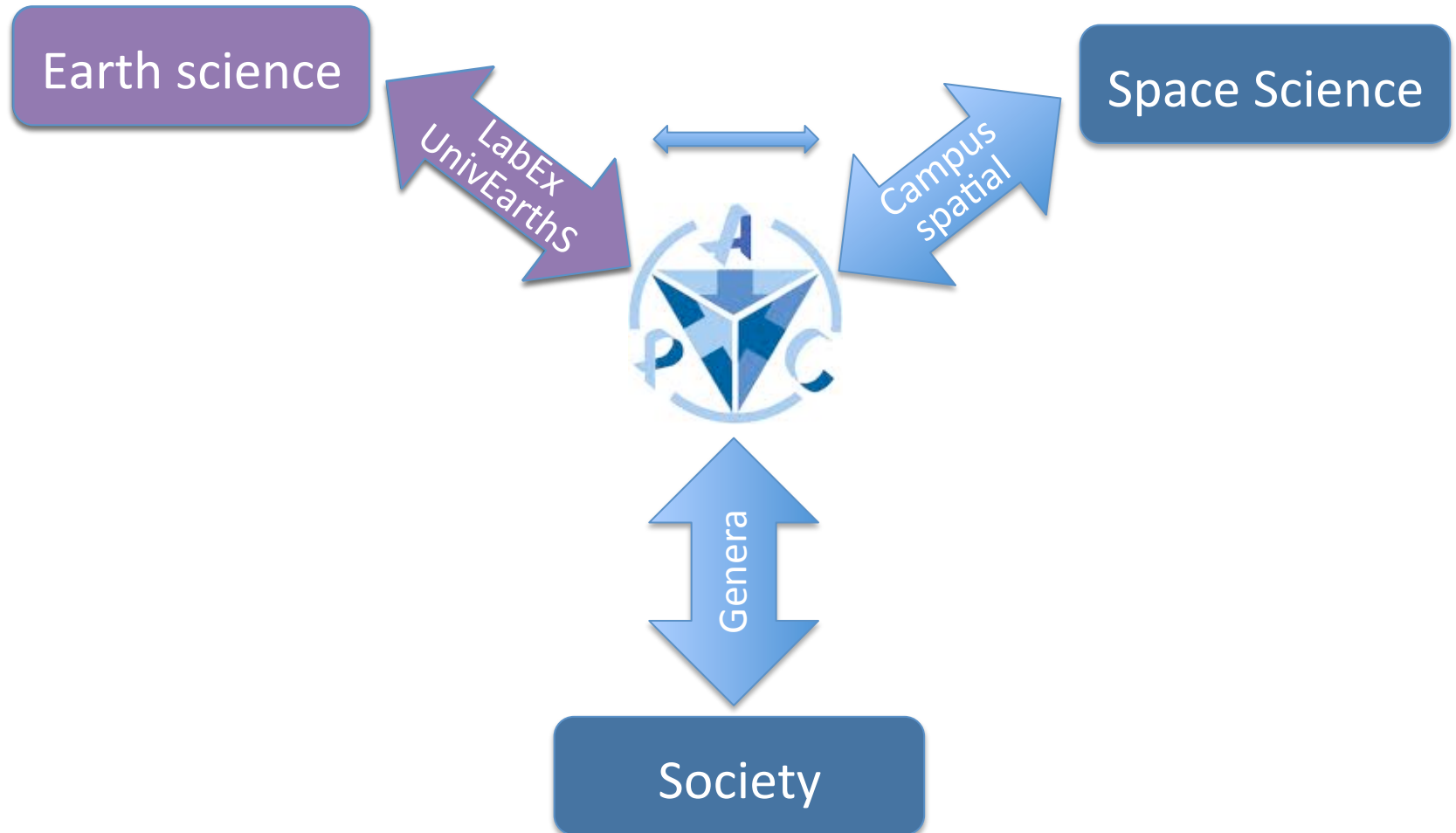


APC Scientific Council, November 20th 2017

Antoine Kouchner

INTERDISCIPLINARITY



APC + Earth Science: UnivEarthS



in the context of “Excellence initiatives” of ANR: 9M Euros for 2011-2019

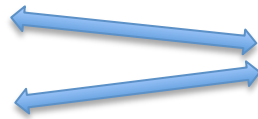
- Federating 3 laboratories



~20 projects, of 3 types

- Frontier (one main theme per lab)
- Interface
- Exploratory

+ Education + Valorisation



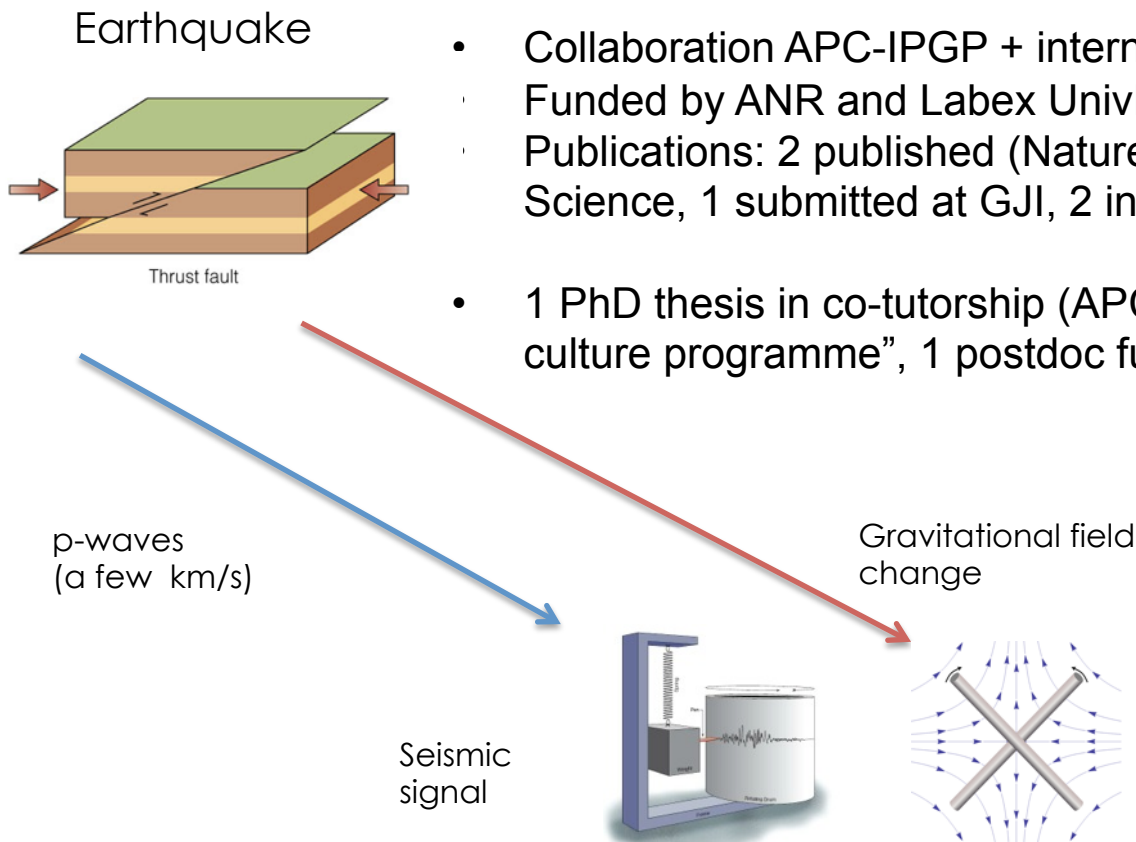
INTERDISCIPLINARITY

“Astroparticle messengers to study the Earth”

APC + Earth Science : Gravitational Waves

E3: E-GRAAL (Earthquake GRavity Alerts) (M.Barsuglia et al.)

Feasibility study of a new earthquake early warning system based on prompt gravity perturbations from earthquakes



- Collaboration APC-IPGP + international (USA, Japan, Italy)
- Funded by ANR and Labex UnivEarthS
- Publications: 2 published (Nature Comm and GJI), 1 accepted in Science, 1 submitted at GJI, 2 in preparation)
- 1 PhD thesis in co-tutorship (APC-IPGP) funded by USPC “double culture programme”, 1 postdoc funded by ANR
- Strong links with Virgo and GW detection techniques
- Study of the local gravity noise useful also for future gravitational-wave experiment

Image: IRIS

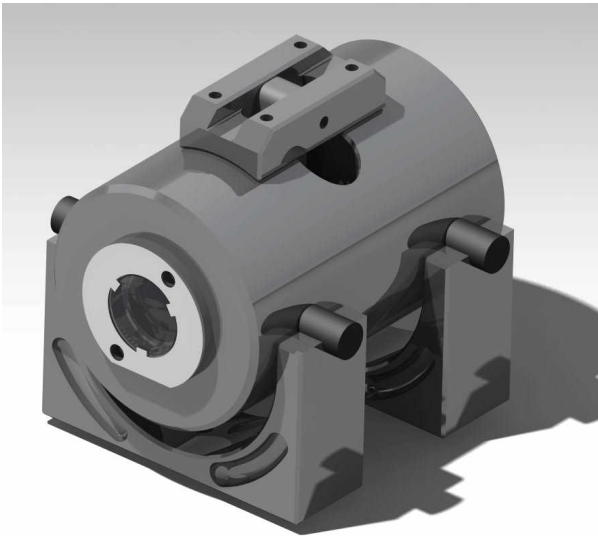
APC + Earth Science : Gravitational Waves

I3 Interferometric readout for seismometers (H. Hailoin/ Ph. Lognonné.)

Development of an optical readout system for broad band planetary seismometers

- Collaboration APC-IPGP
- Funded by Labex UnivEarthS
- 1 PhD thesis in co-tutorship (APC-IPGP) funded by USPC “double culture programme”
- Strong links with gravitational-waves detection techniques ...

Prototype (few cm)

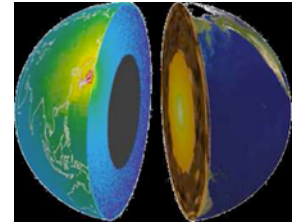


First measurements in lab



APC + Earth Science : Neutrinos

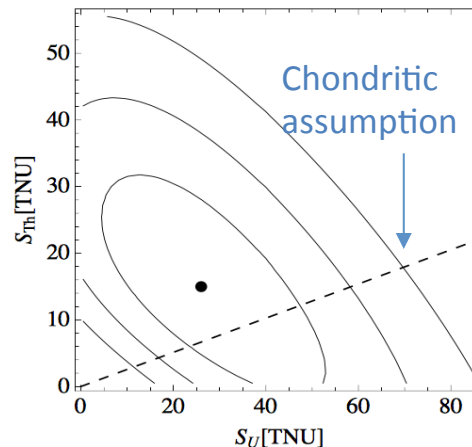
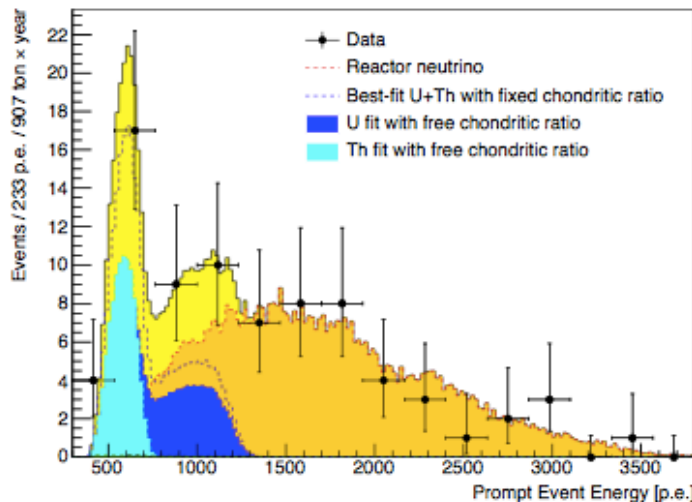
UnivEarthS Project I2 “Geoparticles” (A.T. et al.) **Geo-neutrinos:**
unique messengers on the structure and composition of the Earth’s interior



Latest result by **Borexino**

5 σ measurement of geo- ν + U/Th Ratio

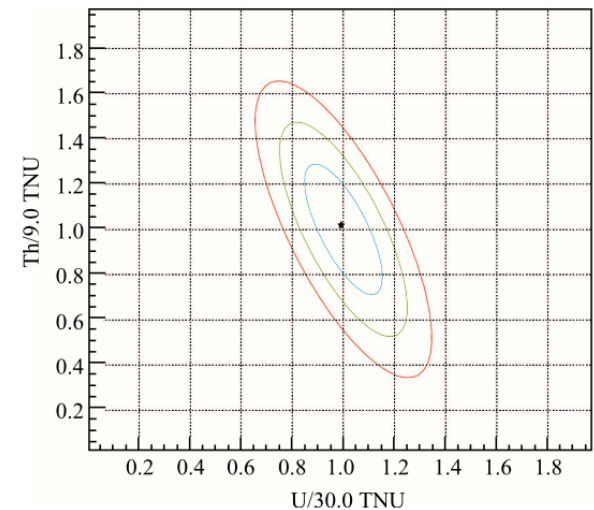
Phys. Rev. D92 (2015) 3, 031101



Prospects with **JUNO**
Measure flux with O(10%) error

Measure Mantle contribution

Precision on U/Th ratio (discriminate models)



Chinese Phys. C **40** 033003 (2016)

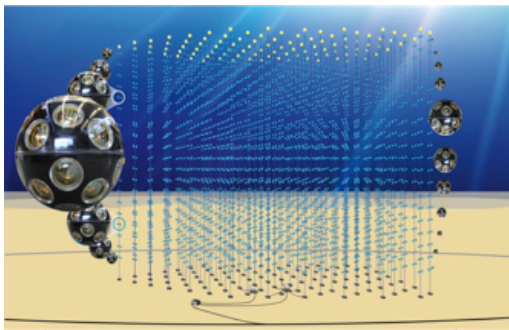
APC + Earth Science : Neutrinos

UnivEarthS Project I8: ARGOS

(also funded by IdEx SPC 2015-2017)

Astroparticle Research, Geology and Oceanography Studies

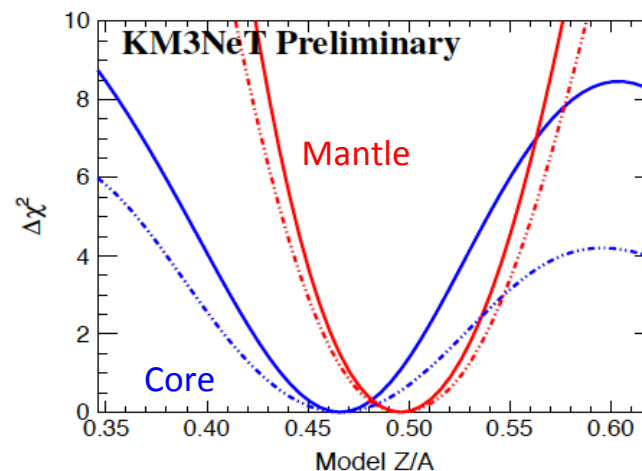
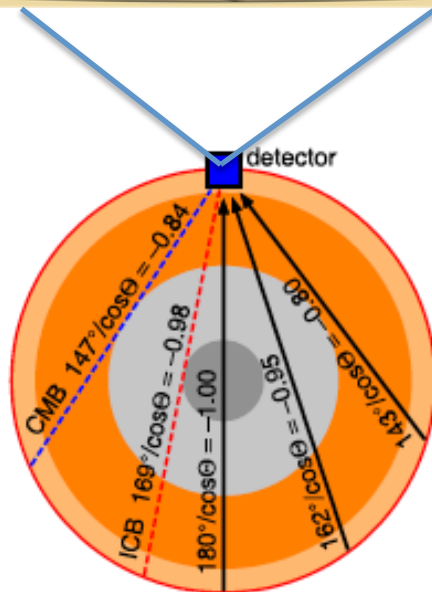
(V. Van Elewyck et al., APC+IPGP, started 2016)



Use data from KM3NeT neutrino telescope to perform **neutrino oscillation tomography**:

Exploit matter effects in atmospheric ν oscillations ($\sim \text{GeV}$) to constrain the Earth composition (Z/A):

- abundance of light elements (H) in the core
- water content in the mantle



APC + Earth Science : Neutrinos

UnivEarthS Project I8: ARGOS

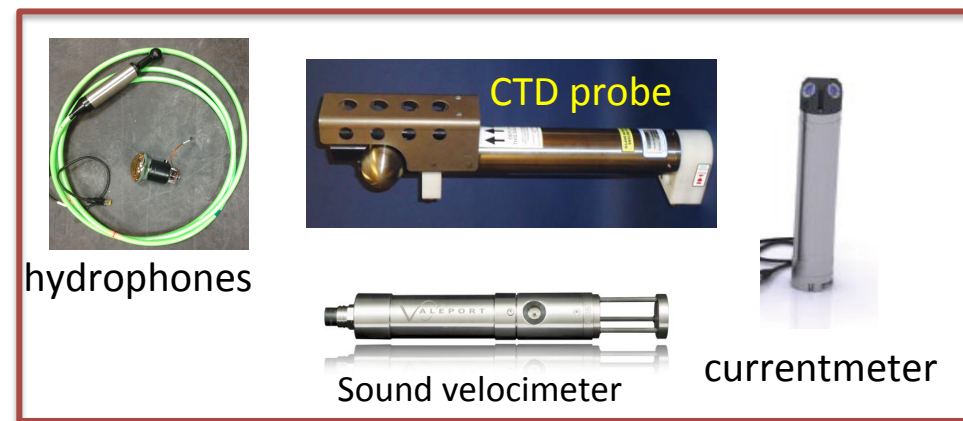
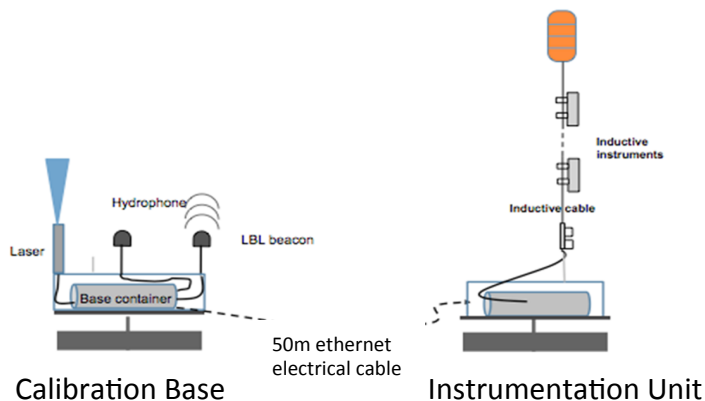
Astroparticle Research, Geology and Oceanography Studies

(V. Van Elewyck et al., APC+IPGP, started 2016)

KM3NeT provides the Earth and Sea science community with a cabled observatory in various locations of the Mediterranean abysses:

- continuous data taking on large periods of time (~few years)
- variety of instruments for environmental/seismic monitoring

APC in charge of the Calibration Units of KM3NeT:



Collaborations started with IPGP: seismology, acoustics

1 engineer funded by LabEx and mutualized APC/IPGP (2016-2018)

APC + Sea Science : Neutrinos

Labex

UnivEarthS

 UNIVERSITÉS
GAVENIN

USPC
Université Sorbonne
Paris Cité

Terre - Planète - Univers

Home

Overview

Projects

Publications

Educational

Job Opportunity

Toolkit

KM3NeT and associated sciences workshop on the 6th of December at IPGP

2 December 2016 18: ARGOS, Interface Project, News, Non classé, UnivEarthS Workshop



On the 6th of December, at the IPGP, a "KM3NeT and Associated Sciences" workshop will be held to identify ways of collaboration between colleagues of the APC and the IPGP, on the sismo / ocean aspects in relation to the instrumentation available on KM3NeT. This workshop is part of the ARGOS interface project of LabEx UnivEarthS.

This workshop is organized by Antoine Kouchner (APC), Véronique Van Elewyck (APC) and Edouard Kaminski (IPGP).

Search ...

Scientific Committee 2016



Défi
Instrumentation aux limites
MI
Mission Interdisciplinarité

Project ETADAM
A. Kouchner et al.

Bioluminescence studies
Will be made in APC (C. Donzaud)

APC Scientific Committee, April 8th 2016

Advantages of cabled observatories:

Real-time

High power

High bandwidth

High frequency

Multiple sensors in same location

Continuous

Long term

Trigger for studies with other sensors (AUV, boat,...)

Oceanography (water circulation, climate change):

Current intensity and direction, water temperature, water salinity, oxygen, radionuclides...

Geophysics (geohazard):

Seismic phenomena, low frequency passive acoustics, magnetic field variations,...

Biology (micro-biology, cetaceans,...):

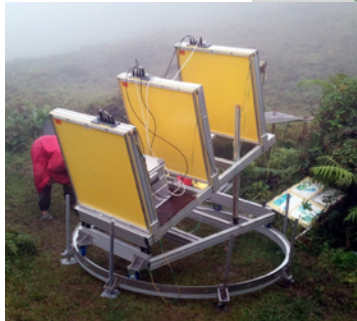
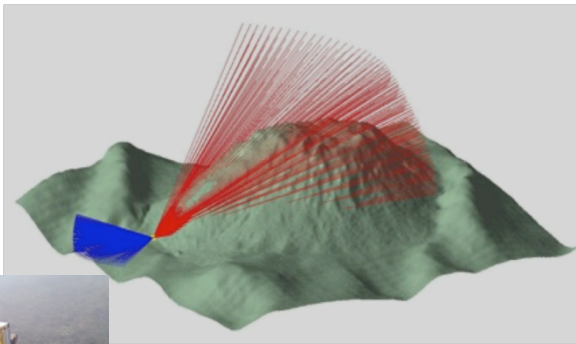
Passive acoustics, biofouling, bioluminescence, video, water samples analysis,...

interdisciplinarity

APC + Earth Science: Muons

UnivEarthS Project I2 “Geoparticles”

Muon tomography to map and monitor density variations of volcanoes



Link with background simulations for the Double Chooz experiment
[JCAP 1702 (2017) no.02, 017]

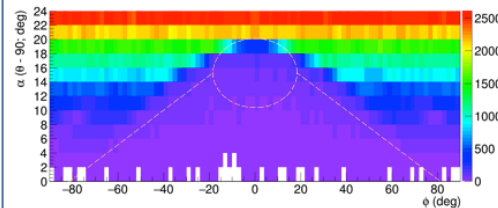
Recent developments:

applications to archaeology (S.K. et al.)

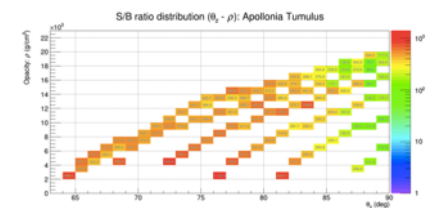
Muon tomography of Macedonian tumuli



Full simulation studies



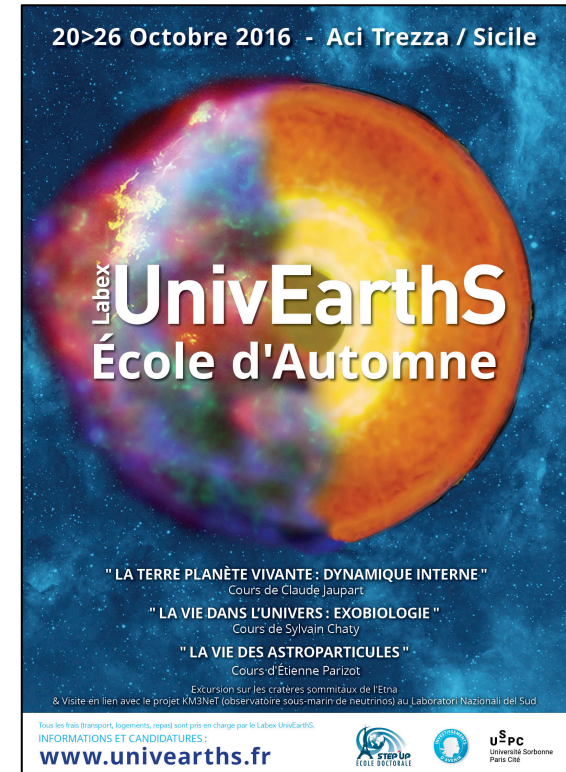
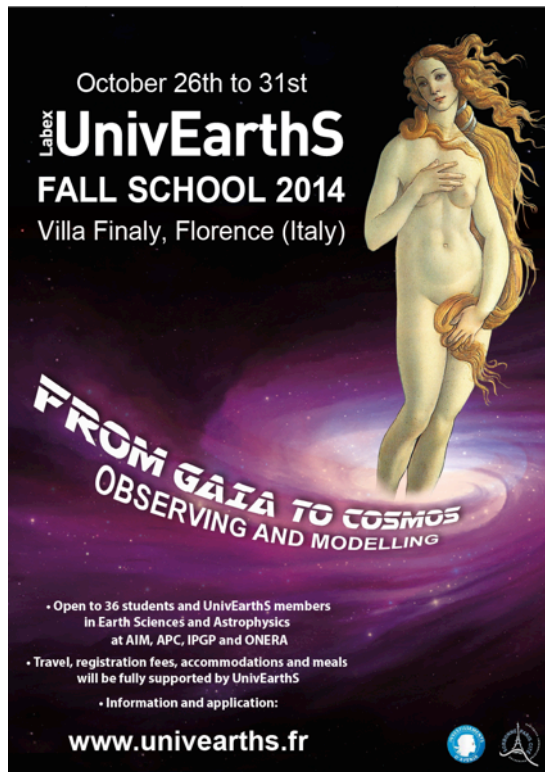
Measured mu flux vs direction
[J.Phys.Conf.Ser. 718 (2016)]



Background from scattered muons
[under review by JINST]

→ Measurement campaign at Apollonia (Greece) foreseen in 2018.
Collaboration with French laboratories (IPNL, LAPP, CEA) and Greek Universities (Physics + Archaeology)

APC + Earth Science: UnivEarthS school



- About 40 participants: PhD, postdocs, M2, engineers, high-school teachers
- Lectures on Astro(Particle)Physics, Geo-science, Common tools
- Posters and mini-presentations by the students
- (No school in 2017 → Focus on Graduate School)

APC + Earth Science: Strategic Alliance

Future Plans

- UnivEarthS+
 - Towards a Graduate School Earth Planet UnivEarths -- Not retained
- ✓ SESAME Plateforme Calcul DANTE (APC, IPGP)
 - ✓ Resubmit
 - ✓ Funding through Idex (if granted)

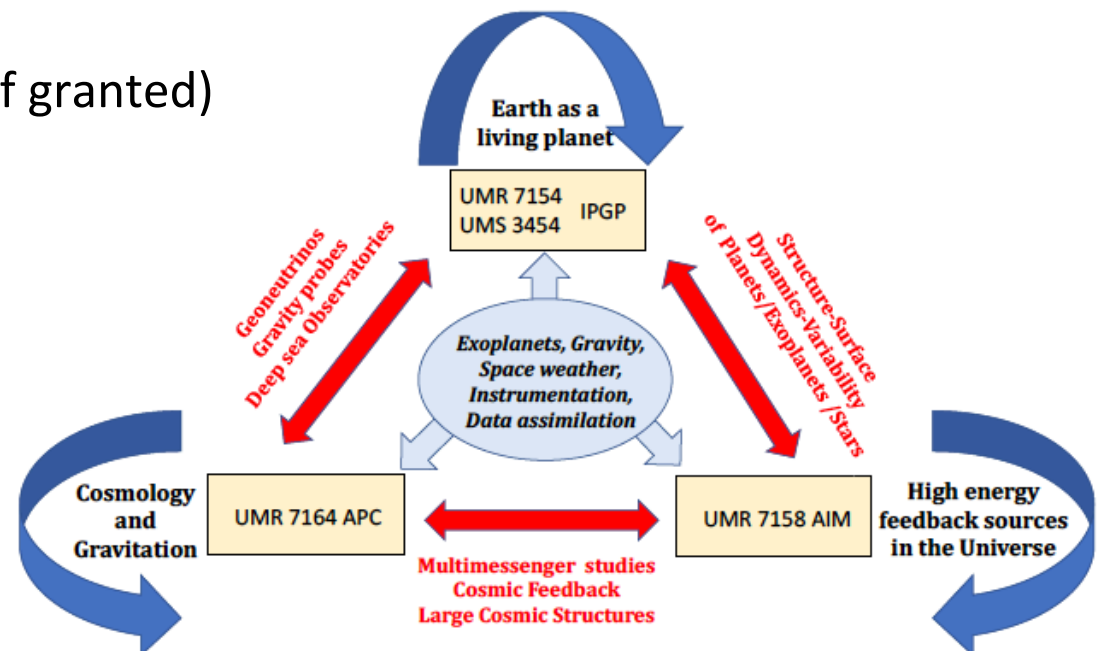
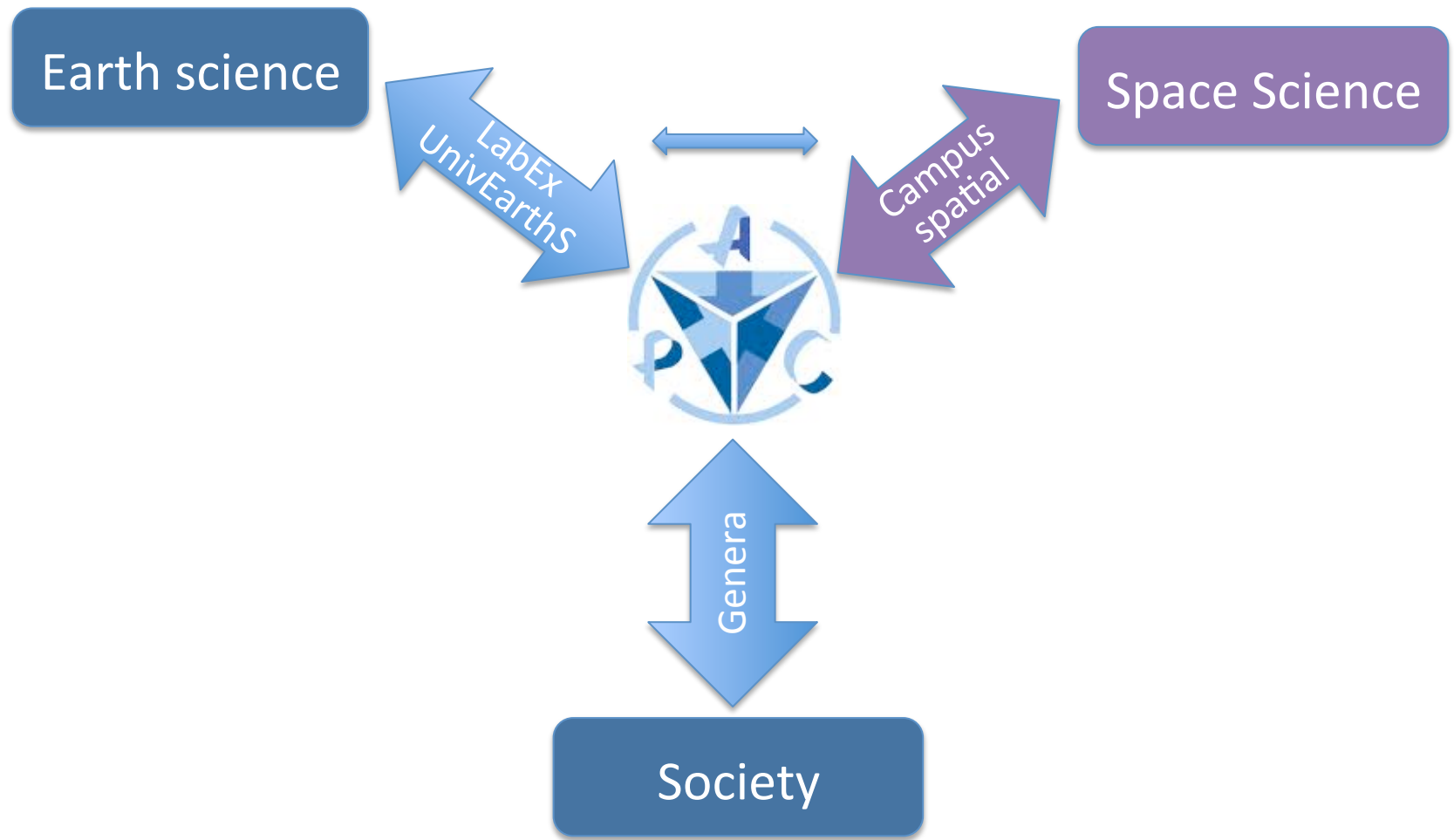


Fig. 2.1: overview of the scientific scope for the future of UnivEarths



APC + Space Science: Campus Spatial

“Action pluri-disciplinaire” since 2009

- Two USPC institutes (Univ. Paris Diderot and IPGP)
- 9 research laboratories: Earth, Planets, Universe
- different UPD departments: Physics, Chemistry, Maths, STEP, GHSS

Aim: develop the “space” role of Université Paris Diderot and multidisciplinary around “space”



- Paris Diderot funding: 60 k€/y
- Paris Rive Gauche Campus established as one of French sites hosting “space” laboratories
- 20 scientific or technological projects funded up to now
- Education: Master with Vietnam, Masters related to space science, IgoSat student satellite

Key role of **APC and its instrumental platforms** (clean room, low-noise room, 3D measurement machines, experimental hall) in preparing for space missions for 2019+ (Taranis, InSight, Lisa...)

APC + Space Science: IGOsSat

IGOSat Ionospheric and Gamma-ray Observation Satellite
(H. Halloin & H. Benhizia)



Educational project of the LabEx UnivEarthS

Lab partners : IPGP + APC

Main objective:

Training students to space engineering

Scientific Payload:

GPS receiver for studying the Electronic Content of the Ionosphere

Scintillator for characterizing Electrons and Gamma-rays content

Mission profile :

3U CubeSat (10x10x34 cm, <4kg, ~4W)

Quasi polar orbit at 650 km altitude

Partnerships:

Funding : LabEx UnivEarthS + CNES + Space Campus

Educational : Universities of Hanoï and Ho-Chi-Minh City

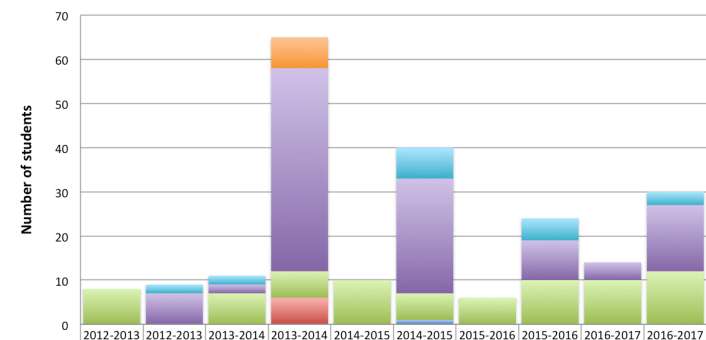
Status:

Phase C completed in Sept. 2017

Launch planned in 2019 (1 year nominal mission duration)



Evolution of number of students on the IGOsSat project



>230 students since 2012
~15 interns / year

FACe : François Arago Center – Data Science

APC data analysis center for space missions.

Since 2010.

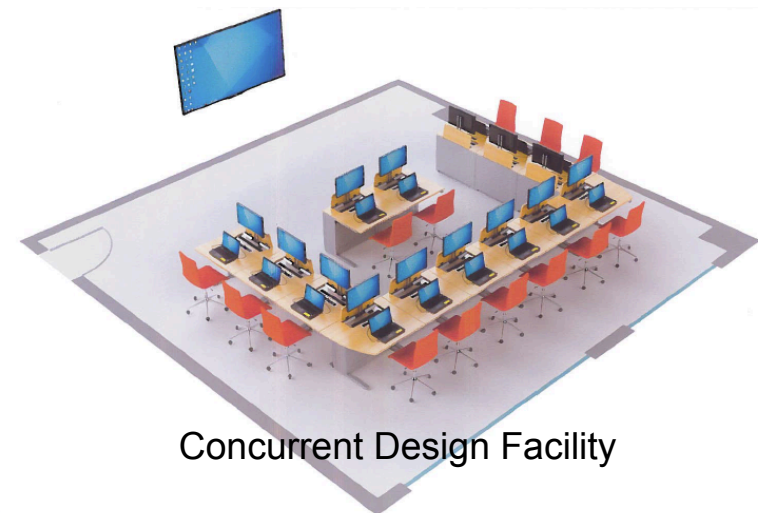
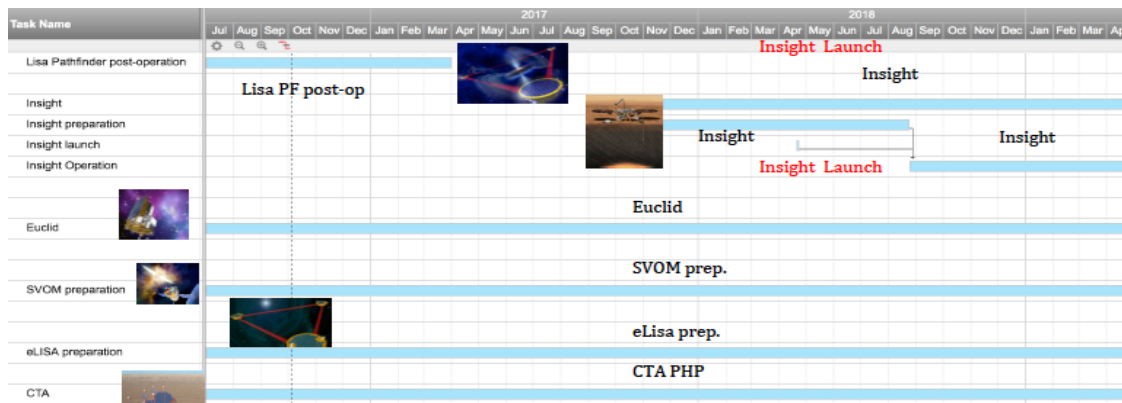
Location: Biopark but moving to Condorcet and IPGP in 2018.

Strong link with the **CC-IN2P3**.

Ressources:

Offices, meeting rooms, video-conference rooms, computing room, CDF.

Projects: CTA, EUCLID, LISA, SVOM,...



DANTE : MULTI DATA ANALYSIS AND COMPUTING ENVIRONMENT FOR SCIENCE

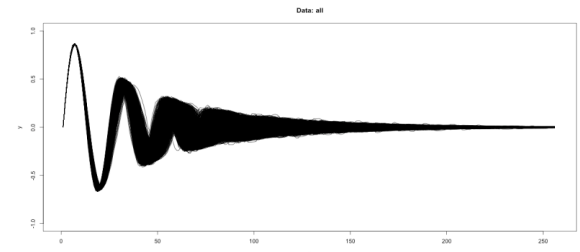
(As part of FAcE)

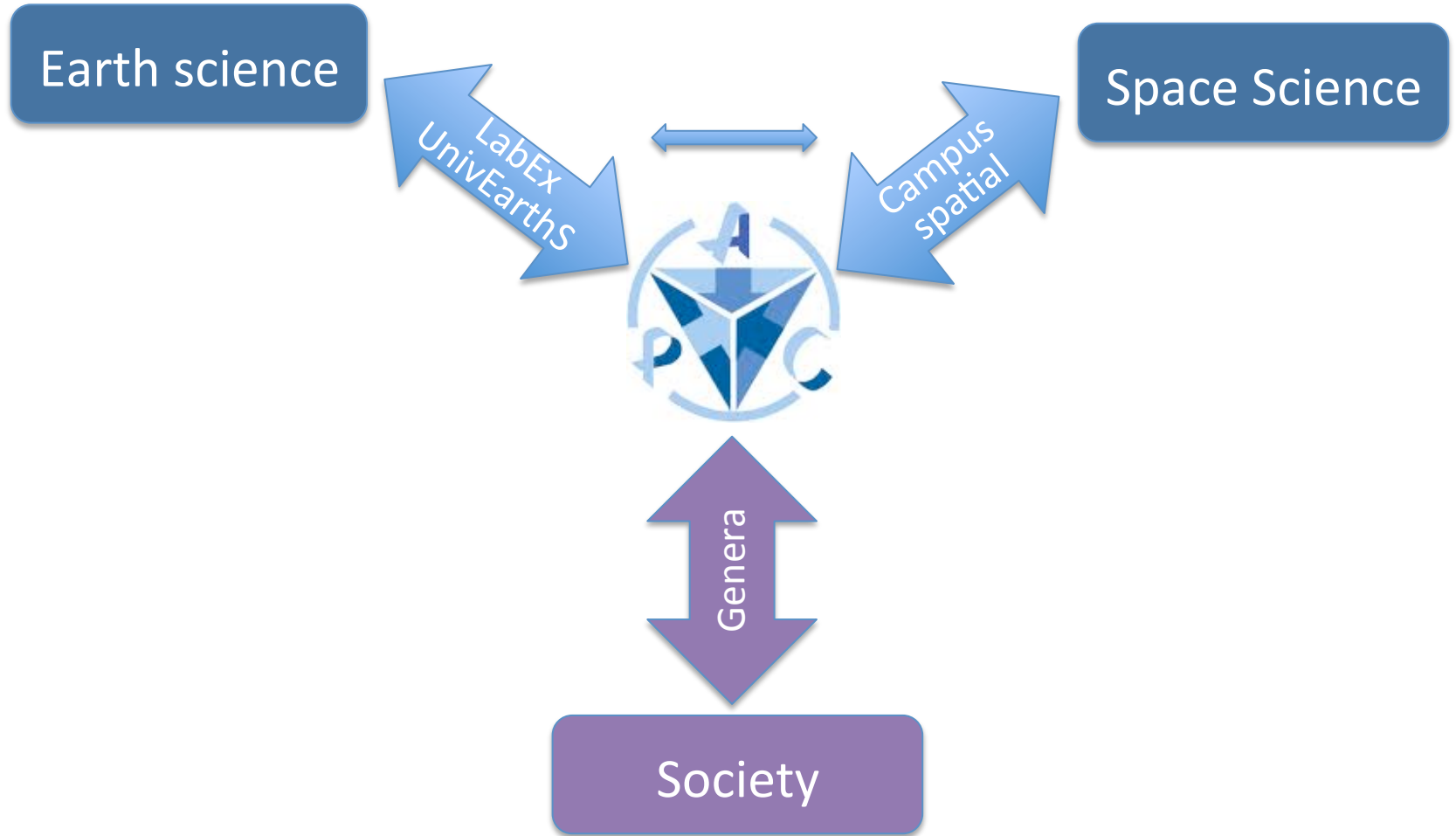
- Context:
 - Moving out of the FAcE
 - LabEx UnivEarthS partners: APC/IPGP
 - USPC ComUE's platforms: Campus Spatial PRG, CIRRUS/S-CAPAD, P2IDS
 - SESAME call of 2017: 2 years funding
 - Joint skills of APC/IPGP
- Goals:
 - A scientific instrument
 - A center of innovative and multidisciplinary expertise
 - A key centre of P2IDS (Paris Interdisciplinary Institute for Data Sciences)
- Scientific challenges:
 - Numerical laboratory: explore Big Data
 - Center of expertise: machine shop/MarketPlace
 - Applicative sprints
- IT challenges:
 - Federated then mutualised computing ressources of APC and IPGP @IPGP
 - Upgrade of APC and IPGP clusters



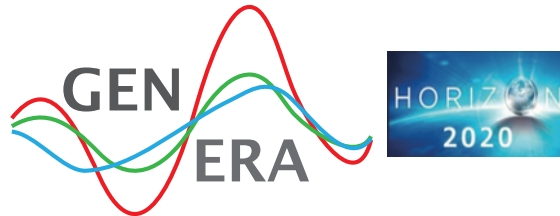
MASTODON project: Time series

- Started in April 2016, 2 workshops organised:
 - <https://indico.in2p3.fr/event/13934>
 - <https://indico.in2p3.fr/event/13186/>
 - International participation, hands-on session, presentation by private sector (EDF, Safran-Tech, Phimeca, Data2i)
 - New collaborations: human-computer interaction, visualisation
- Challenges in template fitting:
 - Continuous measurement at kHz rate
 - Huge number of templates to compare with gravitational wave signal
- (One) solution:
 - Index templates
- Outlook:
 - Results on analysis of super massive black hole light curves
 - Deeper investigation gravitational waves vs. Indexing technique
 - Computer-human interaction: develop new visualisation and manipulation interfaces





APC + Social Science : GENERA



EU funded in the frame of H2020-GERI-2014-1

- 2015-2018, 3.34 Mio Euro funding
- 14 beneficiaries from 11 countries
- Objectives: assess the status of gender issues and GEPs, support organisations in implementing
- Shall establish a long-term perspective beyond project lifetime (network, monitoring)

GENERA: implementation at APC

1) Actions towards students, role models

- Masterclass on UN day of women in science (11/02/2016)
- Intervention at Summer School for undergraduate students (16/07/2017)
- Discussion session at High School Teachers' school EPhyD (31/08/2017)
- Exhibit "Physique de femmes" at Fête de la Science 2017

2) Encourage women to apply

- L'Oréal-Unesco Prize (E. Capocasa and V. Domcke, 2016)
- Nominations of group and service leaders

