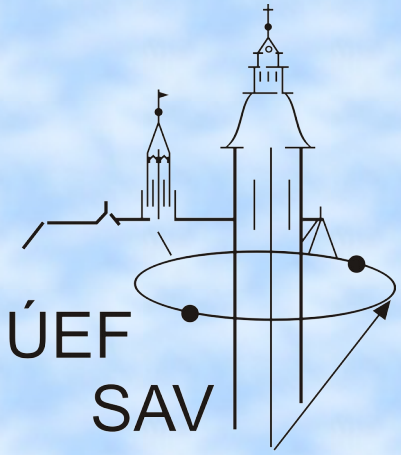
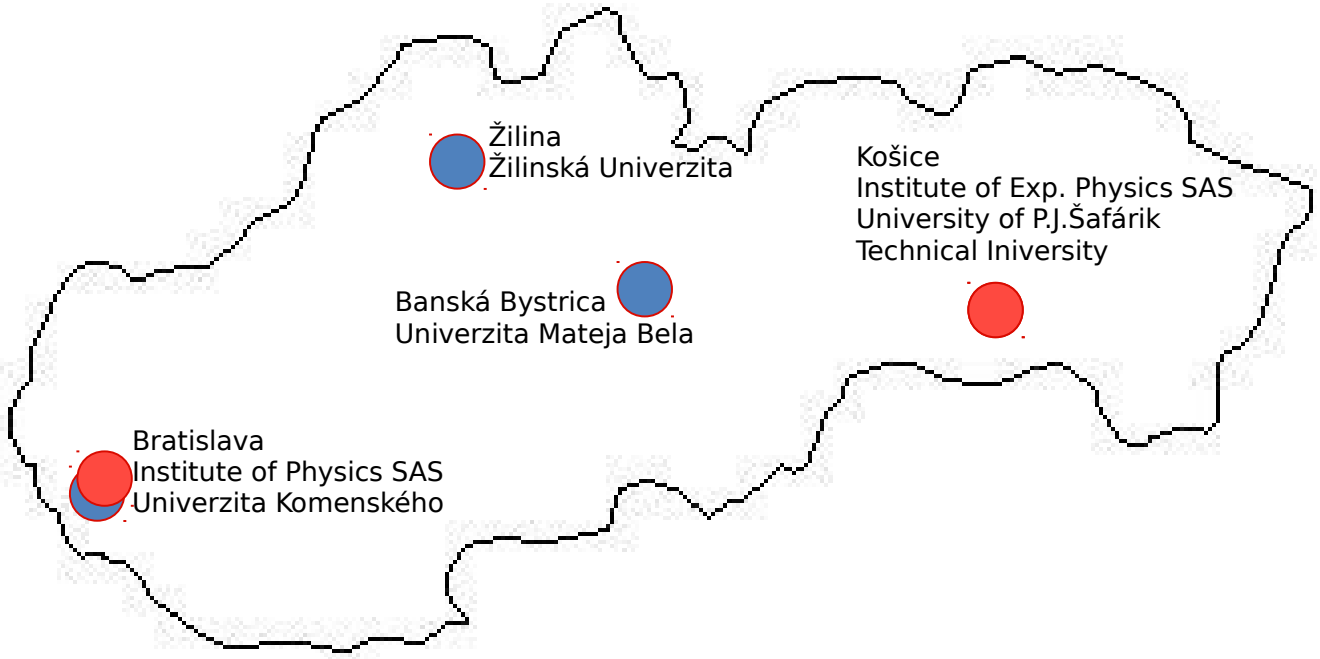


CERN, Slovakia and Industry 4.0

Ivan Králik
IEP SAS Košice, Slovakia

Industry4.0@HEPTech 2018

Slovak Republic will soon celebrate its 25 years of its active presence at CERN



Slovak institutions currently active in particle physics

Organization of Slovak membership at CERN

- **Responsible bodies:**
  - Science and Funding agency:

    Ministry of education, science, research and sport
  - Political: **Ministry of foreign affairs**

- **Advisory and initiative body:**
  - **Committee for co-operation of Slovakia with CERN**

Slovak activities at CERN

Experiments:

Past:		Present:		
SPS	LEP	LHC	SPS	
NA34/3 Helios 3	DELPHI	ALICE	NA62	ISOLDE
WA94		ATLAS		
WA97				
NA57				
NA49				

Theory

- Activities are regulated according long-term concept of Slovak involvement at CERN

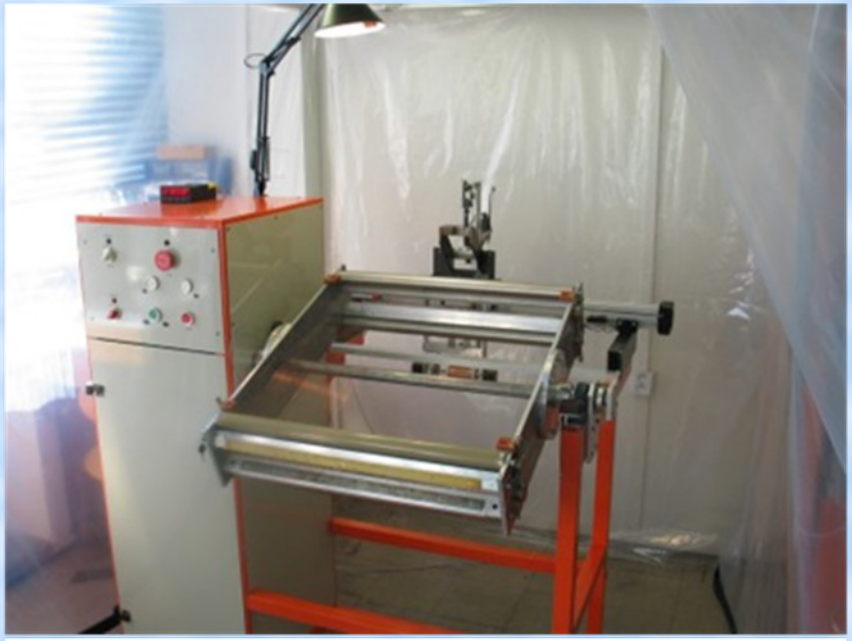
Experimental program at Large Hadron Collider

- Slovakia contributed to construction and actively participate in two large experiments at the CERN LHC accelerator
  - **ALICE**
  - **ATLAS**
- Great challenge for both academic institutions, as well as our industry

Precise machining and assembly of the readout chamber for the ALICE TPC detector

Faculty of Mathematics, Physics and Informatics
Comenius University
Bratislava

Development, assembly and testing of the Internal Readout Chambers of the ALICE TPC detector

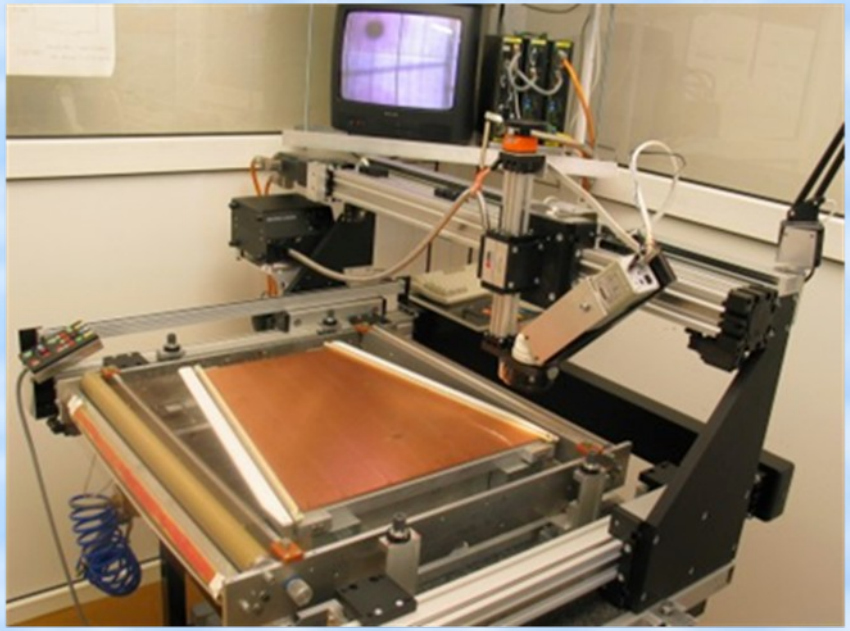


Winding machine

Every readout chamber contains 800 metallic wires placed with 0.02 mm precision.

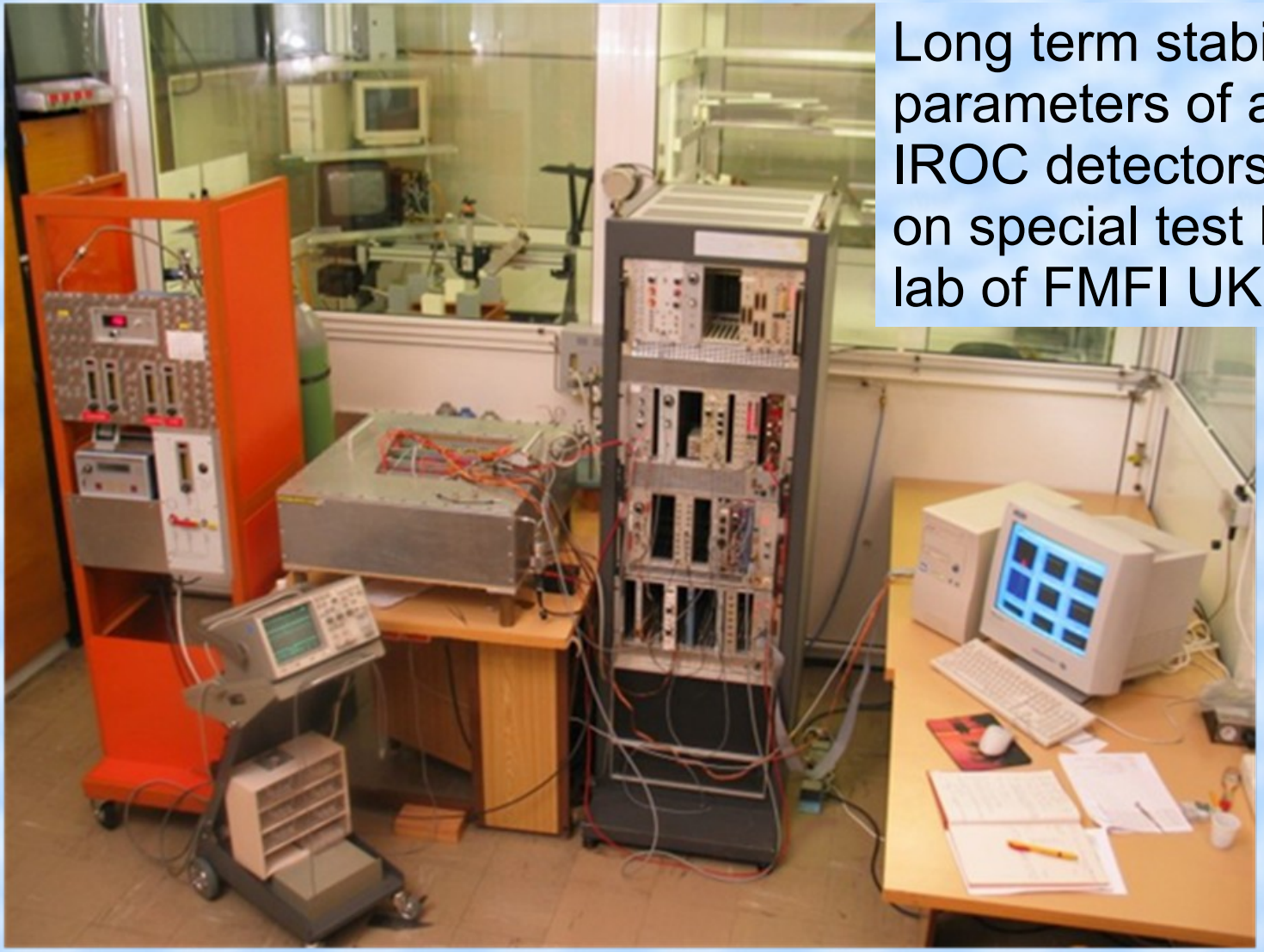
FMFI UK designed a winding machine ...

... and a stand for the assembly and testing of IROC detectors



Production of IROC in a high precision Assembly system

Development, assembly and testing of the Internal Readout Chambers of the ALICE TPC detector



Long term stability of the operation parameters of all 26 produced IROC detectors was tested on special test bench in detector lab of FMFI UK ....

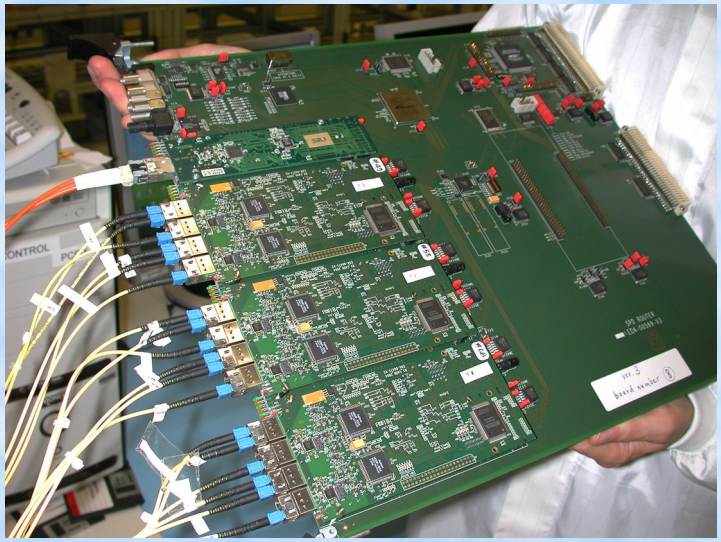
Test bench in Bratislava Detector Lab. for TPC IROC tests.

Development, assembly and testing of the Internal Readout Chambers of the ALICE TPC detector

... and finally installed into the TPC detector of the ALICE experiment at the CERN LHC

Development of electronics for the ALICE experiment

Institute of Experimental Physics
Slovak Academy of Sciences
Košice

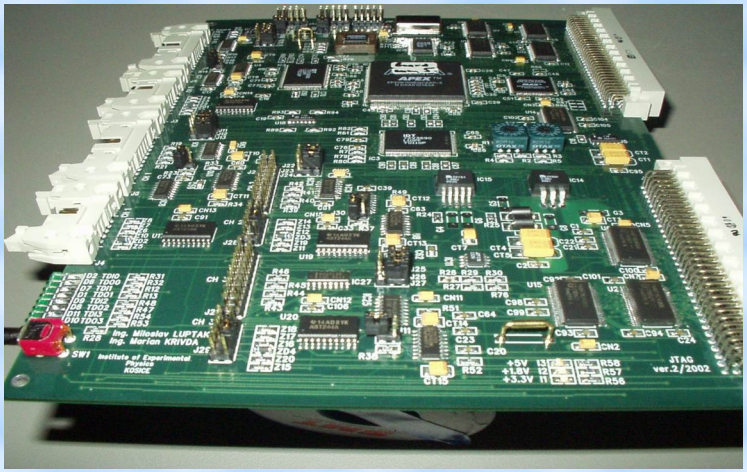


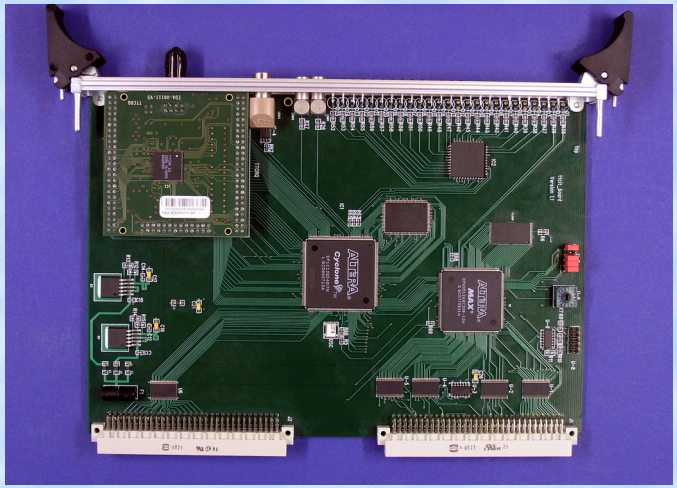
Router for Silicon Pixel Detector (ALICE)

20 9U VME boards provides communication between the SPD (~10 million channels) and the central trigger, DAQ and DCS. Logic was implemented in the **field programmable gate arrays**.

JTAG controller for SPD (ALICE)

An electronic module used for configuration and monitoring of each pixel chip in the Silicon Pixel Detector of ALICE. Logic implemented in FPGA. 24 modules built.





TTCit module (ALICE)

The main purpose of this module is monitoring and debugging of the trigger signal traffic between the central trigger processor and individual detectors.

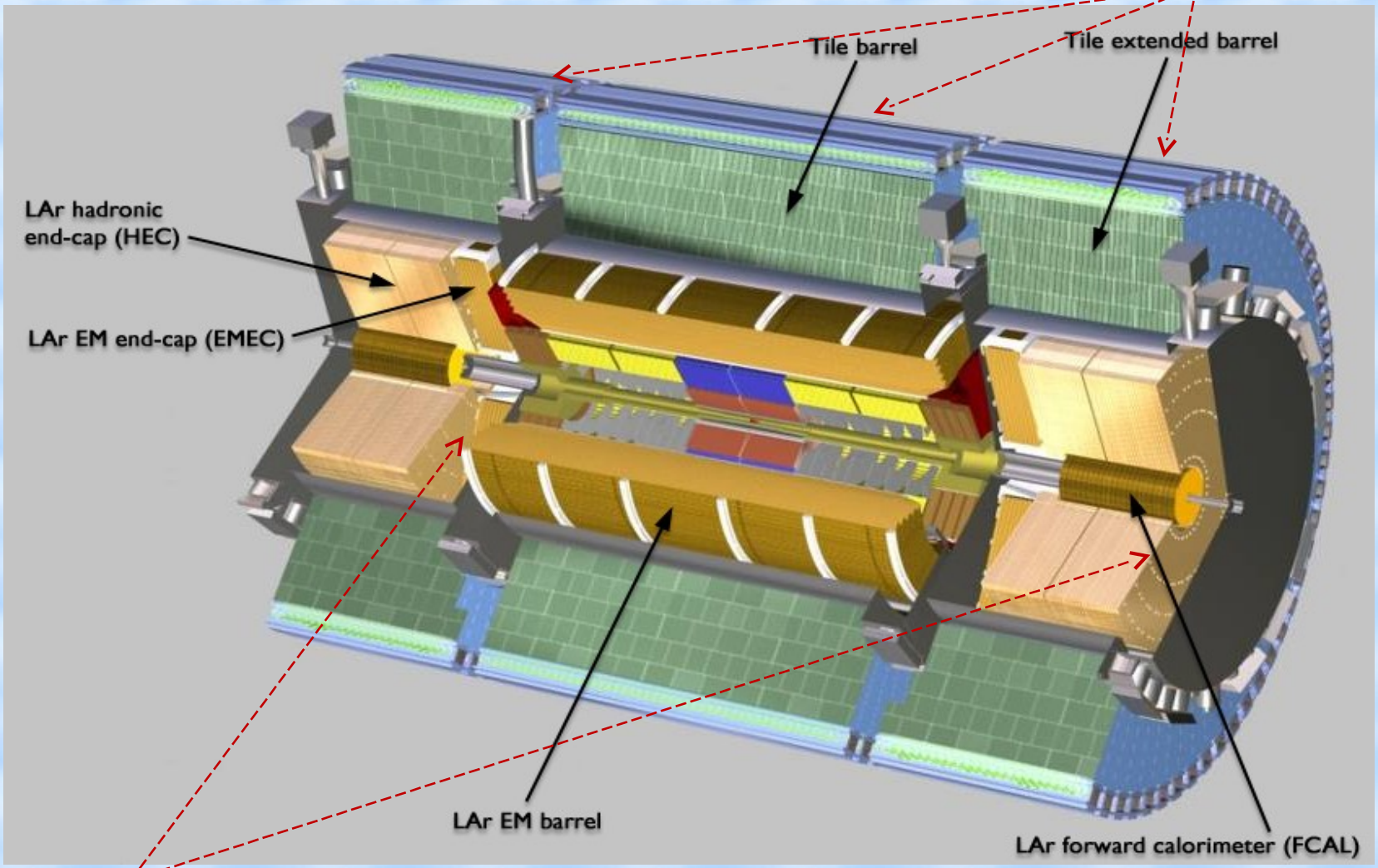
Calorimetry for the ATLAS experiment

Faculty of Mathematics, Physics and Informatics
Comenius University
Bratislava

Institute of Experimental Physics
Slovak Academy of Sciences
Košice

Contribution to the ATLAS calorimetry

Comenius Univ. Bratislava



IEP SAS Košice

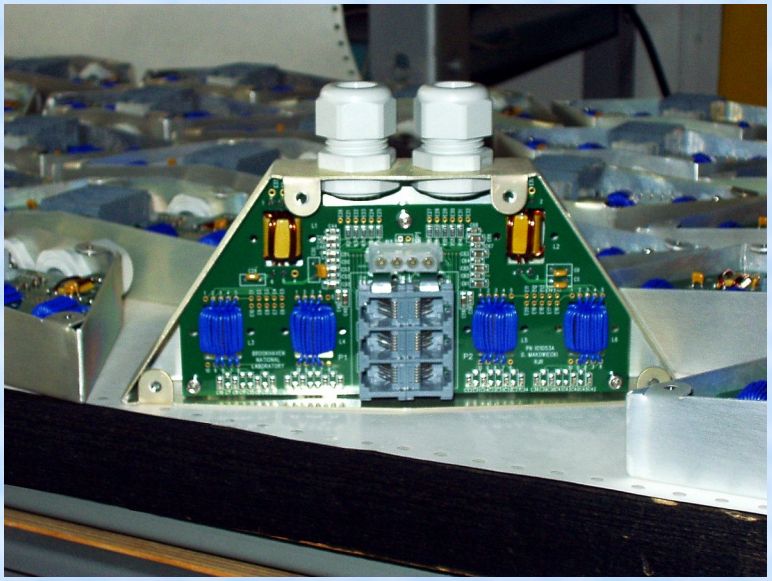
Contribution to the ATLAS calorimetry

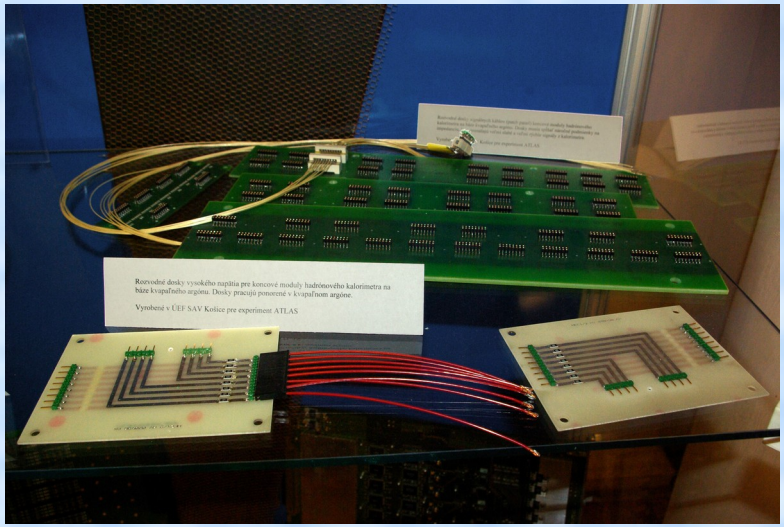
- ***Tile calorimeter (FMFI UK Bratislava)***
  - Preparation/Construction: test of photomultipliers
  - Extensive test beam measurements
  - Commissioning: low voltage power supply installation

- ***Hadronic end cap calorimeter (IEP SAS Košice)***
  - Development of on-line calibration procedures
  - and ...

Filter boxes (ATLAS)

An integral part of the system used for monitoring of various parameters of liquid argon in the ATLAS calorimeter cryostat. Their purpose is reduction of noise in monitoring circuits. 70 filter boxes built.





HV, calibration and signal distribution boards (ATLAS)

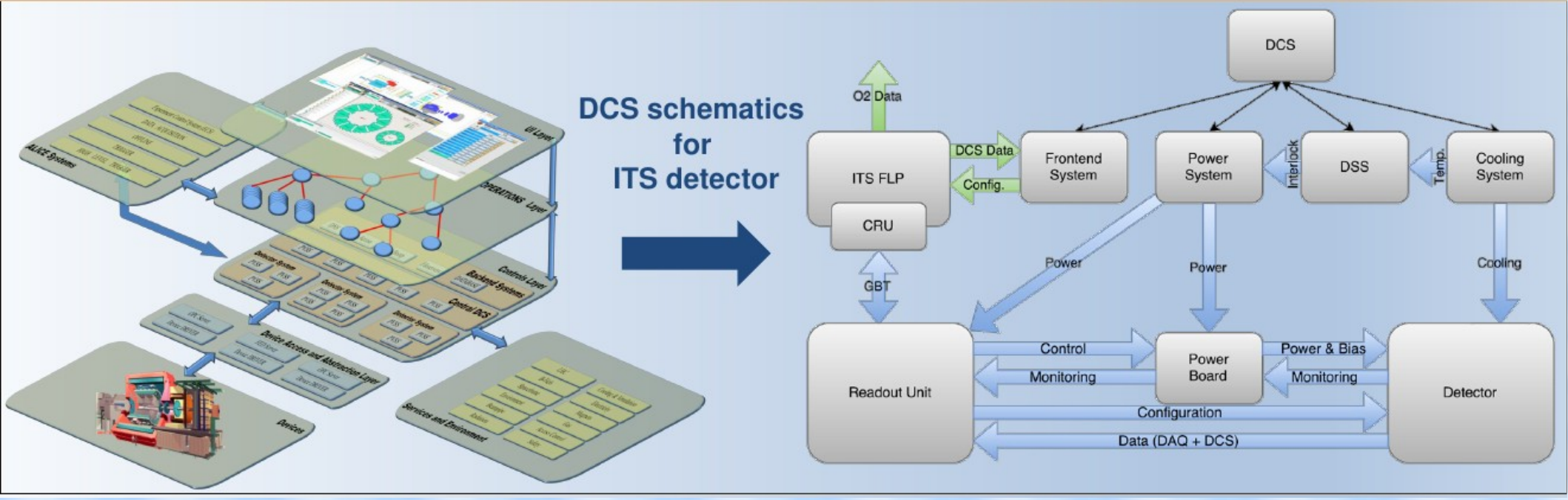
5 types of distribution boards for the end-cap hadron calorimeter. All boards were designed for operation at the temperature of liquid argon which put stringent technological constraints. 488 boards built.

Magnetic shielding (ATLAS)

Parts of the electric isolation and magnetic shielding of the low voltage power supplies for the calorimeters. 153 isolation holders and 253 magnetic shields (4.5 tonnes) were provided.

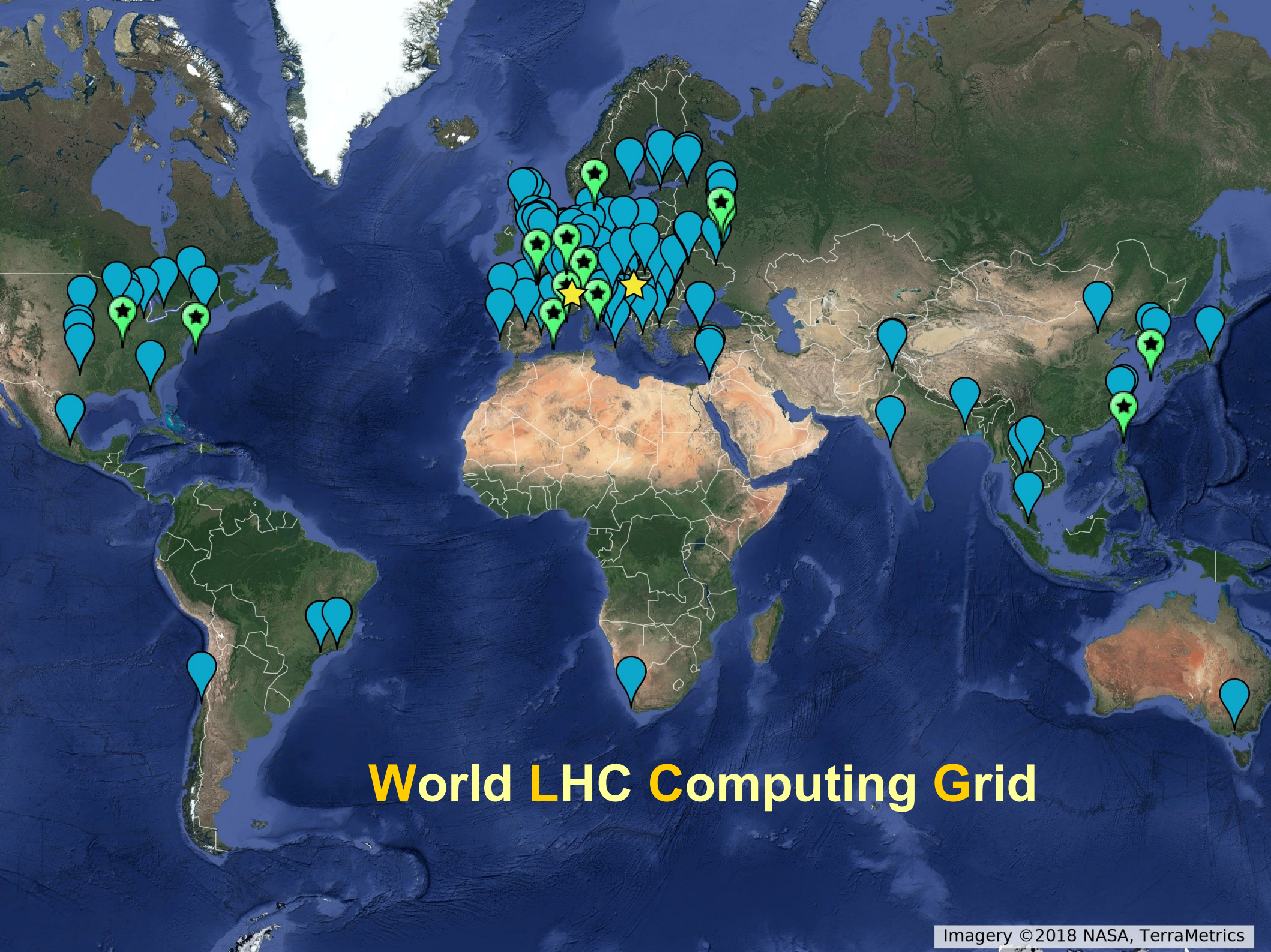
Distributed control systems for the ALICE experiment

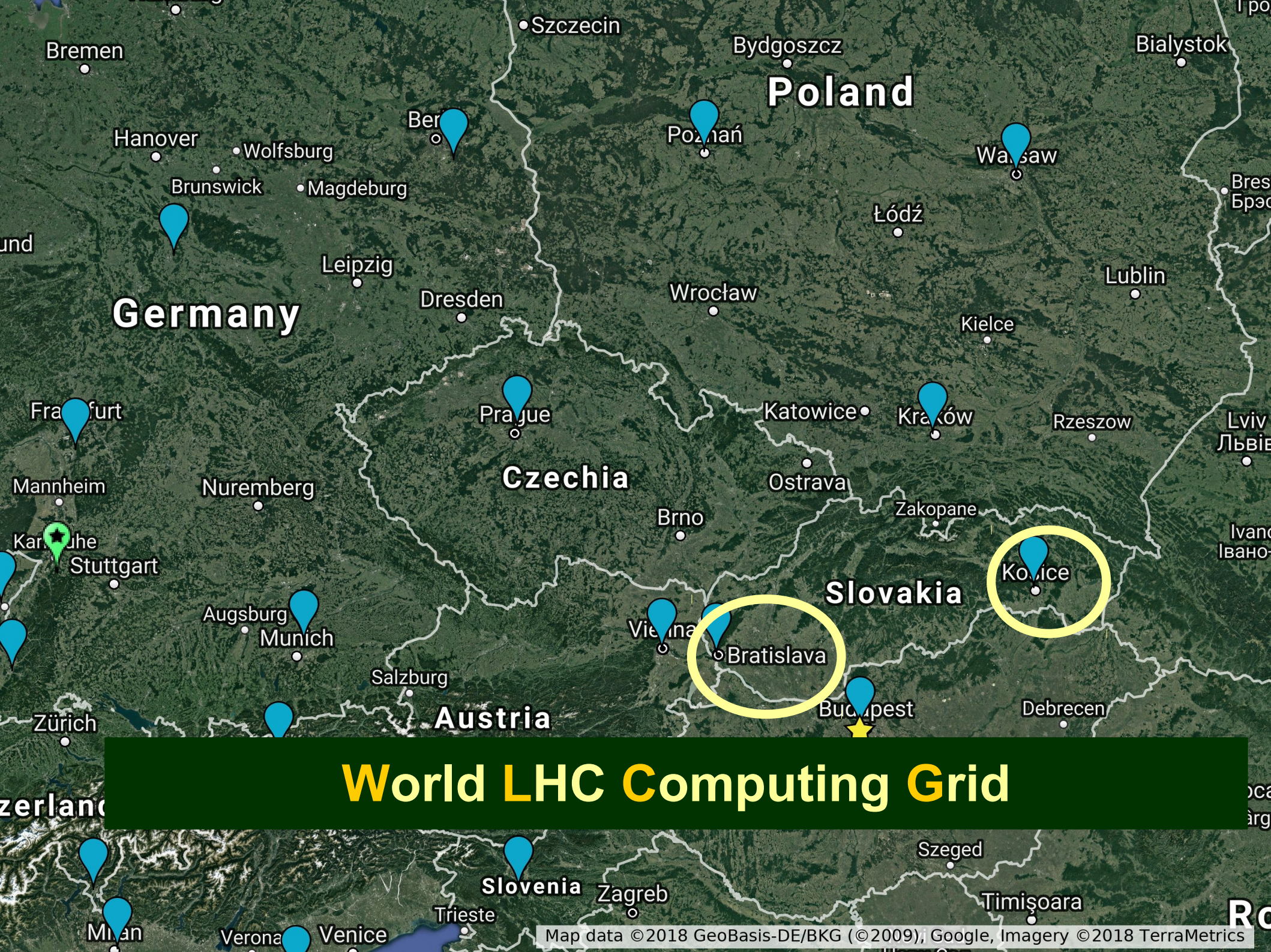
Faculty of Electrical Engineering
Technical University
Košice



Development of the Detector Control System for the ALICE Inner Tracking System

Distributed control system to be implemented during the forthcoming upgrade of the ALICE experiment.


World LHC Computing Grid
Imagery ©2018 NASA, TerraMetrics


Bremen
Szczecin
Bydgoszcz
Białystok
Poland
Hanover
Wolfsburg
Brunswick
Magdeburg
Poznań
Warsaw
Łódź
Leipzig
Dresden
Germany
Wrocław
Lublin
Kielce
Frankfurt
Prague
Katowice
Kraków
Rzeszow
Lviv
Львів
Mannheim
Nuremberg
Czechia
Ostrava
Zakopane
Brno
Karlsruhe
Stuttgart
Košice
Slovakia
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Szeged
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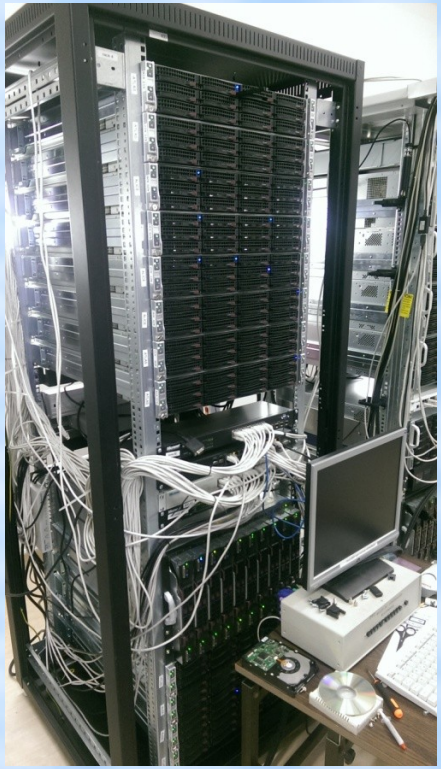
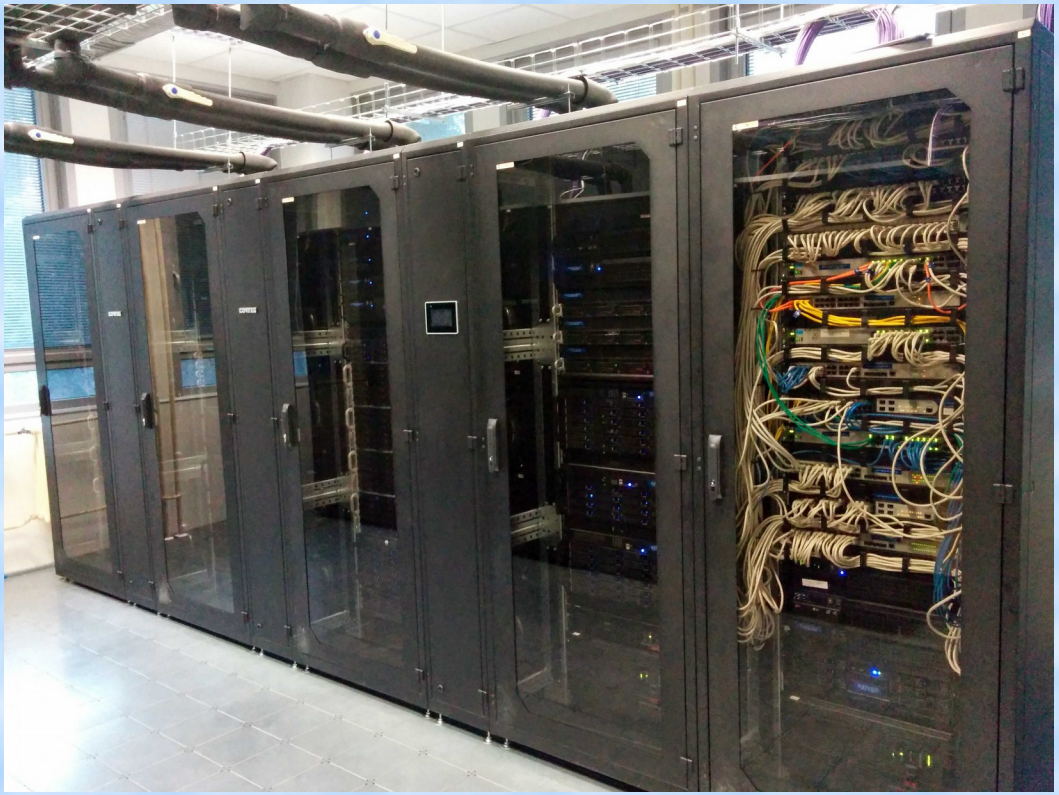
Trieste
Venice
Verona
Map data ©2018 GeoBasis-DE/BKG (©2009), Google, Imagery ©2018 TerraMetrics

Infrastructure	Site Name	Physical CPU	Logical CPU	HEPSPEC06	Disk (GB)	Tape (GB)
EGI	FMPhI-UNIBA	168	672	7,065	1,246,030	0
EGI	IEPSAS-Kosice	102	812	12,940	1,663,935	0
Total		**270**	**1,484**	**20,005**	**2,909,965**	**0**

FMFI UK Bratislava



IEP SAS Košice



Success of Slovak industry at CERN

ILO

Industrial Liaison Officer

Representative of CERN member state
for transfer of the technical informations,
and seeking suppliers for CERN, mainly in his country

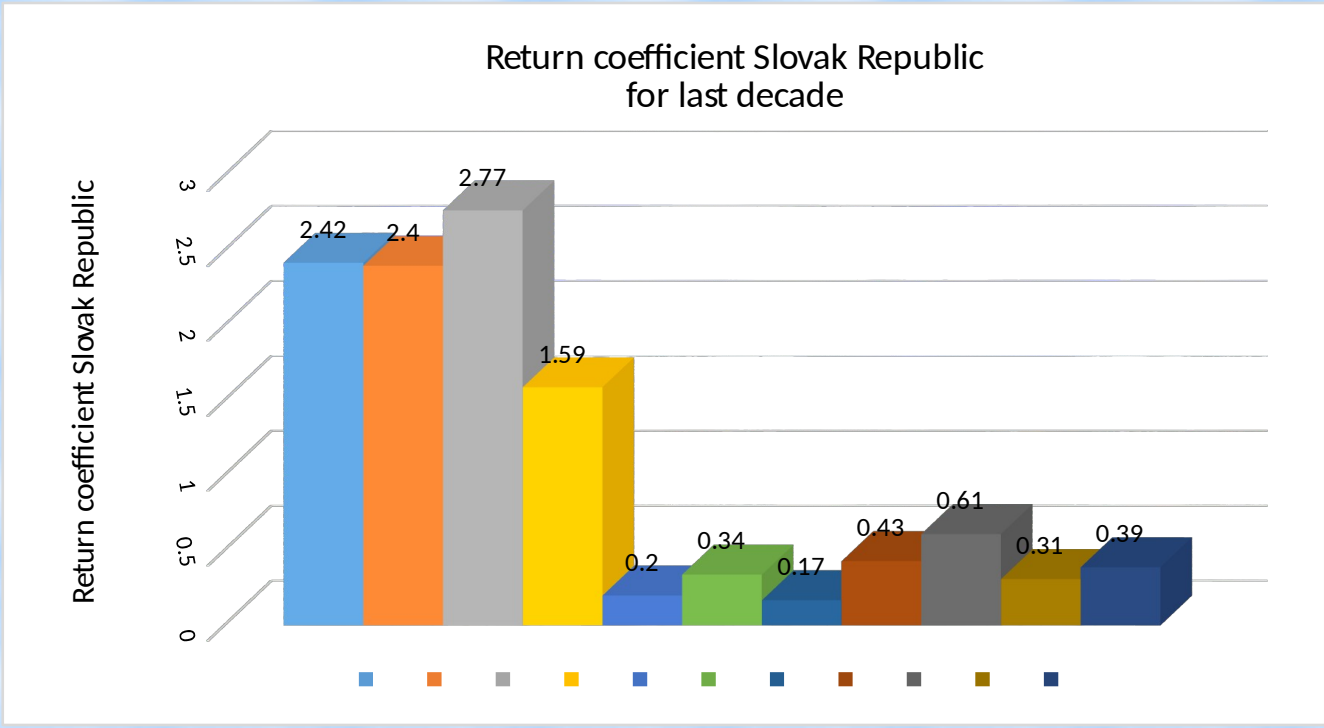
ILO is integrated into the CERN
Finance and Procurement Department /FP/

Dipl. Ing. Štefan MOLOKÁČ, PhD.
ILO + TTLO CERN
Slovak republic

Institute of Experimental Physics SAS
Watsonava 47, SK - 04001 Košice 1
Tel. / fax: 055 7295948
e-mail: stefan.molokac@cern.ch
molokac@saske.sk

Return coefficient

- Return coefficient is a ratio between values of supplies procured from a given country and the membership contribution in particular year
- In the last decade the average return coefficient of Slovakia was 1.12



2001 - Supplies from Slovak Republic to CERN

11 Slovak companies participated in 73 tenders

Tender IT 2794

- Drilling of horizontal and vertical holes in concrete and rock,
- **VÚEZ Levice was ranked 2. best Offer**
- Value of supplies 1 399 000,- CHF
- /consisted from smaller amounts/
- ***Return coefficient reached 1.71***

2002 - Supplies from Slovak Republic to CERN

11 Slovak companies participated in 58 tenders

Winners

Tender IT 4645

- Supply and assembly of the LHC short straight section cryostat
- **SES Tlmače: *value 8 862 400,- CHF***

Tender IT 2952

- LHC Precision transfer alignement set for LHC cryo-magnet instalation
- **VVÚ ZŤS Košice: *value 2 330 000,- CHF***

The Winners of the Great Tenders from Slovakia for period 2000 - 2015

IT-2952/EST/LHC - PRECISION TRANSFER EQUIPMENT SETS

Winner : VVÚ ZŤS Košice, Slovakia

IT – 3200 /TS / LHC -Motor units /134 stepping motors and drivers/

Winner : VVU ZŤS Košice, Slovakia

CERN/FC/4865 Supply Burndy conectors

Winner : Elektrické systémy Trnava, Slovakia

IT - 4645 Supply and essembly of the LHC short straight section cryostat

Winner: SES Tlmače, Slovakia

IT-3713 Supporting system of the RF-structures

Winner : VVÚ ZŤS Košice, Slovakia

DO-26 295 Hydraulic tractors

Winner : VVÚ ZŤS Košice, Slovakia

DO-26 035 High resolution linear actuators

Winner : VVÚ ZŤS Košice, Slovakia

Golden Hadron award, 07.12.2005
VVÚ ZŤS Košice, SLOVAKIA

During last decade CERN procured

from Slovak Republic

supplies for 24 524 000 CHF

Slovak Republic was ranked among the Members with the highest return coefficient in CERN

Benefits of Slovak membership at CERN

- Slovak membership at CERN brings to our physicists a possibility to work on the highest level scientific research
- It is pushing up not only scientific, but also technological level in Slovakia
- It is a great opportunity for Slovak industry to participate on the supply contracts to CERN. SR reached a high return coefficient
- The technology transfer form CERN to Slovakia can be attractive, but is not fully used yet
- Possibility of using WLCG gives to our institutes practically unlimited CERN oriented computational power
- Within 25 years Slovak physicists gained at CERN large experience and also contributed to outstanding scientific results