



**ATLAS SAFETY UPGRADE PROGRAM
WITHIN ATLAB FRAMEWORK**

O. Beltramello - 18.02.2013

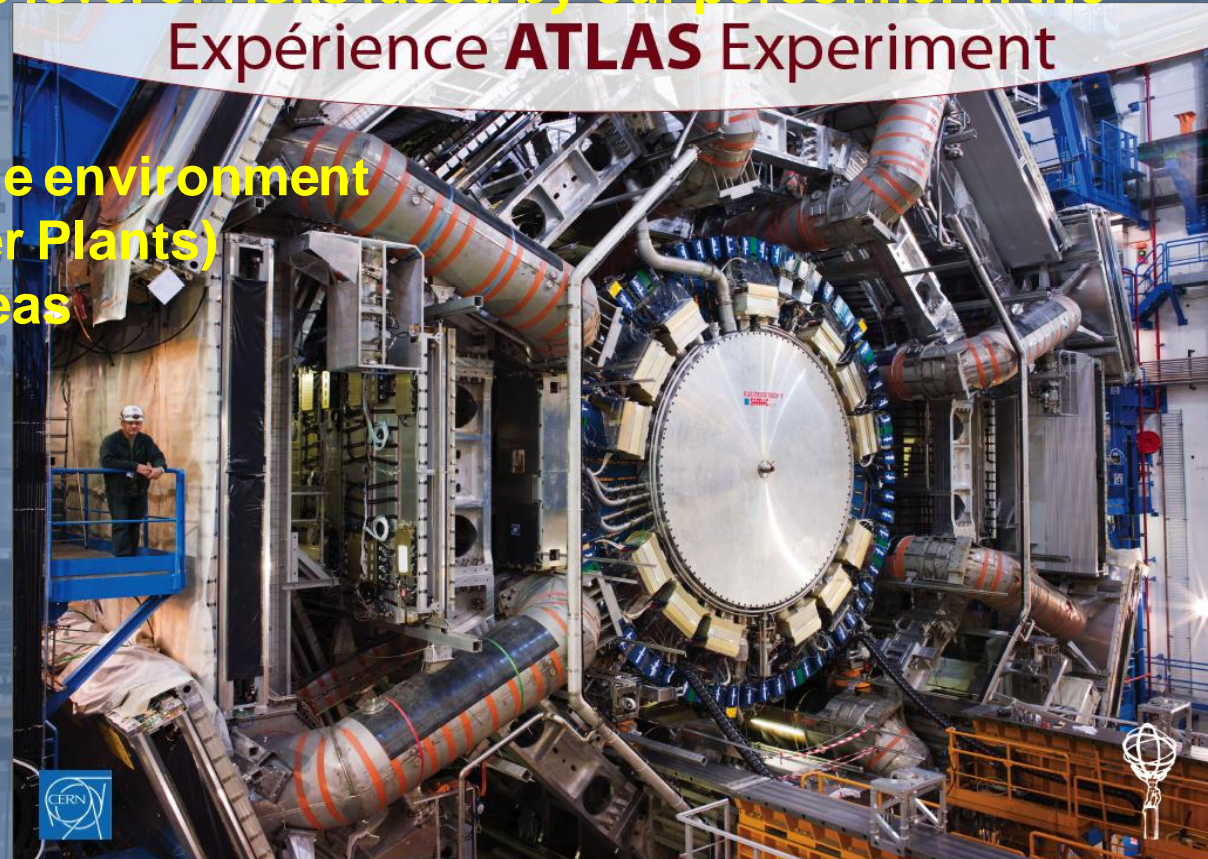
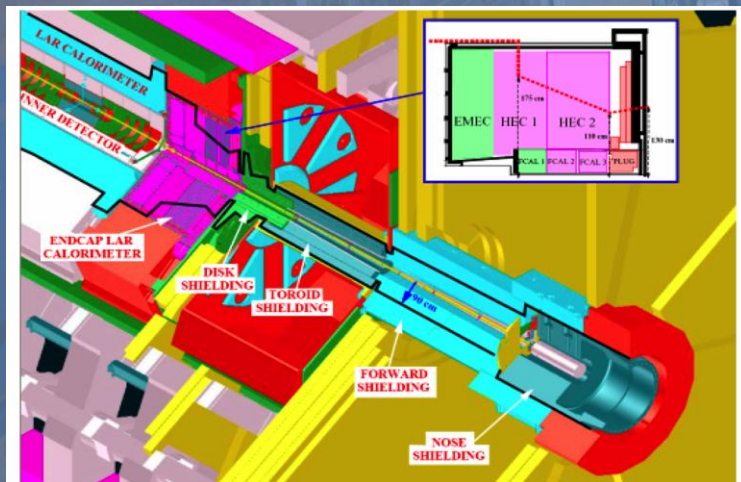
Why a Safety Upgrade Program ?

As a result of the intensive ATLAS Detector Upgrade Program and the increase of the performance of the LHC (luminosity) in the coming years:

→ the radiations levels and generally the level of risks faced by our personnel in the coming years will increase by a lot.

Our personnel will be exposed to extreme environment

- ✓ radiations (at least as in Nuclear Power Plants)
- ✓ in confined and difficult accessible areas



The ATLAS safety upgrade program is aiming to assist them and eventually to replace them to perform these tasks.

It is developed in several stages following the ATLAS Upgrade Program

Content and framework of the Safety Upgrade Program ?

1. Development of the **ATWPSS system**, ATLAS Wireless Personal Safety and Supervision system:
the goal is to improve safety of personnel intervening in high radiation areas for planned interventions or in case emergency

✓ We are supervising them, their environment and their activities :

- * **audio / video connection**
- * **monitoring of environment parameters: dose rates, gases concentration, T, H**
- * **monitoring of their health data (heart rate, internal T, stress levels, detection of fall, etc..)**

✓ We are providing the worker information

- * **various infrastructure of display systems: IPAds, Head Mounted Display, ..**
- * **from various nature: working procedures, environmental data (especially the dose maps), systems data, etc..**
- * **using virtual and augmented reality technologies**

This system should increase the safety levels of the personnel, reduce the errors, decrease the time needed during the interventions and reduce the stress linked to these interventions

Content and framework of the Safety Upgrade Program ?

The ATWPSS system is developed in several stages :

- ✓ a pre prototype has been already designed and manufactured (virtual reality)
- ✓ augmented reality technologies should be developed much beyond the current state of the heart, and integrated in the system as well as other cutting edge technologies:

this done currently in particular within the FP7 Marie Curie **EDUSAFE Initial Training Network** program.

- ✓ the R&D initiated within EDUSAFE will be developed further to enable **industrialization of a robust and integrated system via other EU funding schemes.**

2. Development of remote handling and robotics technologies towards the ATLAS/CERN needs in order to enable remote work for the maintenance and upgrade activities for which the radiation risk is high and where we do not want to expose our personnel.

The ATWPSS and the especially the Augmented Reality and related technologies will be integrated and adapted to the robotics/ remote handling development program.

Content and framework of the Safety Upgrade Program ?

This safety upgrade program is run by the ATLAS Safety group within the ATLAS collaboration.

We want (and we need) to extend our collaboration to partners external to the ATLAS Collaboration.

This is (and must be) done within the ATLAB framework !
We will complement the funding via various EU programs.

Currently the following institutions/industries are collaborating on the project :

Athens University of Economics and Business, Greece

Canberra, France

CERN / ATLAS

EPFL, Switzerland

Novocaptis, Greece

National Technical University Athens, Greece

Prisma Electronics, Greece

Technical University of Munich, Germany

Universita Degli Studi Di Roma Tor Vergata, Italy

Aristotle University of Thessaloniki, Greece

CAEN University, France

Democritus University of Thrace, Greece



Status of the ATWPSS system development

Several pre-prototypes configurations were developed and tested in the ATLAS experimental cavern during the 2011/2012 shutdown.

A new version of the system has been designed and developed by **ATLAS, PRISMA Electronics and NOVOCAPTIS** in 2012 to cope with the needs of LS1, the two years maintenance/upgrade period of the LHC.

10 systems are currently being commissioned and will be ready next week for the start of LS1 .

1 Head Mounted Display have been purchased from **LUMUS company** and being tested (a collaboration is envisaged with this company to optimize the electronics and develop the associated software).

A collaboration is envisaged with **MIRION** company (dosimetry) to develop the communication between the operational dosimeter and the ATWPSS



Status of the ATWPSS system development

The control system software is under development and test, ready for LS1

European Organization for Nuclear Research

ATLAS Wireless Safety System



Alexandre Santos (PTU-01) | Dr Shivago (PTU-02) | George Clooney (PTU-03) | Tim Berners-Lee (PTU-04) | Cameras | Interventions | Summary | Settings

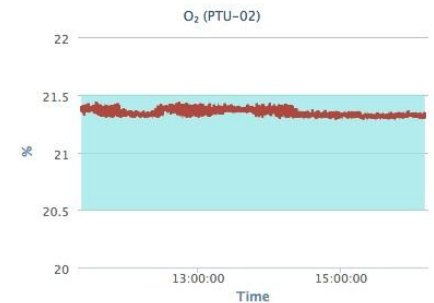
Alarms

Panic Button	Cleared
Dose Rate	ALARM
Fall Detect	Cleared

Status: Online
Call 'Dr Shivago'
Make Impact conference

Measurements

Dose Rate	0.00	µSv/h
Temperature	30.58	°C
Barometric Pressure	3.13	bar
O ₂	21.31	%
CO ₂	9958.48	ppm
Humidity	14.53	%
Dose Accum	11.00	µSv
Body Temperature	11.78	°C
Battery Level	100.00	%



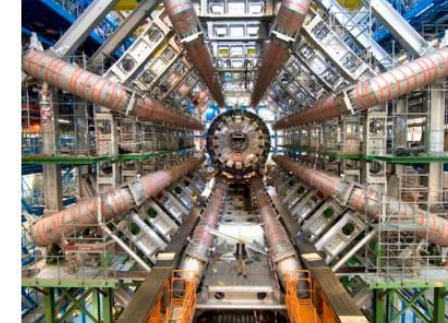
General Info

Audio Status	Ok
DAQ Status	Ok
Dosimeter Status	Unknown
DB Connect Status	Ok
DB Update Status	Ok
Start Time	10 Feb 2013 14:33
Duration	3 d 1 h 36 m

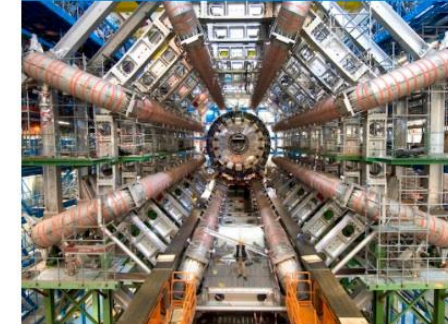
Helmet Camera



Hand-held Camera



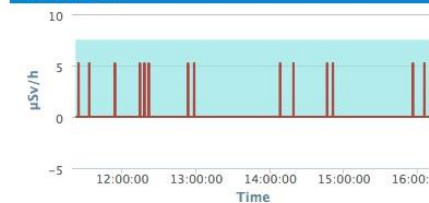
Worker View



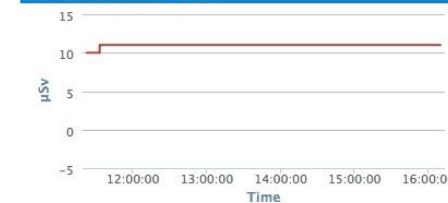
Dosimeter

Dose Rate	0.00	µSv/h
Dose Accum	11.00	µSv

Dose Rate



Accumulated Dose



Supervisor

Copyright© 2011-2013 CERN - ATLAS Wireless Safety System - 0.9.1-SNAPSHOT

These ATWPSS prototypes are the basis of the future upgrades and development (EDUSAFE, etc...)

EDUSAFE, a Marie Curie Initial Training Network

3.2 ME budget

1st Sept. 2012 – August 2016

10 Early Stage Researchers (ESR)

2 Experienced Researchers (ER)

Coordinator: CERN/ATLAS

9 Full Partners (3 industries):

AUEB, Athens University of Economics and Business, Greece

Canberra, France

CERN / ATLAS, Switzerland

EPFL, Ecole Polytechnique Federale de Lausanne, Switzerland

Novocaptis, Greece

NTUA, National Technical University Athens, Greece

Prisma, Greece

TUM, Technical University of Munich, Germany

Universita Degli Studi Di Roma Tor Vergata, Italy

4 Associated Partners:

AUTH, Aristotle University of Thessaloniki, Greece

CAEN University, France

DUTH, Democritus University of Thrace, Greece

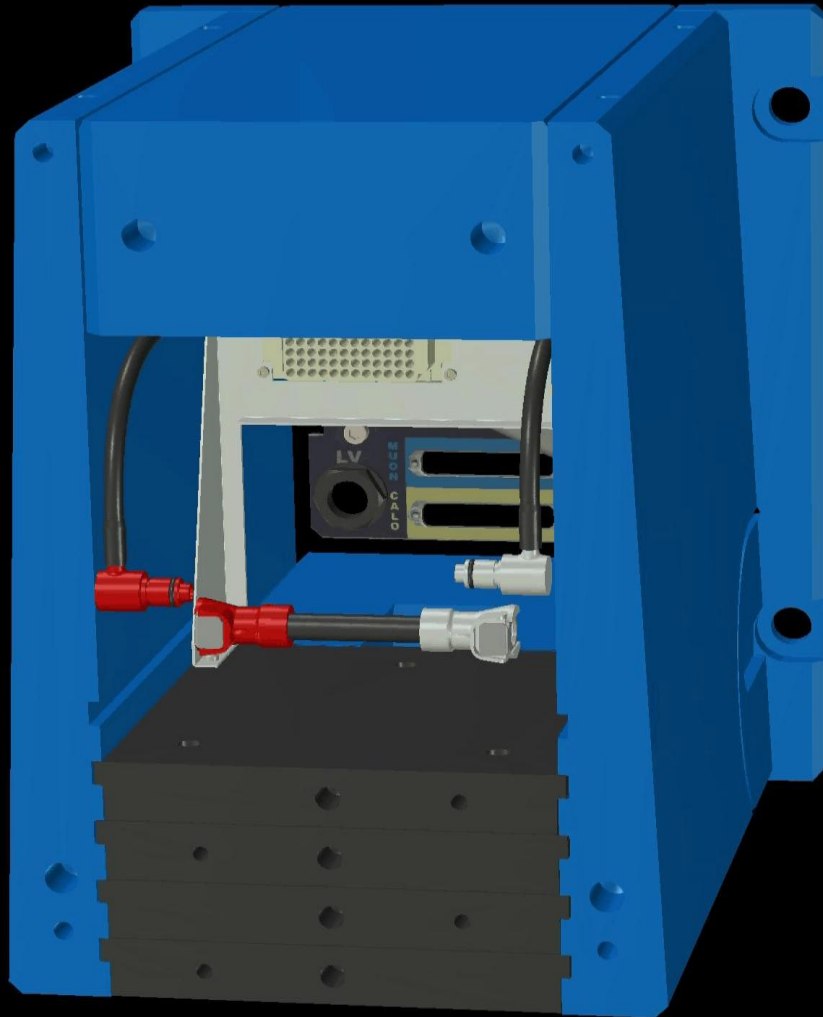
NTUA, National Technical University Athens, Greece



What are the EDUSAFE Research and Training Challenges

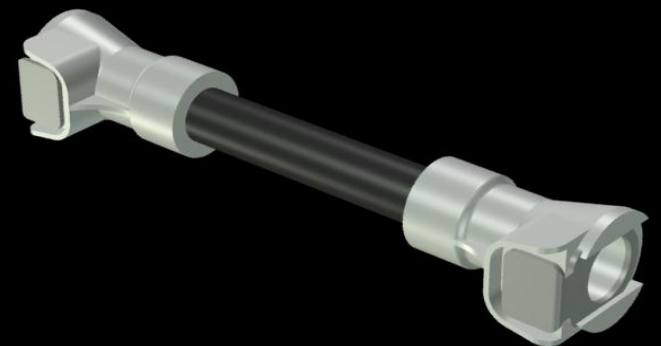
- Real time data transmission **in difficult wireless environments**
- Instantaneous data analysis:
 - **pattern recognition (time lag less than human interaction speed)**
 - **pose determination coming from various sources (video, sensors,..)**
- Real time data visualization methods, **VR and AR system architecture optimization, rendering**
- Integrated control system **development adaptable to various environment**
- **Analysis and development of the most appropriate display infrastructure systems, architecture and command methods to visualize data.**
- **Development beyond the state of the art of a light and fast gamma radiation camera and its associated SW with AR features and integrated the system**
- **Portability, wearability, complex interfaces of the personal portable system optimization**

Tile Calorimeter Drawer Extraction Phase 3 – Bypass cooling hoses



➤ Bypass the fLVPS cooling hoses by connecting them to each end of the bypass cooling hose

Tool: Bypass cooling hose



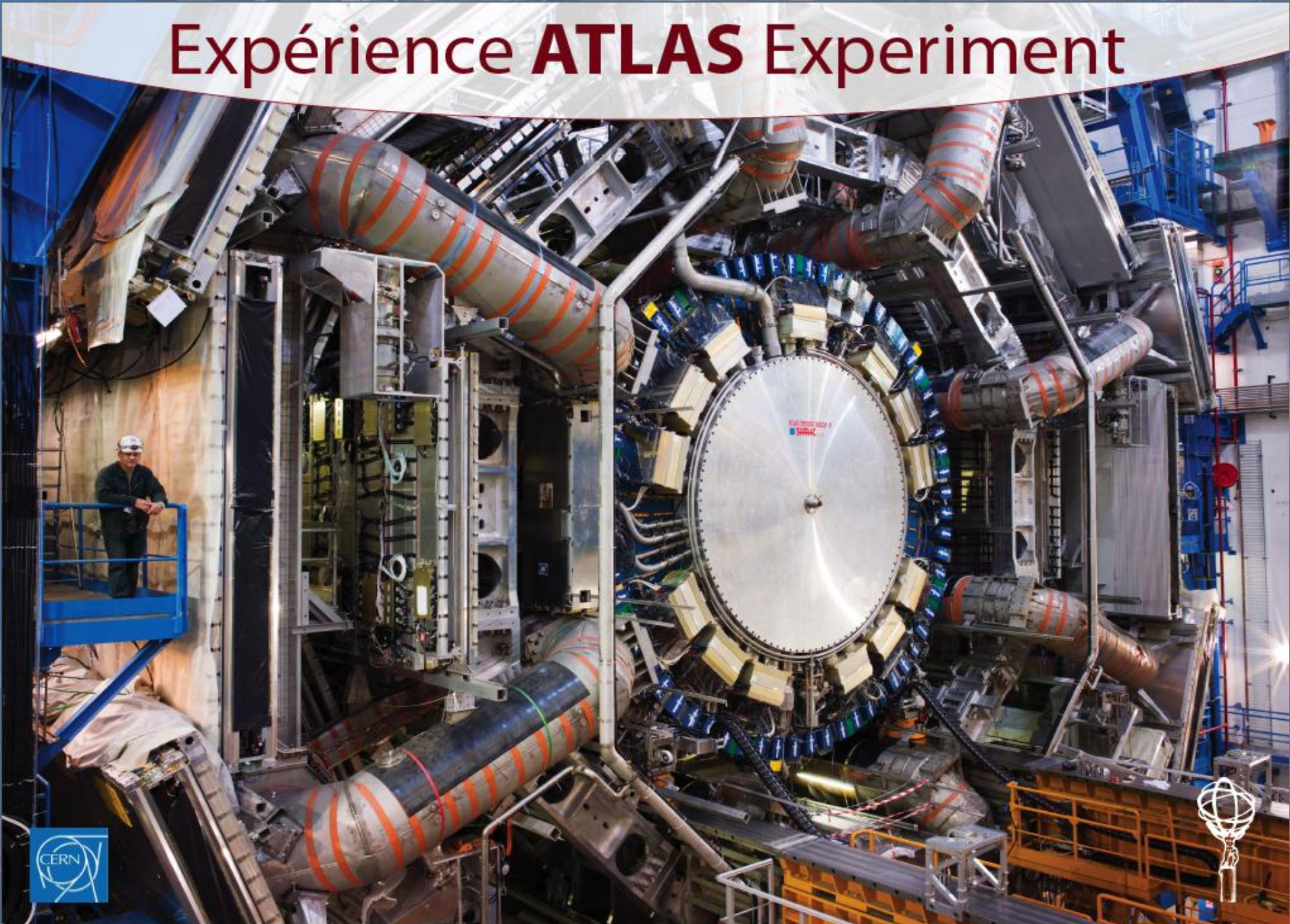
What are the EDUSAFE Research and Training Challenges

The researchers will be trained via an intensive training program combined with very practical technology and systems development:

- The main aspect will be on-the-job training through the work on the individual research project.
In his host institution, each fellow will have the possibility to follow colloquium, scientific courses, and seminar.
All ESR will be offered the possibility to do a doctorate.
- All ESR and ER will be offered an intensive secondment training program (up to 30 % of their time) on specific and appropriate technical topics but also in management, career development, leadership, IPs, economical aspects, soft skills...
This is delivered via knowledge transfer, work place based training, introduction to techniques and methodology, and if required appropriate formal courses.
- Several network training events will be organized:
Joint training Event, Workshops, Summer Schools
- The training program will be complemented by regular testing campaigns in the ATLAS Experimental Areas (2 weeks)

The ATLAS experiment at CERN will be used as a test facility and demonstration platform ...

Expérience **ATLAS** Experiment



EDUSAFE Work Package Research Program and Organization

Work Package 1: Project Management CERN

Network Coordinator, Olga Beltramello

Project Office, Seamus Hegarty, Gregory Cavallo, Marie Trabaud, Karen Ernst, Hanna Poikela

Work Package 2: Augmented and Virtual Reality technology development

Work Package Leader, Giulio Aielli - University Roma 2

ESR1 / ER1 – University Roma 2 – SIC: Giulio Aielli

Electronics engineering, mathematics, IC design and development

ESR1 is recruited:
Ali Abdallah (*Liban*)

WRM ship development : new pattern recognition concept derived from the LHC experimental research

- ❖ **Mathematical and theoretical study of the WRM concept, adaptation of the computer vision advanced methods and algorithm to WRM - ESR1**
- ❖ **Development of an integrated prototype (ship, readout system and electronics), test bench, system integration - ER1**

Work Package 2:

ESR2 / ER2 – Ecole Polytechnique Federale de Lausanne – SIC: Vincent Lepetit

Computer vision, computer science, mathematics

3D Tracking System development

- ❖ Development of a fast image patches recognition method (core of the 3D tracking system), robust to lightening and perspective changes
Algorithm developed and tested first on SW and then adapted to the WRM platform- ESR2
- ❖ Development of a 3D tracking system exploiting the image patches recognition library. Evolution of the 3D tracking system to the WRM accelerated image patches recognition - ER2

**ESR2 is recruited:
Alberto Crivellaro (*Italy*)**

Work Package 2:

ESR3 – Novocaptis – SIC: Stathis Kasderidis

Associate Partner: AUTH, Loukas Petrou

Electrical/Computer Engineering, Computer Science, Communications Engineering, Physics, Mathematics

Mobile Sensing and Data transfer platform

- ❖ **Design of a mobile sensing and audio / video transmission platform and optimization for long, fast and reliable transmission**
- Design and test of a high bandwidth and robust wireless integrated transmission system suitable for real time data transmission**

ESR4 – CERN – SIC: Olga Beltramello

Associate Partner: Roma II

Electrical and Computer Engineering
/ Software Engineering / Electronics.

**ESR4 is recruited:
LakshmiPrahba Sekar Nattamai
(India)**

Authoring and Visualizer software development

- ❖ **Architecture design and development of the authoring and visualizer software for the selected infrastructure display, for Virtual and Augmented Reality, rendering methods optimization, system integration and validation.**

Work Package 3: Safety System modularity and adaptability of the HW and SW of the control system and the wearable personnel safety system.

Work Package Leader, Serafeim Katsikas – Prisma

ESR5 – NTUA– SIC: Evangelos Gazis

Applied Physics, Electrical & Computing Engineering

Control system

- ❖ **Architecture design and development of the control system and Data Acquisition system architecture. Adaptability and scalability to various environments and markets. Gamma radiation maps determination and in situ correlation methods.**

ESR6 – Prisma– SIC: Serafeim Katsikas

Associate Partner: DUTH, Ioannis Andreadis

Electrical/Electronic Engineering & ICT.

Personnel Safety System modularity and integration optimization

- ❖ **Personnel safety system architecture design and optimization for wearability, power consumption, interfaces, adaptability to various environments and markets (software development, micro-electronics design and development)**

Work Package 4: Safety System enhancement research

Work Package Leader, Nabil Mena – Canberra

ESR7 and ESR8 – Canberra – SIC: Nabil Mena

Associate Partner: Caen University Gilles Ban

Software engineering

ESR7 is under recruitment process:

Enzo Paradiso (*Italy*)

Gamma radiation imaging and fast dose calculation code

- ❖ Development of a new generation of gamma radiation imaging system using the LHC most advanced technologies: portability and sensitivity improvement, new and fast reconstruction algorithm development, fast dose rate calculation codes development.

ESR9 – Technical University of Munich, TUM – SIC: Gudrun Klinker

AR- based display and interaction environment

Computer Science or Computer Engineering

ESR9 is under recruitment process: Itoh Yuta (*Japan*)

- ❖ Analysis of the display scenarios requirements, design and implementation of flexible display set-up, protocol of command optimization, with a user-centered methodology.

Work Package 5: Technology assessment and exploitation
Work Package Leader, Theodore Apostolopoulos, AUEB

ESR10 – AUEB – SIC: Theodore Apostolopoulos

Computing, Informatics and Information Systems

Technology assessment and Exploitation

Technology assessment of the whole safety system, map some other extreme environment technical specifications and requirements.

Development of a methodology to take into account these requirements while building the primary prototype so that the future development costs and time – to – market can be reduced.

Investigation of the IP and licensing rules in order to support the detailed exploitation plan to transfer the system to other markets.

Work Package 6: Integration, testing and demonstration at CERN of the Personal Safety System

Work Package Leader, O. Beltramello, CERN

All partners including ESR10

An integrated system will be developed and tested to demonstrate each component functionality, reliability and durability in extreme situations

Status of the EDUSAFE Consortium Agreement and ATLAB Partnership Agreement

The EDUSAFE Consortium Agreement have been revised and a second version has been issued with the comments gathered (some compromises had been done).

We would like to sign the Consortium Agreement as soon as possible.

In parallel, we have began to sign the ATLAB Partnership Agreement with some of you.

We would like to finalize these signature process as soon as possible.

Conclusion

The ATLAS Safety upgrade program is mandatory to cope with the safety issues especially radiations that we will have to face in the coming years.

We are running parallel R&D programs within the ATLAB framework to be able to collaborate with industrial partners and institutions external to ATLAS collaboration.

EDUSAFE ITN is on progress:

recruitment is well advanced

ATLAB PA and EDUSAFE CA must now be signed otherwise we can not proceed efficiently with the program

A first general technical meeting will be organized in April

In parallel to EDUSAFE we are now looking to other EU funding schemes to finance robotics/ remote handling and the AR technologies development.