

LabEx UnivEarthS 10th Scientific Committee

16 November 2020
Remote meeting

UnivEarthS: Earth, Planets, Universe

Directors:

M. Chaussidon (IPGP) and A. Kouchner (APC)

Presidency of the scientific committee:

G. Smoot president, S. Loucatos VP

Project coordinator: A. Olivier-Kaiser

Communication: Nam Phan Van Song

Partners



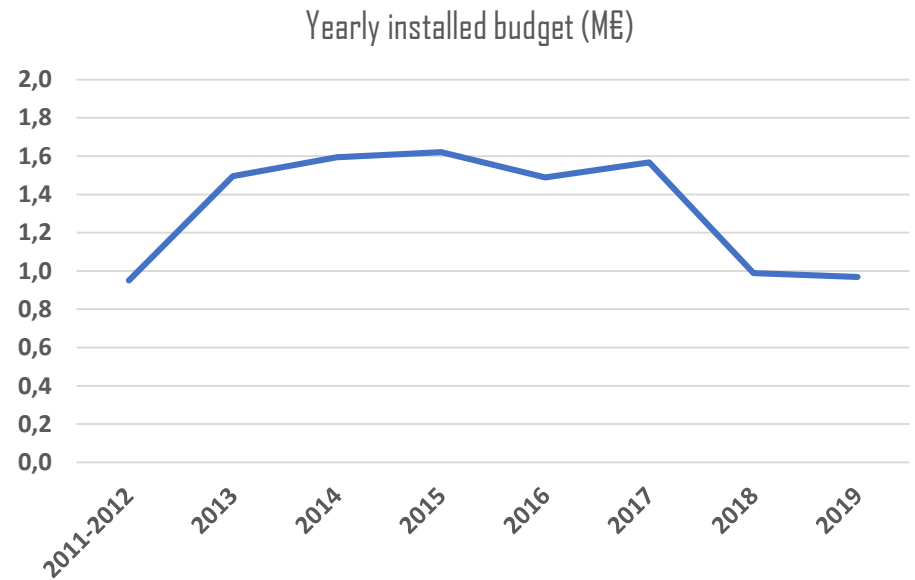
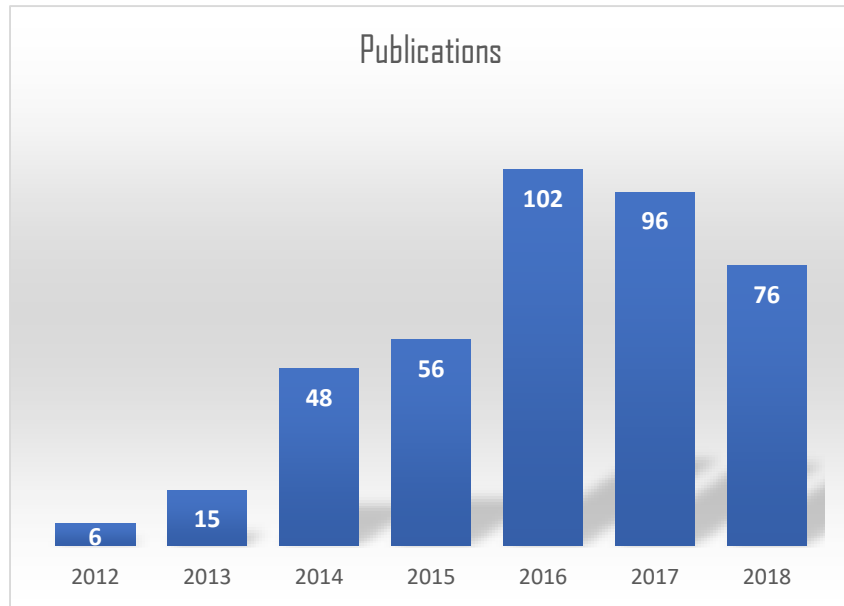
Supervising institutions



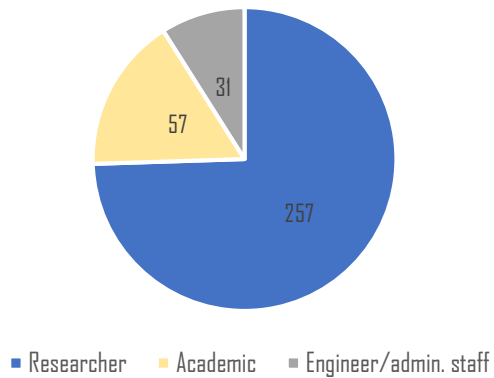
UnivEarthS combines the scientific expertise, technical know how, experience in space experiments and human resources of three research institutes, all international leaders in their disciplinary field, in order to develop original interdisciplinary research projects. Their expertise includes Earth and environmental sciences (IPGP), planetary sciences (IPGP, AIM), high energy astrophysics (AIM, APC), cosmology and fundamental physics (APC).

Key figures

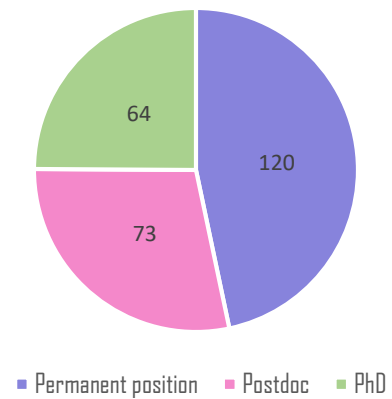
Total budget for 2011-2019: 9 M€



People involved in UnivEarthS (2011-2018)



Researchers (2011-2018)



UnivEarthS+

March 2019: "L'Université de Paris" has been officially created

→ is financially and legally responsible for the IdEx

February 2019: a prolongation of the LabEx UnivEarthS was granted for 2020-2024 with a new budget of 4,38 M€

September 2019: 26 projects have been proposed including 18 new ones

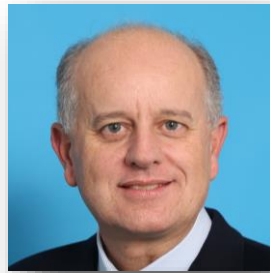
In February 2020 the UnivEarthS Executive Board endorsed 19 projects following the recommendations of this SC

[Fundings for 2020](#)

- This year is special given the health crisis and that the new projects launched in early 2020 have not been able to progress as initially planned.
- This is why we have chosen not to evaluate the projects right away (we will certainly do so in mid 2021).
- Not all of the SC was officially solicited as a referee (because there were only 3 new projects to review + 1 old one who had to resubmit). But next year it will be different: we will need everyone!
- new members have joined us: **Carsten DOMINIK, Christine THOMAS, Marianne LEMOINE-GOUMARD** (replacing Ursula BASSLER, Anny CAZENAVE, Guillaume DUBUS).
- After the deliberations, one of the 2 referees will have to submit a summary of the evaluation (5 lines) which will then be sent to the PI.



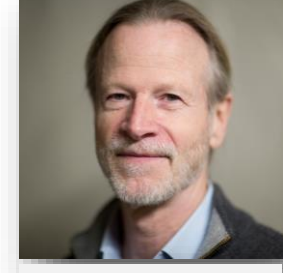
Anna Franckowiak



Augusto Neri



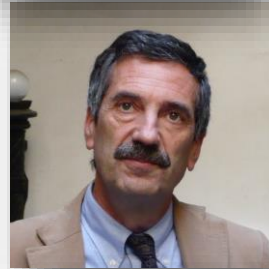
Catherine Johnson



David Shoemaker



Donald Dingwell



Fernando Ferroni



Juan-José Hernandez-Rey



Liane Benning



Maud Boyet



Carsten Dominik



Marianne Lemoine-Goumard



Christine Thomas



George Smoot



Sotiris Loucatos

Scientific committee

LabEx UnivEarthS: 10th scientific committee

- Exploratory project call for proposals for the period 2021-2022.
- The objective is to support for 2 years (with an evaluation at the end of the first year) research projects exploring new ideas or concepts within the LabEx research topics and initiating new synergies. Innovative, risky and interdisciplinary projects are encouraged.
- The budget envelope is a maximum of 20 k€ per year and will not include personnel expenses (except for trainees).
- The projects submitted must involve at least two researchers from two founding laboratories (APC, AIM, IPGP or ONERA) or one researcher from a founding laboratory and one researcher from the following laboratories or institutions: IMCCE, LUTH, GEPI and University of Paris.

We have received 3 applications for new exploratory projects.

Referees:

- Exploratory project led by E. Capocasa: **D. Shoemaker & A. Franckowiak**
- Exploratory project led by S. Jacquemoud: **L. Benning & C. Johnson**
- Exploratory project led by C. Gouiffès : **J.-J. Hernandez-Rey & M. Lemoine-Goumard**

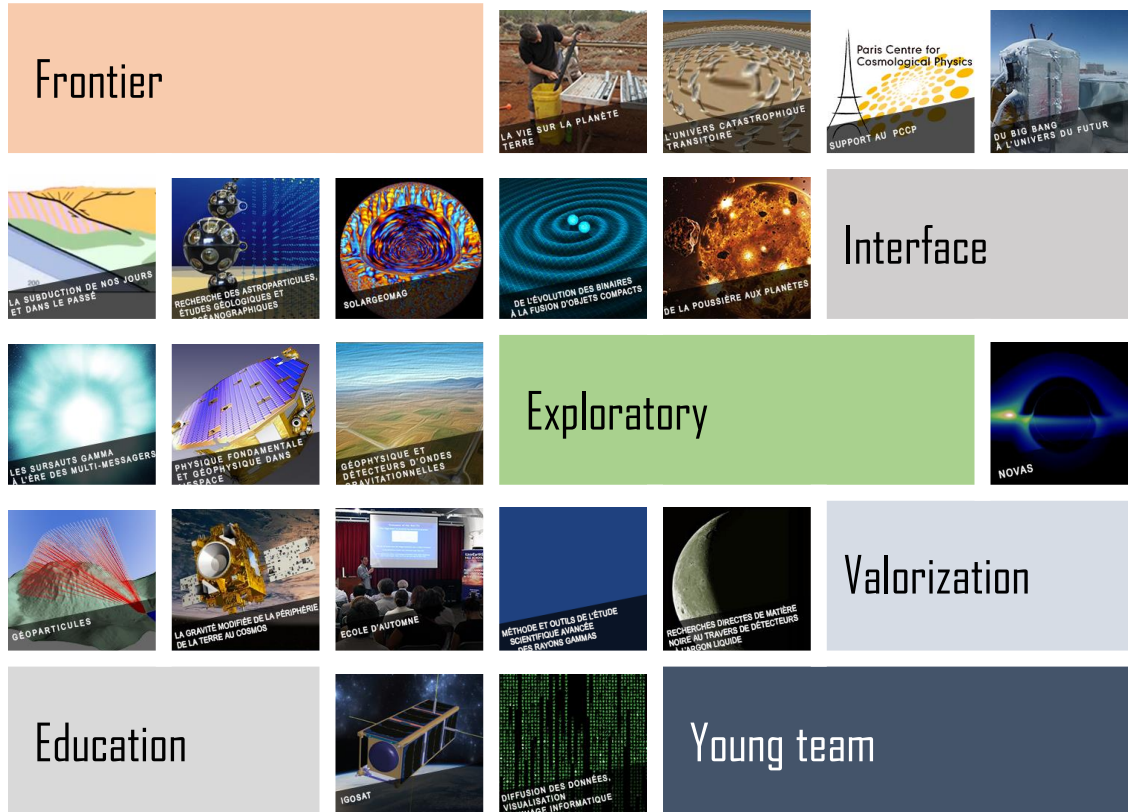
Exploratory projects have a maximum budget of 20 k€ per year.

We have 1 Frontier project to evaluate again. This project had been supported last year but on the condition that another proposal be submitted this year (proposal that puts more emphasis on synergies between research teams).

This is the Frontier project led by J. Badro and we propose the same referees as last year: **M. Boyet & D. Dingwell**.

Reminder: Frontier projects have a maximum budget of 100 k€ per year.

Work-Packages



Examples

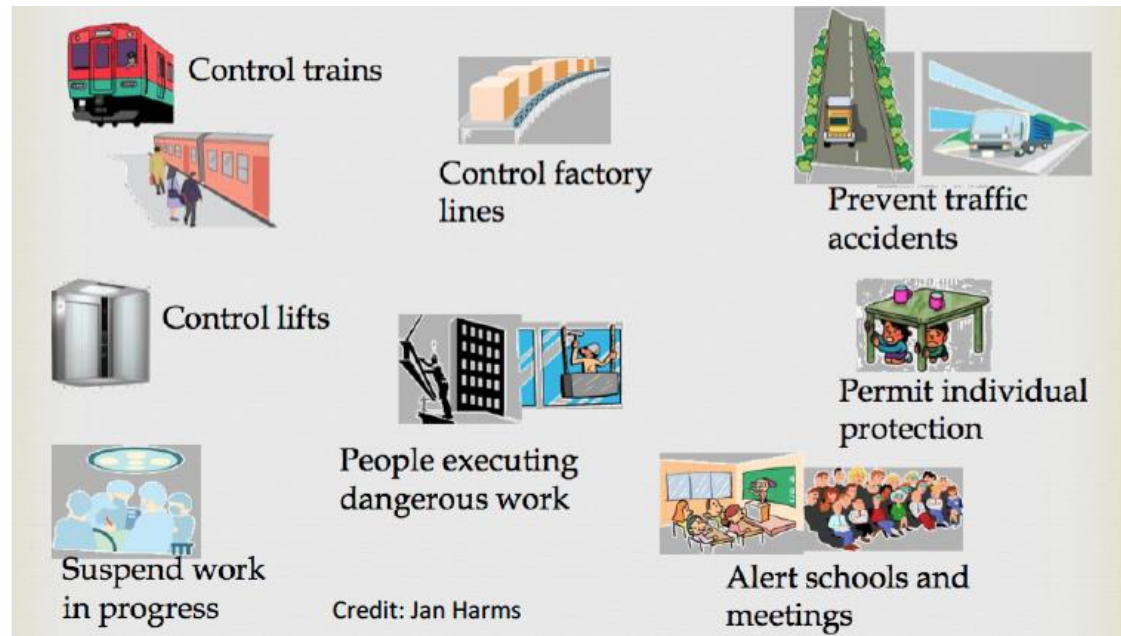
Towards faster seismic early-warning alerts

Can we detect the gravity perturbation due to an earthquake before the arrival of the seismic waves?

Can we detect the gravity perturbation to improve the current earthquake early-warning systems?

Rationale:

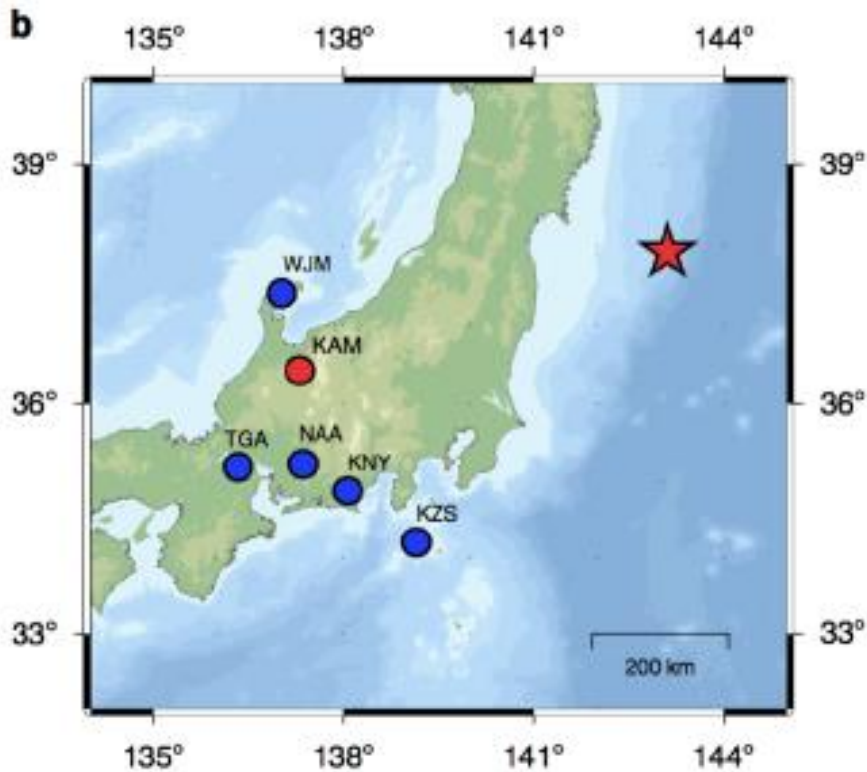
Gravity (speed of light) / Seismic waves (few km/s)



Towards faster seismic early-warning alerts

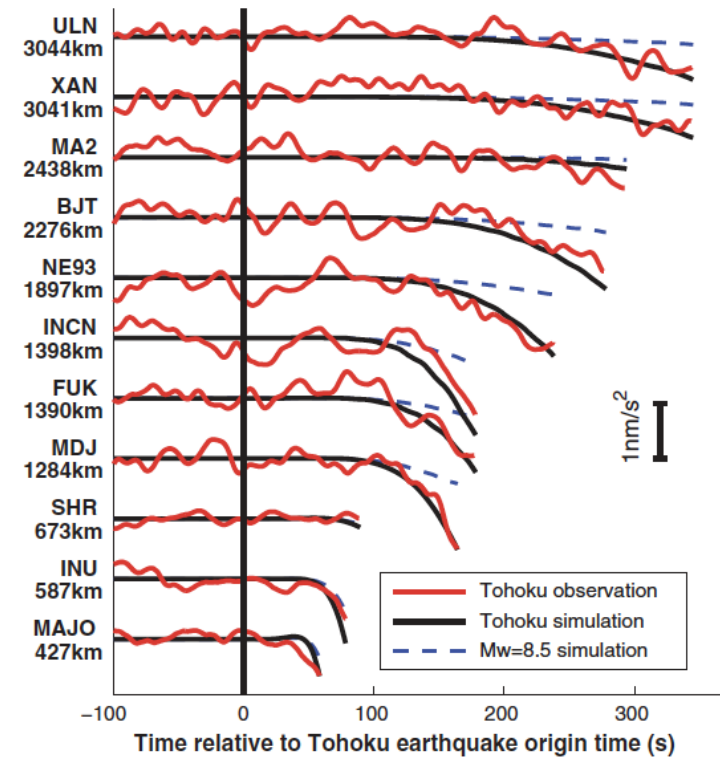
1. Prompt gravity signal induced by the 2011 Tohoku-Oki earthquake.

Nature Com. (20216), 7, 13349



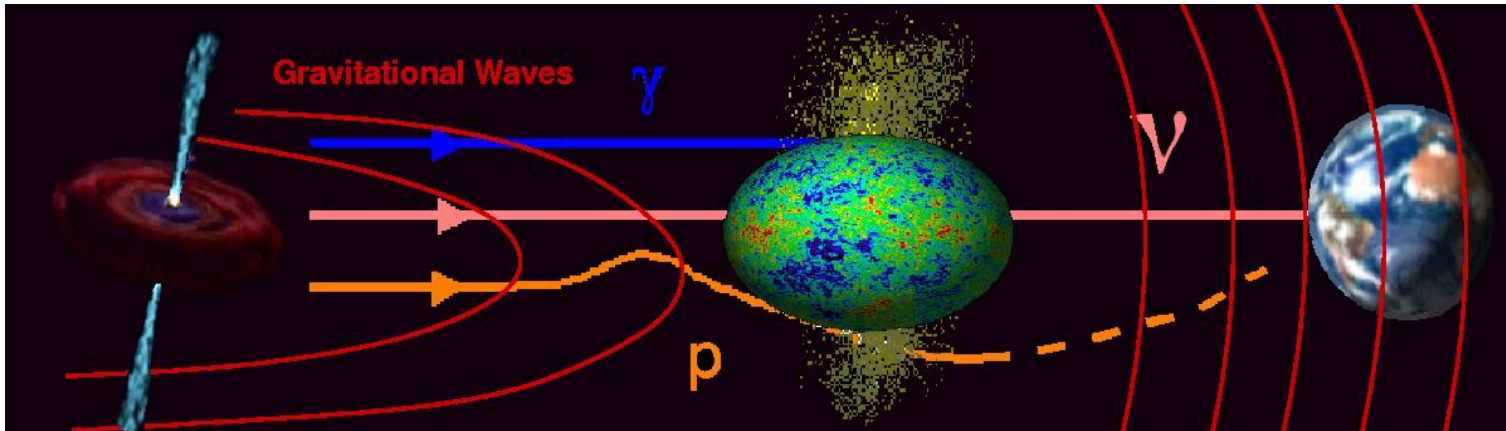
2. Observations and Modeling of the elasto-gravity signals preceding direct seismic waves

Science (2017) 358, Issue 6367



Superconducting gravimeter
& broadband seismometers

Astroparticle: particles for astrophysics



Bring together particle physics and astrophysics for a better understanding of the Universe and fundamental physics

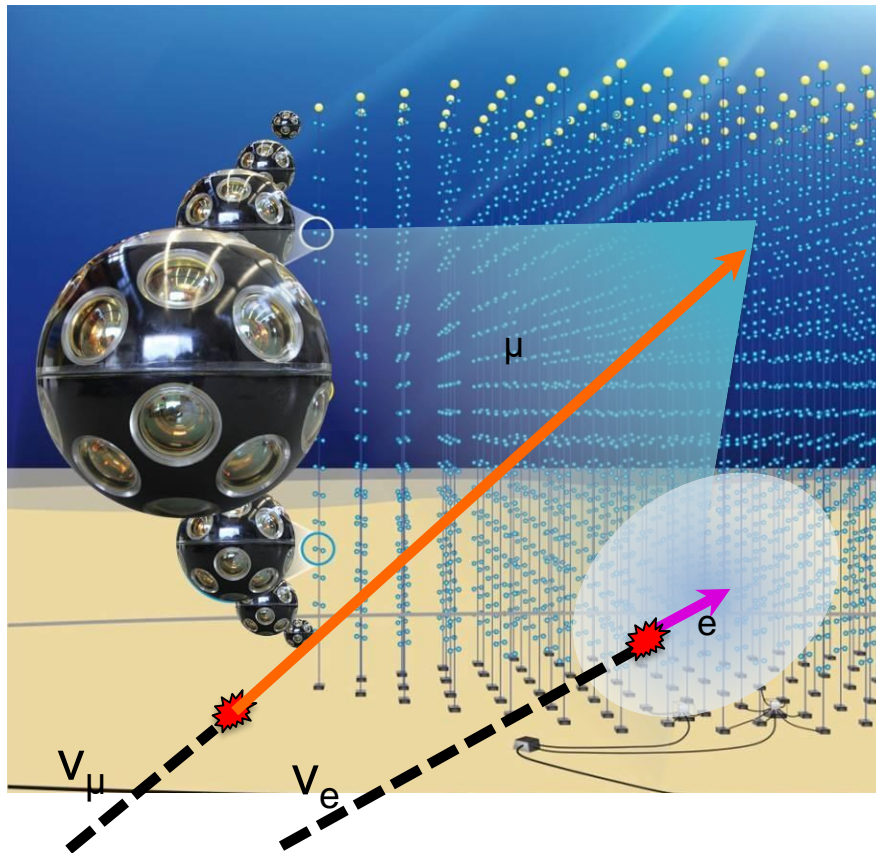
From multi-wavelength to multi-messenger astronomy: open new observation windows on the Universe

Gravitational Waves, Nuclei, Neutrinos, photons carry distinct information

Particles for geosciences: atmospheric neutrinos

A 3D matrix of digital optical modules detects Cherenkov light

Use atmospheric neutrinos to probe deep Earth composition
Oscillation patterns depend on electron density

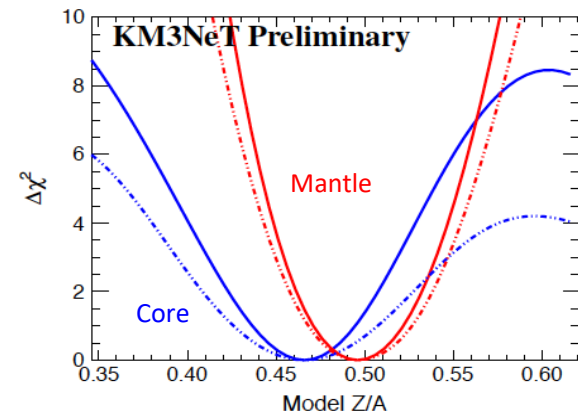
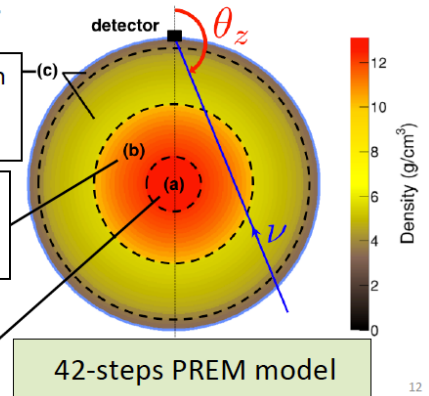


→ 3 chemically distinct layers
→ Z/A uniform in each layer

Mantle-crust: $R_{\text{ext}} \approx 6400$ km
pyrolite (rock model)
 $Z/A = 0.496$

Outer core: $R_{\text{ext}} \approx 3480$ km
pure Fe (+ 5% Ni)
 $Z/A = 0.4656$ (0.4661)

Inner core: $R_{\text{ext}} \approx 1220$ km
pure Fe
 $Z/A = 0.4656$



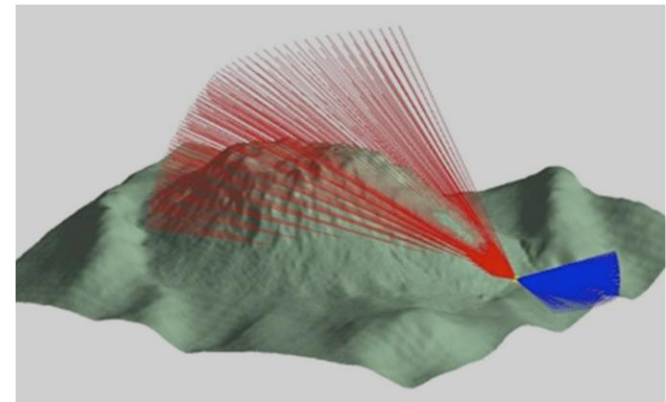
Particles for geosciences

Muon tomography

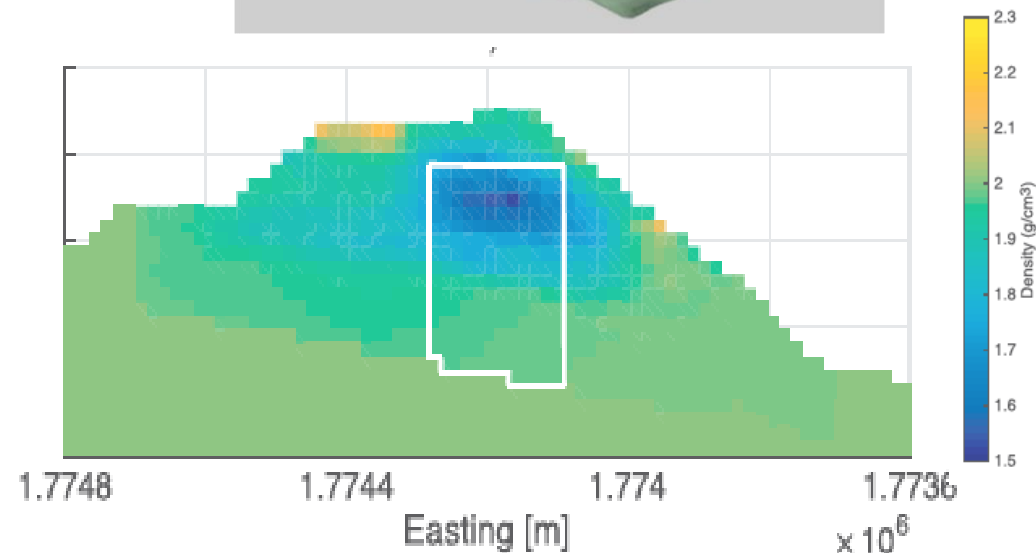
To map and monitor density variations of volcanoes

Non invasive, non destructive

Complementary to other techniques (electric resistivity...)



Three-dimensional density structure of La Soufrière lava dome
Rosas Carbajal et al., 2017



Possible applications in archeology

From evolving binaries to the merging of compact objects

Two facts:

The majority of massive stars live in a binary

LIGO/Virgo collaboration detects tens of merging (O3)

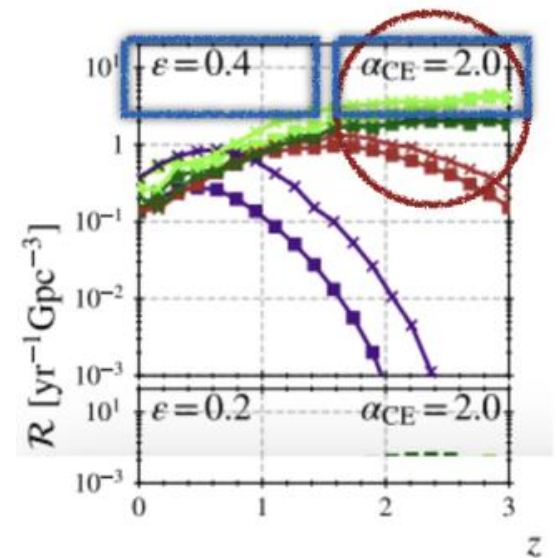
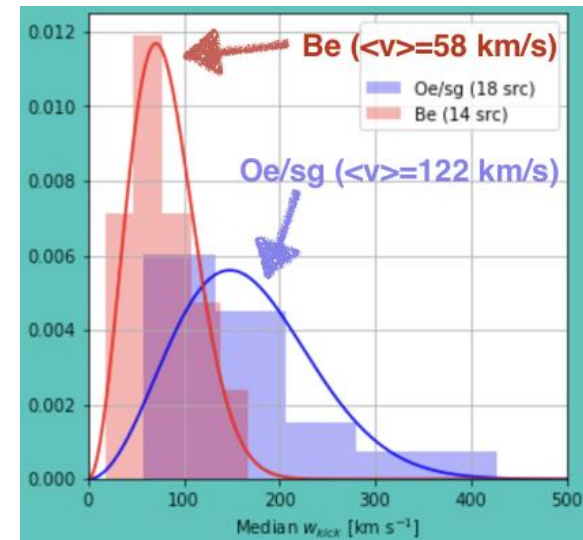
What is happening in between?

Binaries evolve, and only a few of them will merge in a Hubble time, depending on many characteristics

Aim: better understand key steps in evolution of binaries, using Gaia DR2 + LIGO/Virgo detections

Some results

- Gaia DR2 observations to constrain the natal kick received at NS collapse: binaries hosting massive stars survive to higher kick velocity
- MESA simulations to derive merger rate density vs redshift \rightarrow feedback on binary evolution (efficiency of mass transfer ϵ and common envelope α_{CE})

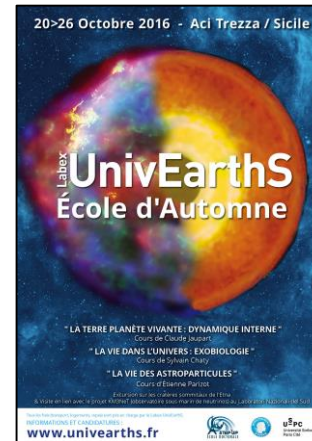
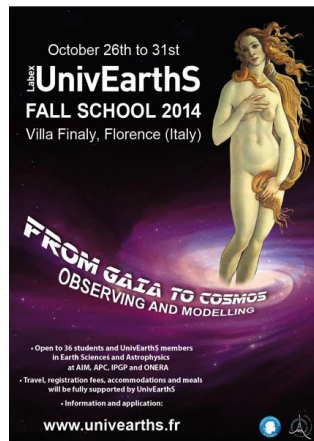


Top: Garcia, Chaty, Fortin, Chassande Mottin, Porter, 2019 subm.

Bottom: Garcia, Bunzel, Chaty, Porter, Chassande-Mottin, 2019 subm.

UnivEarthS fall schools

Was foreseen for 2020 :



About 40 participants: PhD, postdocs, M2, engineers, high-school teachers
Lectures on Astroparticle Physics, Geo-science, Common tools
Posters and mini-presentations by the students

Training in Space Sciences

IGOSat

Ionospheric and Gamma-ray Observation Satellite

Educational project of the LabEx UnivEarthS

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

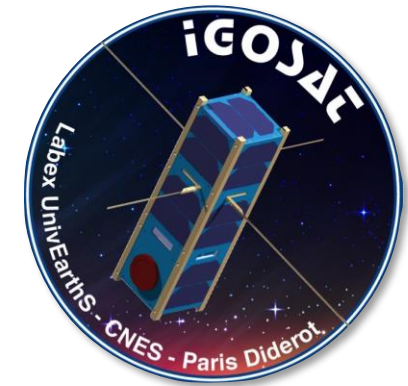
3U CubeSat (10 x 10 x 34 cm, <4kg, ~4W)

Quasi polar orbit at 650 km altitude

Partnerships

Funding: LabEx UnivEarthS + CNES + Space Campus

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



Summary and Outlook

Strong links established between geophysics, astro- and particle physics

More challenges ahead, including instrumentation

UnivEarthS+ is to enlarge and reinforce the synergies

UnivEarthS gave rise to other successful initiatives

Doctoral School STEP'UP

Merge IPGP computing center S-CAPAD (IPGP) and FACe (APC)

Within USPC platforms: e.g. Campus Spatial

Potential for a Graduate School

[SC timetable](#)