# The In-Orbit Commissioning of MSG-1

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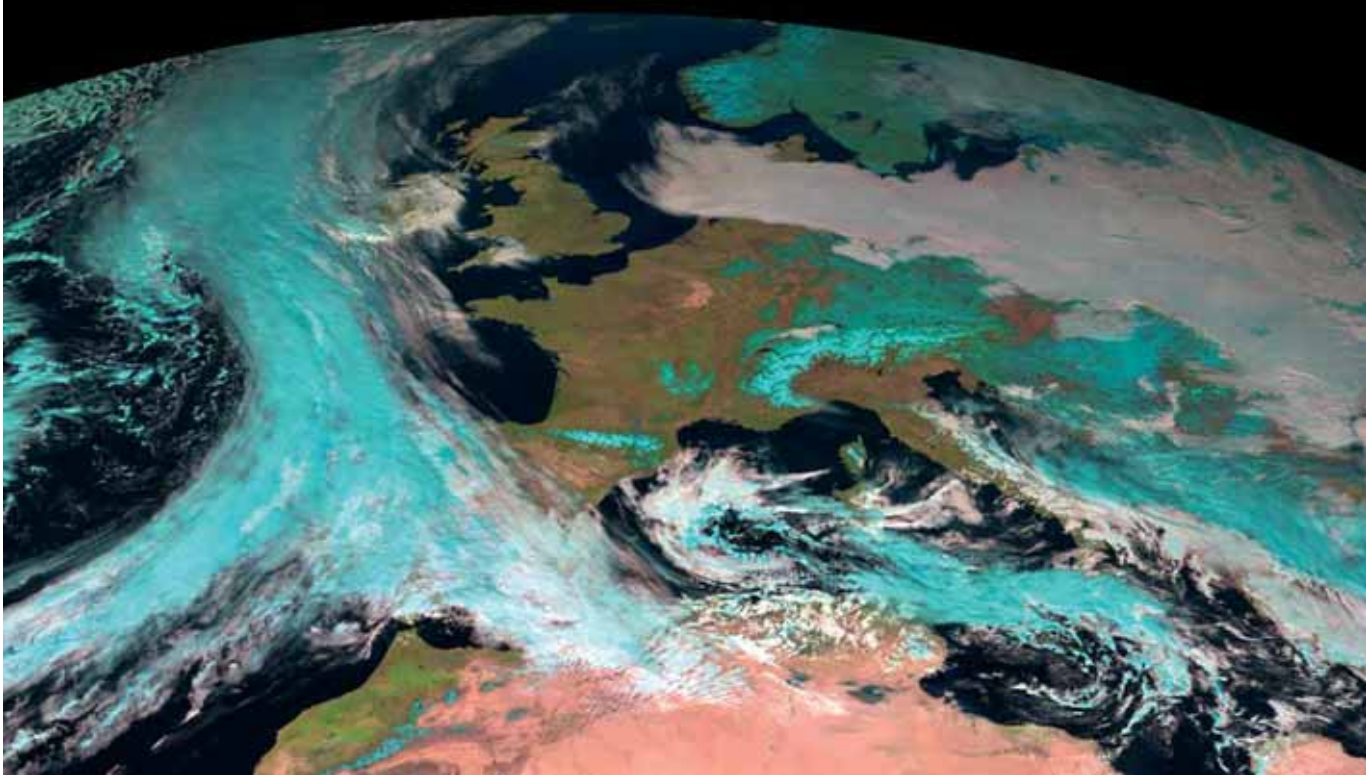


*The MSG programme is a co-operative endeavour by ESA and Eumetsat, the European Organisation for the Exploitation of Meteorological Satellites set up in 1986 to establish, maintain and operate a European system of meteorological satellites. ESA is responsible for designing and developing the first of the four satellites in the MSG programme (the fourth of which has recently been approved), whilst Eumetsat, based in Darmstadt, Germany, has overall responsibility for defining the end-user requirements, developing the ground segment, and procuring the launchers. Eumetsat, which will also operate the system, is contributing about 30% of the development costs for MSG-1 and fully financing the three subsequent flight units (MSG-2, MSG-3 and MSG-4).*

*The MSG-1 satellite's final inspection before launch (photo courtesy of Alcatel Space Industry, Cannes)*

Following on from Meteosat, the Meteosat Second Generation (MSG) programme promises to provide advanced and more frequent data for short-range and medium-range weather forecasting and climate monitoring for at least the next 12 years. MSG will transmit more than 20 times the volume of information delivered by its predecessor, with a spatial resolution of 1 km in the visible spectrum compared to the current 2.5 km. It will therefore beam down sharper images of changing weather patterns, over an area that includes all of Europe and Africa as well as some parts of Asia, every 15 minutes instead of the 30 minutes that it now takes. MSG will help to monitor developing weather systems over areas such as oceans, where such information is normally sparse, to help predict extreme weather conditions. With its 12 channels (the current Meteosat has only 3), MSG will provide meteorologists with new insights into the condition of the Earth's atmosphere, land and ocean surfaces.

The first satellite in the new series, MSG-1, was successfully launched on 28 August 2002, and is currently in the midst of its in-orbit Commissioning Phase, during which the performances of both the spacecraft platform and the sophisticated instruments that it carries are being thoroughly checked out before putting the satellite into operational service.

## Commissioning the Satellite

The results from the SEVIRI instrument (Spinning Enhanced Visible and Infrared Imager) instrument have been very encouraging. The first image was received on 28 November 2002. The basic functionalities of GERB (Geostationary Earth Radiation Budget) instrument have also been successfully tested and the first image from that instrument was received on 12 December.

On the spacecraft side, two anomalies have been detected, both of which have been thoroughly investigated and solutions put in place to mitigate their consequences. Described in more detail in the accompanying panel, they have no impact on the data acquisition or lifetime of the mission, but the onboard-amplifier (SSPA) anomaly has some repercussion for the data-dissemination scenario.

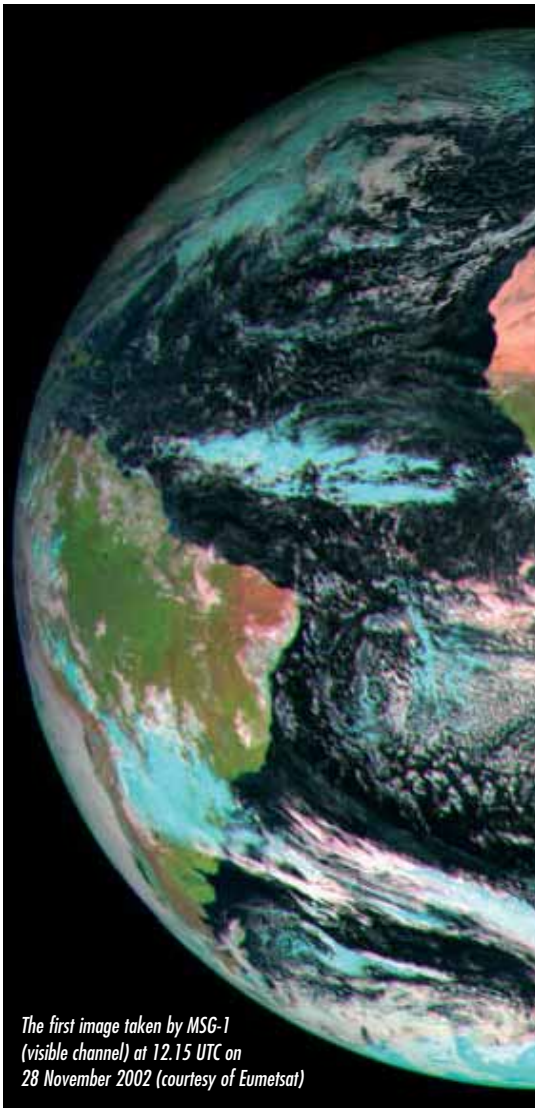
## How the Instruments are Performing

### *SEVIRI*

The SEVIRI Imaging Radiometer is the main optical payload on the MSG satellite series. Since the launch on 28 August 2002, SEVIRI has successfully undergone the un-locking of its scanning mechanism, a decontamination exercise, and has taken the first images. It has been taking images almost continuously since the beginning of 2003.

The goals for SEVIRI during the Commissioning Phase are two-fold:

– to check the radiometer's functionality against the specifications given to industry, and
– to demonstrate its imaging and radiometric performances using the Image Quality Ground-Support Equipment (IQGSE) and verify its compliance with the design specifications established by ESA and Eumetsat.



*The first image taken by MSG-1 (visible channel) at 12.15 UTC on 28 November 2002 (courtesy of Eumetsat)*

The Commissioning Phase also includes optimisation of the overall imaging system to allow Eumetsat to operate MSG-1 under the best possible conditions.

The first SEVIRI image was acquired successfully in all channels at the first attempt on 28 November, with very promising quality even without any rectification. The subsequent imaging functional and performance tests conducted using the IQGSE have been proceeding successfully, giving results of a very high quality. The ground-segment's tuning has been completed satisfactorily with the IQGSE, and it is ready for 'pseudo-real-time' processing of SEVIRI's image data. The calibration trend (gain drop) exhibited by the long-wavelength

## Two Problems – Two Solutions

The satellite Commissioning Phase identified two spacecraft-related problems:

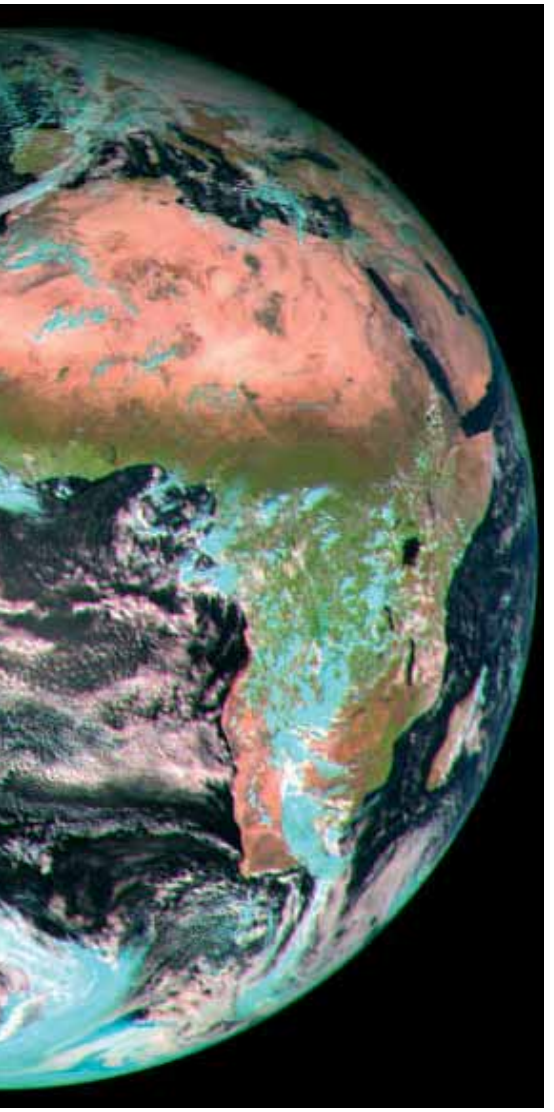
### Wobble

The Commissioning Phase started with the satellite spinning at 100 rpm and with a remaining mass of 1220 kg. After the platform and radio-frequency link validation, a 'wobble' (small regular changes in spin-axis tilt) was detected on the satellite. It was not significant, however, and the satellite performance remained well within specification. Detailed investigations were initiated and by 13 January the problem was solved. It turned out to be caused by the migration of fuel due to heating - and thus expansion - of the fuel.

### An Amplifier Anomaly

On 17 October, the Commissioning Phase had to be temporarily suspended due to an anomaly in a Solid-State Power Amplifier (SSPA). SSPA-C, used for the dissemination of processed images in High-Rate Image Transition (HRIT) mode, experienced an unexplained switch-off, which is still being investigated. Although the satellite was designed with a 4/3 redundancy for the SSPA, it seems prudent not to rely on the SSPA for the high-rate and low-rate dissemination (HRIT/LRIT) of processed images. Consequently, an alternative data-dissemination scenario using commercial communication satellites is currently being investigated. The MSG-1 mission communication system will then be limited to the downlinking of raw satellite data, its Search & Rescue mission (GEOSAR) and data reception from the Data Collection Platforms (DCPs).

The MSG-1 payloads were reactivated on 26 November in a new configuration to minimise the risk of further SSPA problems. The on-going Commissioning Phase is nevertheless demonstrating that, despite the SPPA problem, the platform is working well and the predicted mission lifetime still exceeds 7 years.



channels showed signs of an increase in contamination (humidity) level, as expected. A long decontamination exercise was therefore performed during the satellite's eclipse period in March, restoring SEVIRI's full performance.

### *GERB*

The Geostationary Earth Radiation Budget scientific instrument is accommodated on the MSG spacecraft as an Announcement of Opportunity (AO) payload. GERB is a highly accurate, visible-infrared radiometer designed to make unique measurements of the outgoing short- and long-wave components of the Earth's Radiation Budget (ERB) from geostationary orbit. The ERB is the balance between radiation coming from the Sun and the outgoing reflected and scattered solar radiation, plus thermal infrared emissions to space. GERB will also be flown on the next three satellites in the MSG programme.

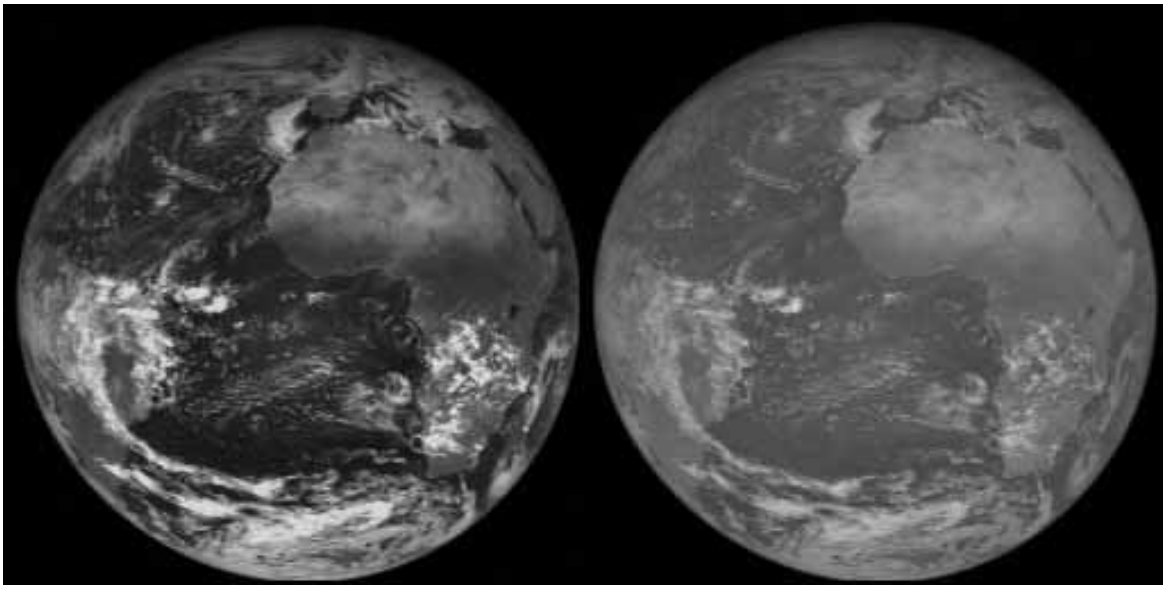
The GERB measurements from geostationary orbit offer huge advantages in terms of temporal resolution compared with similar instruments in low Earth orbit. Such measurements have not been achieved previously and are extremely important because they will permit a rigorous check on our understanding of the diurnal variations in the ERB, which in turn will enable improved operational weather monitoring and permit further important progress in climate-change research. Both short-wave (0.32 - 4 micron) and total (0.32 - 30 micron) radiance measurements will be made, with the long-wave (4 - 30 micron) data being obtained by subtraction. The accuracy requirements are consistent with previous radiation-budget measurements.

The initial post-launch checkout of the GERB instrument was completed in early December and showed that all systems were working as expected. The first GERB image was recorded on 12 December. The instrument is subjected to a constant force of 16g due to the satellite's rotation, and this particularly affects the de-scan mirror mechanism. Since correct functioning of this mechanism is critical to the operation of the instrument, it has been monitored very closely during the Commissioning Phase and its performance is excellent.

GERB's image data are sent from Eumetsat in Darmstadt (D) to the Rutherford Appleton Laboratory (RAL) in the UK in near-real time, processed at RAL and then forwarded to the Royal Meteorological Institute of Belgium (RMIB) about 20 minutes later. RMIB performs further data processing, which is then available to the science team about two hours later. This system is working well and fully validated data will be available to users later this year.

## MSG-1 Event Log Since Launch

| | |
|---|---|
| 28.08.02 | 22.45h UTC - MSG-1 launched from Kourou |
| 25.09.02 | MSG-1 control handed over to Eumetsat |
| 17.10.02 | Commissioning suspended due to SSPA anomaly |
| 26.11.02 | Payload re-activation with new satellite configuration |
| 28.11.02 | First SEVIRI image received |
| 09.12.02 | GERB activated |
| 12.12.02 | First GERB image received |
| 13.01.03 | Wobble problem solved |
| End Jan. 03 | First transfer of un-rectified images to Meteorological Product Extraction Facility (MPEF) |
| 06.02.03 | Mini scan functional test |
| 12.02.03 | First IQGSE rectified images |
| 28.02.03 | Start spring eclipse season, lasting until 16 April |
| 18.03.03 | Start SEVIRI decontamination |
| 27.03.03 | Successful Satellite Commissioning Results Review. Delta CCR foreseen for mid-July, after completion of SEVIRI and GERB commissioning |
| April 2003 | First alternative dissemination trial |
| June 2003 | Commissioning Phase-B with final Image Processing Facility (IMPF) |
| End 2003 | Entry into operational service |



GERB images taken at 12.55 UT on 1 February 2003. The one on the left shows radiances in the short- wave channel, and the one on the right radiances in the total channel

### GEOSAR

The small Geostationary Search and Rescue (GEOSAR) communications payload carried by MSG will detect and relay distress signals transmitted by distress beacons to an international rescue network developed by Canada, France, the USA and Russia, and designed to assist search-and-rescue operations worldwide.

This payload's commissioning is composed of three phases:

– Phase-1: MSG-1 SAR transponder verification
– Phase-2 : GEOLUT/MSG-1 transponder compatibility (coordinated with CNES)
– Phase 3 : Demonstration and evaluation (organised by COSPAS-SARSAT).

Phase-1 has been successfully completed, with all parameters well within specified values, as confirmed by the Test Review Board on 27 February. Phase-2 began in March and is still in progress, while Phase-3 is foreseen to start this summer.

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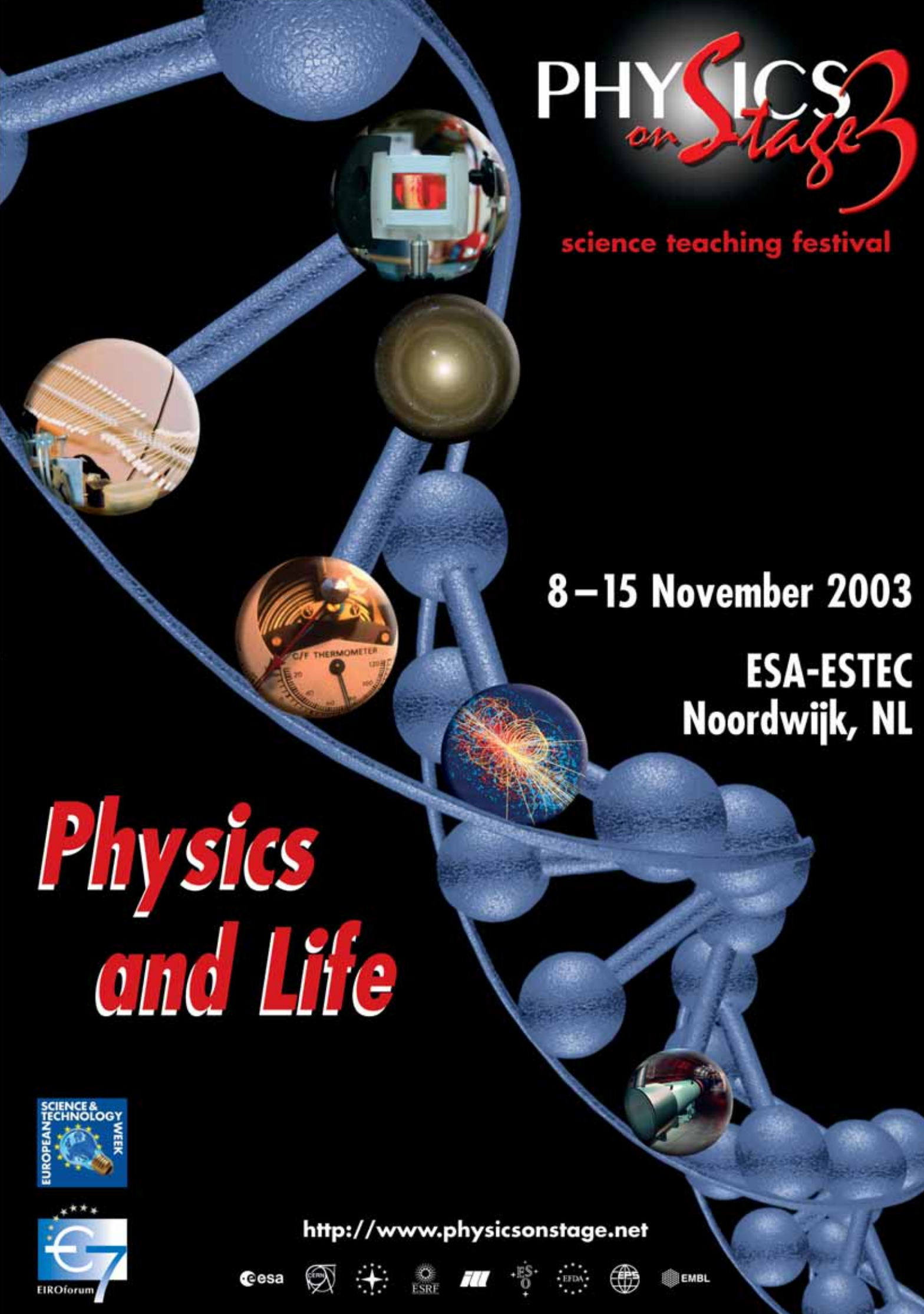
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