

A composite image showing particle tracks on the left and a colorful nebula on the right, set against a dark starry background.

Sonder les infinis : des particules au cosmos

Subatech Laboratory

Gines Martinez, director

L2 14 novembre 2022

Journées Informatiques de l'IN2P3 (Le Croisic)

# Subatech in few words



**IMT Atlantique**  
Bretagne-Pays de la Loire  
École Mines-Télécom



IMT Transfert



Pôle Sciences et  
Technologie



UMR 6457 (since 1994)  
Located at IMT Atlantique  
Campus de Nantes

On October 1<sup>st</sup> 2022

208 staff

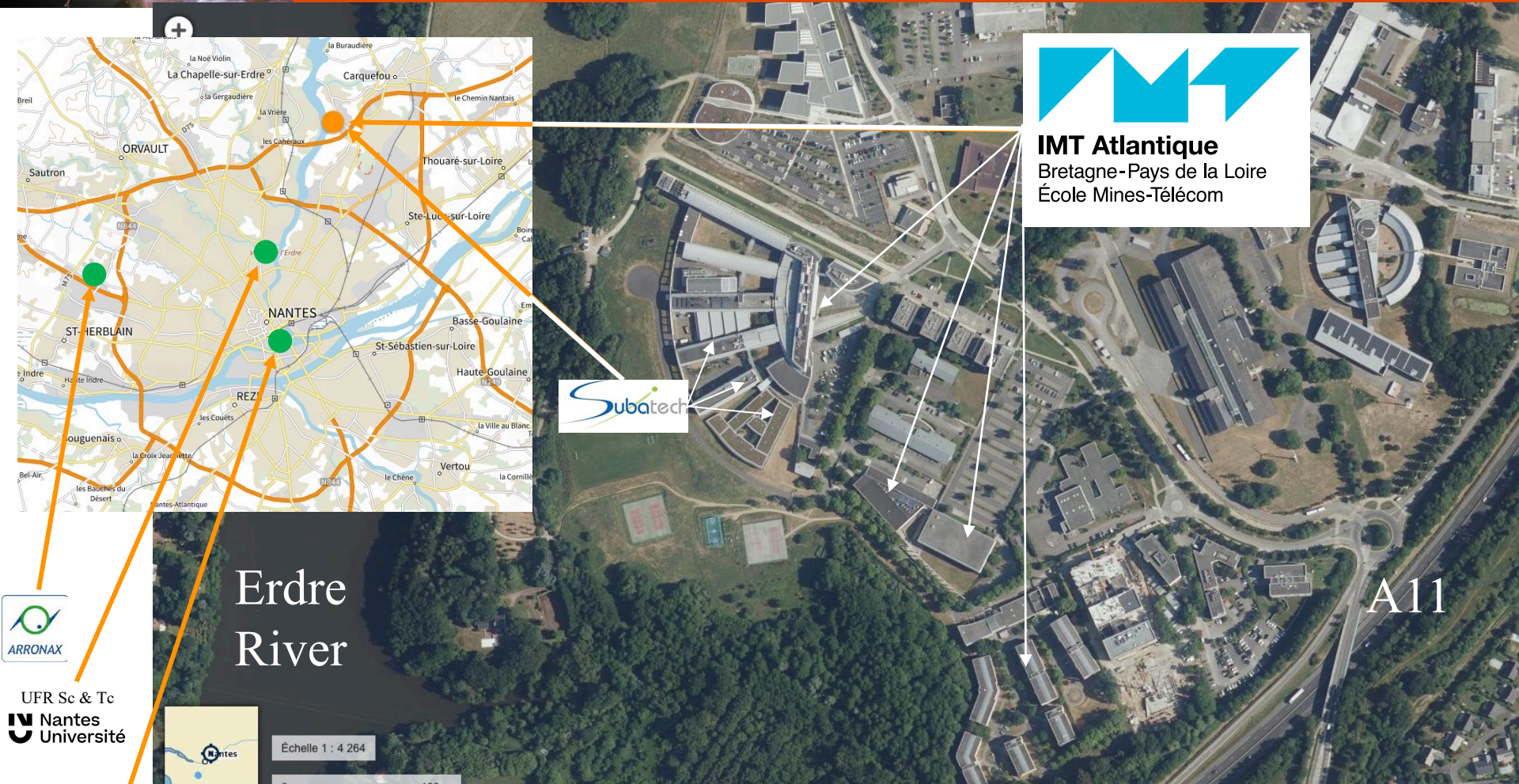
60 C & EC (24 CNRS, 19 IMT Atlantique, 17 NU), dont 4 Emerites

79 IT (52 CNRS, 12 Armines, 9 IMT Atlantique, 6 NU)

20 post-docs (9 CNRS, 5 NU, 6 IMT Atlantique)

49 PhD (15 CNRS, 16 IMT Atlantique, 10 UN, 8 others)

# Location



**IMT Atlantique**  
Bretagne-Pays de la Loire  
École Mines-Télécom



Erdre  
River

A11

Total surface of Subatech about 7350 m<sup>2</sup> (1126 m<sup>2</sup> experimental area, 800 m<sup>2</sup> mechanical workshop, 560 m<sup>2</sup> + 320 m<sup>2</sup> radiochemistry laboratory and SMART, including 590 m<sup>2</sup> ZRR)



UFR Sc & Tc  
Nantes  
Université

XEMIS2





# Subatech research “leitmotif”

Probing and understanding the infinitely small and the infinitely large, structured around large instruments for nuclear and particle physics in international collaborations, driven by the IN2P3.

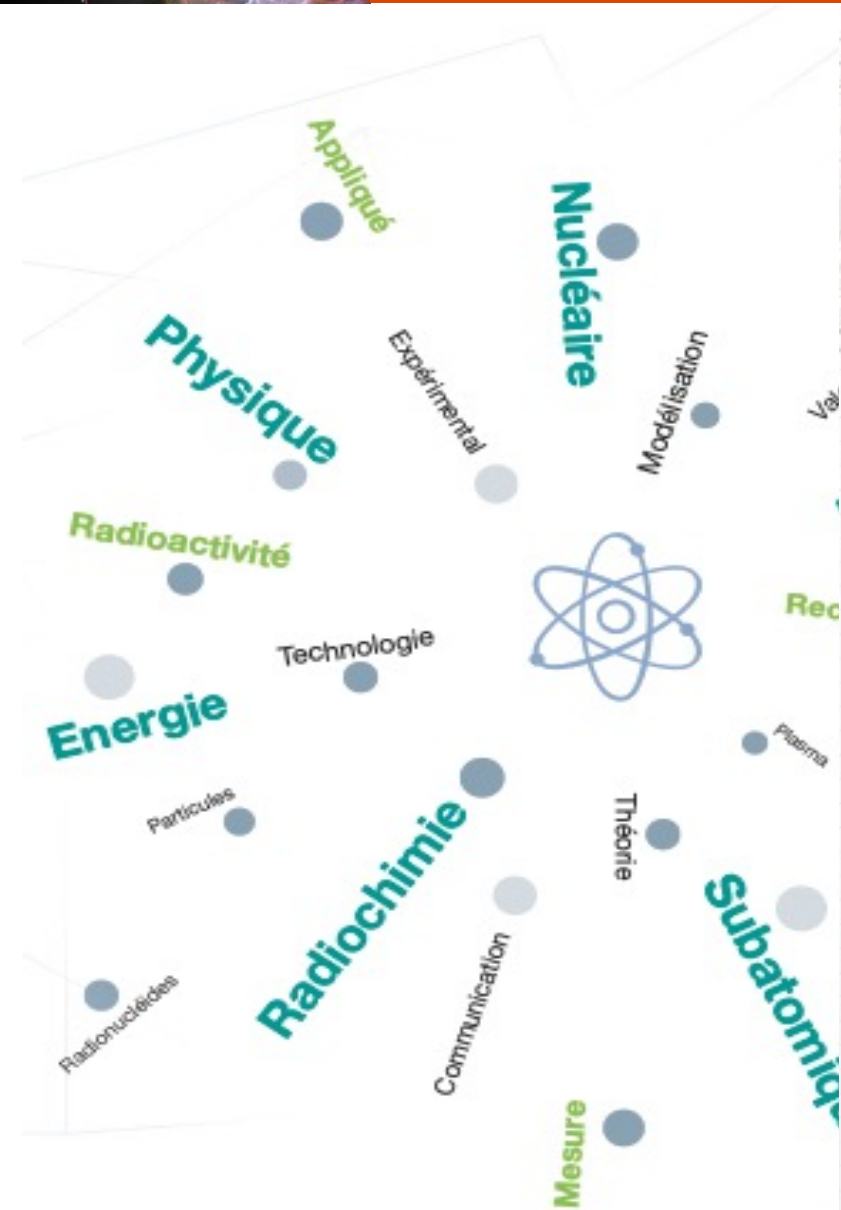
Research programme and large team in radiochemistry.

Applications of nuclear field to energy, environment and health.

Research and development technology programs. Integration in large experiments. Mastering of new techniques associated to subatomic physics.



# The thematic axis of Subatech



Subatech

$$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu} + \bar{\psi} \not{D} \psi + \bar{\psi} \psi + \phi \not{D} \phi + \bar{\phi} \phi + \mathcal{L}_{\text{int}}(\psi, \phi)$$

LES DEUX INFINIS

NUCLÉAIRE POUR L'ÉNERGIE ET L'ENVIRONNEMENT

NUCLÉAIRE POUR LA SANTÉ

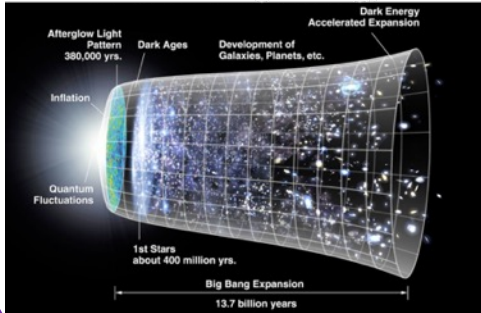
TECHNOLOGIES ASSOCIÉES



# Research axis of Subatech

## The Two Infinits

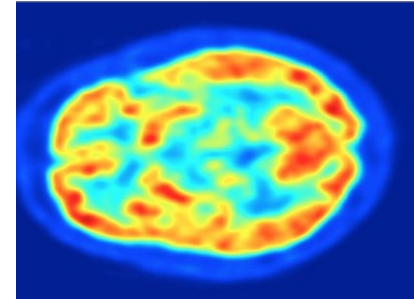
Universes of High Energy



ALICE Run3@LHC  
Project upgrade LHCb Run5  
JUNO & KM3NeT  
XENONnT & NEXO & Darwin  
(NA)2STARS & SPIRAL  
GW (Virgo + ET)  
Excellence in thory (QCD, ...)  
EU Strong2020

## Nuclear field for Health

XEMIS2  
SMILES  
Production and chemistry of  
radionuclides for health  
➔ XEMIS3-HT  
FLASHMod  
Collaboration Arronax, ICO,  
CRCINA, CHU of Nantes.



## Nuclear field for Environment and Energy

Environment & Nuclear



“Chaire Industrielle” “Stockage”  
(ANDRA, EDF, ORANO)  
Projects around ZATU (CNRS, OSUNA)  
EU EURAD and PREDIS  
LabCom “Tesmarac”  
Simulations of nuclear reactor and  
nuclear data (NA)2STARS, E-Shape. EU  
SANDA & EU SAMOSAFER)  
Scenario (CLASS, FIT). Inter-  
disciplinarity programme with  
sociology and economy

## Associated Technologies

Mechanics & Electronics  
Computing for research  
(LATIM, LS2N)  
Detection technologies :  
LiquidO , LXe, Sphere  
Techniques in radiochemistry,  
Measurement of radioactivity  
(SMART)  
Ion Beam Analysis





# Research Teams and Services





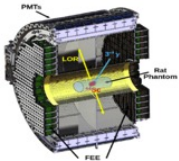
# Infrastructures and platform



1. SMART : Platform for the measurement of radioactivity in the environment created in 1994, 16 staff (2 CNRS, 13 ARMINES, 1 IMT Atlantique). Valorisation / Visibility / Neutrality. About 40 (over 46) ASN (Autorité de Sécurité Nucléaire) authorisations for the measurement of radionuclides in the environment. Cofrac Accreditation since 1998.



2. Infrastructure Tiers2-WLCG (Worldwide LHC Computing Grid) One of the 8 French Tier2 for the LHC experiments at CERN. 98% availability and 1424CPU used. Synergy with CCIPL (1040 CPU Centre de Calcul Intensif de Pays de la Loire). Storage 2.5 PBytes



3. Installation XEMIS2@CIMA (CRCINA). Infrastructure ready in CHU since 2020. Commissioning in 2022. Photon-positron Emission Tomography of small animals using new radionuclides ( $^{44}\text{Sc}$ ). Collaboration CRCINA, Arronax, LATIM (Brest) and Subatech.



4. Radiochemistry Laboratory. Unique Laboratory in the local and regional context. ASN authorisation of active sample analysis. Nuclear metrology, isotopic/element analysis, spectroscopic analysis etc.



5. Mechanical workshop. Large equipment which are unique in the local context. A 3D printer (for PEEK matter). New 5-axis machining system to be acquired in 2022.



# Local, regional, national and international ecosystem

The two infinities



Energy and environment



Health

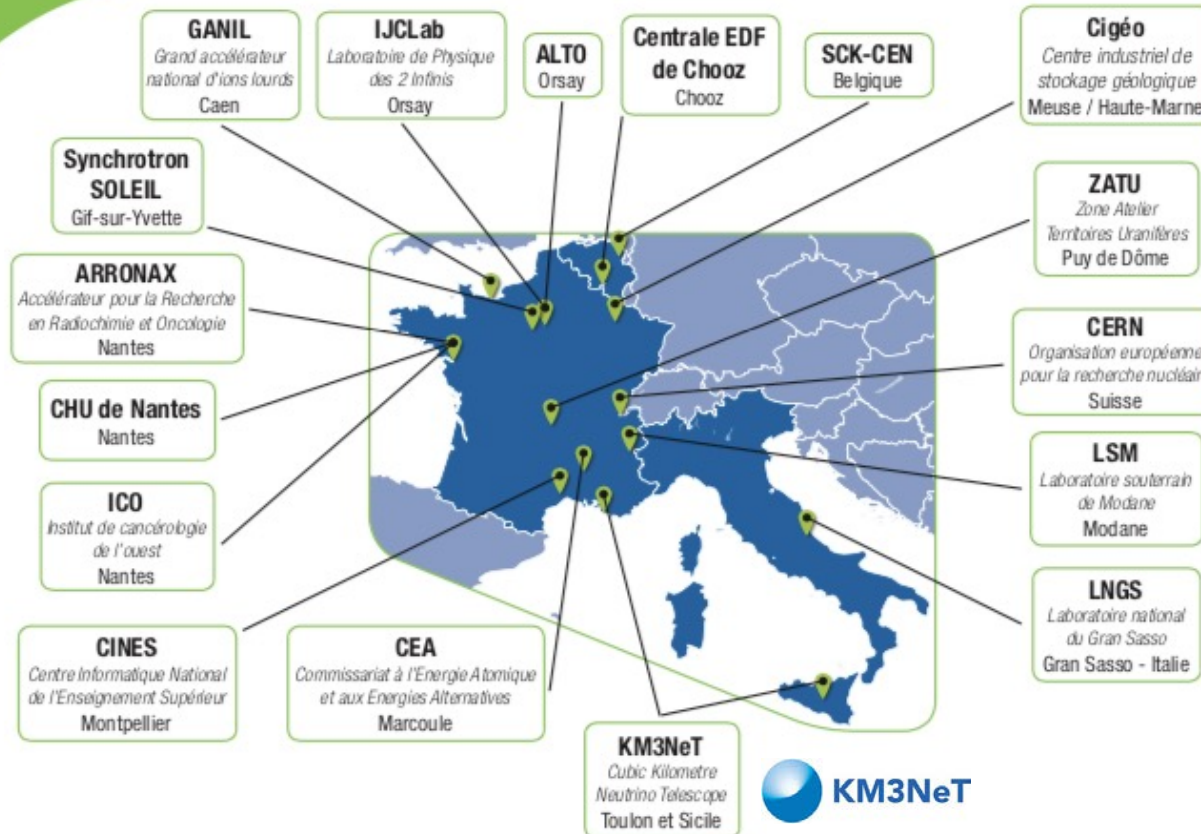


Associated technologies



# National & International Collaborations

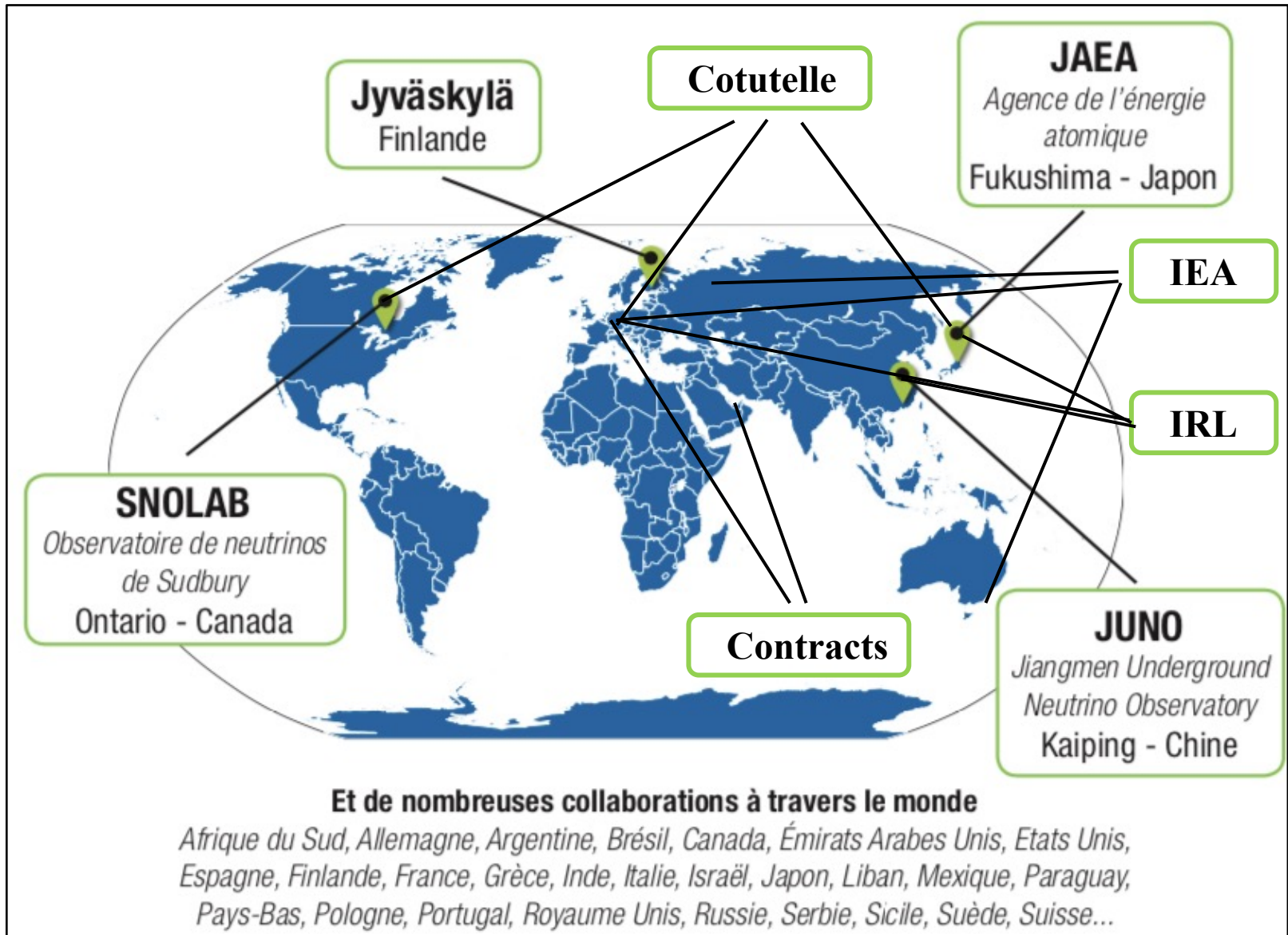
## NOS SITES EXPÉRIMENTAUX PARTENAIRES



**EURAD, STRONG2020, PREDIS, SANDA, SAMOSAfer, RADIONORM, HEAVYQGP, SARENA, ENEN+, A-CYNCH**



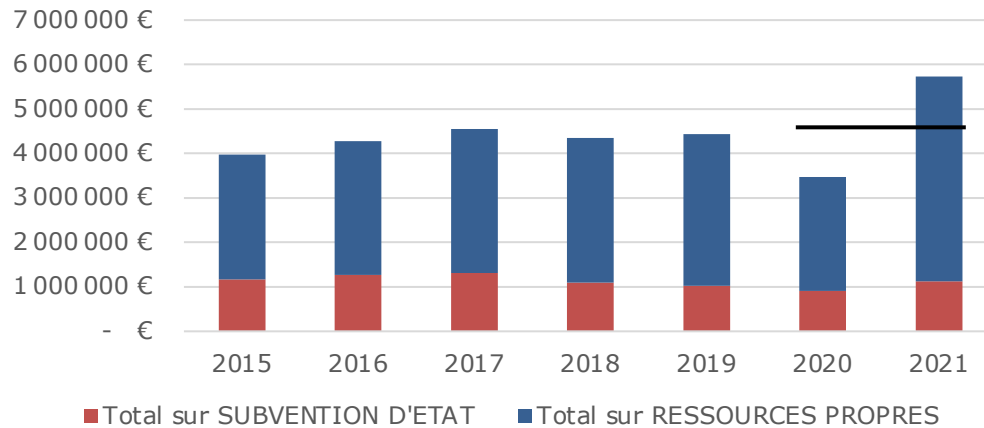
# International Collaborations



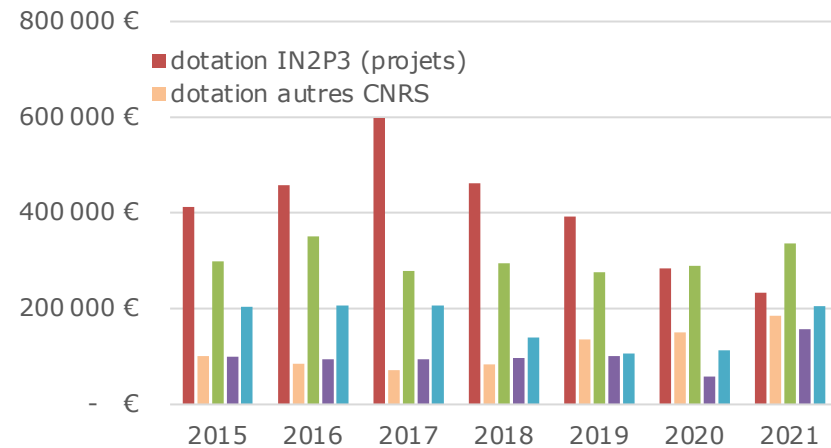


# Subatech Budget

Evolution du budget total de SUBATECH de 2015 à 2021



Evolution du budget en subvention d'Etat par tutelle de 2015 à 2021

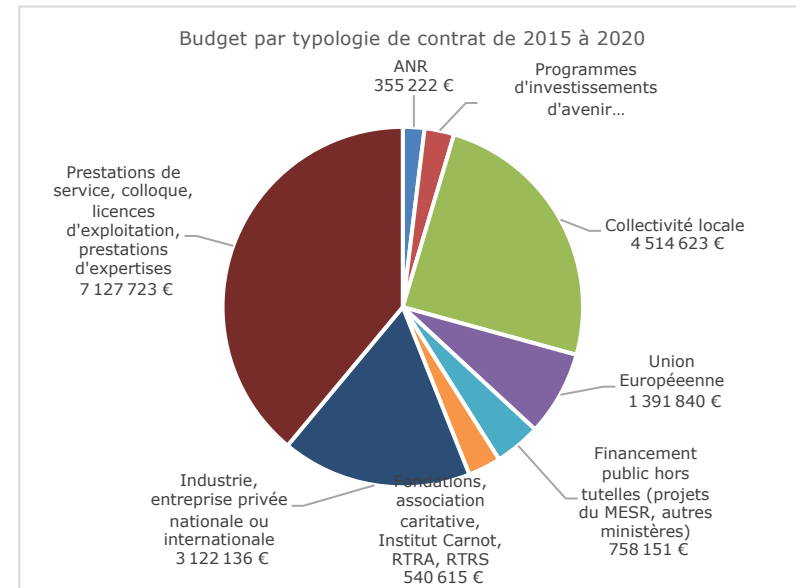


Salary annual budget of about 9 M€

Annual budget 4-5 M€ :

- budget from “tutelles” 0.9-1.1 M€
- research contracts about 2.8-3.0 M€
- SMART activity about 1.1-1.2 M€

Total budget about 13.5 M€ per year

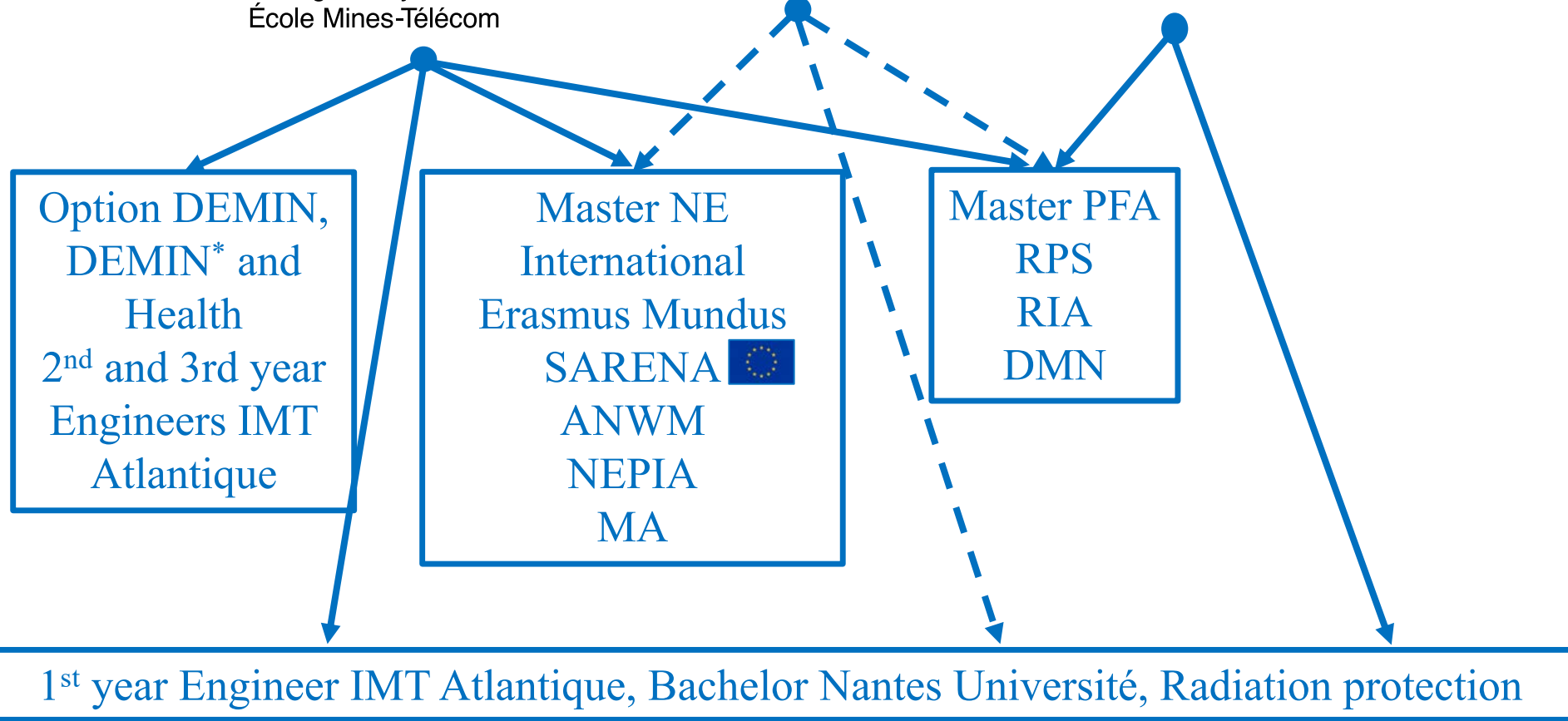




# Teaching activities

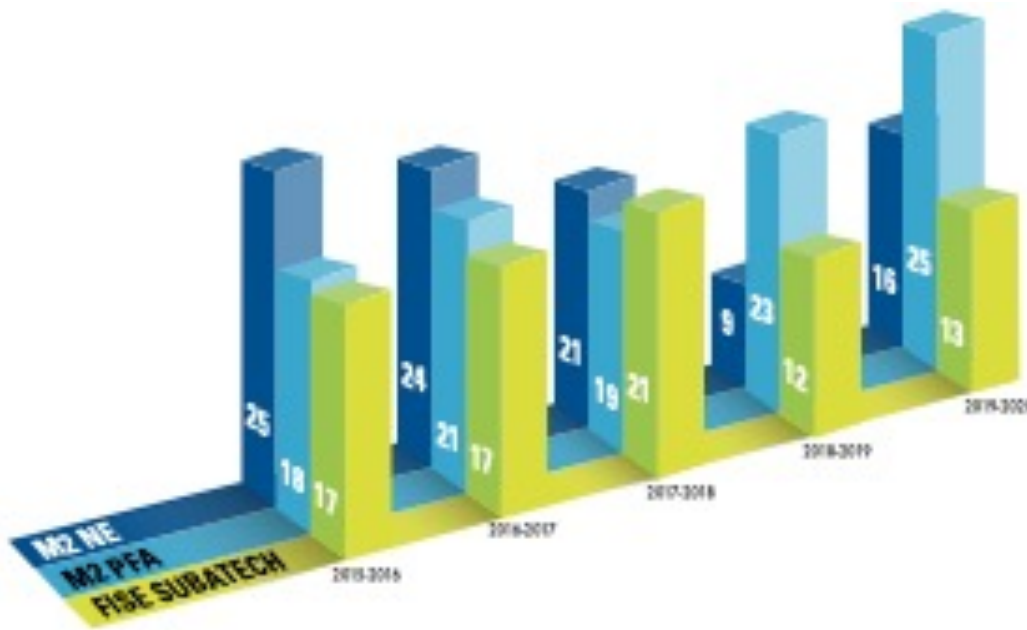


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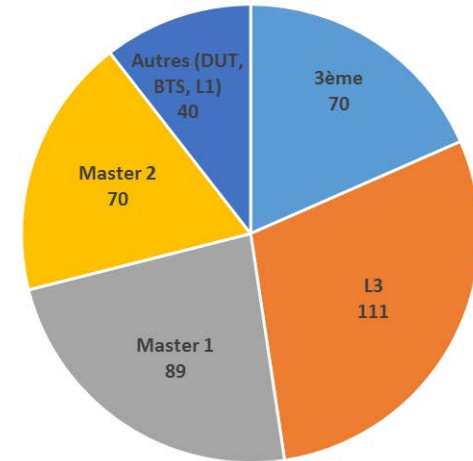




# Number of students and internships



Bilan stagiaires de 2015 à 2020



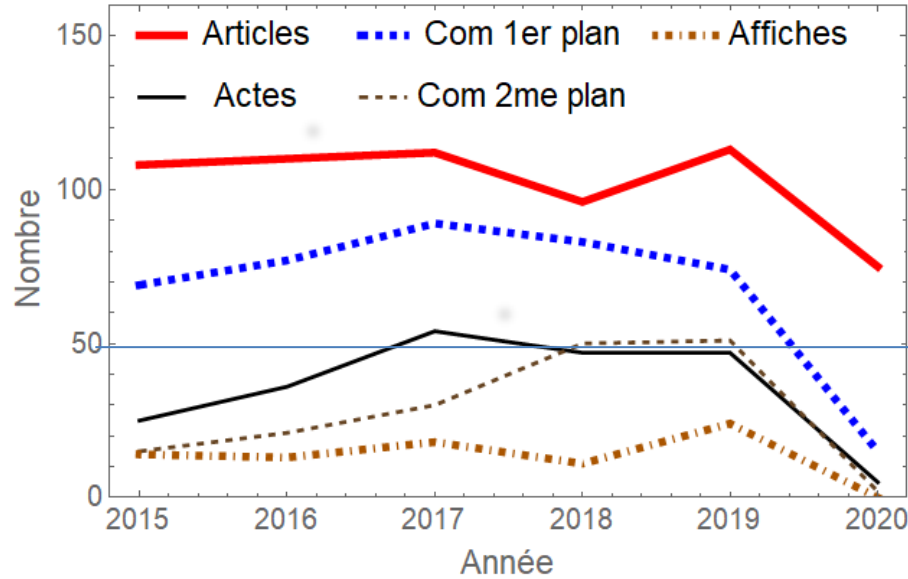
About **60** “master level” students every year with a “nuclear profile”

Strong implication in internships from school, high school, bachelor and master level



# Subatech scientific production

2015-2022



	astroparticules	neutrino	plasma	PRISMA	radiochimie	SEN	théorie	xénon	Subatech
Thèses	2	2	8	6	15	2	6	2	45
HDR		0.5		1	2	1		2.5	7

Table 2: Nombre de thèses et d'HDR sur la période d'évaluation.

About 110 articles “peer-review” per year

About 125 oral presentations per year

About 9 PhD defences per year (success rate 91%)

About 1 HDR defences per year



# Rapport d'activité 2015 - 2020



## Le mot du directeur de Subatech

*A word from the director of Subatech*

Ayant pris la direction de Subatech au 1<sup>er</sup> septembre 2018, succédant à Bernd GRAMBOW, c'est un honneur de présenter cette synthèse de nos activités pendant le quinquennat 2015-2020.

Comme vous allez le découvrir dans ce document, la production scientifique et technique des équipes et services de Subatech a été abondante et de très bonne qualité. Elle a été accompagnée d'une implication forte dans l'enseignement de nos domaines, la valorisation de nos recherches et un engagement déterminé autour de la diffusion de la culture. La fin de cette période a été fortement affectée par la crise COVID19 à laquelle les membres de Subatech ont fait face, respectant les nouvelles règles, garantissant une continuité d'activité, participant à des projets collaboratifs pour réduire l'impact de l'épidémie et en faisant des dons de matériel lors des premiers instants incertains de cette crise inédite.

Ce bilan très positif n'aurait pas été possible sans l'engagement du personnel de Subatech, le soutien et le financement fidèle de nos tutelles, des collectivités locales, de la Région des Pays de la Loire, de l'État et de l'Europe. Merci !

Je vous souhaite une très bonne lecture.

*Since September 1st 2018, I succeeded Bernd GRAMBOW as head of Subatech. As the Director, it is an honor to present this summary of our activities during the 2015-2020 five-year period.*

*As you will reading this document, the scientific and technical production of Subatech's teams and services has been abundant and of very high quality. It has been accompanied by a strong involvement in the teaching of our fields, the valorization of our research and a determined commitment to the diffusion of culture. The end of this period was strongly affected by the COVID19 crisis, which Subatech members faced, respecting the new rules, guaranteeing business continuity, participating in collaborative projects to reduce the impact of the epidemic, and donating materials in the first uncertain moments of this unprecedented crisis.*

*This very positive assessment would not have been possible without the commitment of Subatech staff, the support and faithful funding of our supervising organisations, local authorities, the Pays de la Loire Region, the French government and European Union. Thank you for your support!*

*I wish you a very good reading.*

**Bernd GRAMBOW,**  
Prof. IMT Atlantique,  
Directeur du laboratoire  
de Subatech  
de 2011 à août 2018

*Director of the laboratory  
of Subatech from 2011  
to August 2018*



**Gines MARTINEZ,**  
DR1 CNRS,  
Directeur du laboratoire  
de Subatech depuis  
septembre 2018

*Director of the laboratory  
of Subatech since  
september 2018*

<http://www-subatech.in2p3.fr/images/General/rapport-activites-subatech-2015-2020.pdf>



# Good meeting and Thank you!



Sonder les infinis : des particules au cosmos

