

# CERN Knowledge Transfer & Aerospace Applications

**Enrico Chesta**

Knowledge Transfer Group

IPT Department

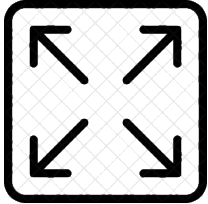
**Belgium @ CERN**

19-03-19

# CERN's Knowledge Transfer Activities



# KT Mission



**Maximise** the technological and knowledge return to society in particular through Member States industry



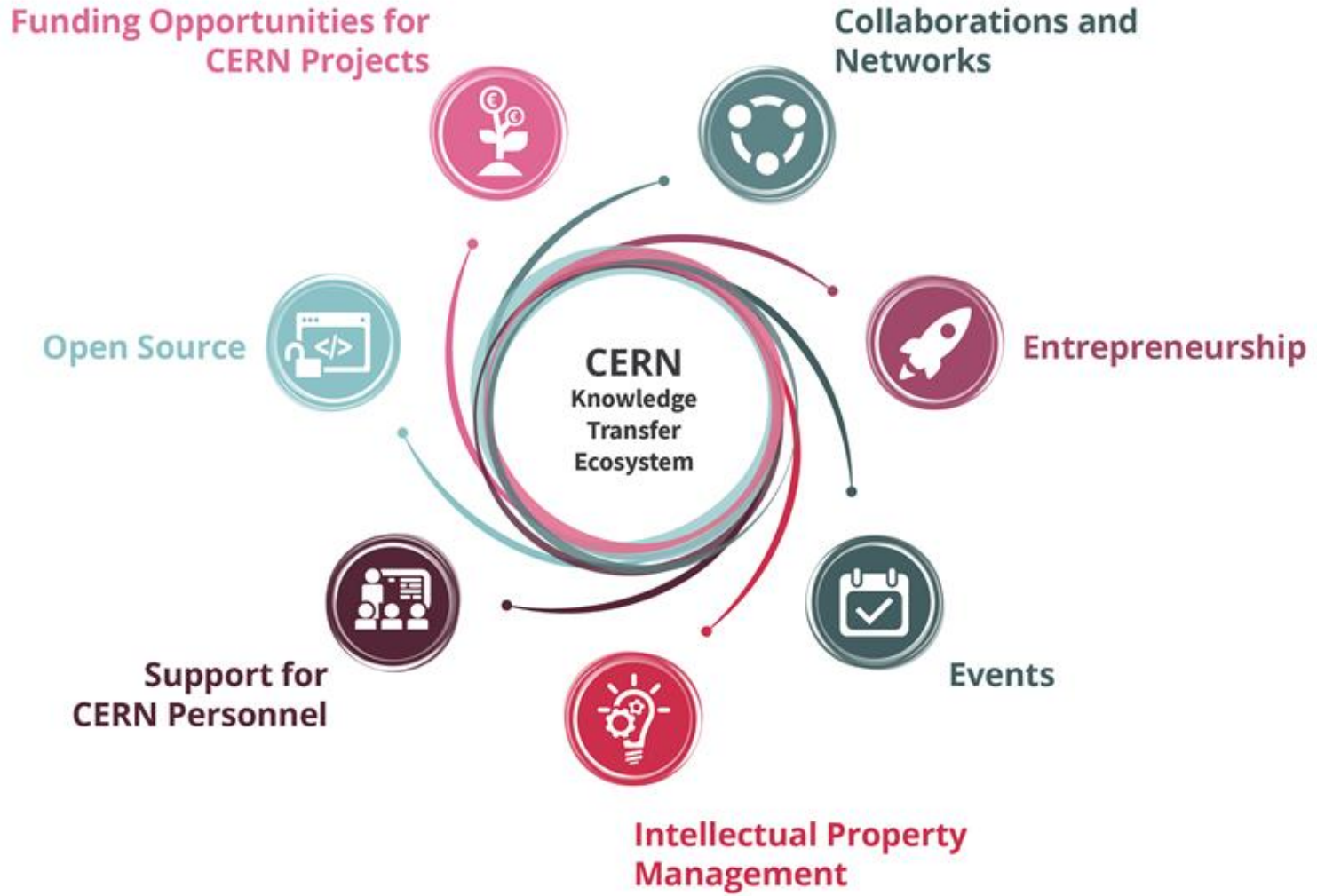
**Promote** CERN as a centre of excellence for technology and innovation



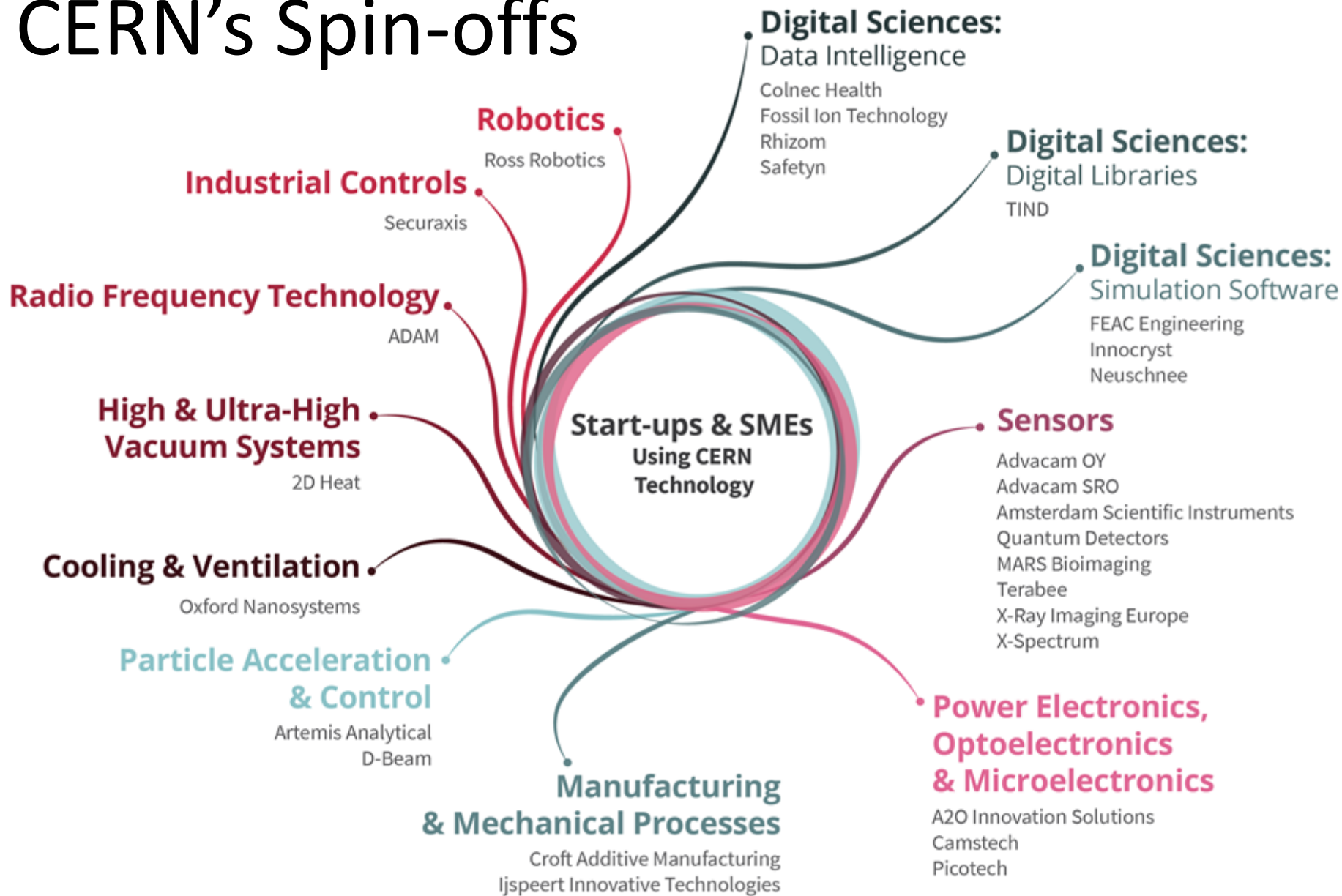
**Demonstrate** the importance and impact of fundamental research investments

**Key concepts: Dissemination and Impact**

# KT Ecosystem

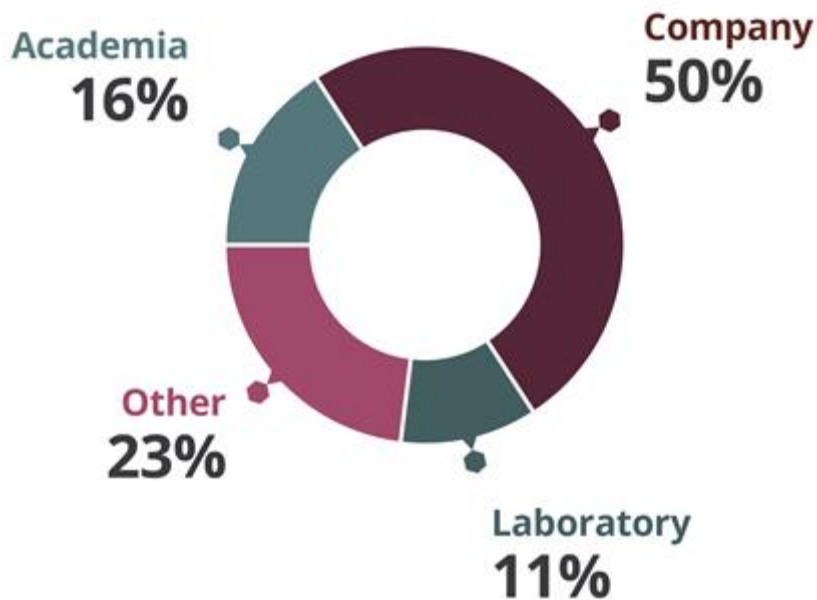


# CERN's Spin-offs

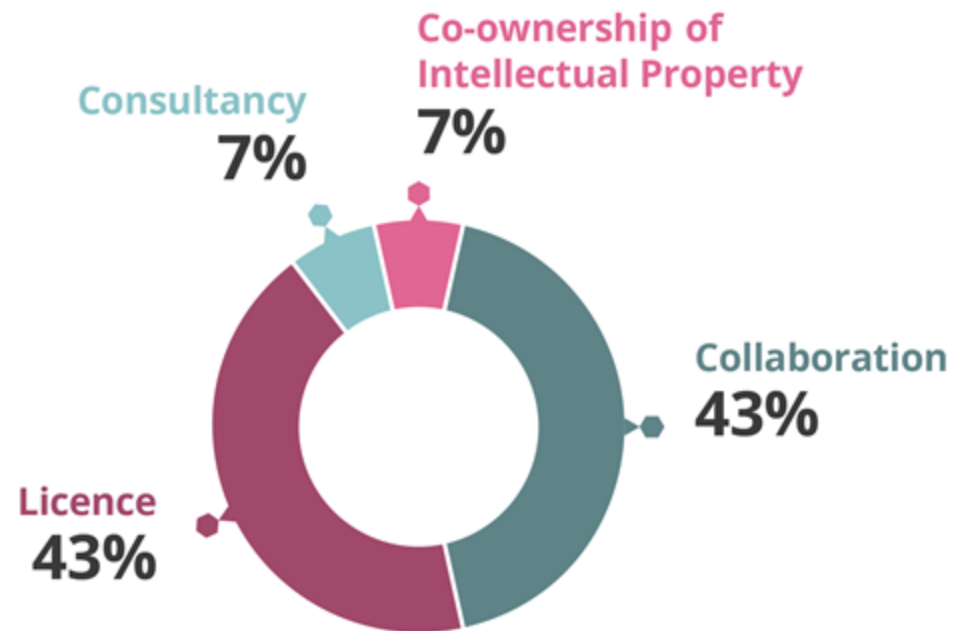


# KT Contracts - 2018

## Contract by Partner



## Contract by Type



# Value Proposition: CERN's know-how

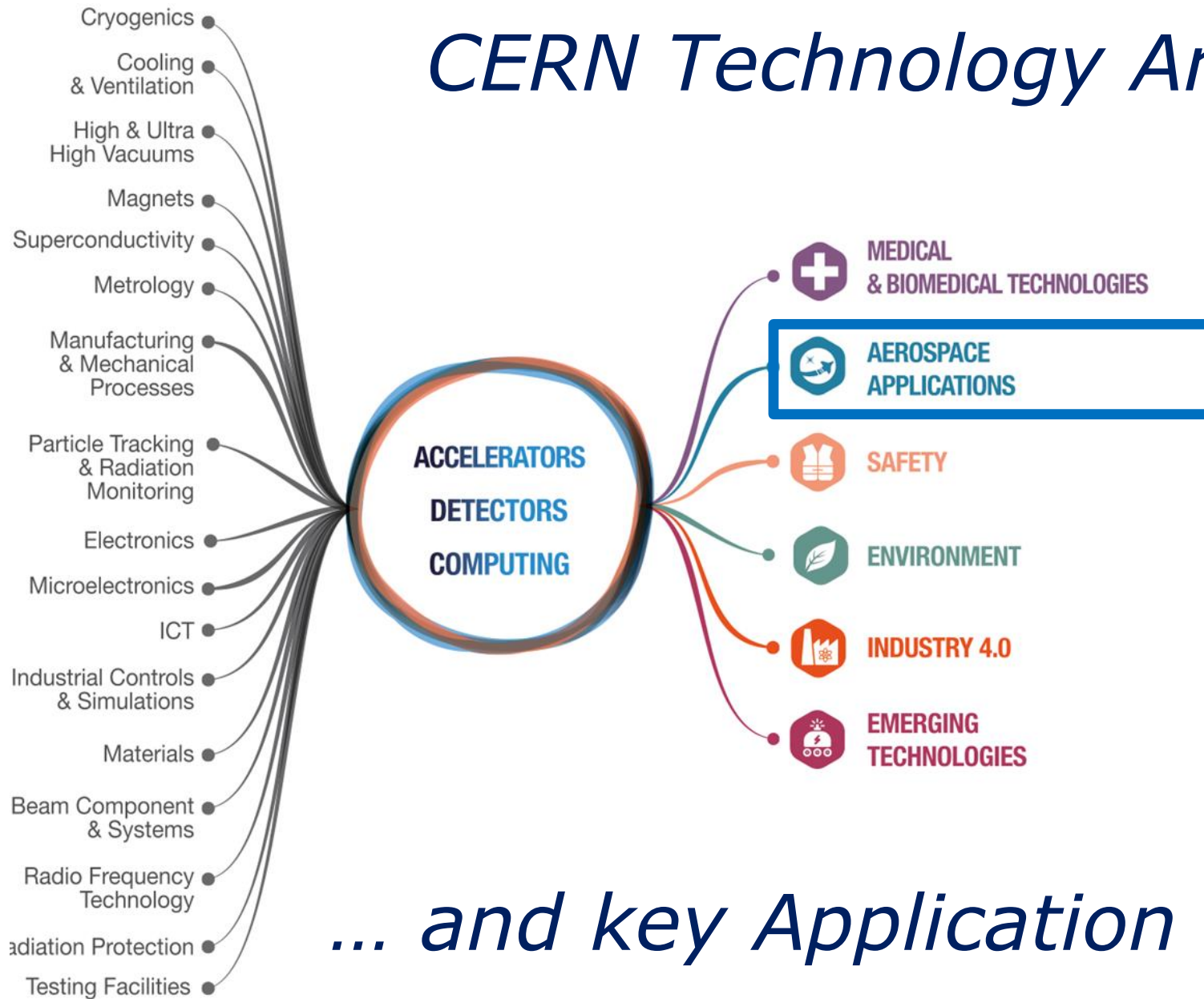
## SUPERCONDUCTING MAGNETS

*CERN's knowhow and facilities for end-to-end design, assembly, testing and operation of superconductive magnet systems*

# Value Proposition: CERN's technologies

**CERN Technologies accessible to companies in CERN Member States**

# CERN Technology Areas...

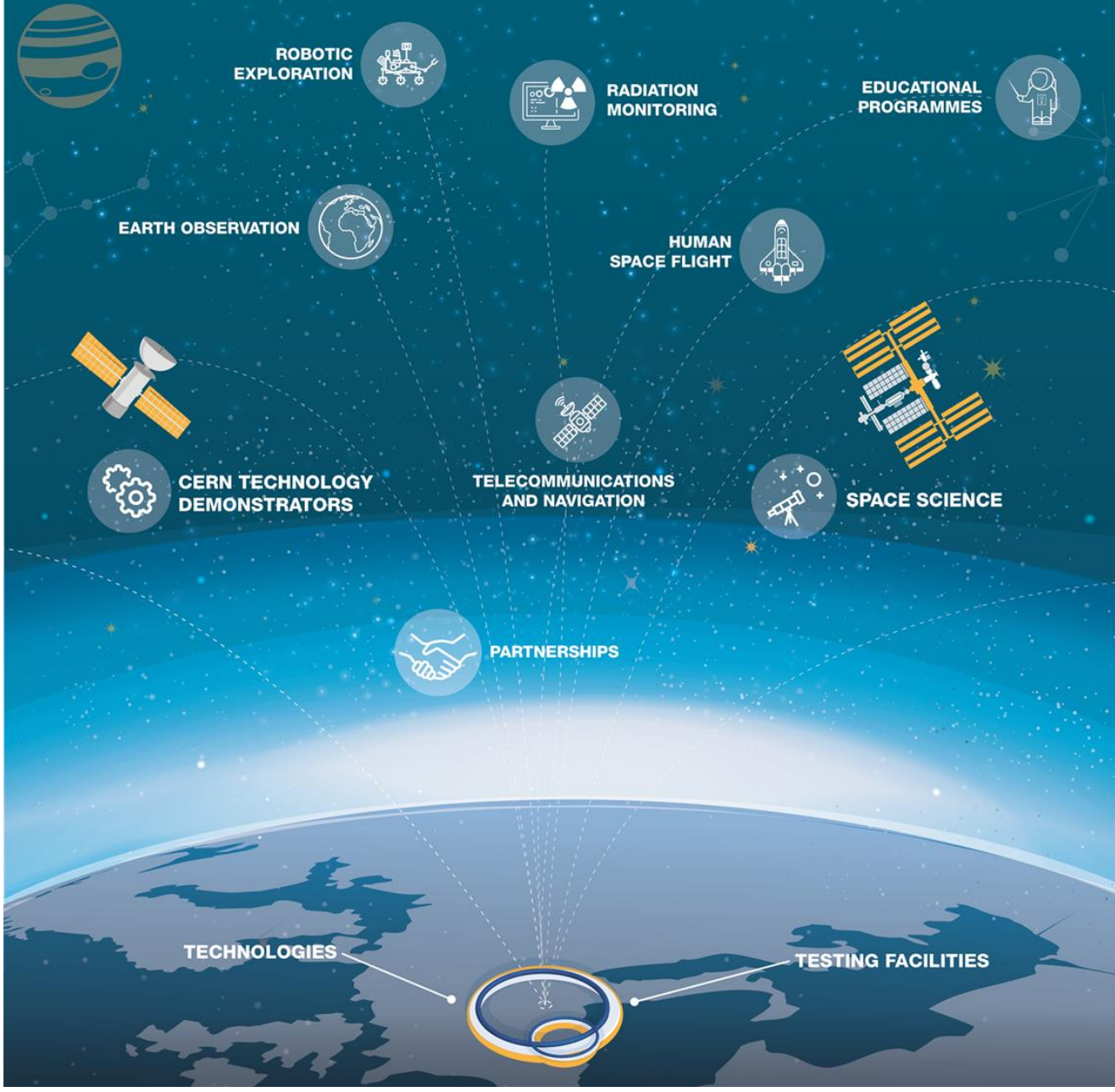


... and key Application Fields



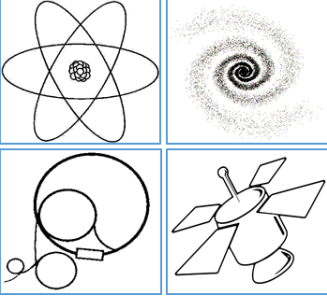
# CERN's Aerospace Applications





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# Value Proposition/CERN's knowhow: link to Aerospace Applications

## DATA ANALYTICS

CERN's knowhow and experience with 'big data' analysis for high energy physics and control of systems used in the LHC.

## HIGH VOLUME DATA MANAGEMENT & STORAGE

CERN's unique knowhow derived from storage and worldwide distribution of vast amounts of data

## MACHINE LEARNING & DEEP LEARNING

Knowhow and experience derived from early adoption of neural network techniques by particle physics community

## HIGH & ULTRA-HIGH VACUUM SYSTEMS

Expertise in the design, construction and operation of one of the largest and most complex vacuum systems in the world

## CRYOGENICS

CERN's unique knowhow derived from 60 years of designing, installing and operating the world's largest cryogenics installation

## MANUFACTURING AND MECHANICAL PROCESSES

CERN develops manufacturing solutions for machines operating at the limits of precision, size, speed and power

## MATERIAL SCIENCE

Novel fabrication methods and analysis procedures for materials operating at the extremes of precision and endurance

## METROLOGY

Unique know-how derived from the precise construction and operation of some of the world's largest and most complex machines

## OPTOELECTRONICS & MICROELECTRONICS

CERN's unique know-how derived from years of designing, testing and installing microelectronics exposed to harsh environments.

## PARTICLE TRACKING & CALORIMETRY

CERN's unique know-how derived from years of designing, testing, building and operating complex detector systems.

## RADIATION PROTECTION & MONITORING

CERN's unique knowhow derived from years of designing, installing and operating systems to monitor level of radiations.

## RADIO FREQUENCY TECHNOLOGY

Expertise in the design, construction, maintenance and upgrade of one of the most complex operational RF systems in the world

## ROBOTICS

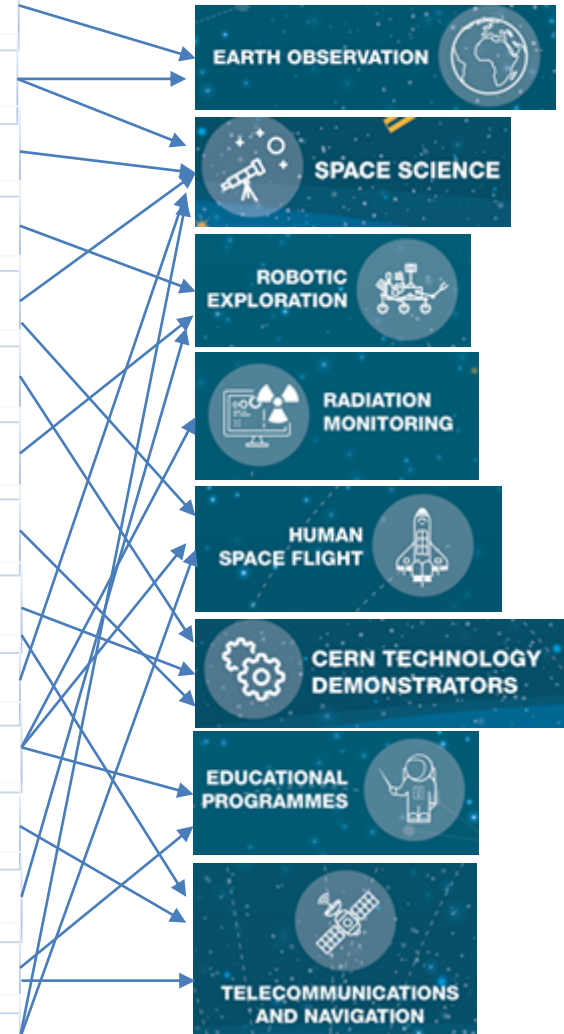
CERN's unique knowhow in designing, building, operating robotics systems for interventions in harsh environments

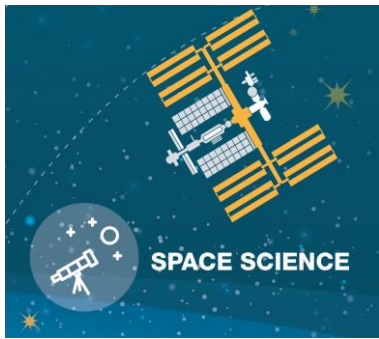
## SENSORS

CERN's unique knowhow derived from years of developing, using, characterizing a large amount of sensors.

## SUPERCONDUCTING MAGNETS

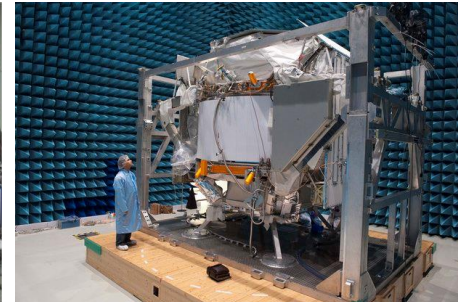
CERN's knowhow and facilities for end-to-end design, assembly, testing and operation of superconductive magnet systems





# CERN Supported Scientific Experiments in Space - Examples

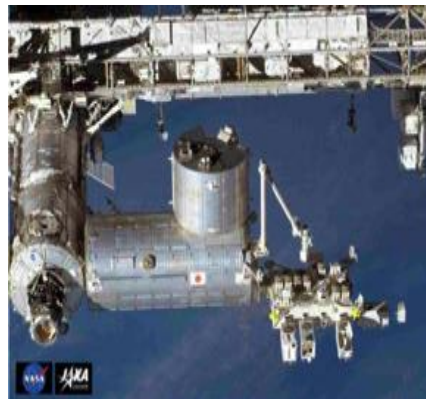
Astroparticle Physics – Astrophysics - Cosmology



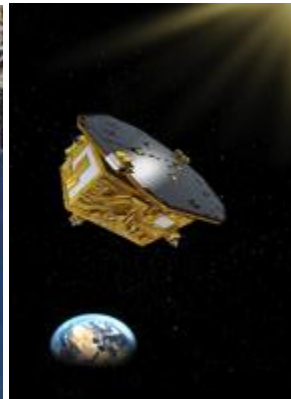
**AMS-02**



**Nucleon**



**CALET**



**LISA Pathfinder**



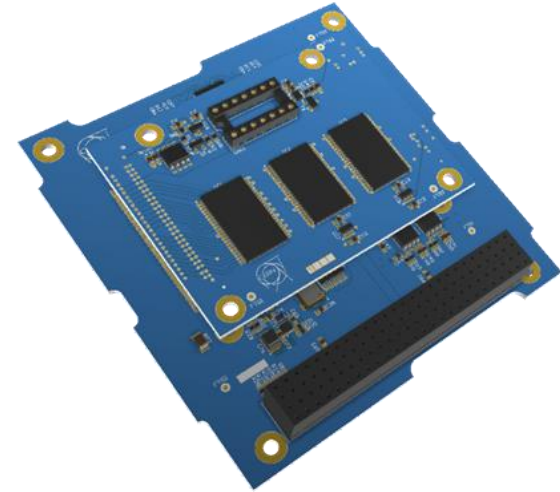
**DAMPE**



**EUCLID**



# CELESTA – First CERN nanosatellite SpaceRadMon and CHARM demonstrator



## SpaceRadMon

CubeSat mini-payload for  
radiation monitoring

**CELESTA** – CERN Iatch-up and radmon experiment student satellite  
Collaboration with the University of Montpellier and ESA

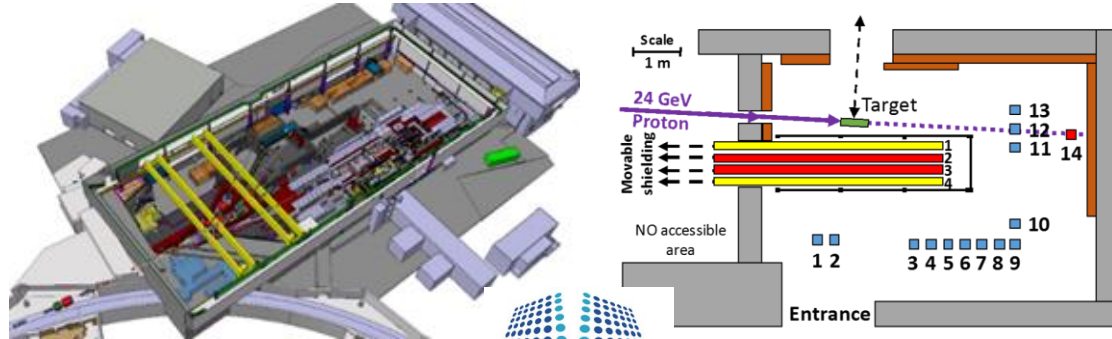


# Unique Irradiation Facilities



## VESPER

Very energetic Electron facility for Space Planetary Exploration missions in harsh Radiative environments



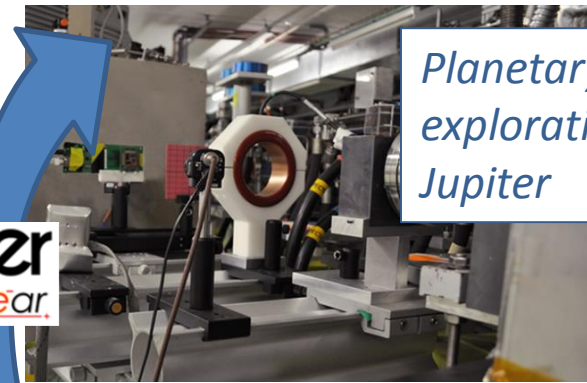
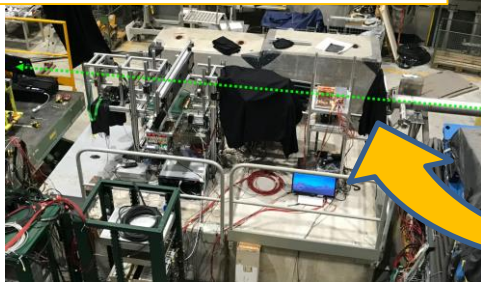
## CHARM

CERN High energy Accelerator Mixed field/facility

# Testing Facilities: full spectrum irradiation tests in 2018



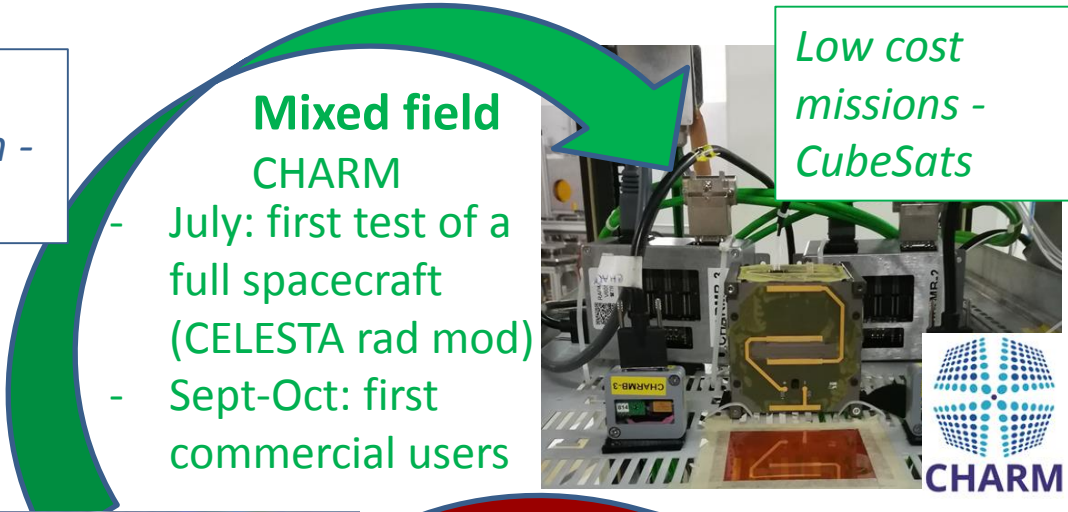
*Space Science –  
Chinese Space Station*



*Planetary  
exploration -  
Jupiter*

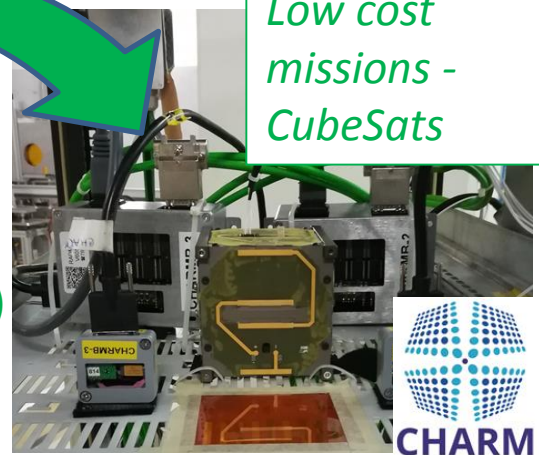
**Very high energy  
electrons**  
VESPER  
- March:  
JUICE tests

**Ultra high-energy protons**  
SPS North Area H2  
- Nov: HERD tests



**Mixed field  
CHARM**

- July: first test of a full spacecraft (CELESTA rad mod)
- Sept-Oct: first commercial users



*Low cost  
missions -  
CubeSats*

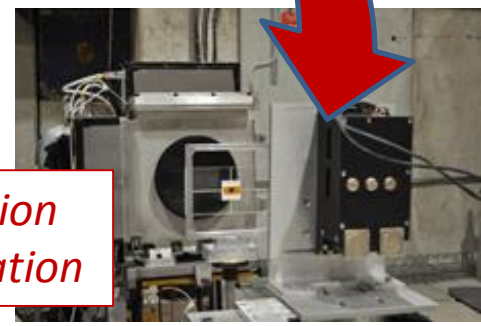


**Ultra high-energy  
heavy ions**

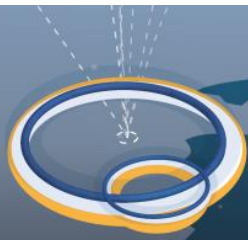
- SPS North Area H8  
- Nov-Dec:  
ESA/Intel  
tests



*Earth Observation  
Telecommunication*



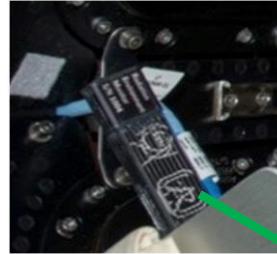
TECHNOLOGIES



# Examples of CERN Technologies for Space



## Hybrid Pixel Detectors

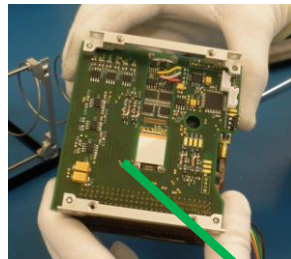
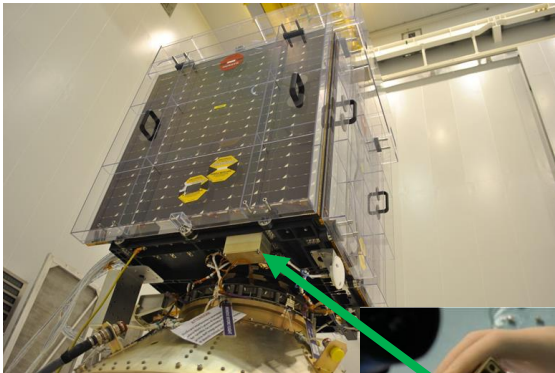


REM on ISS



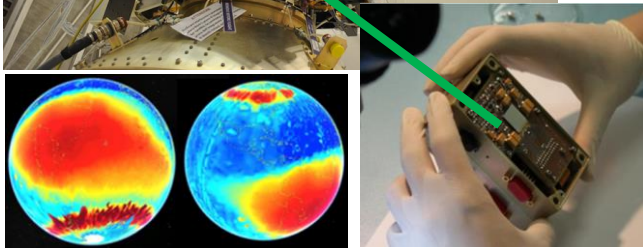
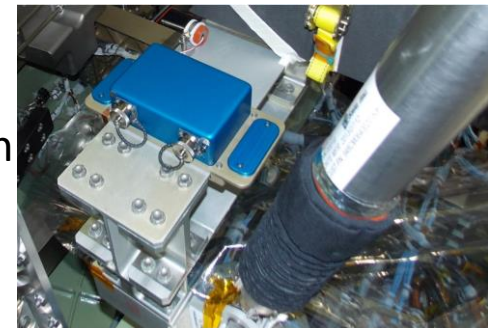
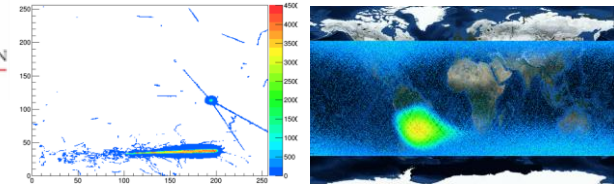
UNIVERSITY OF HOUSTON  
Learning. Leading.

## SATRAM on Proba-V



X-ray telescope  
VZLUSAT-1  
QB50

BIRD  
on  
Orion

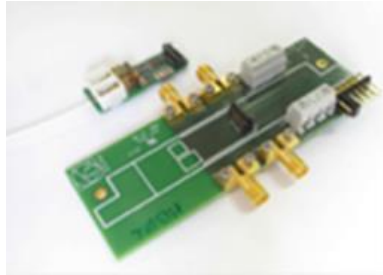
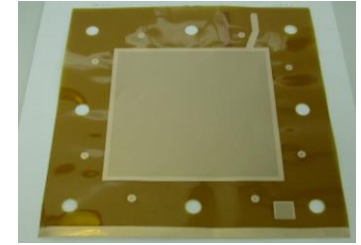
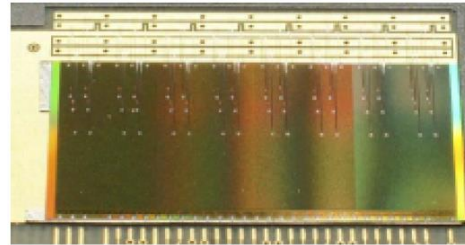






# Examples of CERN Technologies for Space

**Detector technologies based on Monolithic Active Pixel Sensors (MAPS) or Gas Electron Multipliers (GEMs)**



**Rad-hard electronic devices for power distribution and high speed links**

**Composite cryostats and structures**

**Micro-engineering and advanced materials for thermal management**



**HTS magnets for astroparticle spectrometry and radiation shielding**



**Software for big-data management and analysis**



# Institutional Cooperation



Thank you very much for your attention

We look forward to collaborating with  
you in the future!

[enrico.chesta@cern.ch](mailto:enrico.chesta@cern.ch)