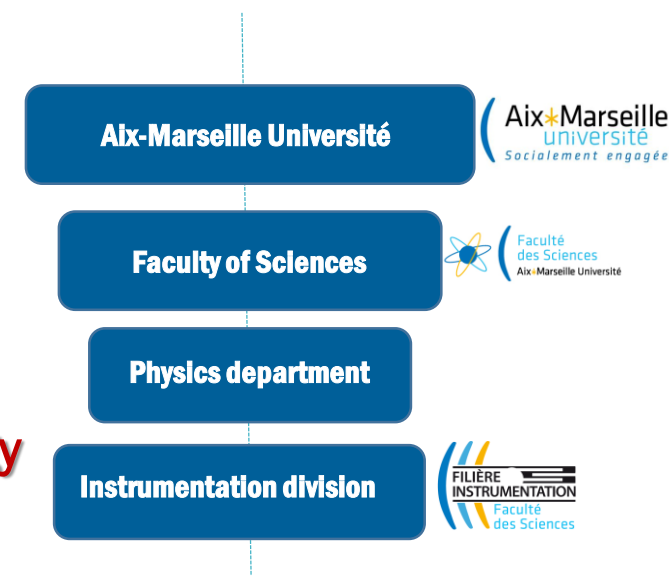


## IMSci-Nu Master

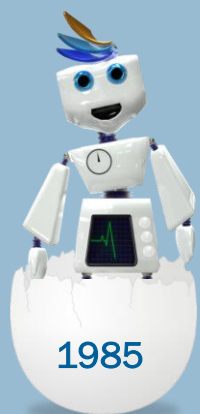
(Instrumentation and Measurement Science for  
Major Nuclear Research Facilities)

# Filière Instrumentation / Instrumentation division

- ❑ Unit of the department of physics in the faculty of Sciences in Aix-Marseille University (AMU)
- ❑ Filière Instrumentation created in 1985
- ❑ ISO 9001 Quality certification since 2003 
- ❑ Different training programs: apprentices and block-release training programs or Initial training program or Prior experimental learning and continuing education
- ❑ 1 Vocational Bachelor's Degree: Professions in Instrumentation, Measurement, Quality Control
- ❑ **1 Master's Degree: Instrumentation, Measurement, Metrology with 5 Tracks**
  - ❑ 200 students
  - ❑ 110 lecturers, professors, industrial trainers
  - ❑ > 100 companies for student internships and apprenticeship
  - ❑ Several research structures and ISFIN institute involved
  - ❑ Industrial steering committee and agreements with various companies

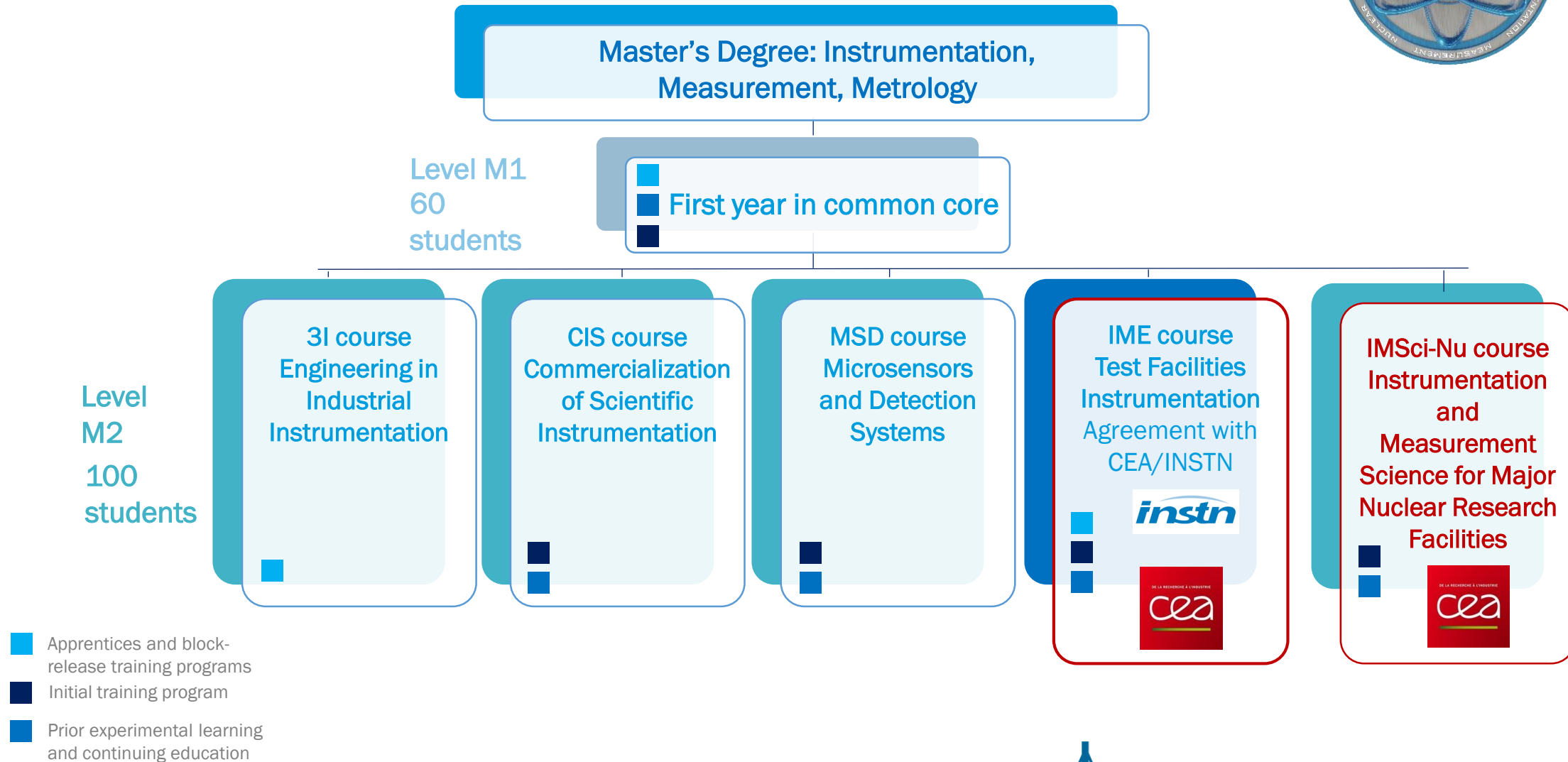


Filière  
Instrumentation



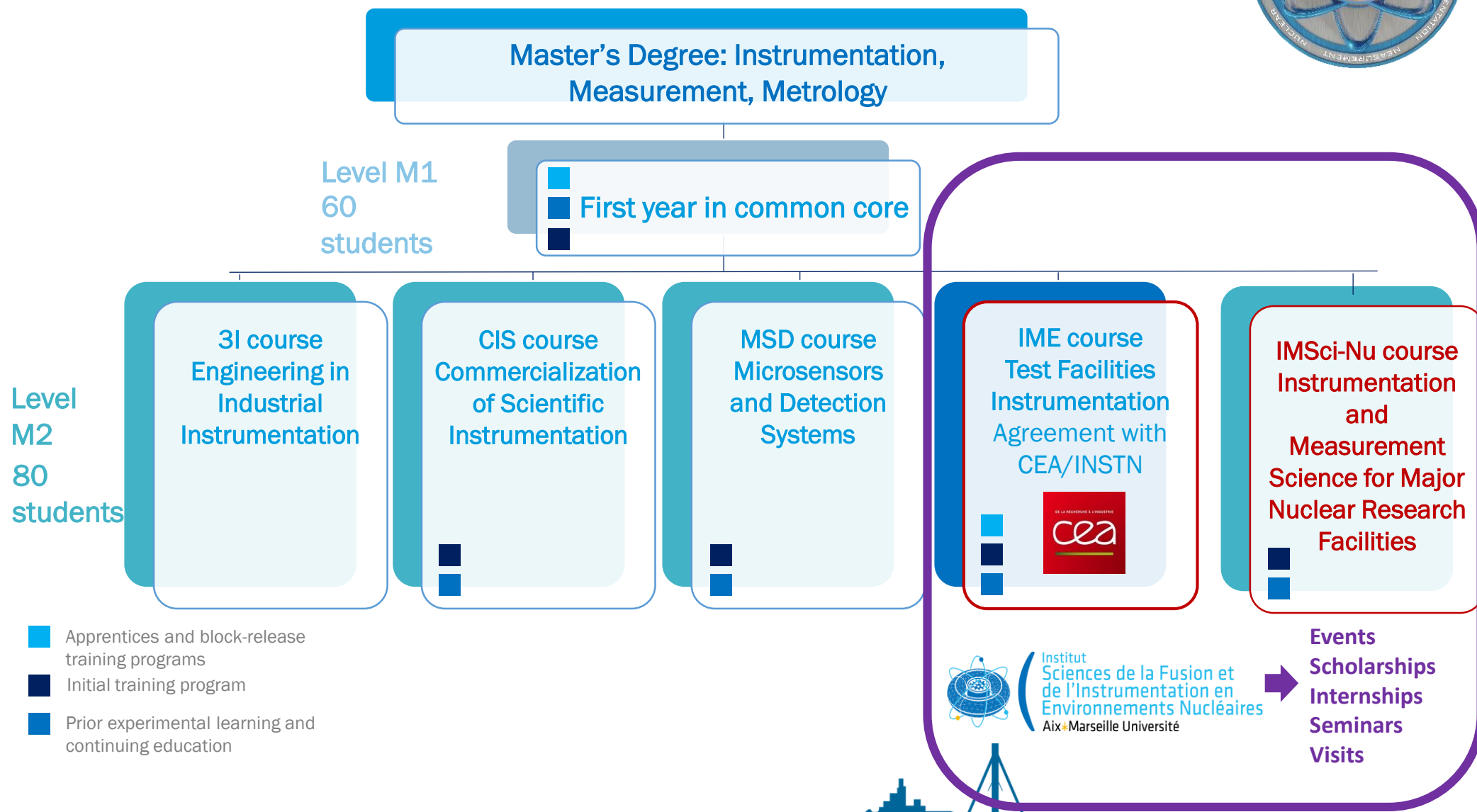
# Master's degree in Instrumentation, Measurement, Metrology

## Master IMM



# Master's degree in Instrumentation, Measurement, Metrology

## Master IMM



## Field:

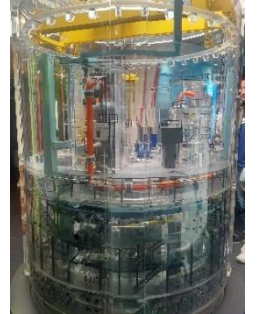
- Instrumentation and Measurement Science for Major Nuclear Research Facilities (fission and fusion)

## Motivations:

- Major fission and fusion facilities in the close vicinity of AMU (CEA, ITER, IRSN → 80 km)
- Need for transverse fission / fusion actions due to the increasing importance of nuclear aspects in ITER
- International need for a diploma to train researchers and specialist engineers

## Objective: to train specialist researchers, project managers and engineers able to

- choose instrumentation
- implement measurements in order to realize experimental physics work for major equipment in the field of nuclear energy (nuclear fission, fusion),
- and to interpret the results thanks to numerical simulations, if necessary



## Creation:

- In October 2022

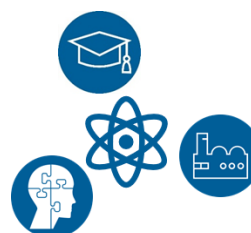
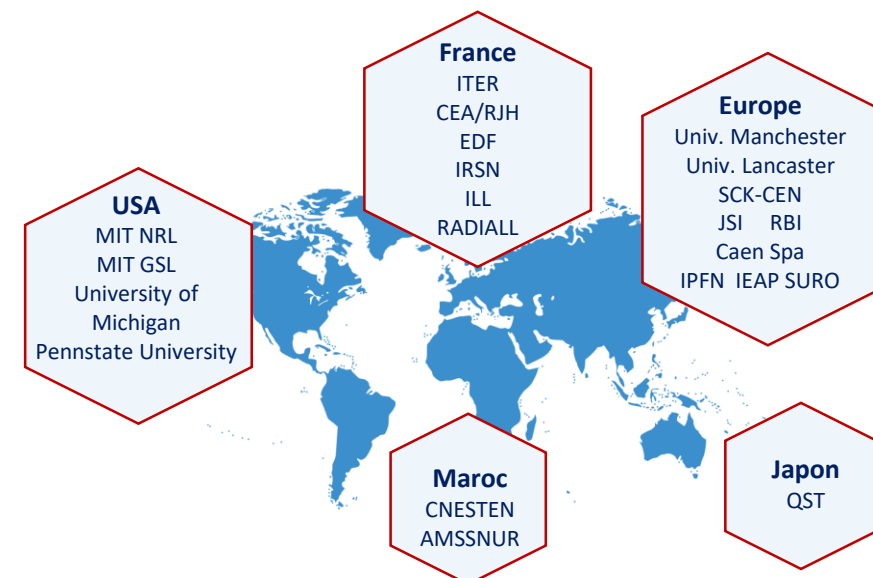


## Certification:

- Quality certified (ISO 9001)

## Partners:

- 23 partners who have formulated a letter of support and interest (academics, nuclear centers, companies, organizations) and are involved in the IMSci-Nu program



IMSci-Nu course  
Instrumentation  
and  
Measurement  
Science for Major  
Nuclear Research  
Facilities

## Specificities:

- Taught in English
- 1-year with 340 h of courses from October to March, followed by an internship (from 4 to 6 months in France or abroad)
- IMSci-Nu courses realized by professors, lecturers, scientists and experts coming from Universities, Research institutions, Nuclear Centers, Companies from France and abroad
- A comprehensive program involving the partners for courses, hands-on activities, remote experiments on nuclear facilities, research project, visits, seminars, winter school, internship topics

IMSci-Nu course  
Instrumentation  
and  
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Facilities



# IMSci-Nu

## Training program

- 2 Education units: Disciplinary courses (nuclear, fission, fusion, instrumentation, detection, diagnostics)
- Education unit: Major nuclear facilities
- Education unit: Modeling and experimental work with practical activities, including online activities in real time on major nuclear facilities abroad at MIT (USA), JSI (Slovenia), IPFN (Portugal)
- Education unit: Laboratory research project course
- Education unit: Interculturality and international communication course with a school involving international partners (IMSci-Nu 1-week winter School at the end of February and beginning of March)
- Education unit: Visits to nuclear facilities + 4 to 6 month internship in connection with a major international facility in France or abroad Research support in the course network

IMSci-Nu course  
Instrumentation  
and  
Measurement  
Science for Major  
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Facilities



Units	ECTS	Modules	Hours	Total
Fundamentals in nuclear fission and fusion	6	Nuclear Physics	14	42
		Radiation-Matter Interactions	7	
		Nuclear fission and fusion reactions	7	
		Plasma, material damage, heat transfer	14	
Major nuclear facilities and challenges	6	Tokamaks	7	49
		ITER and DEMO	7	
		Research reactors and MTR, JHR	7	
		Nuclear Power Plants, SMRs/AMRs	7	
		Reactor operating principle and control system	7	
		Reactor and tokamak experiments including TBM (Tritium breeding)	7	
Other installations: accelerators, generators, ...	7			
Nuclear detection, instrumentation and fusion diagnostics	12	Radiation detection	7	84
		Identification of sources of uncertainty	14	
		Non-destructive testing methods	14	
		Nuclear heating rate measurement	7	
		Principle of radioprotection	7	
		Measurements and instrumentation under severe thermo-hydraulic conditions	10.5	
		Instrumentation for dismantling and remediation	10.5	
		Extreme constraints for tokamak measurement systems	7	
Thermal diagnostics for tokamaks	7			
Modeling and experimental work	6	Particle transport modeling (course)	7	59.5
		Particle transport modelling (practical)	7	
		Thermal and fluid modeling (course)	3.5	
		Thermal and fluid modeling (practical)	7	
		Practical work on major nuclear facilities (remote, 3D)	21	
		Hands-on activities on detectors, sensors and characterization devices	14	
Total S1	30			234.5
Interculturality, international communication and scientific seminars	6	(Inter)cultural Intelligence	3.5	49
		Cultural Patterns & Variability (communicating effectively in the global workplace)	3.5	
		Communication Strategies for Intercultural Teamwork	3.5	
		Designing and Delivering Effective Sponsor Talks	3.5	
		Global Writers-Global Readers	3.5	
		Less is More (style and substance in writing up research)	1.75	
		Strategic Communication	1.75	
Scientific seminar series (school, remote, in-person)	28			
Research project	6	Research project with bibliographical, experimental and numerical activities	42	42
Professionalization and Internship	18	Remote and in-person visits (major instruments in France and abroad, laboratories)	14	14
		4 to 6 month internship on international facilities with thesis and oral presentation		
Total S2	30			105
TOTAL M2	60			339



## □ Training program

- The hands-on activities associated to the Education Unit **“Modeling and Experimental Work”** are carried out at Aix-Marseille University and thanks to online remote experiments on major nuclear facilities
- The **“Research project”** Unit involves several laboratories of Aix-Marseille University providing state-of-the-art topics in the fission and the fusion fields
- The IMSci-Nu program includes a **1-week winter school** with several talks given by international partners (MIT-USA, JSI-Slovenia, University of Lancaster, University of Michigan, IPFN-Portugal, SCK-CEN-Belgium, CAEN Spa, ...), with a visit of the CEA (Cadarache center) and with a poster session (posters realized by IMSci-Nu students on their work conducted in the education unit “Research Project” and by PhD students)
- Students are supervised and assisted individually in their search for an internship

IMSci-Nu course  
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Total S2	30			105
Total M2	60			339



# IMSci-Nu



## □ Benefits for students enrolled:

- a team of supervisors involved in different high-level joint research programs conducted in nuclear instrumentation (Joint laboratory LIMMEX (AMU-CEA-CNRS)) and involved in international conferences such as ANIMMA
- an important sustained network of Alumni of the Filière Instrumentation (150 students per academic year) inside the Physics Department of the Sciences Faculty of Aix-Marseille University
- a mentoring event is organized each academic year with IMM students, partners, sponsors, companies to develop links between various actors
- various actions developed within the framework of the graduate school of ISFIN institute (seminars, thematic days, visits, scholarships)
- two kinds of scholarship (1000 euros/month for 10 months). TIGER master's Excellence scholarships (A\*MIDEX foundation program) enables to finance international students with excellent backgrounds and other scholarships from ISFIN institute are available for students never enrolled in an Aix-Marseille University degree. An application is required.





## □ Admission requirements:

- A first year of master (M1) or a master degree (M2) or a master of science degree (MSc) in instrumentation or metrology or applied sciences or nuclear physics or physics or physics-chemistry or material sciences or thermal sciences or energy or engineering sciences or microelectronics or fluid mechanics
- Engineer degree in instrumentation or metrology or applied science or nuclear physics or physics or physics-chemistry or material sciences or thermal sciences or energy or microelectronics or fluid mechanics



## □ To apply:

- Campus France platform for several countries
- E-Candidat for the other countries (France, Europe)

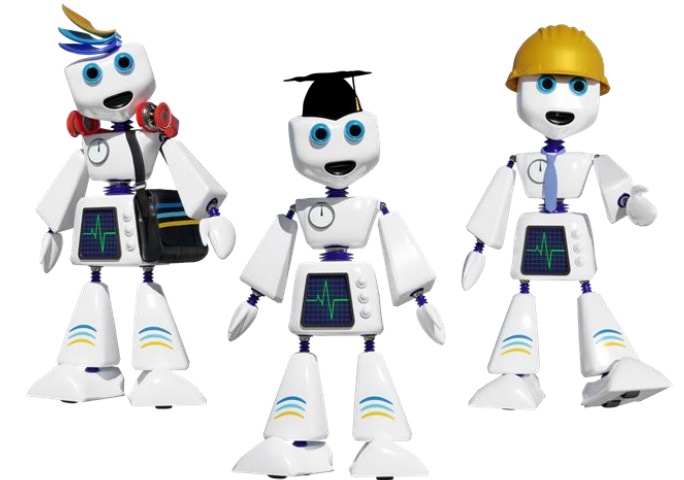
<https://candidatures.univ-amu.fr/candidatures/#!accueilView>

→ Faculté des Sciences, Master, Master 2 Instrumentation, mesure, métrologie :  
Instrumentation and measurement science for major nuclear research facil.



## □ The main jobs after the Master's degree

- PhDs
- Research engineer positions in universities, nuclear research centers and other research organizations, international nuclear infrastructures
- R&D project manager positions in nuclear research centers, high-tech companies and international nuclear infrastructures
- Nuclear engineer positions in nuclear centers, service companies or international industries
- Test engineer positions in nuclear research centers, high-tech companies or industrial R&D departments
- Instrumentation design engineer positions in universities, nuclear research centers and other research organizations or in high-tech companies
- Metrology engineer and metrology manager positions in public or private specialized laboratories, service companies or industries



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## □ Contact

○ Prof. Christelle Reynard-Carette

[christelle.carette@univ-amu.fr](mailto:christelle.carette@univ-amu.fr)

<https://www.linkedin.com/in/christelle-reynard-carette-1a49bb15a/>



## □ Website

<http://filiere-instrumentation.com/master-imm/imsci-nu-master>

## □ Interactive presentation

<https://view.genial.ly/61e462af45bdb80d2d183dfe>



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Facilities

# IMSci-Nu

IMSci-Nu course  
Instrumentation  
and  
Measurement  
Science for Major  
Nuclear Research  
Facilities

Instrumentation, Measurement Science for major Nuclear research facilities



Aix-Marseille université  
Socialement engagée



Institut Sciences de la Fusion et de l'Instrumentation en Environnements Nucléaires  
Aix-Marseille Université



An original international 1-year master's track created in 2022



Fission and fusion nuclear energy



Very close major nuclear research facilities (ITER, JHR, CABRI, WEST...)



Over 20 worldwide partners (universities, nuclear centers, institutes, companies)



ISO 9001 quality certification



Scholarship opportunities



A 1-year track taught in English



A comprehensive track including:

Lectures and seminars provided by prestigious scientists and experts (25% from international partners), hands-on activities, remote experiments on nuclear facilities (MIT reactor and JSI reactor), research projects, internship, winter school, facility visits, international mobility...



Associated to an education division with a long-standing experience and an important sustained alumni network



A team of supervisors involved in different high-level joint programs conducted in innovative instrumentation



Linked to various research laboratories and companies



Associated to scientific events (IMSci-Nu School, ANIMMA conference...)



Contact person:

Prof. Christelle Reynard-Carette (AMU, Marseille, France)  
christelle.carette@univ-amu.fr



# Aix-Marseille University in a nutshell

# Aix-Marseille University in a nutshell



- From the end of the XIX<sup>th</sup> century to 1968:  
The faculties are merged into Aix-Marseille University,  
chaired by the Rector of the Academy



- 1970-1973: Aix-Marseille Universities I, II and III are created

- 2007-2009: The merger of the three universities is thought through and Aix-Marseille University's founding principles are adopted
- December 10<sup>th</sup>, 2010: The university's legal status are voted
- November 28<sup>th</sup> and 29<sup>th</sup>, 2011: The three councils are elected



- January 1<sup>st</sup>, 2012: Aix-Marseille University is created

In the South of France, AMU headquarters, Marseille



80 km from CEA, ITER org  
and IRSN (JHR, CABRI,  
WEST, ITER...)



# Aix-Marseille University in a nutshell



- More than **80,000 students**, including 10,000 international students
- Over **3,000 doctoral students** 39,5% of whom are from abroad (from 105 countries)



- A staff of **8,000**, including 4,400 senior lecturers, professors, teachers
- 17 faculties**, schools or institutes



- 18 Aix-Marseille University institutes**
- 122 research structures** including 113 research units and 9 federative research structures
- 12 doctoral schools

- 1 long-term Initiative of Excellence (IDEX)** project (€26 Million per year)
- 1 City of Innovation and Knowledge (CISAM)
- 1 European Civic University (CIVIS) in cooperation with 9 universities



- 820,000 m<sup>2</sup> net floor area for 5 campuses



- A budget of €720 Millions

# Aix-Marseille University in a nutshell



## □ 6 education and research fields

- Arts, humanities, languages and social sciences
- Law and political science
- Economics and management
- Health
- **Science and technology**
- Multidisciplinary sector (technological institute and education departement)

## □ 5 interdisciplinary research interests

- **Energy**
- The environment
- Health and life sciences
- Advanced sciences and technologies
- The humanities

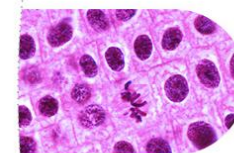


### • Nuclear fusion and fission

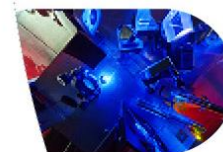
- Bioenergy
- Energy storage
- Energy efficiency
- Energy transition



- Climatology
- Man/Environment interactions
- Resources
- Oceanology



- Oncology
- Immunology
- Neurosciences
- Microbiology and infectious diseases
- Imaging
- Genetics
- Nutrition/Cardiovascular



- Optics/Photonics
- Microelectronics
- Aeronautics/Spatial domain
- Mathematics
- Particle physics
- Astronomy/Cosmology



- Mediterranean studies
- Digital humanities
- Migrations
- Archeology
- Brain/Languages
- Globalization
- Economics/Public policies
- Law

# Aix-Marseille University in a nutshell



□ AMU created in 2012 (1st January)

