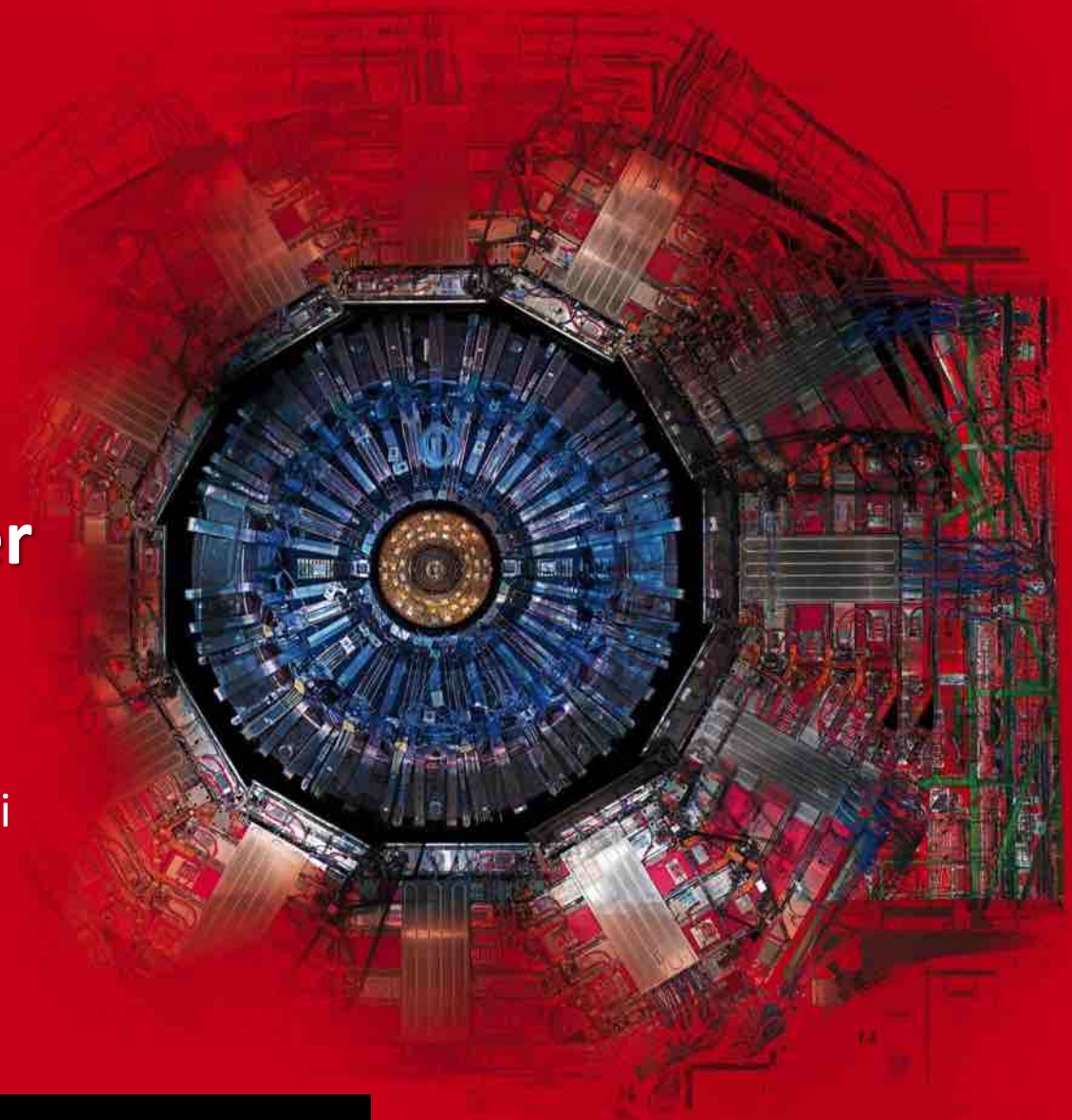
High School Career Day



Laboratori Nazionali di Frascati
3 Aprile 2017

CAEN Electronic Instrumentation
Tools for Discovery

CAEN (Costruzioni Apparecchiature Elettroniche Nucleare)

Cristina Mattone

c.mattone@caen.it
Skype: cristinamattone

About me….

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- **Master Degree** in Particle Physics

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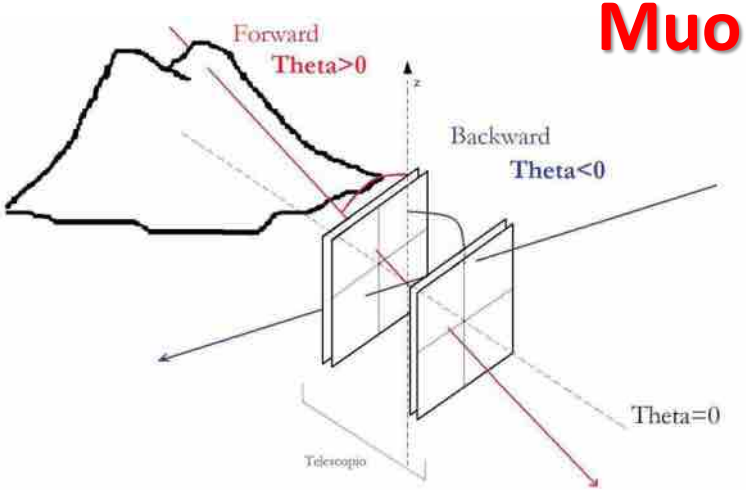
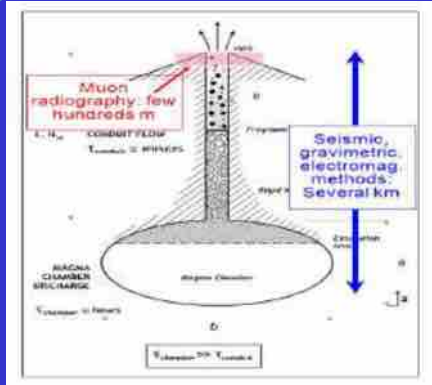
Muon Radiography





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Radon Detector

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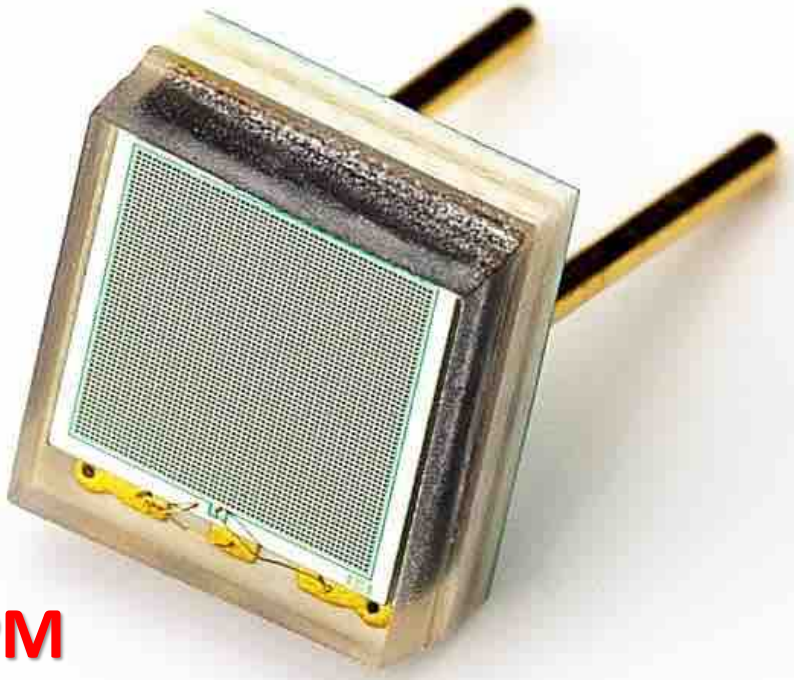

Single Photon detection - SiPM

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- Responsible of the CAEN **Educational Project** and **Application Scientist**

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Network of Companies

- Founded in 1979, CAEN SpA (Costruzioni Appearecchiature Elettroniche Nucleare) is an important industrial spin-off of the INFN
- 120 people (assembly not included)
- Core business: Electronic Instrumentation for physics experiments (world leader)
- Spin-off activities:
  RFID (2003), CAENels (2010), CAENqS (2012), CAEN SyS (2016)

Quality Certification

Worldwide presence

Worldwide sales network offices in Italy, Germany, USA, Distributors in more than 30 countries.

Portfolio: > 5000 customers

Customers Include all world leading research centres as:

- **Europe: CERN, INFN, CEA, CNRS; GSI, ESO, ISIS, Ganil, PSI, …**
- **USA: FNAL, SLAC, Los Alamos, BNL, Jlab, …**
- **Asia: J-Park, KEK, Riken, IHEP, TIFR, …**
- **Africa: iThemba Labs, …**

And private companies:

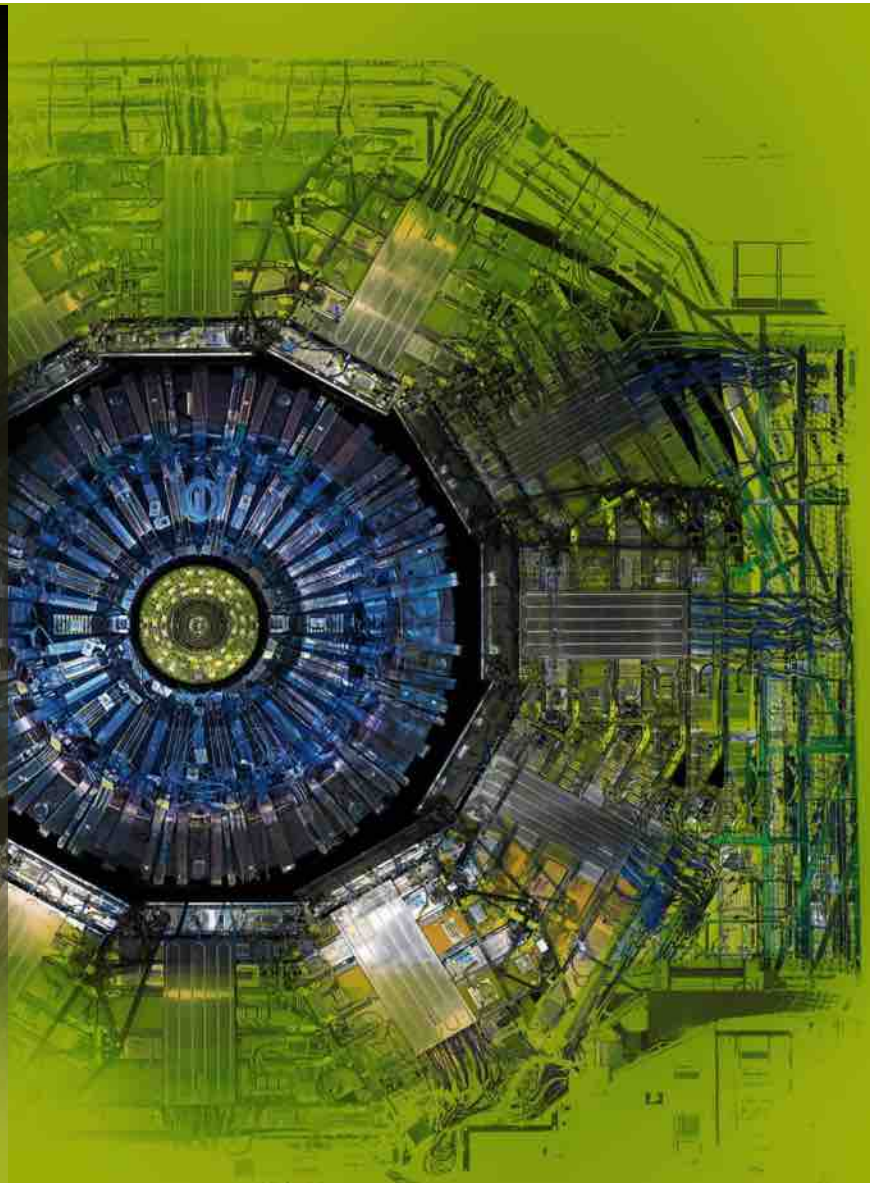
- **GE, Siemens, SAIC, L3, Raytheon, Lockheed…**

Market

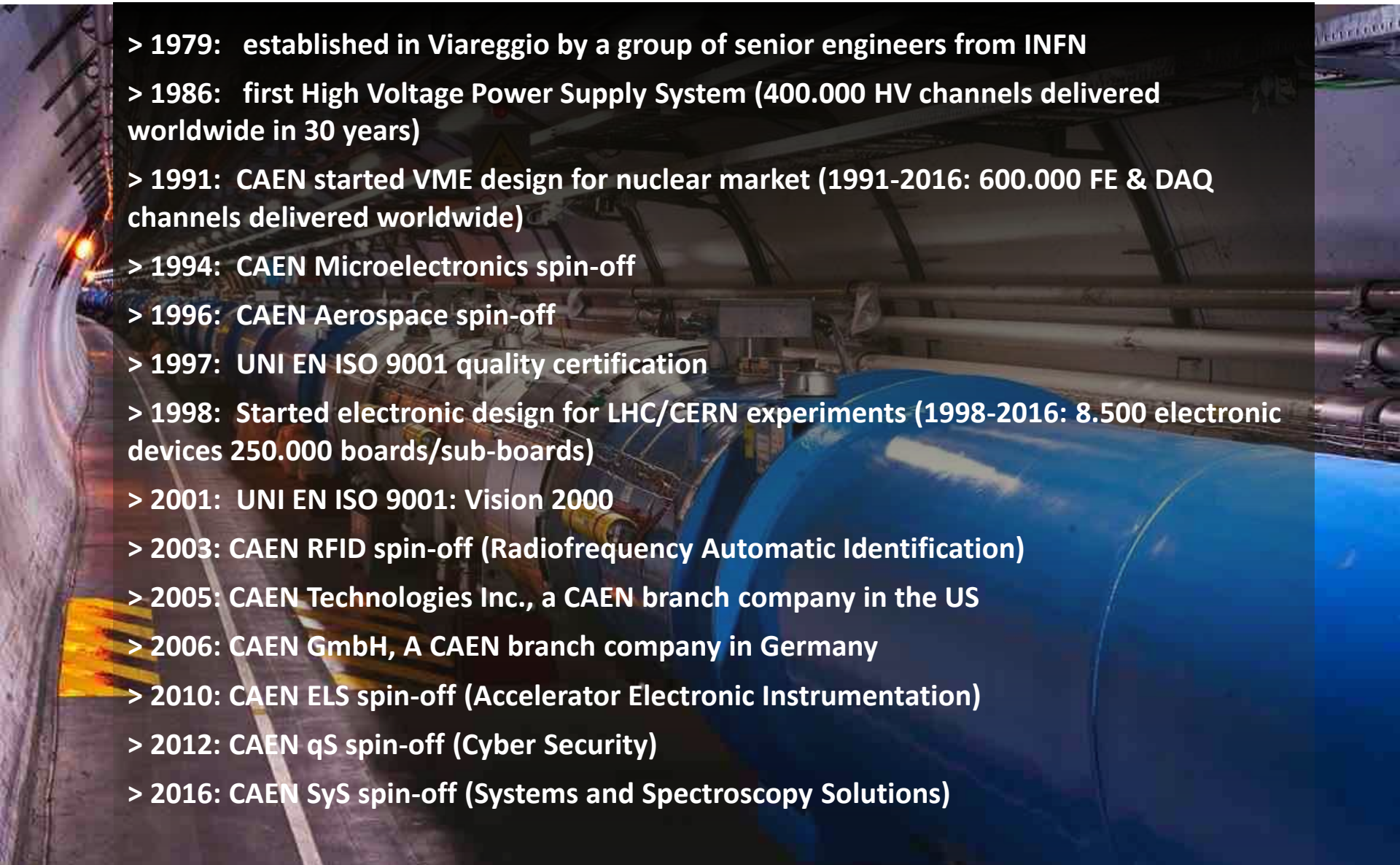
For more than 35 years CAEN has been providing Scientists and Engineers with the most advanced electronic instrumentation for any particle or radiation detectors

Strong of an extremely close collaboration with the world major research laboratories CAEN is proud to produce the best tools for:

- **> High Energy Physics**
- **> Astrophysics**
- **> Neutrino Physics**
- **> Dark Matter Investigation**
- **> Nuclear Physics**
- **> Material Science**
- **> Medical Applications**
- **> Homeland Security**
- **> Industrial Applications**



Milestones: 1979 - 2016



> 1979: established in Viareggio by a group of senior engineers from INFN

> 1986: first High Voltage Power Supply System (400.000 HV channels delivered worldwide in 30 years)

> 1991: CAEN started VME design for nuclear market (1991-2016: 600.000 FE & DAQ channels delivered worldwide)

> 1994: CAEN Microelectronics spin-off

> 1996: CAEN Aerospace spin-off

> 1997: UNI EN ISO 9001 quality certification

> 1998: Started electronic design for LHC/CERN experiments (1998-2016: 8.500 electronic devices 250.000 boards/sub-boards)

> 2001: UNI EN ISO 9001: Vision 2000

> 2003: CAEN RFID spin-off (Radiofrequency Automatic Identification)

> 2005: CAEN Technologies Inc., a CAEN branch company in the US

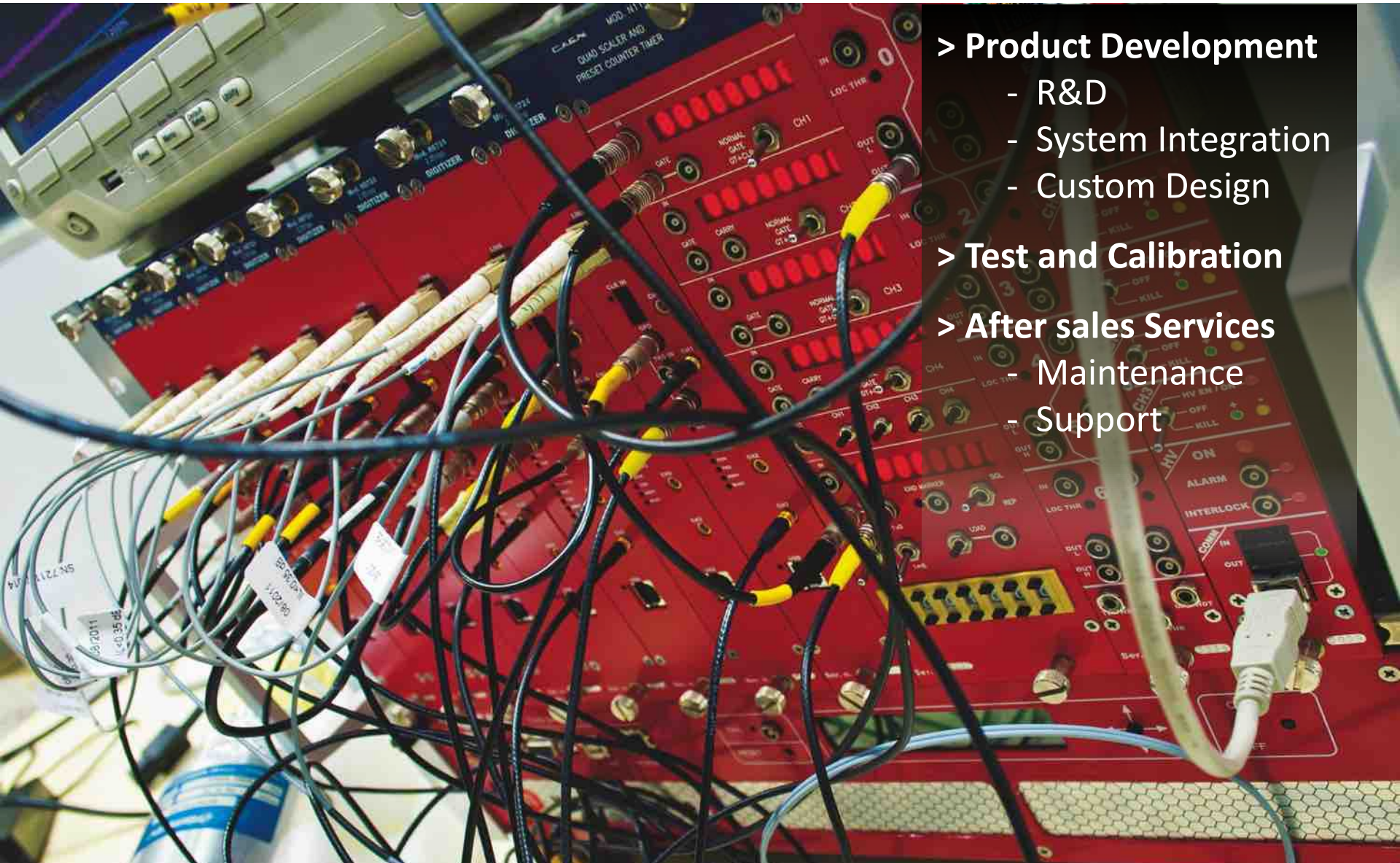
> 2006: CAEN GmbH, A CAEN branch company in Germany

> 2010: CAEN ELS spin-off (Accelerator Electronic Instrumentation)

> 2012: CAEN qS spin-off (Cyber Security)

> 2016: CAEN SyS spin-off (Systems and Spectroscopy Solutions)

Key strengths



> Product Development
- R&D
- System Integration
- Custom Design

> Test and Calibration

> After sales Services
- Maintenance
- Support

Product Development

- The R&D division is strong of 50 high level Physicists and Engineers who adopt forefront technologies to design innovative products
- Ongoing collaborations with important institutes such as: Elettra, CEA, CNRS (LAL, IRES..), PSI, INFN…

Test

- All assembling activities are outsourced
- Experienced group of 20 engineers dedicated to in-house Test and Calibration of the entire production
- Capability: 500 complex modules/month
- All procedures are ISO certified providing the complete traceability of the products

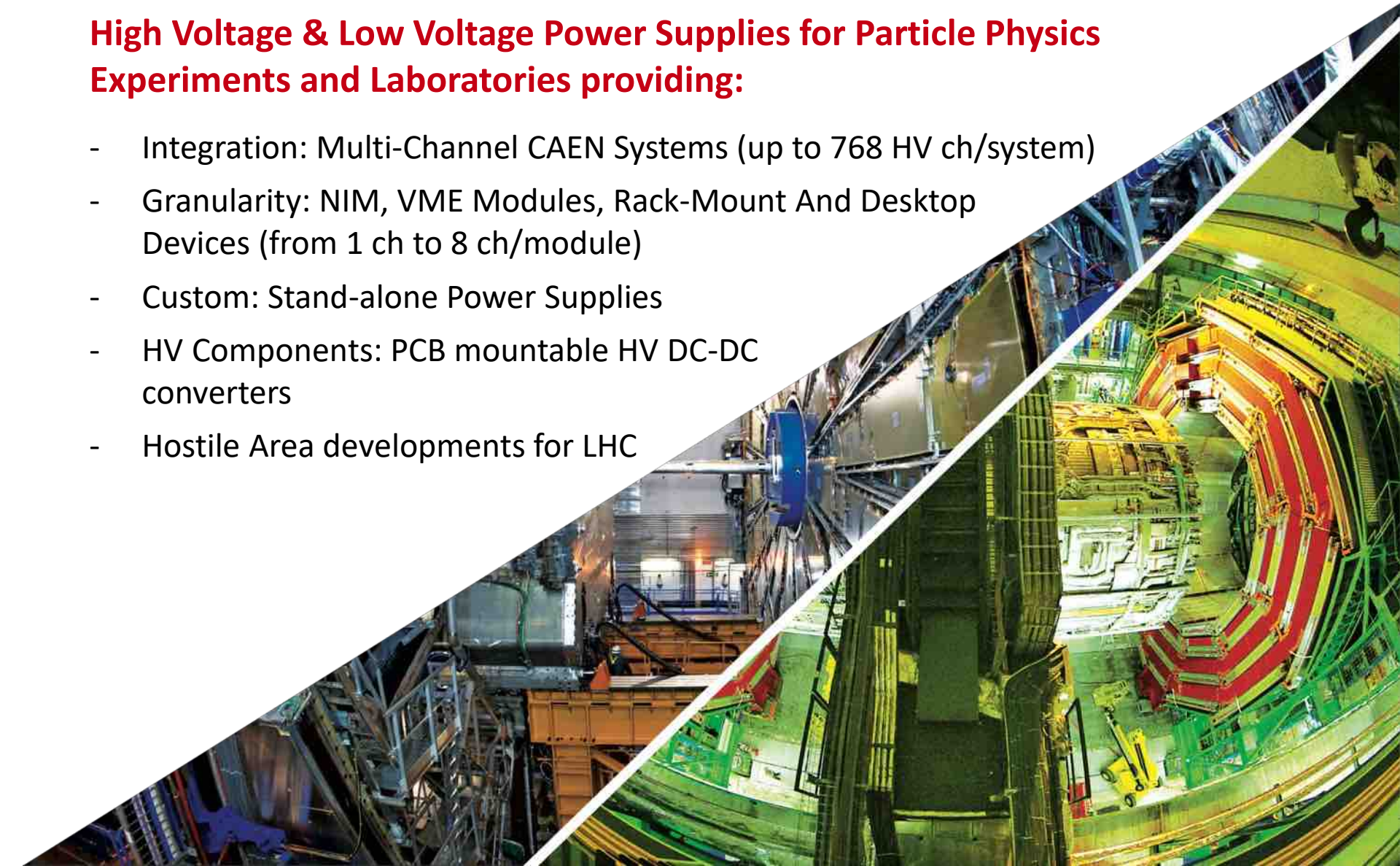
Maintenance and Support services

- Excellent pre - and after - sales support
- Strong maintenance division (25 engineers)
- Long Term Maintenance Contract (CERN 10 years and more)
- On line support service
- Short intervention time (on request, on-site within one day only in Europe)
- Short delivery (on request worldwide)

Power Supplies Expertise

High Voltage & Low Voltage Power Supplies for Particle Physics Experiments and Laboratories providing:

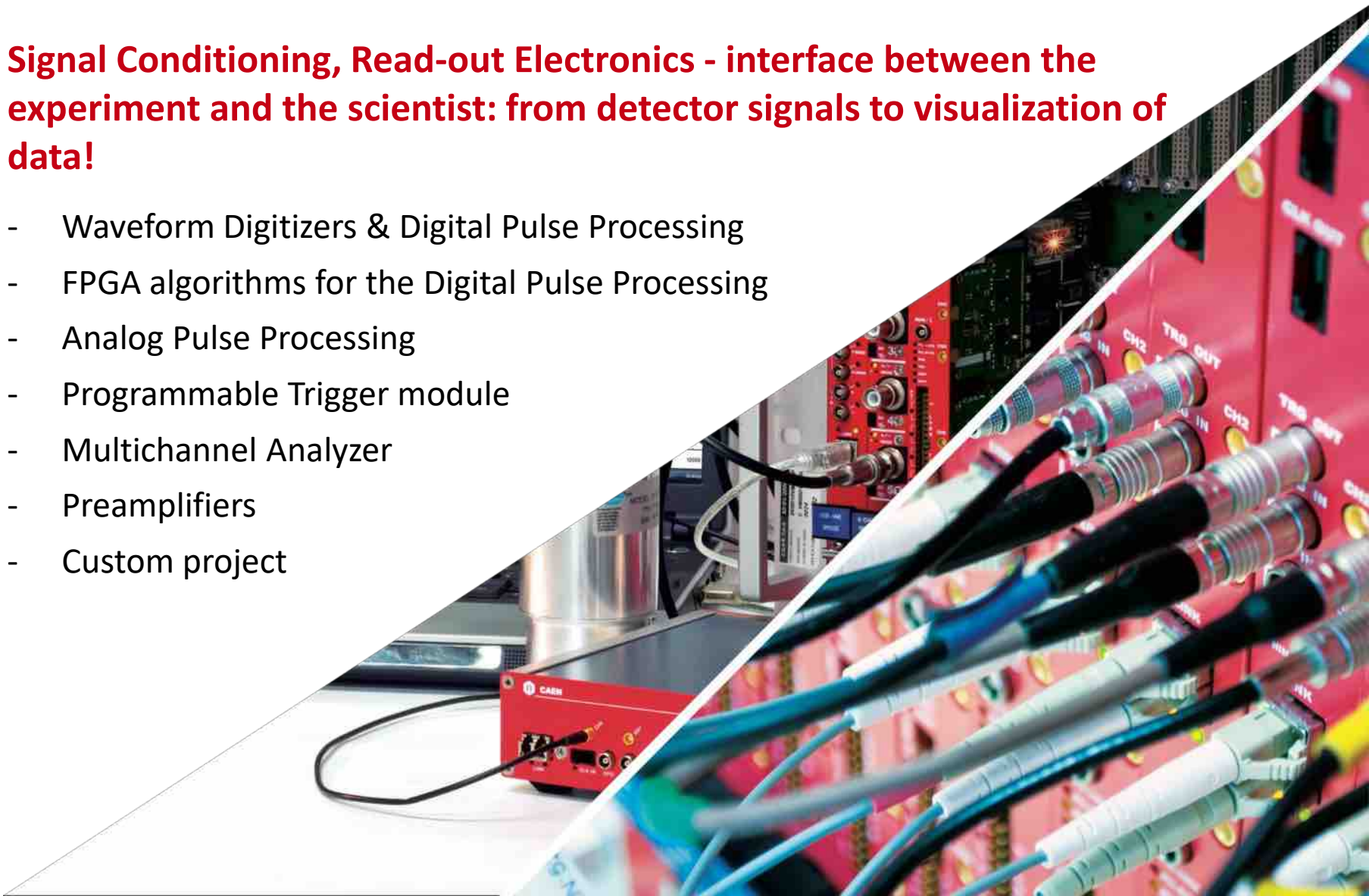
- Integration: Multi-Channel CAEN Systems (up to 768 HV ch/system)
- Granularity: NIM, VME Modules, Rack-Mount And Desktop Devices (from 1 ch to 8 ch/module)
- Custom: Stand-alone Power Supplies
- HV Components: PCB mountable HV DC-DC converters
- Hostile Area developments for LHC



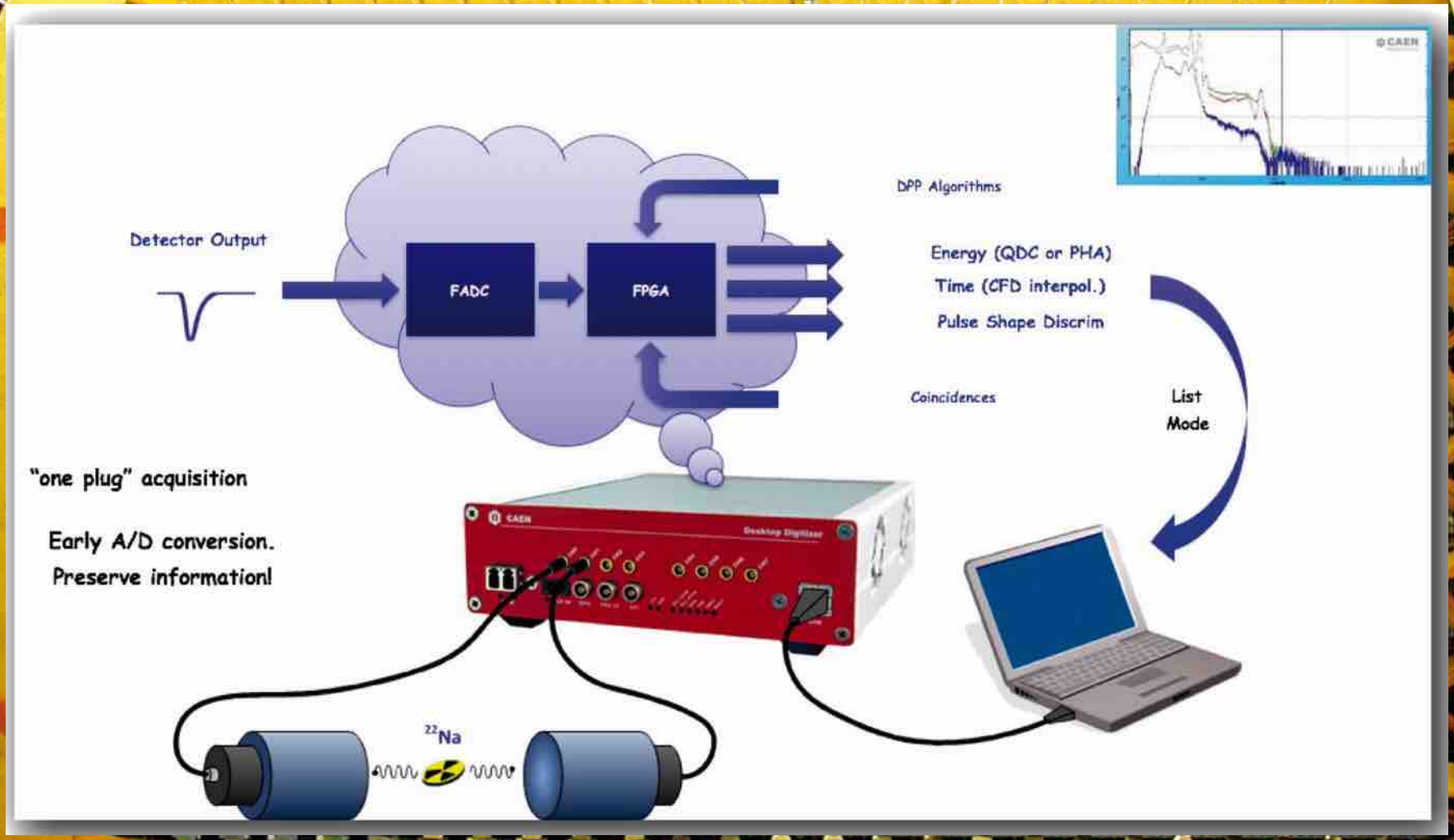
Pulse Processing Expertise

Signal Conditioning, Read-out Electronics - interface between the experiment and the scientist: from detector signals to visualization of data!

- Waveform Digitizers & Digital Pulse Processing
- FPGA algorithms for the Digital Pulse Processing
- Analog Pulse Processing
- Programmable Trigger module
- Multichannel Analyzer
- Preamplifiers
- Custom project



Fully digital acquisition chain From raw waveforms to spectra



Custom Developments: Case History

Strong capability to manage complex custom solutions

- High Voltage
- Digital and Analog Pulse Processing

LV Power Supply for ALMA (ESO)

> Design of custom LV Power Supply System for ALMA
> 86 Complex LV Systems delivered (688 power channels)
> Harsh environmental condition (desert at 5,000 m altitude)
> Designed to operate for at least 30 years; 24/7 (24 hours a day, seven days a week)

San Pedro de Atacama (5000 meters above sea level), Chajnantor plateau Chile.
The most complex ground-based astronomical observatory in the world.

NA62@CERN

CAEN was contract-awarded to design and manufacture the Calorimeter REAdout Module (CREAM); 455 modules – 13,249 ch for the NA62@CERN Liquid Krypton Calorimeter (LKr)

> VME 6U form factor

- 32 channel
- 14 bit 50 MS/s ADC
- 2 Vpp input dynamics (differential)
- 14-bit programmable DC offset adjustment (±1V)
- Memory buffer:
  - 26 MB circular buffer
  - 5.2 GB event buffer
- Gbit Ethernet port for data readout
- VME64X compliant interface

455 modules - 13,249 read-out channels

XMass @ Kamioka, Japan

> Dark Matter experiment using a liquid Xenon TPC

> Equipped with 84 digitizers modules

> 672 channels - 10 bit @ 1GHz

Readout Bandwidth = ~2 MB/s/ch
Total aggregate throughput = ~ 1GB/s

Pierre Auger Observatory

> Based on A7501 PCB mount HV DC-DC converter
> Extended Temperature working range: -10°C÷70°C
> Designed for long working life in harsh environment

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> Extended Temperature working range: -10°C÷70°C

> High efficiency
> 2100 V/100 µA output ranges
> Available with positive or negative polarity
> Stand alone architecture
> Compact package: 34,5 x 62,9 x 119 mm3

A tailored solution for Large Area experiments in harsh environment: A7501PB

International Atomic Energy Agency

> 12 liquid scintillators
> Digital DPP and Waveform readout
> Sustained throughput: 340 MB/s

The Fast Neutron Collar (FNCL) is a liquid scintillator-based instrument developed as an efficient NDA (non destructive assay - test) tool for verification of modern NPP's Fresh Fuel Rods

Fast neutron counting System for safeguards and non proliferation activities (IAEA): SD7750

GammaFly: Airborn Gamma Spectroscopy

Aerial monitoring system of environmental radioactivity with applications in:

> Homeland security
> Environmental protection
> Geological and soil mapping
> Uranium and mineral exploration
> Mineral/gas and oil processing
> Environmental radioactivity monitoring

4x4 array of 1 liter NaI detectors

CERN/LHC Electronics in Hostile Environments & Experiments

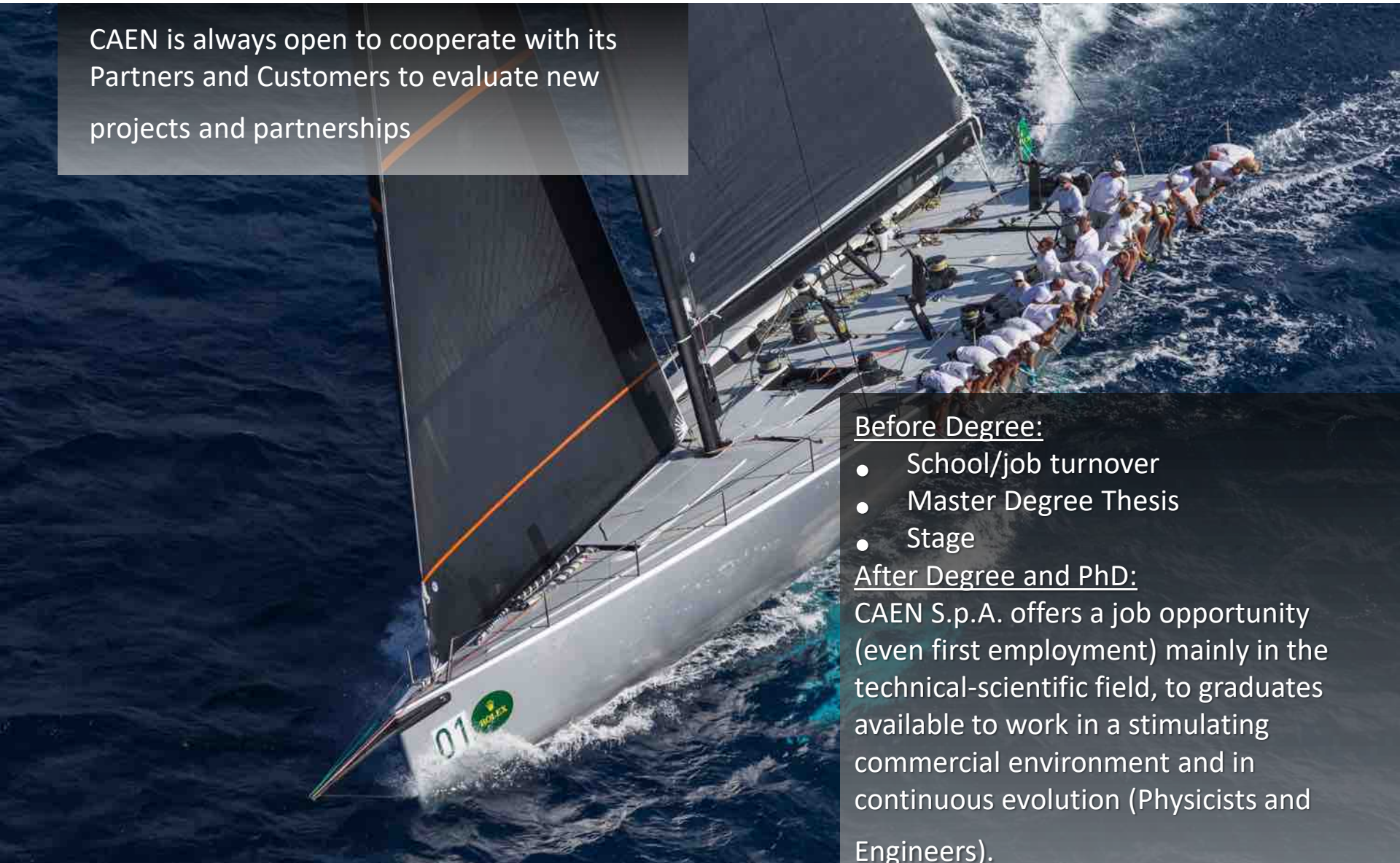
"EASY" Multi Function System
> 7 kGauss magnetic field
> 1*1011 p/cm2 TD - 15 kRad TID
> 2*1012 n/cm2 TD

1998 – 2016
SYNERGY for SUCCESS
18 years of joint efforts to achieve top performances
> 8.500 electronic devices
> 250.000 boards/sub-boards

CAEN has received the "CMS Crystal Award" for the development and production of the power system for the CMS/LHC Tracker

Designed with COTS components to work in "hostile" areas

Winning Synergies and Job Opportunities



CAEN is always open to cooperate with its Partners and Customers to evaluate new projects and partnerships

Before Degree:

- School/job turnover
- Master Degree Thesis
- Stage

After Degree and PhD:

CAEN S.p.A. offers a job opportunity (even first employment) mainly in the technical-scientific field, to graduates available to work in a stimulating commercial environment and in continuous evolution (Physicists and Engineers).

CAEN
Tools for Discovery

Thank you for your attention!