Enigmass Education

Laurent DEROME, november 28, 2021

with slides from J. Collot (ESIPAP) and P. Del Amo Sanchez (GRASPA)



Enigmass/Education Enigmass2 Project

- The plan is to build on the successful developments undertaken during Enigmass1, and to strengthen and extend them:
 - ESIPAP (European School of Instrumentation in Particle and Astroparticle Physics) GrasSPA (Graduate School of Particle physics in Annecy);

 - M2/PhD fellowships
 - Visitors
 - Graduate School













European School of Instrumentation in Particle & Astroparticle Physics

Enigmass/Education ESIPAP

- THE reference school in HEP instrumentation in the vicinity of CERN, the world agora of the HEP community.
- Very broad & intensive school with REAL exams : ECTS 2 courses of 4 weeks each, that can be followed entirely or selectively by weeks
- Selective admission of up to 2 x 16 students per year at international level
- Open to Master, PhD students and junior professionals



Sharing smiles & flags for the final picture !





esida

European Scientific Institute



1. PROGRAMME EVOLUTION

- • Full remote edition (lectures, tutorials and practicals)
- Quite a lot of changes despite the conditions
- Course 2 changed names and was almost totally reprogrammed !

COURSE 1 **PHYSICS OF PARTICLE & ASTROPARTICLE DETECTORS**

Week 1

Experimental Subatomic Physics Experimental Cosmology. Experimental Astroparticle Physics

Week 2

Interaction of Particles With Matter Radioprotection Tracking **Machine learning Remote Lab sessions**

Week 3

Calorimetry TMVA Lab **Imaging & Cherenkov Detectors Particle Identification Muon Detection Remote Lab sessions**

Week 4

Detector Simulation C++ Programming Computing lab sessions

COURSE 2 **ADVANCED LECTURES ON DETECTORS AND APPLICATIONS**

Week 5

Detector Technologies & Electronics : Detector Technologies

General aspects Gaseous detectors Noble liquid detectors Low temperature detectors Semiconductor detectors **Cherenkov and TR detectors** Gravitational wave detection Scintillation detectors **Gaseous neutron detectors**

Signal Processing & Electronics

Week 6

Real Time Computing & Data Handling

Trigger **Data Handling Trigger & Data Acquisition Software FPGA C++** Programming **Python Programming**

Week

Magnet for particle detectors **Medical Applications Additive Printing Project Management Practical labs**

Week 8

Medical applications & Project

Medical Radioisotopes Radiotherapy :

Medical physics challenges in modern radiotherapy Beam monitoring in high-intensity treatments **Quality assurance**

Nanoparticles to boost radiation therapies

Medical Imaging :

Medical challenges in diagnostic imaging Photon imaging Advances in nuclear medicine X-ray phase contrast imaging Ultrasound

Tutored applied project design









2. FACULTY





3. Attendance curve



Balanced attendance !



- ••• All lectures are separately evaluated by students
- Each evaluation separately forwarded to concerned teacher(s)
- Most evaluations are very very positive (many thanks to all teachers and tutors)
- The medical applications lectures were really well received.
- End-of-school project was a great success : students call for more of that
- ••• Remote labs met the objectives despite the conditions !
- Students call for more hands-on, practicals, tutorials, exercises
- The student satisfaction of course 2 is now as high as course 1





••• Given the uncertainty but also considering the student satisfaction, we decided to organize a new remote edition for 2022



OTTAL DE L 23 August **28** 2021 ANNECY FRANCE

Registration deadline : JUNE 10th https://lapp.in2p3.fr/graspa2021

GraSPA2021

GRASPA

3 August **8** 2021 NNECY **ANCE**

gistration deadline : JUNE 10th ps://lapp.in2p3.fr/graspa2021

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ESIPAP WHY GraSPA?

- Decrease in number of students enrolling in Physics at university ⇒ less and less students dream of doing a career in Physics!
- Inspire and help 3rd and 4th year physics students (before they choose a field) to pursue a career in Particle Physics/Astro/Cosmo ⇒ Summer School!
- Limited offer of schools addressing this audience (CERN, DESY, GSI...)

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GraSPA HOW?

- 1 week-long School, 4h (theoretical & experimental) introductory courses on few topics: LHC physics, neutrinos, heavy flavours, astroparticles, gravitational waves, cosmology, computational tools (ROOT)
- Highly subsidised: accommodation and lunches paid by School, travel funded by students or their institutions (travel grants for few students, a few paid by IDPASC institutes).
- Mostly local lecturers (see below), a few high profile externals



GraSPA 2021

135 applications

32 students (12 France)

	Monday 23	Tuesday 24	Wednesday 25	Thursday 26	Friday 27	Saturday 28	
8h30-9h30	Arrival	Flavour 1/3 [Guadagnoli]	Gravitational Waves 1/3 [Gouaty/Buskulic]	Astro TH (DM) [Serpico]	Gravitational Waves 2/3 [Gouaty/Buskulic]	Late start	
9h30-10h30		(B)SM/LHC TH 1/3 [Schienbein]	(B)SM/LHC TH 3/3 [Schienbein]	Cosmology [Serpico]	Astro EX 1/2 [Maurin]	Neutrino EX [del Amo Sanchez]	
10h30-11h00		coffee	coffee	coffee	coffee	coffee	
11h00-12h00		LHC EX 2/2 [Lorenzo Martinez]	Flavour 3/3 [Guadagnoli]	DM direct detection [Santos]	Astro EX 2/2 [Maurin]	Gravitational Waves 3/3 [Gouaty/Buskulic]	
12h00-14h00	Lunch	lunch	lunch	lunch	lunch	Light lunch & departure	
14h00-15h00	Welcome to the labs (30') +	(B)SM/LHC TH 2/3 [Schienbein]	Free	Detection techniques & applications [Masbou]	Neutrino TH 1/2 [Davidson]		
15h00-16h00	[del Amo Sanchez]	Flavour 2/3 [Guadagnoli]		Detection techniques & applications [Masbou]	Neutrino TH 2/2 [Davidson]		
16h00-16h30	coffee	coffee		coffee	coffee		
16h30-17h30	LHC EX 1/2 [Lorenzo Martinez]			Q/A session			
18h00: Visit to Eutopia/reception					19h30: social dinner		

In 2021, in order to navigate pandemic-related uncertainties: Emphasis on recruiting French students (goal ~50%, attained 38%) Moved to late August to have more visibility on possible restrictions Shorter school (5 days), no hands-on sessions

Pablo del Amo Sánchez, LAPP / Université Savoie Mont Blanc

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GraSPA **2021 LECTURERS**

- 3 LPSC + 3 *LAPP* + *2* LAPTh lecturers
- 2 external lecturers

Lecturers :

Ingo SCHIENBEIN	schien+lpsc in2p3 fr	Intro to the Physics of the Standard Model and beyond (Th.)
Narei LORENZO MARTINEZ	narei.lorenzomartinez+lapp in2p3 fr	LHC Physics (Exp.)
Sacha DAVIDSON	sacha.davidson+lupm in2p3 fr	Neutrinos (Th.)
Pablo DEL AMO SANCHEZ	delamo+lapp in2p3 fr	Neutrinos (Oscillations Exp.)
Diego GUADAGNOLI	guadagnoli+lapth in2p3 fr	Flavour Physics
Pasquale SERPICO	serpico +lapth cnrs fr	Astroparticle Physics (Th.)
David MAURIN	maurin+lpsc in2p3 fr	Astroparticle Physics (Exp.)
Daniel SANTOS	daniel.santos+lpsc in2p3 fr	Dark Matter Direct Detection (Exp.)
Romain GOUATY	gouaty+lapp in2p3 fr	Gravitational Waves
Julien MASBOU	julien.masbou+subatech in2p3 fr	Instrumentation

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(email addresses in second column, replace the "+" by a "@", and the blanks by ".", e.g. "+lapp in2p3 fr" ->"@lapp.in2p3.fr")
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GraSPA 2021 The Result



ENIGMASS meeting - Annecy, 28/10/21

GraSPA 2021

• (Part of) the Frenchies, during the free afternoon

ENIGMASS meeting - Annecy, 28/10/21



GraSPA In the PIPELINE FO

More emphasis on hands-on/ practical sessions

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	Thursday 16	Friday 17	Saturday 18	Sunday 19	Monday 20	Tuesday 21	Wednesday 22	¹ hursday 23
8h30-9h30	Welcome to the labs (30') intro to PP (30')	(B)SM/LHC TH		Free	Astro TH	Gravitational Waves		Ands-on Astroparticle / Cosmology
9h30-10h30	Intro to PP	Flavour	ands-on [2h] Gravitational Naves / Particle		Astro TH	Gravitational Waves	Gravitational Waves	- [21100 + 11130]
10h30-11h00	coffee	coffee	Physics		coffee	coffee	coffee	
11h00-12h00	(B)SM/LHC TH	LHC EX			Cosmology	departure for CERN	Neutrino EX	
12h00-14h00	lunch	lunch	lunch		lunch	12h00-13h00: lunch/sandwiches	lunch	
14h00-15h00	(B)SM/LHC TH	DM direct detection	Hands-on [1h30] Gravitational Wayes / Particle		Astro EX	CERN visit	Neutrino TH	
15h00-16h00	LHC EX	Flavour	Physics		Astro EX		Neutrino TH	
16h00-16h30	coffee	coffee			critee		coffee	
16h30-17h30	Flavour	Gravitational Waves			Q/A session		Neutrino EX	
	18h00: Eutopia/reception							
					Dinner			

- 1 extra school day allocated to hands-on sessions (1.5 days vs 0.5 days in 2019) •
- More variety: Virgo-like interferometers, ATLAS data analysis, Cosmo numerical exercice, Th exercices, others in preparation
- All students to do 2 hands-on sessions : 1 TH + 1 EXP

Q&A session: discussion about PhD and Master (includes presentation of PSC Master2)

GraSPA CONCLUSIONS

After 8 editions, Summer School's vitality & demand as strong as ever!

 \checkmark ~4x more applications than places, excellent feedback from students

- Keep improving the School: more hands-on sessions
- Very much appreciated: easy, direct acces to lecturers, mixing for informal discussions
- Two former GraSPA students now postdocs at LAPP!
- ENIGMASS: ~ 2/3 of the School budget

Great visibility for our labs & universities!

Enigmass/Education Fellowships

- To ensure the success of the Enigmass, a key point is to attract students to contribute on the Enigmass project and to work in our laboratories:
 - Master: 12/yr 4-month M2 internships. (2021: 2@LAPTh, 4@LAPP, 6@LPSC)
 - Doctoral level, 4 Enigmass PhD fellowships (1 in 2020, 1 in 2021), complement the support provided by universities (USMB, UGA) and CNRS (IN2P3, INP).





Enigmass **VISITING SCIENTIST**

- postdocs, professors) to spend time at LAPP, LAPTh and/or LPSC.
- (LPSC).
- The dedicated form available on http://enigmass.in2p3.fr
- Decisions about funding are usually taken once per month, so please submit beginning of the visit).

• The LabEx Enigmass2 runs a visitor program for scientists of all levels (students,

• The typical length of visits is one week. Longer visits can be considered providing that costs are shared with the visitor home institute or another funding source.

• Due to late budget & pandemic, no visit in 2021, first visit to take place in jan. 2022

demands with a sufficient time margin (best more than two months before the



ENIGMASS/Education UGA response to the PIA3 / Graduate schools Call

15 thematics research-based teaching & learning programs in our areas of established strengths or in emergent areas that are of strong relevance to tackle interdisciplinary / socio-economic challenges

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ENIGMASS/Education UGA response to the PIA3 / Graduate schools Call

- The program EXTREME proposal:
 - From the infinitely small (the elementary constituents and their interactions, the quantum world and the properties of matter) to the infinitely large (from the origin of the universe, the stars, the planets at the origin of life)
 - The ambition is to place the dynamics and attractiveness of this research at the heart of our training courses and benefit from the presence of "large instruments" such as IRAM, CERN, ESRF, ILL, EMFL,...
 - M1 and M2 scholarships, Research-intensive tracks, Thematic weeks, European schools, Doctoral lectures.
- Graduate School @ UGA:
 - Requests to extend the program to other UGA academic institution (G-INP),
 - Imposes strict constraints especially on the pooling of courses (6ECTS/M1 + 6ECTS/M2)
 - Limits funding of scholarships to foreign students only.
- Extreme Program not opened in 2021. Opening next year not foreseen at this stage either.



Enigmass/Education Conclusions

- Rich and diverse local ecosystem (CERN, Large instruments, one of the first reseach side in France outside IDF, wold-class universities)
- Successful developments undertaken during Enigmass1
- Enigmass2 project:
 - to strengthen and extend them,
 - to work on their sustainability,
 - and to strengthen the integration with the local training ecosystem.



