

Proposal for an Erasmus Mundus Joint
Master Degree (EMJMD) program
“European Master of Particle Physics”

University of Bologna

University of Clermont Auvergne

TU Dortmund University

Preface

- Will show a reminder of the program
- Includes changes discussed during the last discussion
- Includes changes based on a discussion with the DAAD (national contact for Erasmus)

Aims

- Installation of an EMJMD program in Particle Physics
- The program will take two years and correspond to 120 ECTS credits
- Degree:
 - one joint degree certificate (optimal case) → POSSIBLE?
 - Multiple degree (possible)
- Subjects:
 - Basic and advanced studies of particle physics
 - Analysis and interpretation of high-energy physics data
 - Detector development for particle physics experiments
 - Phenomenology of high-energy physics processes

Consortium

- Applicant/Coordinator: TU Dortmund University
 - Partners:
 - University of Bologna
 - University of Clermont Auvergne
 - Associated partners:
 - DESY (positive)
 - IN2P3
 - INFN
 - Nikhef (positive)
 - Max-Planck-Institute for Physics (positive)
 - CERN (positive)
- We need partners across the world (2 – 3 per continent)
- We need industrial partners (fewer)

Tasks of the associated partners

- Internships or summer student programs
- Supervision of Master theses
- Source of guest lecturers
- Dissemination of the program and research/education of Europe in general
- Participation in a “steering committee”

Duration

- One preparatory year. Optional, but probably very useful
- Four consecutive intakes of two academic years each, i.e. five years of study
- Six years in total
- Unless no other sources of funding are found, the program is not renewable

Participants

- Erasmus funds 60 student scholarships for the whole duration, i.e. 15 per intake on average
- Erasmus funds up to 28 additional students if they come from targeted regions
- Allow additional students if they find private or other sources of funding

Funding

- Management/guest lecturers:
 - 20,000 Euro (preparatory year)
 - 50,000 Euro (per intake)
 - This can be turned into a position at TU Dortmund University (positive signs that the position will be co-financed by the university)
- Erasmus scholarships range between 23,000 Euros and 50,000 per student (for the two years)

Academic schedule and mobility

- Students need to move to at least two countries other than their own
- Our program fixes the mobility schedule:
 - Semester 1 (winter term): Bologna
 - Semester 2 (summer term): Dortmund
 - Semester 3 (winter term): Clermont
 - Semester 4 (summer term): any (associated) partner

Academic schedule (proposal)

- Year 1:
 - Orientation week in Bologna (one week before semester start?)
 - First (winter) semester in **Bologna**; course work according to 30 ECTS credits
 - March/April: BCD summer school (Cargese?) → Mix with students from previous intake; can include guest lecturers; ECTS credits?
 - Second (summer) semester in **Dortmund**; course work according to 30 ECTS credits
 - July – September: Optional internship at DESY or CERN (“summer student program”), at another research laboratory or at a company

Academic schedule (proposal)

- Year 2:
 - Third (winter) semester: **Clermont**; course work corresponding to 12 ECTS credits; internship or preparatory phase for Master thesis corresponding to 18 ECTS credits; may include an excursion to CERN (?)
 - Highlight: trade fair for Master theses, all (associated) partners present their institution
 - March/April: BCD summer school (Cargese?) → Mix with students from next intake; can include guest lecturers; ECTS credits?
 - Fourth (summer) semester: **Bologna, Clermont, Dortmund or associated/affiliated partners**; Master thesis corresponding to 30 ECTS credits

Complementarity through specialization

- Need to argue that the three HEI cover complementary aspects and that there is an added value to the joint degree.
- Suggest the following specializations per HEI:
 - **Statistical methods:** Data analysis, statistics, machine learning
 - **Computing:** Grid computing, programming
 - **Research & development:** Detector development, electronics, accelerators
 - **Particle physics:** Flavor and BSM physics, top-quark physics, QCD, theory
- Have two majors per HEI, particle physics and one specialization
 - **Bologna:** Particle physics, computing
 - **Clermont:** Particle physics, statistical methods
 - **Dortmund:** Particle physics, research & development
- Should be reflected in courses and research
- Also: should include spin-off and value for society

Credit composition

- Strive for broad education in particle physics, distribute the 120 credits accordingly
- **Courses:** 66 ECTS credits, including
 - Introductory particle physics lecture: 6 credits
 - Advanced courses: at least 54 credits, with at least
 - 3 (6 max.) credits from seminars
 - 6 (12 max.) credits from theory lectures
 - 6 (12 max.) credits from lab courses
 - 6 (12 max.) credits from computing
 - Secondary/applied subjects: 6 (12 max.) credits
- **Summer schools/programs:** 6 credits
- **Internship/thesis preparation:** 18 credits
- **Master thesis:** 30 credits

Courses offered

Semester	1			2			3		
Location	Bologna			Dortmund			Clermont		
Courses	Course	Type	CP	Course	Type	CP	Course	Type	CP
Lectures, seminars and lab courses (major):									
Particle physics				Particle physics			Particle physics		
	Introduction to Particle Physics	Lecture	6	Flavor physics in experiment and theory	Lecture	6	Symmetries Introduction to Particle Physics	Lecture	6
	Flavour Physics	Lecture	6	Quantum field theory	Lecture	6	Quantum Field Theory and QCD	Lecture	6
	Quantum Field Theory 1	Lecture	6	Reading course on particle physics topics	Seminar	3	Electroweak scale	Lecture	6
				Physics beyond the Standard model	Seminar	3			
Lectures, seminars and lab courses (minor):									
Computing				Research and development			Statistical methods		
				Experimental aspects of particle physics	Lecture	6	Advanced Statistics, Machine Learning	Lab	6
				Detector systems in particle and medical physics	Seminar	3	Programming, Data Mining	Lab	6
				Particle physics lab course	Lab	6			
				Electronics lab course	Lab	6			
				Advanced Accelerator physics (in German, including	Lecture	6			
Lecture and seminars (general)									
	Statistical and Data Analysis For Nuclear and Subnuclear Physics	Lecture	6	Applied machine learning for physicists	Seminar	3	Detectors and instrumental project	Lab	6
	Laboratory of data acquisition and data processing	Lab	6	Advanced statistical methods (tbd)	Lecture	3	Guest lecture	Lecture	3 or 6
	Advanced detector for high energy physics	Lecture	6	Guest lecture	Lecture	3 or 6			
	Guest lecture	Lecture	3 or 6						
Secondary subjects:									
	General Relativity	Lecture	6	Astroparticle physics	Lecture	3	General relativity, Cosmology	Lecture	6
				General relativity	Lecture	6			
				Cosmology	Lecture	3			
				Neutrinos und Kosmologie	Seminar	3			
Master thesis and preparation:									
							Internship / thesis preparation	Master	18

+ Courses on spin-off

+ Courses on transversal competences

Points of discussion

- General:
 - Potential partners (academic and industrial)?
- For each university:
 - Is a joint degree possible for your university?
 - What are the tuition fees for european/non-european students?
 - How does the program fit into your internationalization strategy?