# MANTIS: a real-time quantitative multispectral imaging system

*MANTIS is a multispectral imagining system, based on a new diagnostic technique recently developed in a collaboration between MIT-PSFC, EPFL, and DIFFER and used to monitor the discharges in the fusion experiment (TCV's system and MAST-U). The MANTIS system collects light through a single window in the tokamak and feeds it to ten cameras that each look at a very narrow wavelength band. MANTIS can analyse density, temperature and the presence of impurities in real time with accuracy. Outside fusion applications, Tthis technology makes it possible to detect also medical impurities in the human body (as cancer) or impurities in materials.*

## Description of the technology

Following a 4-camera prototype developed by MIT-PSFC (dr. Robert Mumgaard) and operated on TCV, a 10 camera system was manufactured in a collaboration between EPFL (dr. Basil Duval) and DIFFER (dr. Wouter Vijvers). At this time a new PCI-express based camera acquisition and Real-time capable analysis system was implemented by the DIFFER group.

MANTIS looks at the lower part of the plasma discharge, where the hot, charged gas is guided to the reactor exhaust wall by magnetic fields. Mantis is designed especially to shape this exhaust plasma into different geometries and study optimal ways of exhausting heat and particles from fusion reactors.

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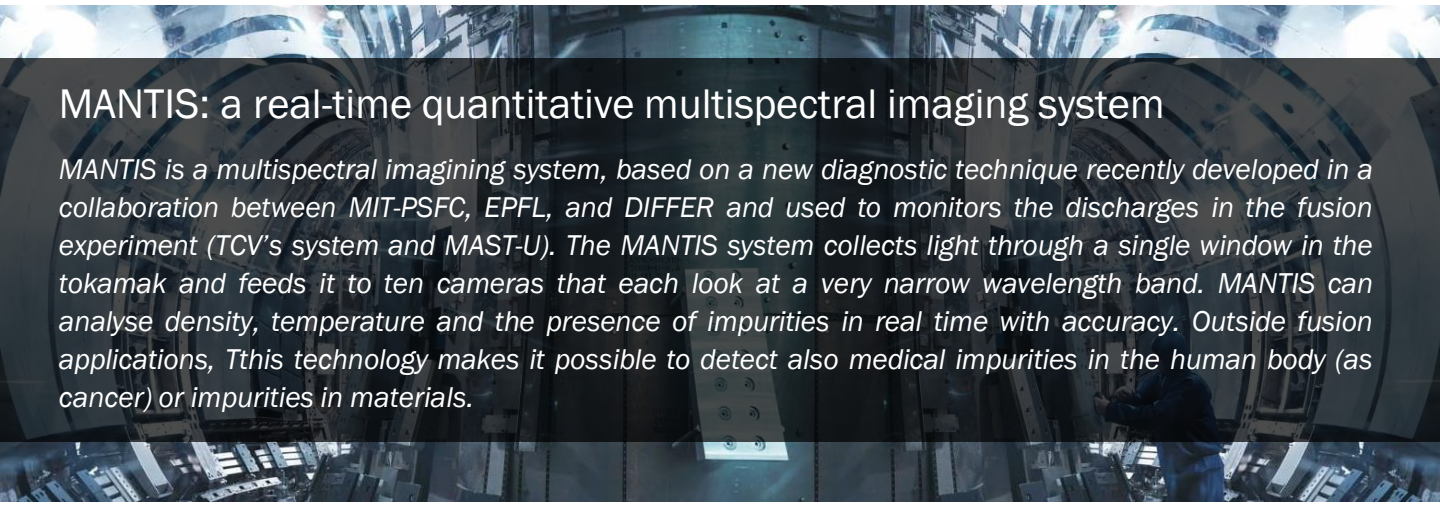
With 10 different channels and a frame rate of 200-2000 images per second, MANTIS can analyse density, temperature and the presence of impurities in the intense exhaust plasma of TCV. With its real-time data analysis capability, MANTIS is designed to hook into the reactor control system and steer the plasma to optimal conditions.



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## Innovation and advantages of the offer

The main benefits of the MANTIS system come from its multispectral and real-time capabilities which make it an interesting tool for researchers and industries. ; The system is uniquely detailed and fast. Combining the information from these cameras allows the system to pinpoint the exact position of the plasma edge and reconstruct temperatures along the exhaust stream, but also to analyse where impurities are present and how they influence the plasma conditions.

## Non-fusion Applications

MANTIS has been developed to find impurities in the plasma (tokomak). MANTIS data is already extensively used at TCV by the local team and international collaborators. A 2nd system will be installed at MAST-U in Culham. Outside fusion applications, This technology makes it possible to detect also medical impurities in the human body (as cancer) or impurities in materials.

## EUROfusion Heritage

MANTIS has been developed within the consortium of EUROfusion (funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053). The system is extensively employed on TCV (a tokamak with variable configuration and which is unique from other tokamaks thanks to its 16 poloidal field coils (PFC)) with a wide range of chromic filters by the local team outside and within several international collaborations. A copy of TCV's system will be installed on MAST-U in Culham.

This technology became a spin-off and received the ATTRACT funding, a European granting scheme for bringing breakthrough imaging technologies developed at academic institutes closer to commercial applications and the support from DIFFER to support chromodynamics towards a soft landing in the market. All partners involved to support the spin-off activities: EU Attract – developing breakthrough technologies, MANTIS diagnostic – analyses fusion plasma in real time, VU LaserLaB – leading institute in the Netherlands on laser diagnostics, DIFFER – Dutch Institute For Fundamental Energy Research.

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