CAEN *Tools for Discovery*

Working Side by Side with Research: CAEN's Perspective on Technology Transfer

A 47-Year Long Experience

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CAEN Group

- CAEN Group is made up of three companies

- CAEN S.p.A. was founded in 1979 as a spin-off of INFN Pisa and is today a world leader serving the fundamental physics research community and the nuclear instrumentation industry.

- Spin-off activities:
- RFID (2003),
- CAENqS (2012),
- CAEN SyS (2016) – CAEN S.p.A. Division in 2019

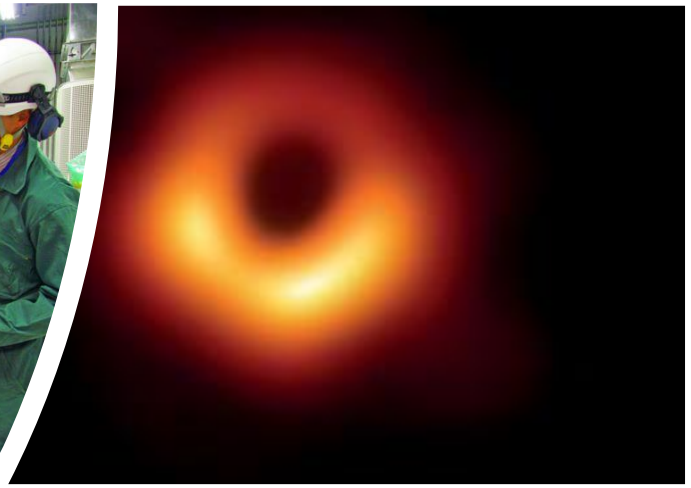
Total Employees: ~200

CAEN Expertise

CAEN itself represents a successful example of technology transfer:
from an academic spin-off to a leading provider of nuclear measurement solutions.

CAEN has been working in close collaboration with major research laboratories worldwide, designing electronics for:

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



… a leading provider of nuclear measurement solutions

Proprietary technology portfolio for radiation and particle detection measurements

Unique Electronic portfolio **with more than 1200 nuclear electronics products**

World-class technology development
More than 100 engineers, physicists and PhDs within the CAEN Group

Global manufacturing capabilities

Worldwide service network

CAEN Designing History

CAEN started with fully custom designs for INFN and CERN.

After some time, the first catalog products were introduced.

Over the years, standard catalog products became increasingly predominant.

Today, about 90% of CAEN products are standard catalog items.

Custom projects still play an important role, although they are no longer as critical as in the past.

Custom project are:

- Custom HW and FW
- Custom FW and SW on standard HW

The CAEN Approach

1. Listening to the user requirements and understand the experimental scenario and possible critical point
2. Checking whether a catalog solution is already fitting with the customer requirements
3. If not, evaluating possible customization
4. If a customization is required, working in collaboration with the customer, to design and test the custom solution
5. The project design starts and remains as a CAEN Intellectual Property

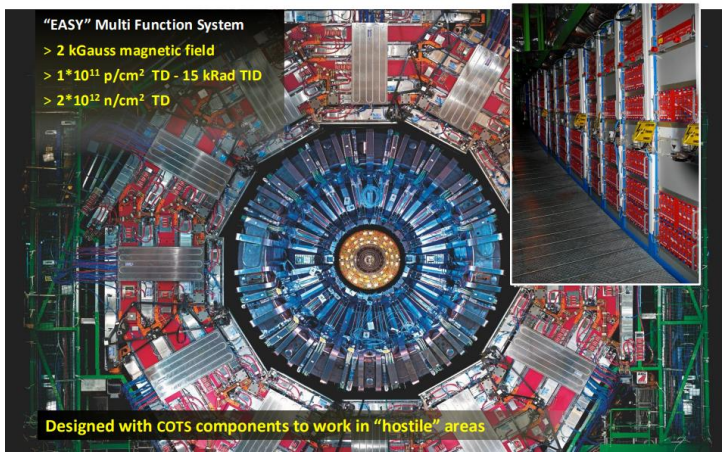
In some cases small customization are enough, in some others a complete custom solution is required.

Each case is evaluated individually in terms of R&D effort, NRE cost, schedule and budget constraints.

Guideline: always trying to do the best to match the user requirements

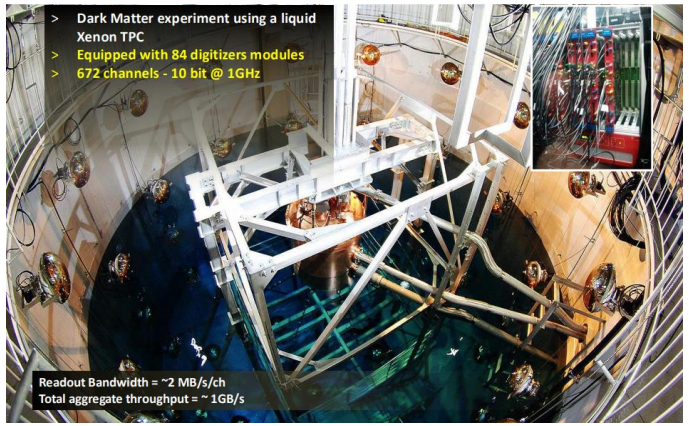
Custom Developments: (some) Case History

CERN/LHC Electronics in Hostile Environments

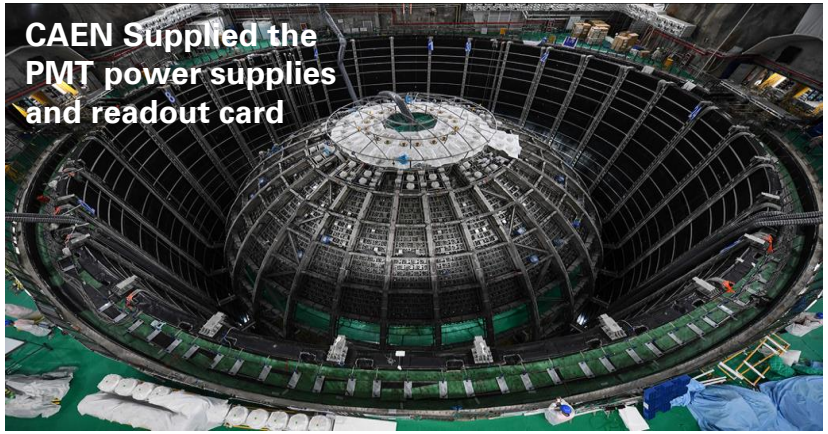


LHAASO @ Daocheng

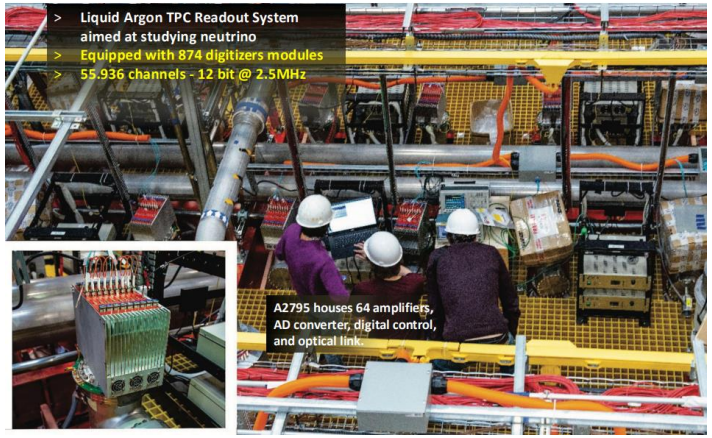
XMass @ Kamioka, Japan



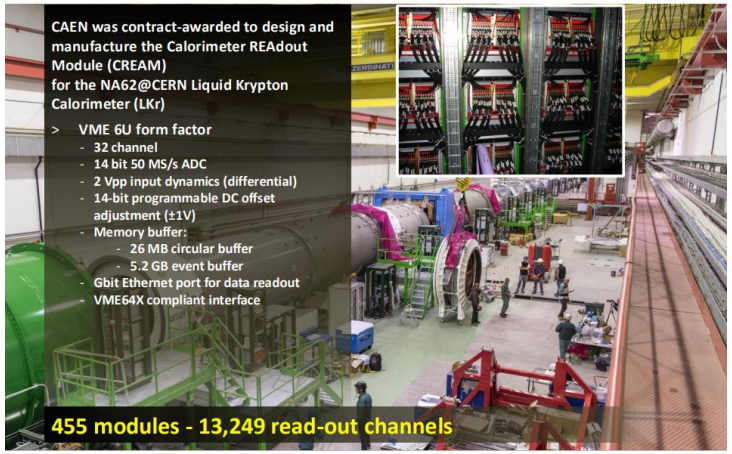
JUNO @ Jiangmen



ICARUS @ Fermilab, USA



NA62@CERN



Technology transfer at CAEN: scope and limits

Technology transfer at CAEN is important but limited to specific domains.

It has been mainly applied in:

- **Educational and training systems**
- **(Specific) Front-end electronics cases and preamplifiers**

In these cases, technology transfer allowed CAEN to **complement internal expertise and fill specific gaps in the product portfolio**, while keeping the final **integration and industrialization in-house**.

In some cases, technology transfer followed a **multi-step path**, from academia to a university spin-off, and only later to CAEN for **final engineering, qualification and commercialization**.

Technology transfer in Educational Field

β and γ Spectroscopy, Photon Physics, Cosmic ray physics, SiPM characterization

UNIVERSITÀ DEGLI STUDI DELL'INSUBRIA

Nuclear Imaging – PET

universidade de aveiro

γ Outdoor Environmental Radioactivity studies and Radioactivity studies in Geology with GM Detector

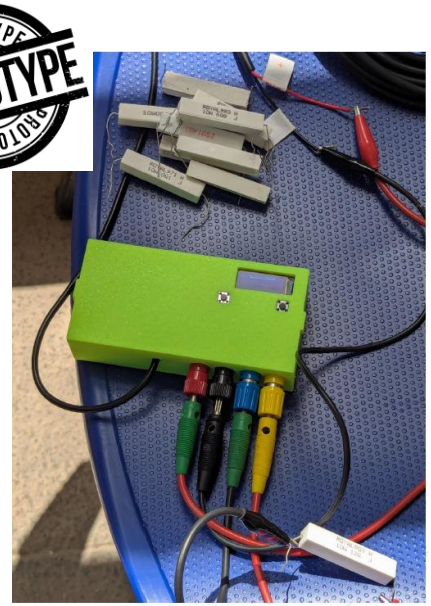
Università degli Studi di Ferrara

GEOExplorer

Solar cell studies

Università degli Studi di Messina

OPEN·FIS



Technology transfer in preamp & DAQ field

Preamplifiers for He3 tubes, Fission Chambers and Diamond detectors

INFN Roma Tor Vergata

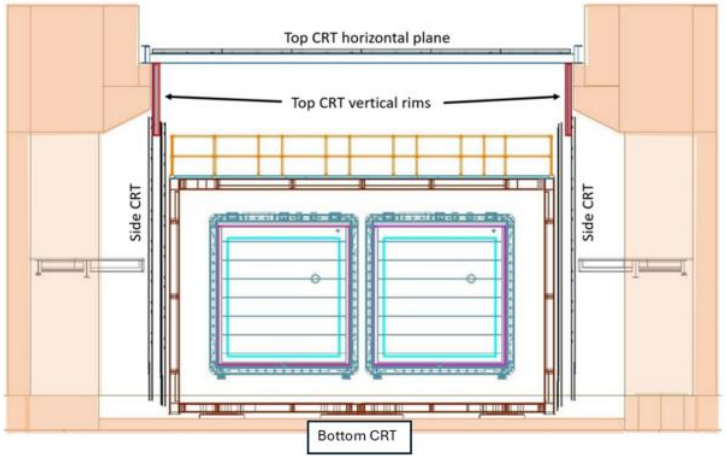
cea

NEUTRONS FOR SOCIETY

SiPM Readout Board for Cosmic Rays Veto

Designed for the ICARUS Cosmic Ray Trigger (CRT) detector (SiPM based)

UNIVERSITÄT BERN



Conclusion

CAEN's R&D paradigm is based on close collaboration with researchers, while keeping technology design and ownership in-house.

Technology transfer plays a role in CAEN's history, but it is **selective and limited to specific areas**.

A business model based exclusively on technology transfer would not be sustainable for a company like CAEN, as it would impact long-term expertise, independence, and product maintainability.

The value of collaboration lies in testing, validating, and improving solutions together with the research community.

Thank you

Backup slides

CAEN Worldwide presence

CAEN boasts more than 40 authorized distributors worldwide and maintains four headquarters strategically located across the globe.

- **CAEN** S.p.A. (Italy)
- **CAEN**spa India Private Limited (India)
- **CAEN** GmbH (Germany)
- **CAEN** Technologies (U.S.A.)

(Some) Key Customers

Product catalogue

- HV and LV Power Supplies for radiation sensors and electronics
  - Multichannel CAEN Universal Systems
  - Multichannel NIM, VME, Desktop and Rack mount Modules
  - PCB mountable HV DC-DC converters
  - Power supplies for hostile area

- Signal Conditioning & Read-out Electronics
  - Preamplifiers
  - NIM, Desktop, Rack mount and VME Front-End/Data Acquisition Modules (Waveform Digitizers)
  - Distributed readout electronics

- Powered Crates and Chassis
  - Low Ripple Linear NIM powered Crates
  - VME64/VME64x Crates

Product catalogue (continues…)

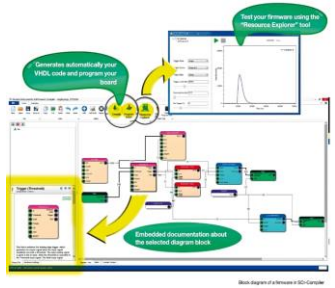
- Detector emulators

- Educational Kit for University and High School Labs

- Custom Developments

- Software for Data Acquistion

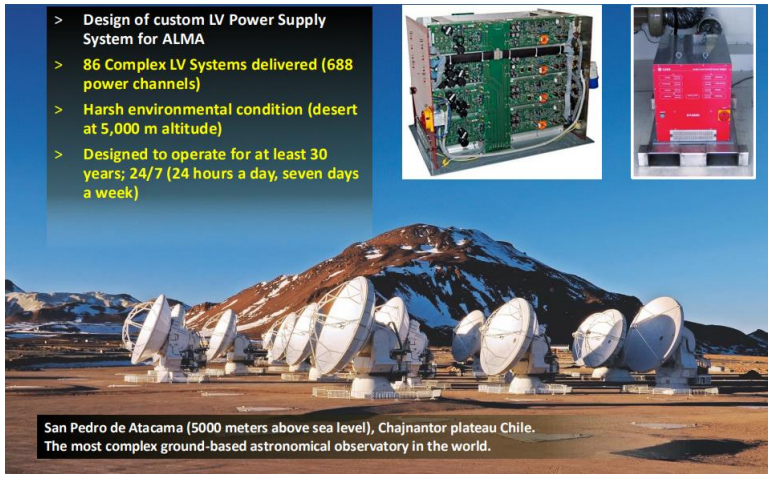
- Software for FPGA Programming



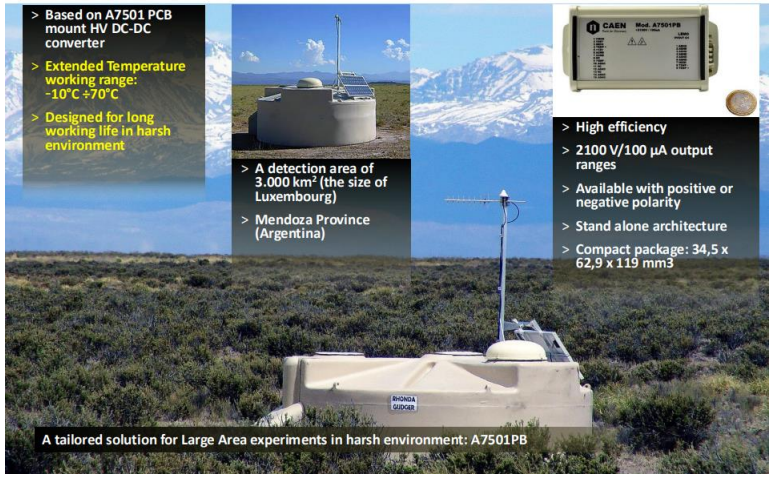
Custom Developments: (some) Case History

CAEN & LHC Experiments

LV Power Supply for ALMA (ESO)



Pierre Auger Observatory



International Atomic Energy Agency