Training through research

Experimental Lab work at UM2

Montpellier

- 8th French city
  2nd French University city (21%) :
- Montpellier 2 is ranked after Paris, Strasbourg, Lyon in Shanghai ranking
- "Faculté des Sciences" : 11 departments
  Physics department
  Students in Master of physics

Nb of students
~ 55 000
~ 15 800 (2012)
6 863 (13/01)
~ 400
~ 40

- « Ecole doctorale » (ED) : « Information, Structure, Système » (I2S)
  - Physics is one out of 7 science fields, not the largest ...
    Others have strong connections with industry.

    ~ 350 PhD students ; ~ 100 new PhD students / yr

- PhD funding :
  - I2S : 4-5 PhD funding / yr for Physics (L2C+LUPM)

    13 / 26 HDR at LUPM → 1 / yr for LUPM
  - Labex OCEVU (8 yr) : 3/yr / 6 labs → 2*0.5 / yr for LUPM + X

From bachelor to master

- **Bachelor degree :**
  Cosmologies, Planetary science / Astrophysics, Particle and Nuclear Physics, Origin of the elements

- **Masters :**

  - **Master Cosmos, Fields and Particles – CCP – :**
    Field theories, Cosmology, Astrophysics, Experimental and theoretical (astro)particle physics

  - **Master Space and Application – EA – (University in Hanoï) :**
    International, Space Science and Technology/Engineering, Nanosatellites

  - **+ Contribution to the Master of Astrophysics (Lebanon)**

- **Master students / yr:**

	M1	M2	
CCP :	5-12	5-14	
EA :	10	9	(spread over 3 French Universities)

- **LUPM PhD's :**
  2 to 5 new PhD's / year (3.3 avg)
  All completed within 3 yrs

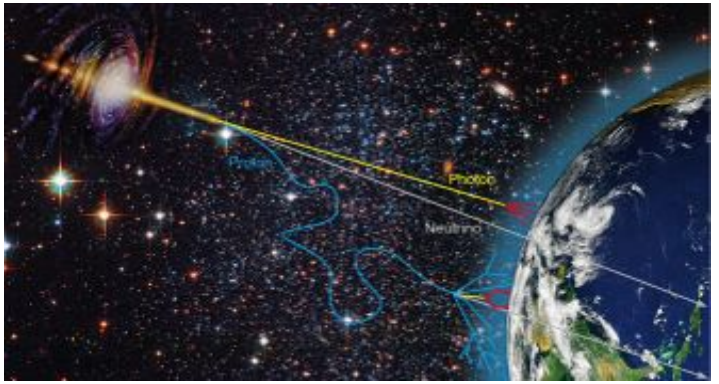
Master « Cosmos, Fields and Particles »

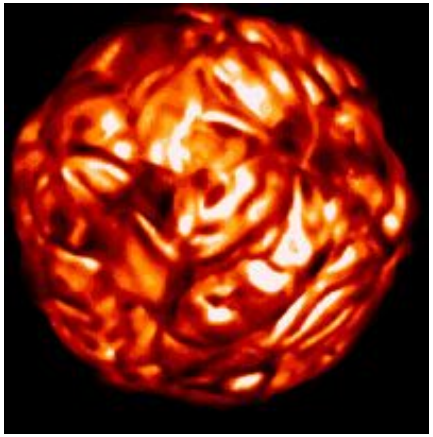
http://www.master-physique.univ-montp2.fr/ccp

- Created in 2004 GAM / GRAAL → LPTA / GRAAL → LUPM / L2C
  Lead : A.Falvard (2004), F.Feinstein (2006), C.Hugonie (2009)

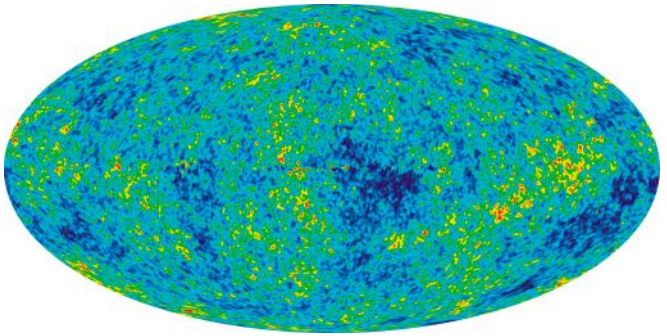
- Topics :

Astro-particles

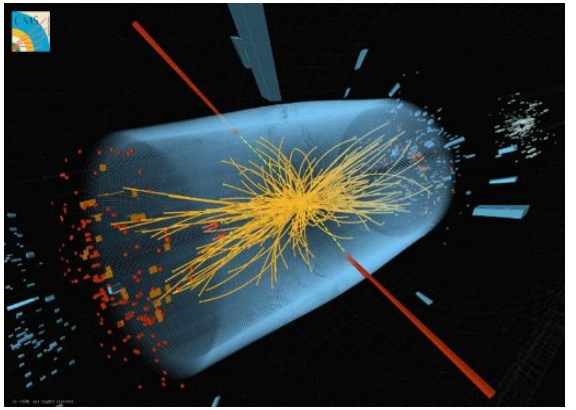




Astrophysics



Cosmology



Particles

- Partners :

Master « Cosmos, Fields and Particles » : LUPM contributions

First year - M1 : 535 hrs

- Semester 1 : 30 ECTS (300 hrs)
  25 % LUPM
- Semester 2 : 22.5 ECTS (225 hrs)
  75 % LUPM
- 6 weeks internship : 7.5 ECTS
  90 % LUPM

LUPM contribution to CCP teaching :

Year 1 : ~ 50 % LUPM

Year 2 : ~ 65 % LUPM

Second year (Semester 3&4) – M2 : 240 hrs

- Astrophysics : 10 ECTS (75 hrs)
  100 % LUPM
- Particles and fields : 10 ECTS (51 hrs)
  40 % LUPM
- Cosmology : 10 ECTS (51 hrs)
  20 % LUPM
- Particle Physics and Instrumentation :
  6 ECTS (36 hrs)
  80 % LUPM
- Experimental lab work : 4 ECTS (24 hrs)
  100 % LUPM
- 3 months internship : 20 ECTS
  15 % LUPM

Master « Cosmos, Fields and Particles » : Number of students and PhD opportunities after graduation

First year :

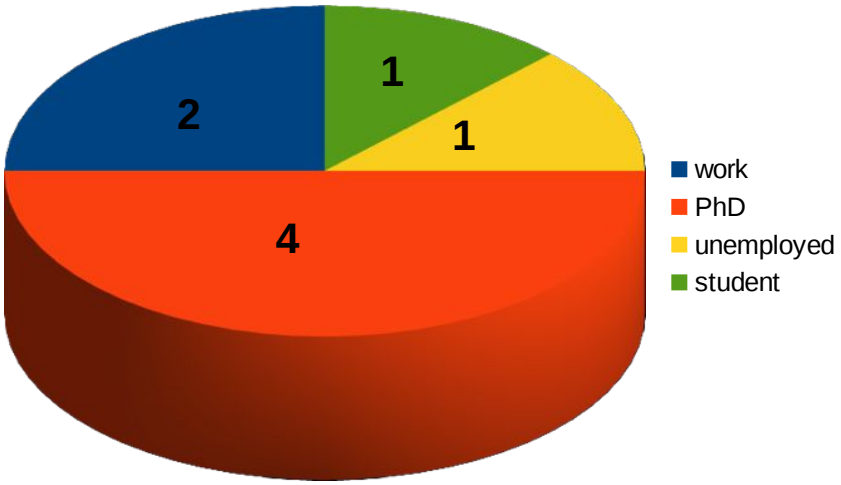
~ 8.5 avg students
(~50% outside)

~ 80% admitted in M2

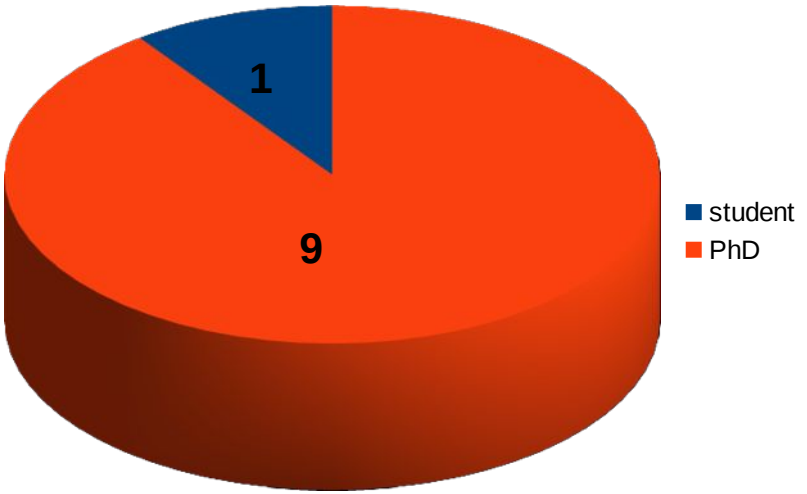
Second year :

~ 9 avg students
(~25% outside)
~ 70 % PhD funding
20% at UM2
50 % outside UM2

2011-2012
(8 students)



2012-2013
(10 students)



Master « Space and Applications »

http://usth.edu.vn/fr/studycourses/mastercourses/master-of-space-and-applications/

- University of Science and Technology of Hanoï (USTH)
  - consortium of ~ 40 French universities
  - 100 MEu – 2010-2020
  - 40 PhD funding / yr
  - 4 masters + 2 (2012)

- S&A Master : USTH + 3 French universities

LUPM LABORATOIRE MONTPELLIER UNIVERS & PARTICULES

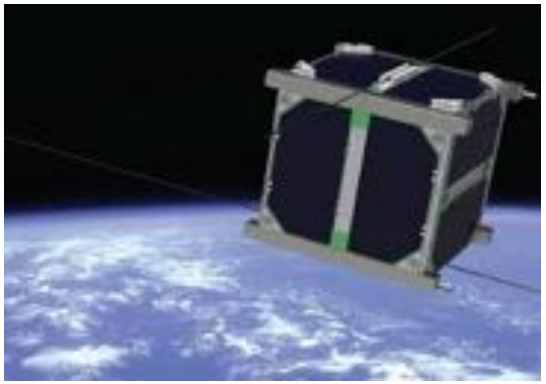
  - drives the Montpellier contribution
  - 3 teaching unit coordinators (2 Faculties + 1 engineer)

2012/2013 M1 class

Started in Septembre 2012

2012-2013 : 10 M1
2013-2014 : 10 M1 + 9 M2

Master « Space and Applications » : Fully within the strategy of Montpellier 2 University



Implication of
LUPM and APC into
IN2P3 space experiments

Montpellier 2 University,
first French student nanosatellite
(ROBUSTA 02/2012)

Vietnam Space Center

Master « Space and Applications » : LUPM contributions

First year :

- **Semester 1 : 28 ECTS (280 hrs)**
- **Semester 2 : 16 ECTS**

  Fluid dynamics

  Particle physics and interaction with matter and detectors. Experimental lab work.

- **6 weeks internship (Vietnam) : 8 ECTS**

Second year (Semester 3&4) : 30 ECTS

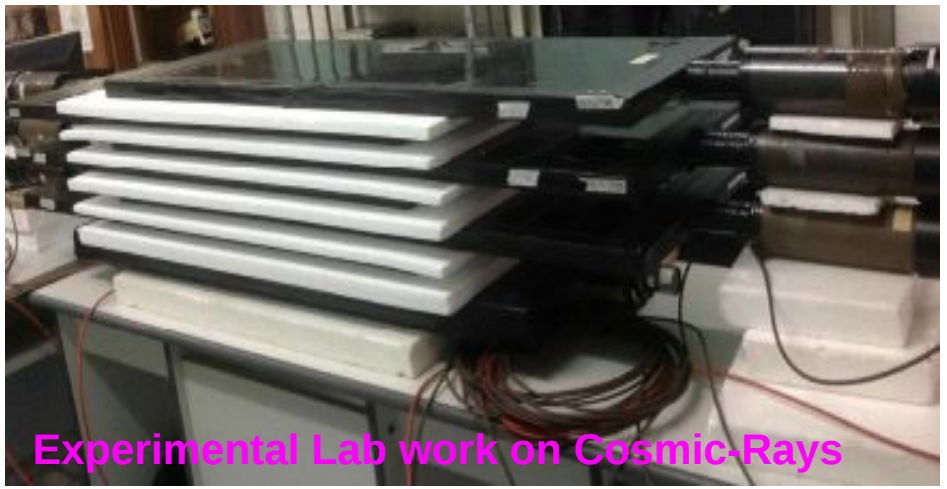
- **Option “Science in space” :**
- **Option “Space Technologies” :**

  GNS Telemetry

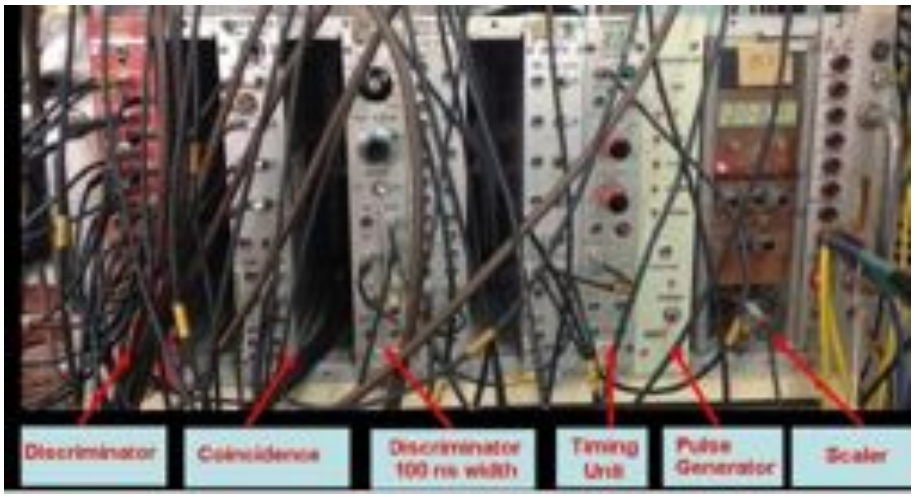
  The effect of ionizing radiation on the components
  F.Saigné IES

  Vaacum technology and Cryogeny
  C.Chaubet L2C

- **6 months internship (France)**



Experimental Lab work on Cosmic-Rays



Conclusions

- **Master Cosmos, Fields and Particles – CCP – : Strategic for LUPM**
  - **Centered on astroparticle physics with strong theoretical grounds**
  - **Well established master degree attractive for French and foreign students (Bordeaux, Clermont-Ferrand, Nantes, Toulouse, … , Romania, Germany, Morocco, Belgium, Lebanon ...) - Erasmus**
  - **Opens to Theses in astroparticle physics, particle physics, cosmology, astrophysics, and solid state physics, ...**
  - **~ 70% of PhD funding after the M2 (~20% at UM2 and 50% in other institutes)**
    → Very good feedback from colleagues
  - **LUPM involvement : ~ 40% (10/26) teaching staff (CNRS + Faculty), 25% FTE secretariat**
- **Master Space and Application – EA – (University in Hanoï) : Part of UM2 strategy**
  - **Unique educational structure in Vietnam for the development of space technology and sciences**
  - **Co-accredited by Vietnam and Montpellier (France) → International collaborations**
  - **Inter-French Universities project**
  - **New PhD funding opportunities for LUPM**
  - **Investigate teaching/research synergy (access to nanosatellites platforms)**
- **PhD's : In 3 years : 10 new PhD's at LUPM despite only 2.5 funding opportunities from ED**

Backup

Program of the first and second years and LUPM contributions

First year - M1 :

- **Semester 1 : 30 ECTS (300 hrs)**
  - Experimental physics (5)
  - Atoms, molecules and radiations (5)
  - Physics of condensed matter (5)
  - Modeling and simulations (2.5+2.5)
  - Fluid dynamics (5)
  - Cosmology 1 (5)
- **Semester 2 : 22.5 ECTS**
  - Statistical physics (5)
  - Astrophysics 1 (5)
  - High energy physics (5)
  - Advanced quantum mechanics (5)
  - Observational astrophysics (2.5)
- **6 weeks internship : 7.5 ECTS**

Contribution to teatching :

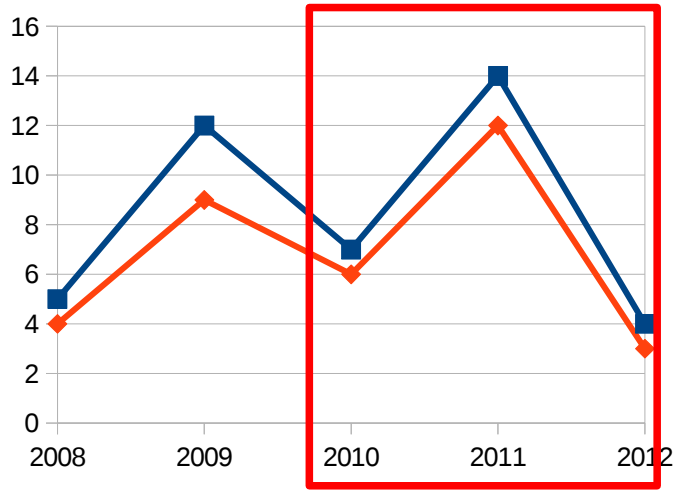
Year 1 : ~ 50 % LUPM
Year 2 : ~ 65 % LUPM ,
27.5 % L2C,
7.5 % Ext

Second year (Semester 3&4) - M2 :

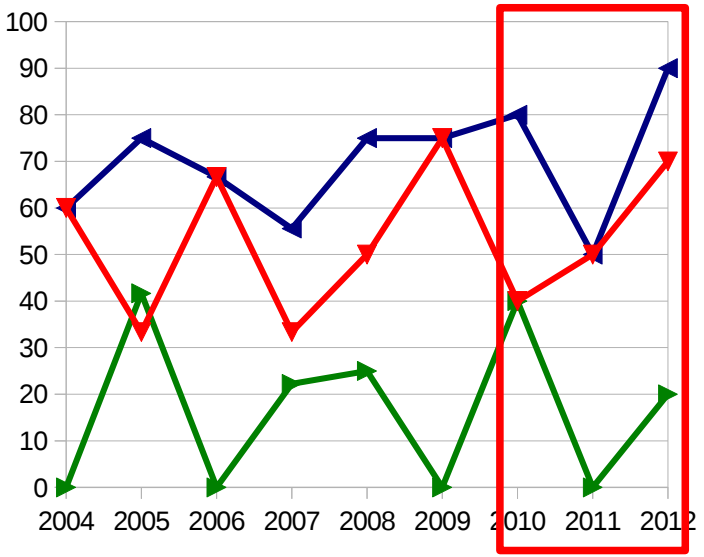
- **Astrophysics 2 : 10 ECTS**
  - Astrophysics and plasmas (33h – 6 ECTS)
  - Radiations at high energies (9h – 2 ECTS)
  - Particles propagation and acceleration (9h – 2 ECTS)
- **Particles and fields : 10 ECTS**
  - Field theories (30h – 6 ECTS)
  - Standard Model (21h – 4 ECTS)
- **Cosmology 2 : 10 ECTS**
  - Primordial universe (25.5 h – 5 ECTS)
  - Large scale structure formation (15h – 3 ECTS)
  - Dark Matter (10.5 h – 2 ECTS)
- **Particle Physics and Instrumentation: 6 ECTS**
  - Experimental techniques (21h – 4 ECTS)
  - Probability and statistics (6h – 1 ECTS)
  - Neutrino physics (9h – 1 ECTS)
- **Experimental lab work : (24h - 4 ECTS)**
  - Cosmic rays (24 hrs – 2 ECTS)
  - Observational astrophysics, OHP (2 ECTS)
- **3 month internship : 20 ECTS**

Number of students and PhD opportunities after graduation

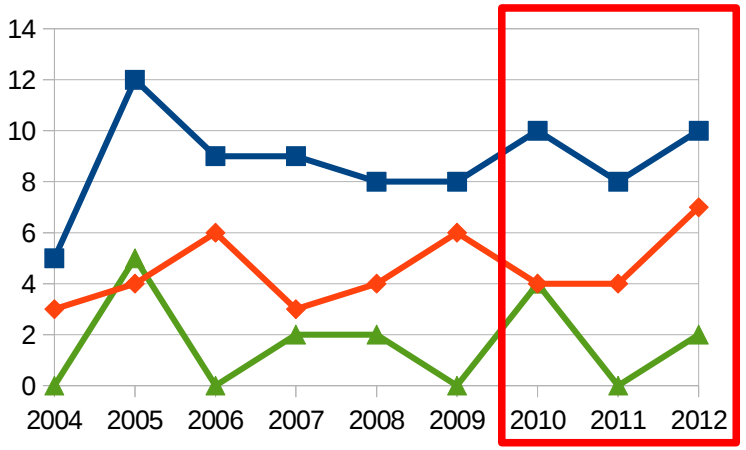
Number of M1 students (~8.5) and Admitted in M2 (~ 81%)



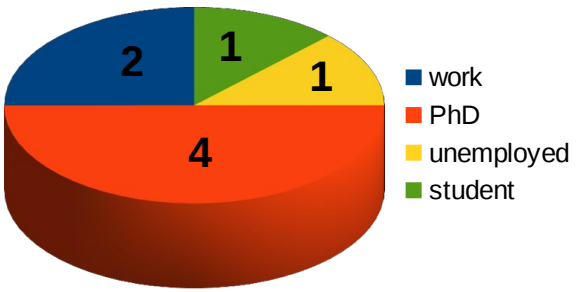
Fraction of PhD funding (~71 % PhD) at UM2 (19%), ext. UM2 (52%)



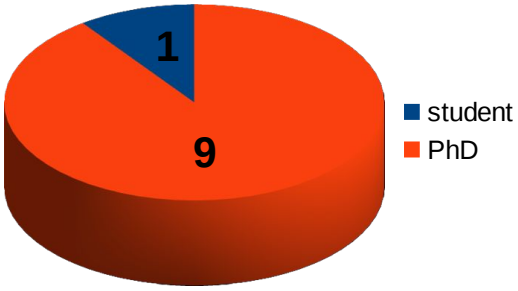
Number of M2 students (~9) PhD at UM2 (19%) PhD ext. UM2 (52%)



2011-2012
8 students



2012-2013
10 students



First and second years : M1/M2

First year - M1 :

- **Semester 1 : 28 ECTS (280 hrs)**

Human, economic, social and juridical science
Basis of solid state physics
Introduction to earth and planetary sciences
Telecoms, Antennas, microwaves 1
Optical systems and image formation
Introduction to satellite technology
Probability and statistics
Introduction to programming
Signal analysis and image processing
Space project management

- **Semester 2 : 16 ECTS**

Introduction to astrophysics and celestial mechanics
Fluid dynamics
D.Puy LUPM
Particle physics and interaction with matter and detectors
E.Nuss LUPM
Orbitography
Space observation of earth
Electronics
Numerical methods

- **6 weeks internship (Vietnam) : 8 ECTS**

Second year (Semester 3&4) - M2 : 30 ECTS

- Human, economic, social and juridical science
Observational techniques
Space and application projects
System project Quality
Earth observation, Theory and observation
Advanced astrophysics
Data processing and Numerical simulations
Finite Element, Method, Control Engineering

- **Option "Science in space" :**
Earth observation 2
Earth observation : Applications
Advanced planetary sciences
Advanced astrophysics
Data processing and Numerical simulations

- **Option "Space Technologies" :**
GNS Telemetry
C.Zurbach LUPM
The effect of ionizing radiation on the components F.Saigné IES
Spacecraft Architecture
Vaacum technology and Cryogeny C.Chaubet L2C

- **Stage 6 month internship (France)**

INTENS Workshop & Nanosatellites ~ 80 participants