

*From high-energy physics
to medicine
(a personnel account)*

S. Tavernier, PETsys electronics, Lisbon

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Wilhelm Conrad Röntgen, working alone in his lab, serendipitously discovered X-rays in 1895



It was a major discovery in fundamental physics, and it almost immediately found medical applications



In 2012, 5'000 physicists working in CERN, Geneva, after ≈ 15 years of gigantic effort, discovered the Brout–Englert-Higgs boson



When will we see the first medical applications of the Brout-Englert-Higgs boson ?

Nowadays fundamental discoveries in physics are unlikely to have medical applications, in fact unlikely to applications at all, *in the foreseeable future*.
Please don't tell our politicians . . .

All big industries have stopped their fundamental physics research labs !

But research centres like CERN are high tech centres, where many advanced technologies are developed. These technologies can and should find their way to applications.

The importance of effective technology transfer

As much as new ideas are fundamental to the advancement of science, technological innovations are the engine of scientific progress.

*Professor Shirley Tilghman
President, Princeton University*



The history of medicine has been defined by advances born of bioscience. Never before has it been driven to this degree by technology.

*Professor Hedi Hricak
Chair, Department of Radiology
Memorial Sloan Kettering Cancer Center*



But technology transfer doesn't come by itself ...

There are examples of spin off from CERN to medicine in the area of Nuclear medicine (PET SPECT), accelerators, electronics, simulation software.

But CERN has been lacking a technology transfer policy. Until not so long ago, CERN didn't think it needed one.

There were many personal initiatives ...

Only too often we have seen this ...

Hey, I've solved your clinical problem



Physicist

I didn't know I had a problem



Physician

Make sure to understand the clinical need and have the physician involved from the beginning

For successful transfer there must be

A clear understanding of the medical need

A clear understanding of the sociology and economics of clinical activity

Implementation channel with industrial partner(s) and a clear understanding of its implications

Case study of translation of CERN technology to Positron Emission Tomography (PET)

It is the part I have been involved in
personally

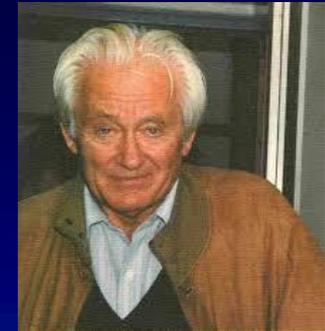
Early work on PET in CERN 1977

Funding: FNS

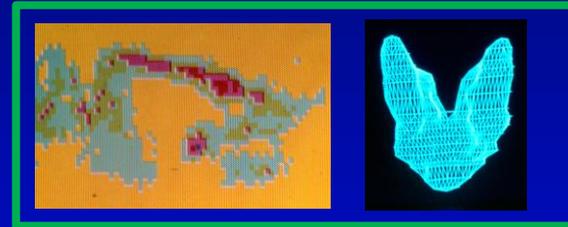
David
Townsend



Allan
Jeavons



Georges Charpak



Michel Defrise VUB

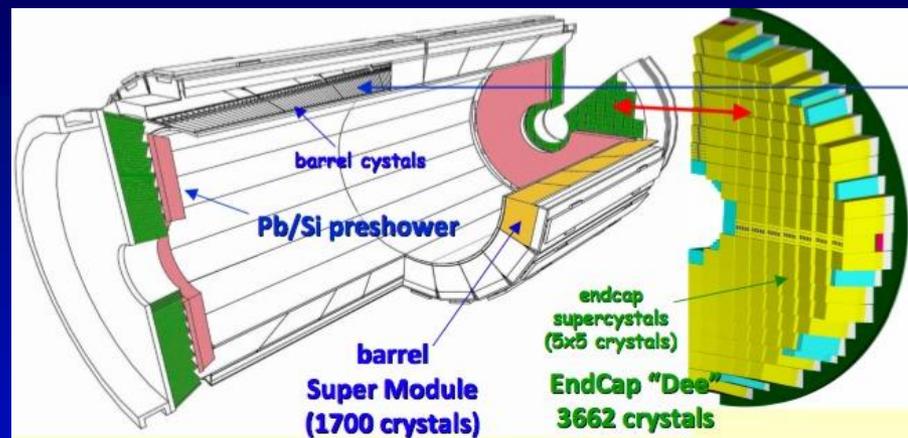
- High Density Multi wire proportional chambers
- Rotating gantry (RT)
- CAMAC electronics
- 3D PET reconstruction
- ^{124}I for thyroid; ^{55}Co for tumor



But CERN management wasn't very interested

Crystal Clear Collaboration \approx 1990

In 1994 the CMS experiment adopted the EM calorimeter based Lead tungstate scintillator proposed by the Crystal Clear collaboration.

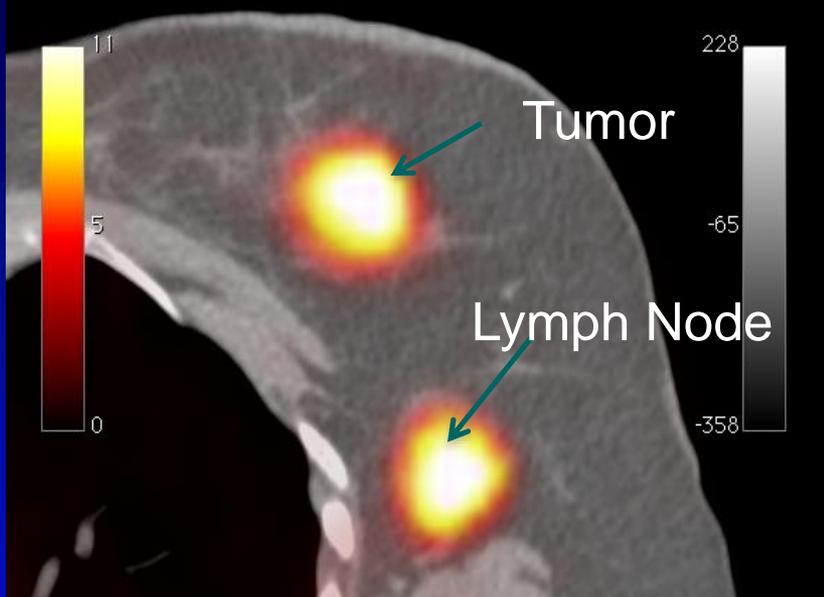


The Crystal Clear Collaboration continued as a collaboration for R&D on scintillation based detectors *both* for HE physics and Nuclear Medicine applications.

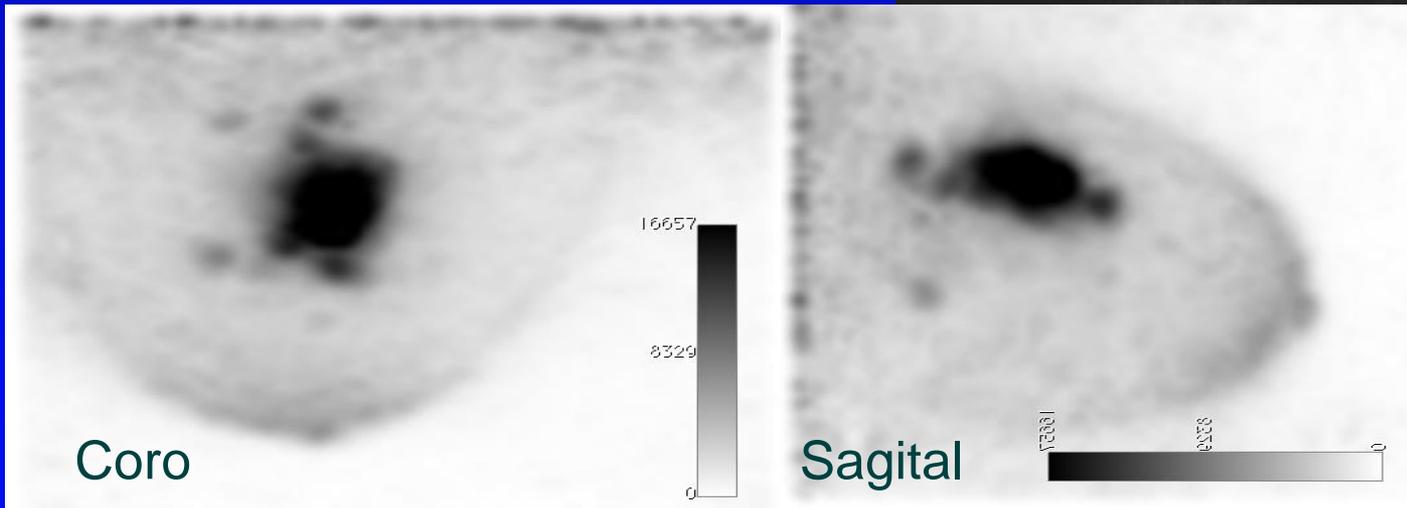
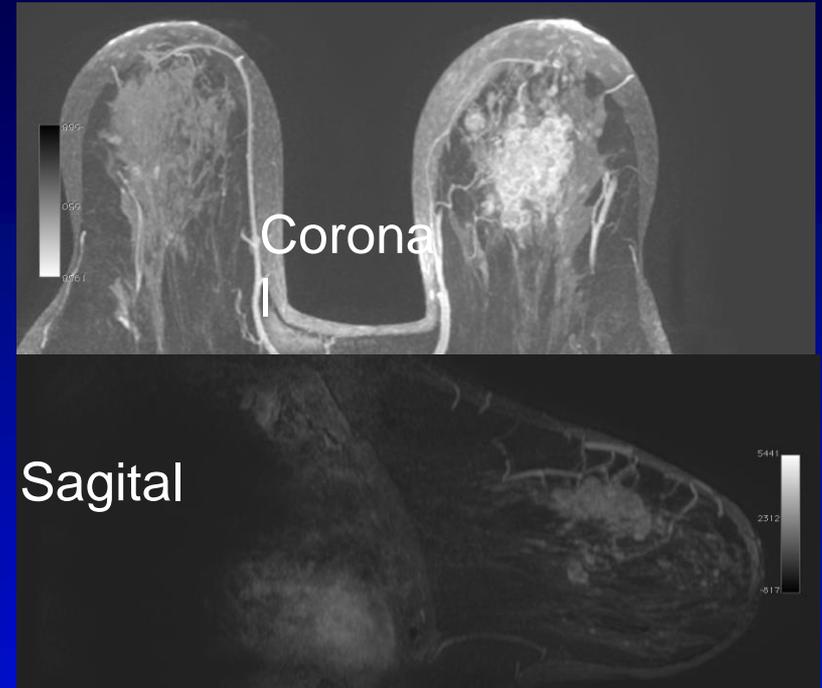
But CERN management was still very reluctant . . .

ClearPEM compared to conventional PET and MR

Siemens Biograph 16 PET/CT



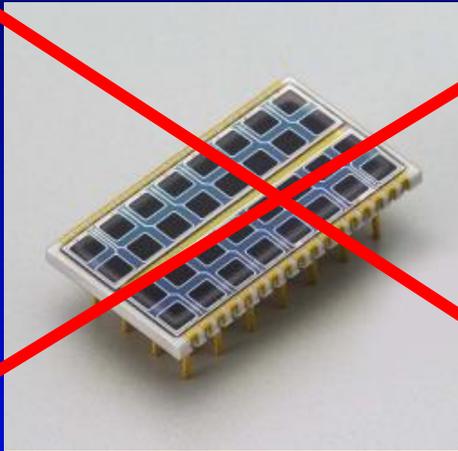
MRI-Multifocal lesion



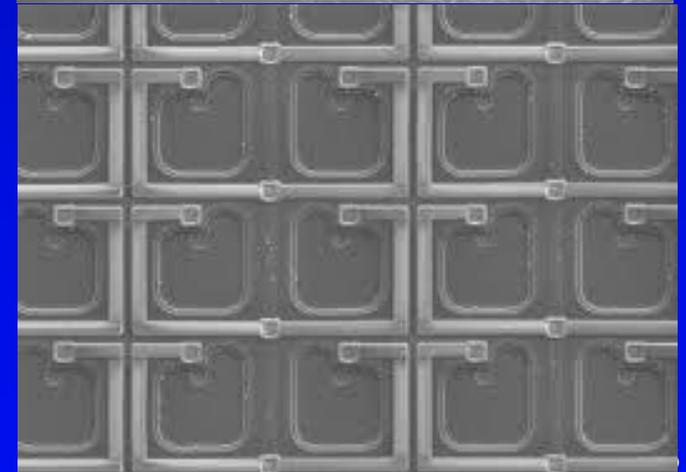
We considered commercialising the CLEARPEM,
But we have been overtaken by technological progress

ClearPEM based
on APDs

APD



SiPM



SiPMs are a disruptive new technology for light detection

It will completely change the PET technology because of

- improved time resolution
 - > increased sensitivity
- PET detector no longer need to be rings
 - > much more geometric freedom,
 - > organ specific PET
- DOI resolution

The EndoTOFPET-US project



The tool

Endo = Endoscopic

TOF = Time of Flight

PET = Positron Emission Tomography

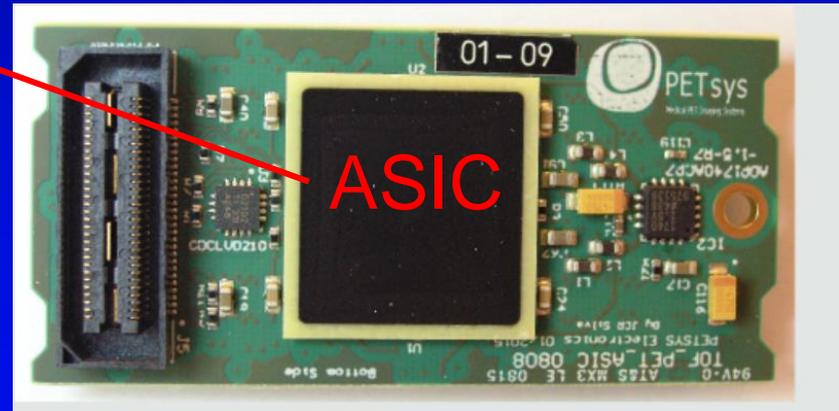
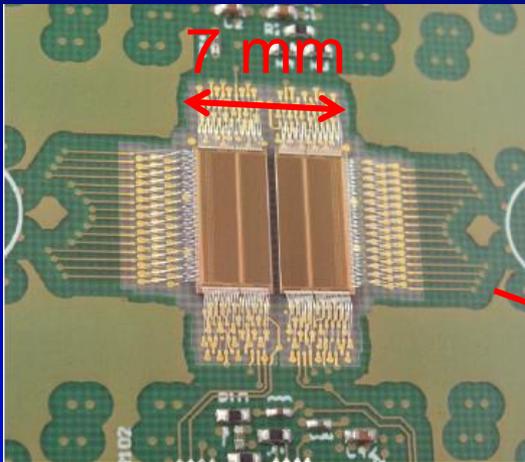
US = Ultrasound

The goals:

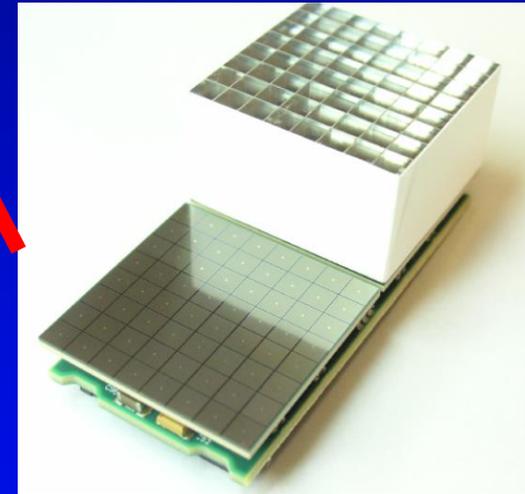
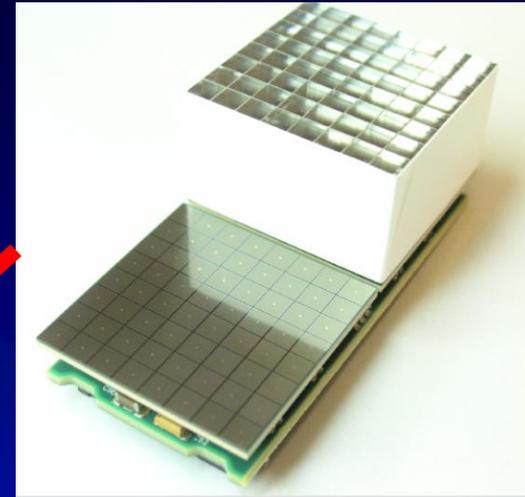
- 1) development of **biomarkers** for prostate and pancreas tumor
- 2) **intra-operative imaging** of prostatic and pancreatic lesions (guided surgery / biopsy)

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In the framework of the ENDOTOFPET project PETsys electronics has developed an ASIC for reading SiPM based, TOF PET detector modules.



With this ASIC we have the affordable readout for building PET scanners with many 10'000 SiPM channels



Together with Prof. João Varela from Technical University Lisbon I decided to try and commercialise this PET readout.



But first we had to raise funding

Eventually raised ≈ 2 M€ to start a Company
PETsys electronics to commercialise the ASIC and
PET readout electronics

Is conclusion, the work done at CERN did produce a spin off company in this case.

We have not made it yet, but I think we are moving in the right direction

But, lets face it, there are disappointingly few spin off companies from CERN.

But how should CERN go about it?

CERN can play an important role in it, but not a leading role.

We should provide a legal framework to the translation of advanced technical developments in particle physics to medicine.

It should involve clinicians, biologists, physicists, funding agencies, entrepreneurs, industry, ..

It will reduce fragmentation and to improve our overall efficiency in a domain where Europe has a large potential to take a leadership.

In this way, hopefully, in the future
transfer from particle physics to
medicine will be more efficient

Thank you for your attention

