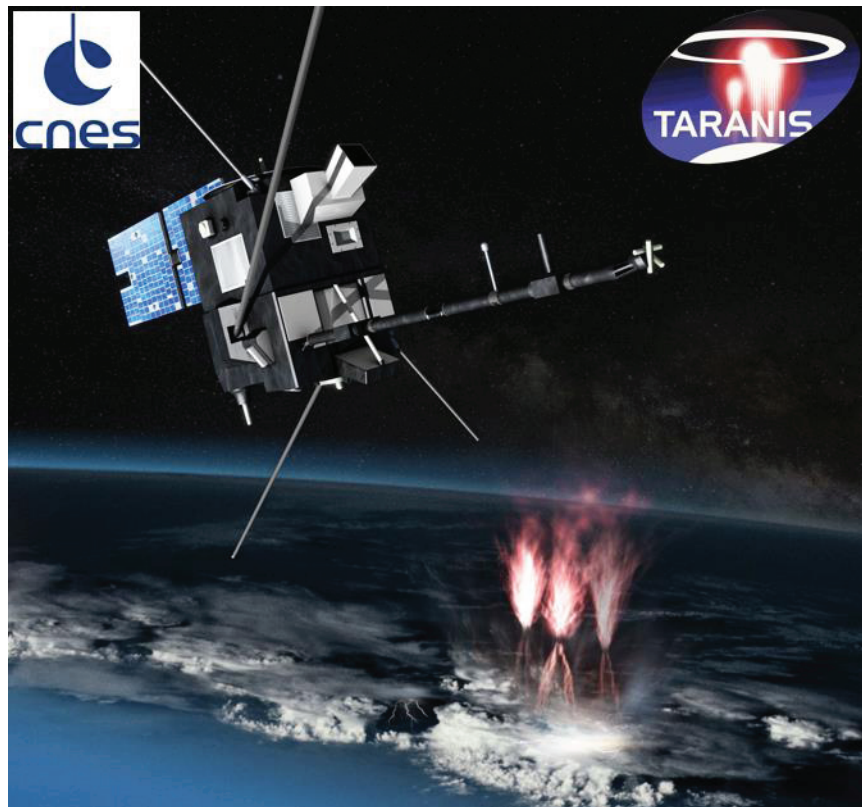


Figure 1. Artist's rendering of the TARANIS mission

## **SCIENTIFIC MISSION CENTER**

The main goals of the data server TARANIS Scientific Mission Center (CMST) are: to deliver the TARANIS data, and to provide on-line tools for their interactive plotting and data processing. Depending on their login classes, users of the CMST will have the possibility to access the functionalities of the following services: data selection and downloading, QuickLook/QuickView selection and downloading, interactive plotting and data processing of TARANIS data. The CMST web site will be located at LPC2E (Orléans, France).