Andra Call for Projects
with the support of the
Investments for the Future Programme

TEMPORAL

Gamma-ray imaging spectrometer based on a temporal imaging method for nuclear decommissioning

Project supported by Andra under the "Investments for the Future Programme" ("Investissements d'Avenir") - Selected under the Andra Call for Projects "Optimization of post-dismantling radioactive waste management", organized in cooperation with the French National Research Agency (ANR).

Duration: 48 months

Project launch: 01/2016

Total project cost: €3.6 million

Sum covered under the Investments for the Future Programme: €1.8 million

Including other funding: €37,000 (Funding from the Champagne-Ardenne Region)

Type of financial support: Subsidy with ROI guarantees for the State

Locations: Rosieres-près-Troyes (10), Saint-Quentin-en-Yvelines (78), Troyes (10), Marseille (13), Orsay (91)

Coordinating body: Damavan Imaging

Partners:
- Damavan Imaging
- Mirion Technologies
- University of Technology of Troyes (UTT)
- Centre for Particle Physics of Marseille (CPPM)
- Weeroc S.A.S

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BACKGROUND

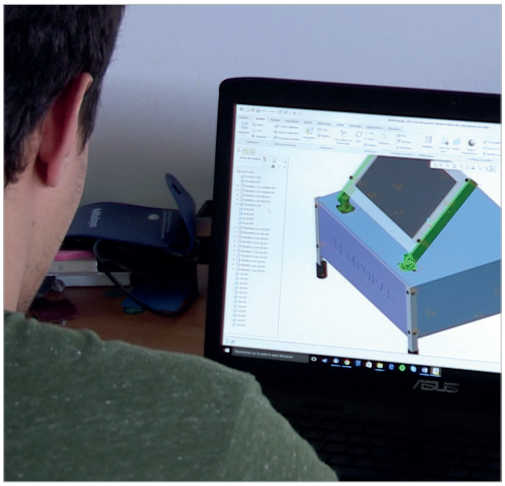
Many tools for measuring radioactivity are now available on the market, particularly for detecting gamma rays emitted by the disintegration of certain radioactive elements. These tools are widely implemented on nuclear decommissioning sites and to control containers of waste produced from these operations. However, current tools generally provide overall measurements of radioactivity and it is not possible to know the exact location of radioactive contamination in a single operation, along with the type of radioactive elements and quantity of radioactivity present. This significantly increases radioactive waste management costs, time and risks.

OBJECTIVES

The TEMPORAL project is an industrial research project aimed at developing a camera that can detect gamma rays and visualise their location and intensity on an image of the mapped area (Compton camera). This camera is based on a new concept, "temporal imaging", which significantly improves its performances compared to existing cameras:

- speed: the TEMPORAL camera will provide wide angle images of gamma rays. Contaminated equipment or a decommissioning site can therefore be observed with a short exposure time;
- location, identification et quantification of radioactive elements in one step: the image obtained with the camera will enable radioactivity to be located with precision, identify the radio-element detected on the image and quantify the associated contamination level;
- sensitivity: the camera will have outstanding sensitivity to low contamination levels (< 1nSv/h);
- cost: the cost of the system should mean that it can be widely used in the nuclear industry.

The temporal imaging concept is based on a combined analysis for each event of the distribution of arrival times and the distribution of scintillation photons that are counted on each pixel of a detector in order to accurately characterise the valid scintillation events in space (X, Y, Z), time (T) and energy (E).



▶ 3D view of the temporal imaging concept.

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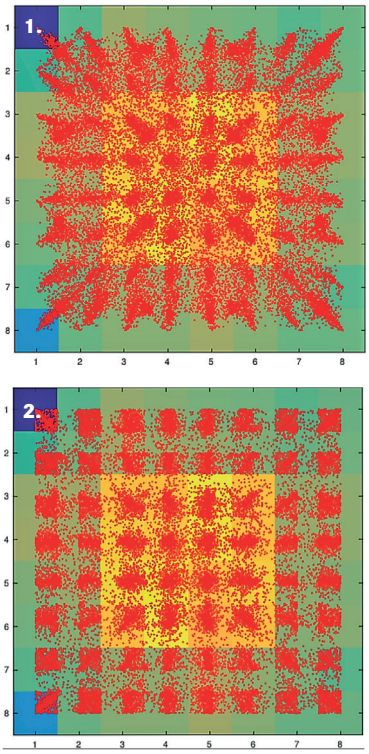
TEMPORAL: Gamma-ray imaging spectrometer based on a temporal imaging method for nuclear decommissioning

The idea behind the TEMPORAL project is to develop a camera that will better detect radioactivity by capturing gamma rays from the disintegration of radioactive atoms.



Comparison of the gamma ray detection process: 1. a traditional imaging system; 2. the more accurate imaging system developed under the TEMPORAL project.

Watch a video of the TEMPORAL project at: **youtube.com/watch?v=VxCoOlPRz_M**

PROJECT SEQUENCE

The TEMPORAL project is a four-year project.

Its first purpose is to test the concept within two years with technology using electronic components available on the market. At the same time, a much higher performance solution will be developed with specific electronic technology not available on the market, but requiring substantial R&D investments. The final product should be market-ready less than a year after project completion.

EXPECTED RESULTS

Innovation

The temporal imaging concept used for this project is radically new. It is based on six patents which the start-up Damavan Imaging has submitted since 2012. The innovative technology relies on a combination of:

- materials for detecting gamma rays that have never been used to make gamma cameras. These materials are 50% denser than steel and transform gamma rays into visible light within less than a nanosecond, which is much quicker than current systems;
- innovative electronics (detectors) and analysis software providing heightened image resolution and excellent sensitivity to low radiation levels. 50 to 80% of gamma rays are detected, compared to 30% with traditional detectors. This system eliminates parasite rays, offering a better signal-noise ratio.

Economic & Social Impact

The TEMPORAL project is led by the start-up Damavan Imaging. Another SME is also involved to develop an electronic component (ASIC).

The production of Compton cameras at Damavan and its partners should generate about ten direct jobs starting in 2021. Over 80% of the sales will be for export.

Impact on radioactive waste management

The Compton camera developed under the TEMPORAL project will be dedicated to gamma ray imaging for nuclear applications.

It will also be used for:

- taking images of radioactive waste drums in order to check their contents (inventory, location of "hot points");
- taking images of a site or large pieces of equipment in the field of decommissioning in order to identify potential contamination zones;
- being installed on an automatic sorting line in order to identify contaminated elements.

APPLICATION AND COMMERCIALISATION

The Compton camera technology developed under the TEMPORAL project could be used for applications outside the nuclear industry:

- checking goods or containers in ports and at borders;
- astrophysics (gamma-ray astronomy satellite);
- medical field: image-guided surgery (precise identification and location of tumours), use for PET scanners, replacement of nuclear (SPECT) imaging technology.