ORIGIN, an EU project targeting real-time 3D dose imaging and source localization in brachytherapy: commissioning and first results of a 16-sensor prototype.

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ORIGIN
optical fibre dose imaging for adaptive brachytherapy

SUMMARY

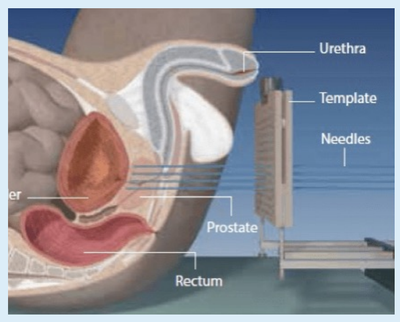
The ORIGIN project addresses the urgent need to deliver more precise and effective BrachyTherapy (BT) treatments for prostate and gynaecological oncology.
The project targets on the development of two innovative single point optical fibre dosimeters with inorganic scintillators on the tip.
The ORIGIN system prototype integrates an array of such sensors with an acquisition system to provide real-time patient dose imaging by signal counting, which is currently unavailable, with a spatial resolution of 0.5 mm for HDR in 0.1 s and 3 mm for LDR in 0.5 s.

ORIGIN brings together a highly multidisciplinary consortium of leaders in their respective fields.

BRACHYTHERAPY

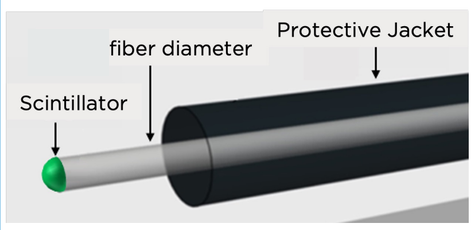
Radiotherapy makes use of ionizing radiation for cancer treatment, which is required by 50-60% of the patients. This treatment can be delivered in the form of external beam radiotherapy, using linear accelerators, or internal radioactive sources (BT).

	Source	Activity	Implantation	<Eγ>	λ @ <Eγ>
LDR	^{125}I	15 MBq	Permanent	35 keV	3 cm
HDR	^{192}Ir	~100 GBq	Temporary	380 keV	10 cm

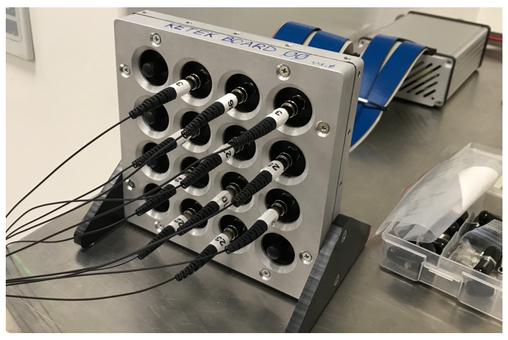


SYSTEM DEVELOPMENT & CHARATERIZATION

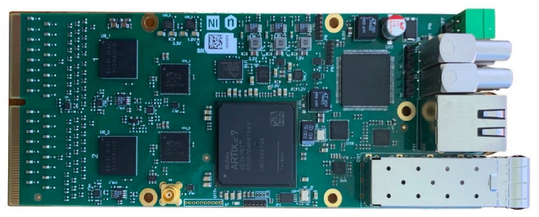
16-CHANNEL SYSTEM



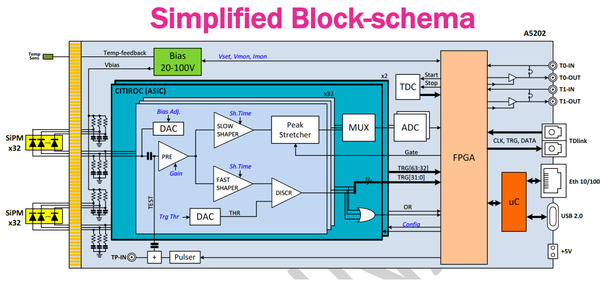
16 optical fiber-based system with scintillating materials on the tip: Gadox for LDR and YVO for HDR.



16 1x1 mm^2 SiPM from KETEK.



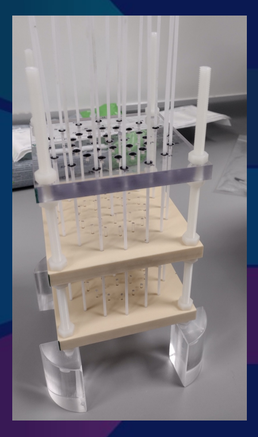
Simplified Block-schema

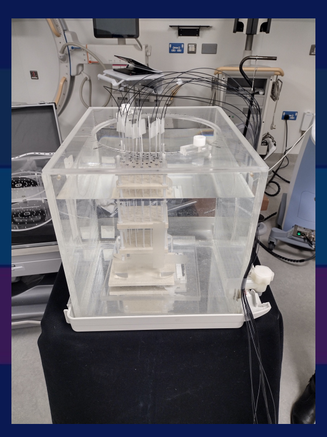


Front-end: **CAEN FERS board (DT5202) - 64 channel (2 CITIROC1A ASICs).**

Among the main features: Single p.e. counting capability (Max 20MHz), SiPM bias voltage 20 – 100V, Ethernet, usb2 and optical link interface for readout (up to 6.25 Gbit/s).

16-CHANNEL SYSTEM CLINICAL MEASUREMENT

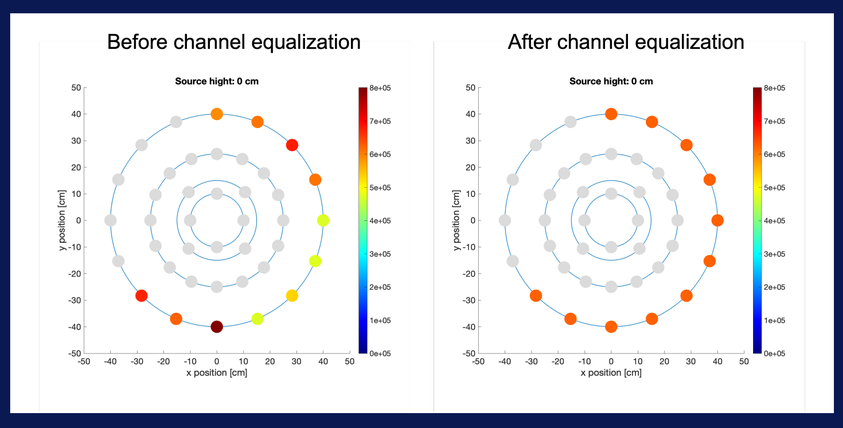




The initial evaluation of the 16-channel system, with sensors placed around a ^{192}Ir radioactive source was performed at the Queen's University Hospital (Belfast, Ireland), using a phantom with a circular geometry in a water tank.

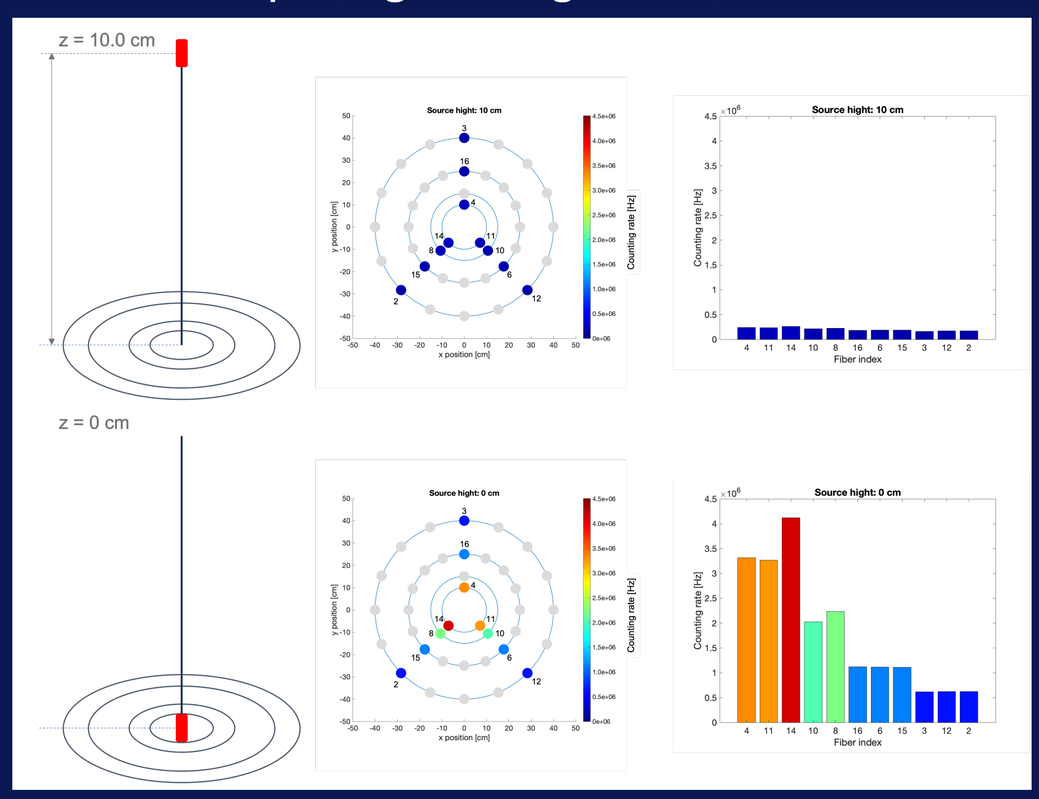
EQUALIZATION PROCEDUERE

Following the equalization procedure, the residual systematic variation (due to the geometrical acceptance, the fiber non-uniformity and positioning) is less than 1%.

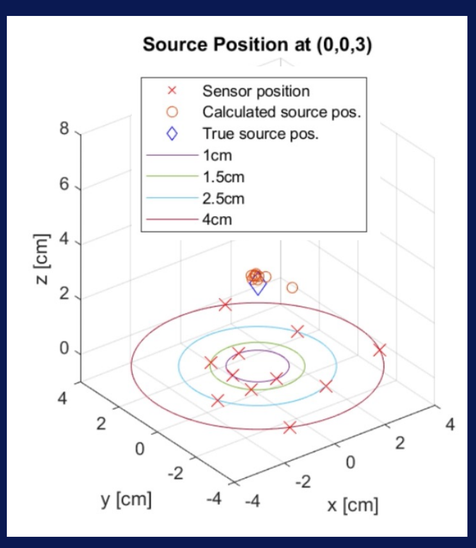


SOURCE LOCALIZATION

The source is moved from a 10 cm distance on the z axis down to the sensors plane (z=0 cm) and the corresponding counting rate as a function of distance was measured.



The Source position was reconstructed using triangulation algorithm based on the counting rate measured by every source.



OUTLOOK

The clinical HDR characterization of the ORIGIN dosimeter shows excellent results, while the LDR characterization results are expected soon. Following a subsequent test with anatomical phantoms, the ORIGIN dosimeter prototype will be integrated in clinical systems.

PHOTONICS PUBLIC PRIVATE PARTNERSHIP
PHOTONICS21
The ORIGIN project is an initiative of the Photonics Public Private Partnership (www.photonics21.org) and has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no 871324.

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