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iTHEPHY
Innovative Team - Teaching
for Physics



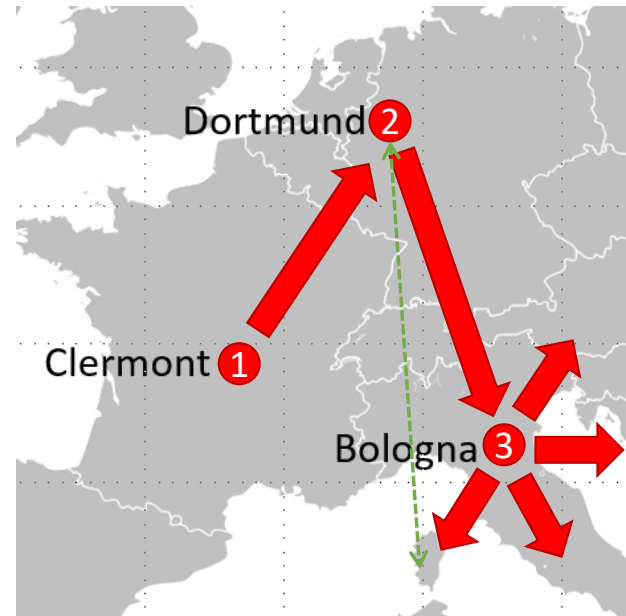
IMAPP

IMAPP: studying in Clermont

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Clermont University pedagogical team, LPC / IN2P3 / CNRS

1) Introduction: the IMAPP travels

Mobility



Schedule:

Sem.	Location	Academic focus	Events
1 (WS)	Clermont	Particle physics and statistics	Orientation week
2 (SS)	Dortmund	Particle physics and detectors	Spring school
3 (WS)	Bologna	Particle physics and computing, introduction Master thesis	Trade fair for Master theses
4 (SS)	Any	Master thesis	Spring school, virtual industry day

1) Introduction: Clermont

- Clermont used to be a rocky place up to 6000 years ago (yesterday).



1) Introduction: Clermont

- Nature is much more quiet these days



Clermont behind
the dome

1) Introduction: Clermont

- The volcanoes from the Campus



- and downtown

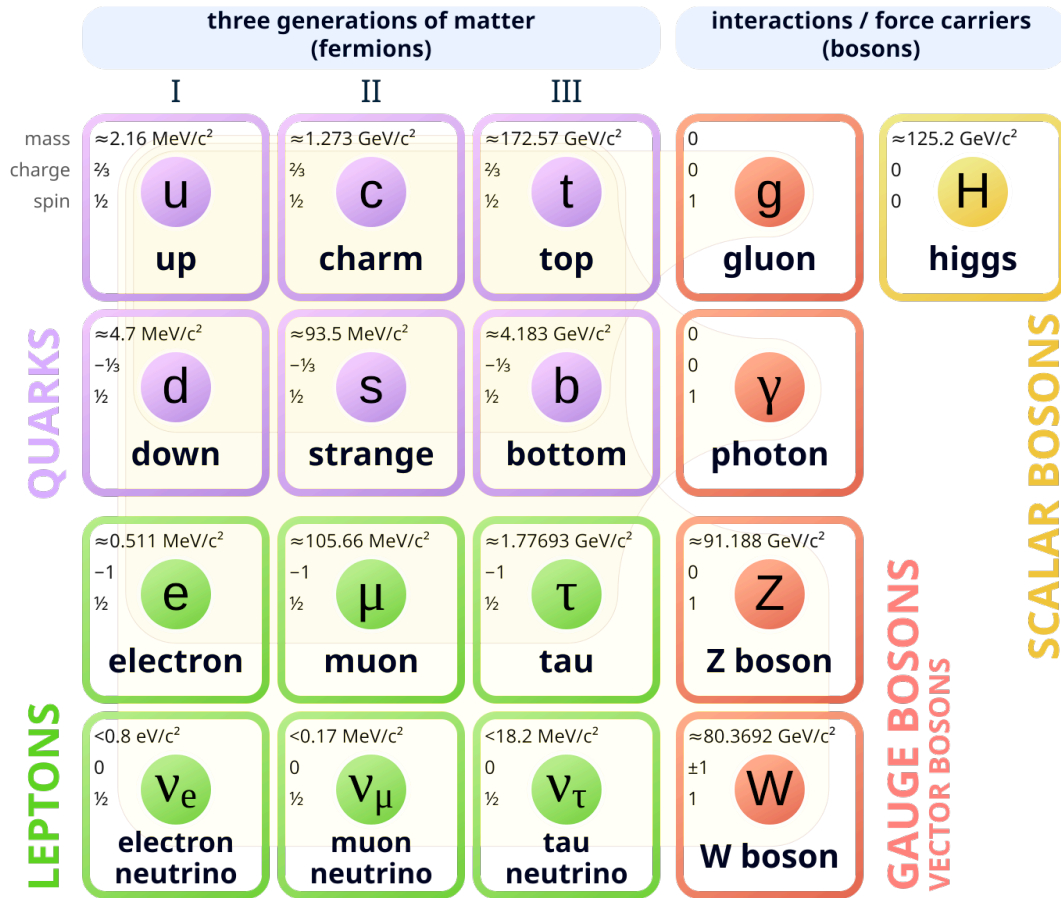


1) Introduction: Clermont Uni. and the particle physics Lab.

- About 30,000 students
- **Multidisciplinary** university (from Humanities to Particle Physics)
- Laboratoire de Physique de Clermont:
 - Large Hadron Collider: **ALICE, ATLAS, LHCb** !
 - Neutrino and lepton Physics: **SoLid, COMET**
 - Observational cosmology: **ZTF, LSST**
 - Theory: **Flavours (heavy and light)**
 - **Medical Physics** (*e.g.* instruments, simulation, biology)
 - **Environmental Physics** (*e.g.* Plasmas, datation, muography)

1) Introduction: particle physics Lab. science framework

Standard Model of Elementary Particles



- The SM describes successfully to date the three elementary electromagnetic, weak and strong interactions with the bizarre particle content on the left.
- Among the open fundamental questions:
- Mass matrix? at first LHC w/ ATLAS and CMS
- Mass mixing matrices? LHC again w/ LHCb, SUPERKEKB w/ Belle 2, the neutrino long baseline experiments HyperK and DUNE and a galaxy of smaller scale experiments ...
- Your three universities are at work on all these subjects.

1) Introduction: particle physics: the iMAPP objectives

- Physics theories (formal lectures and problems solving)
- Physics experiments (formal lectures and problems solving)
- Tools and methods to navigate in these areas:
 - Detector physics skills
 - Computing skills
 - Data analyses skills
- We have designed the program to hopefully bring you all of these skills
- We'd like you to be seen as smart and educated young scientists at the end of your iMAPP journey, well prepared to either join a Ph.D. program in our field or contribute beyond academia.

2) Study plan in Clermont

- Particle Physics and Statistics: the compulsory courses.

Compulsory courses	Credits	
IMAPP-01-01: Introduction to quantum field theory and gauge theories	6 ECTS	48 hours
IMAPP-01-02: Introduction to particle physics and the experimental foundations of the Standard Model	9 ECTS	72 hours
IMAPP-01-03: Programming and Data Analysis	6 ECTS	48 hours
IMAPP-01-06: Statistics and artificial intelligence	6 ECTS	48 hours

2) Study plan in Clermont

- Particle Physics: the compulsory courses
- IMAPP-01-01:
 - **Quantum Field Theory** as the grammar of the elementary particle world. You will learn the lagrangian of a fermion, of a boson (mediating the interaction), how to manipulate the Feynmann rules to write particle scattering or decay processes.
 - **Gauge theories** are describing the elementary interactions from requiring their lagrangian to obey fundamental symmetries. Establishing QED and **QCD** as guidelines.
- IMAPP-01-02:
 - **Exp. and pheno. introduction to particle physics.** You'll learn the elementary content of the Universe. Also a lecture on symmetries (as an input to gauge th.)
 - Foundations of the **Standard Model** of particle physics (exp. and th.). Introductions to **Flavours** (quarks and leptons).

2) Study plan in Clermont

- Statistics and data analysis: the compulsory courses
- IMAPP-01-03 [Next week, preparatory message to follow]:
 - [Programming in python](#) by examples from high energy physics.
 - [Data mining](#) to analyse massive amounts of data.
- IMAPP-01-06:
 - [Statistics](#): mathematical bases of statistics. Treatment of statistical collections, statistical inferences (bayesian and fequentistic). All by examples.
 - [Artificial intelligence](#): foundations of machine learning. Supervised and unsupervised algorithms. Hands-on teaching.

2) Study plan in Clermont

- Statistics and data analysis: the compulsory courses
 - These four teaching units (gathered two modules) are **each** taught **during a week**, solely assigned in the timetable.
 - They are part of a University Diploma of **Data Scientist** delivered by UCA.
 - Usually popular. One additional module of 25 hours is required to obtain this diploma. You can take it in the semester break b/w Clermont and Dortmund.
 - These *technical* teaching modules are providing you with:
 - **Skills useful for** a continuation in exp. and / or pheno. **Ph.D program**.
 - **Skills useful for** a *e.g.* **data scientist job** immediately after the Master.

2) Study plan in Clermont

- Particle Physics and Statistics: the elective courses.

Elective courses	Credits	University
IMAPP-01-04: Guest lectures on various topics	3 ECTS	UCA
IMAPP-01-05: UCA seminar on particle physics	6 ECTS	UCA

We're speaking here of the choice in Clermont (you can take others at TUDO):

- IMAPP-01-04: pick a choice b/w:
 - **Observational Cosmology (20 hours)**
 - **General relativity (20 hours)**
- IMAPP-01-05: the LP Clermont lab. seminars (not examinable). Almost each Friday, you're invited to join the researchers for a seminar in the lab.

2) Study plan: timetable and breaks

- 26/10 — 3/11: autumn holidays.
- Careful that a series of exams immediately follows this break.
- 12/21 — 6/1: X-mas holidays.

2) Study plan: evaluation in Clermont

- All modules are evaluated with written exams.
- For some of the modules, this can be complemented by graded homeworks.
- Advise #1: work hard from the beginning !
- Advise #2: work in team !
- Advise #3: as soon as you experience a difficulty, reach out to the pedagogical team.
- You're about to meet an invaluable experience: getting to know three different university systems, each coming with its own qualities (and flaws!).
- For the Clermont semester: 1) the written exams cannot be taken twice; 2) compensation between modules is at work, *i.e.* the semester is passed if the average grade $>$ or $=$ 10/20; 3) a second chance session is happening in March.

3) The pedagogical team

- Those in the room
- A word of introduction, and a word on their research expertise
- All your professors are active researchers in particle physics, experiment or theory.

3) Ready to go to Cargese ?

- After the Clermont semester [September ; March [
 - You will have received a training in theoretical particle physics.
 - You will have received a training in the experimental foundations of particle physics.
 - You might have received a training about gravitation and / or cosmology.
 - You will have received a training in programming and advanced data analysis, including modern tools of “AI”.
 - You can have received already a first University diploma of Data Scientist
 - You can have followed french lectures (offered but not compulsory).

3) Ready to go to Cargese ?

Objectives for you



- The BCD High Energy Physics (HEP) School is one of the elements pedagogical platform built among the University of Bologna (Italy), Clermont (France) and Dortmund (Germany).
- Some of you are about to enter in HEP field, some of you are already in.
- For the former, the objectives of the School is to give basic representations (aBCD) of the HEP and related fields. For the latter, this is about strengthening the views and motivate the thinking.
- The prism we have chosen is to discuss and highlight the latest results of the field, both theoretical and experimental.

EMJM steering group

ISHEP School 2023

5



Preconisations (workwise)



- The program is dense but with many room left for discussions.
- Ask questions (we might have answers ...), share your views, discuss with lecturers and other students...
- Think about Nature



EMJM steering group

ISHEP School 2023

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4) Miscellanea

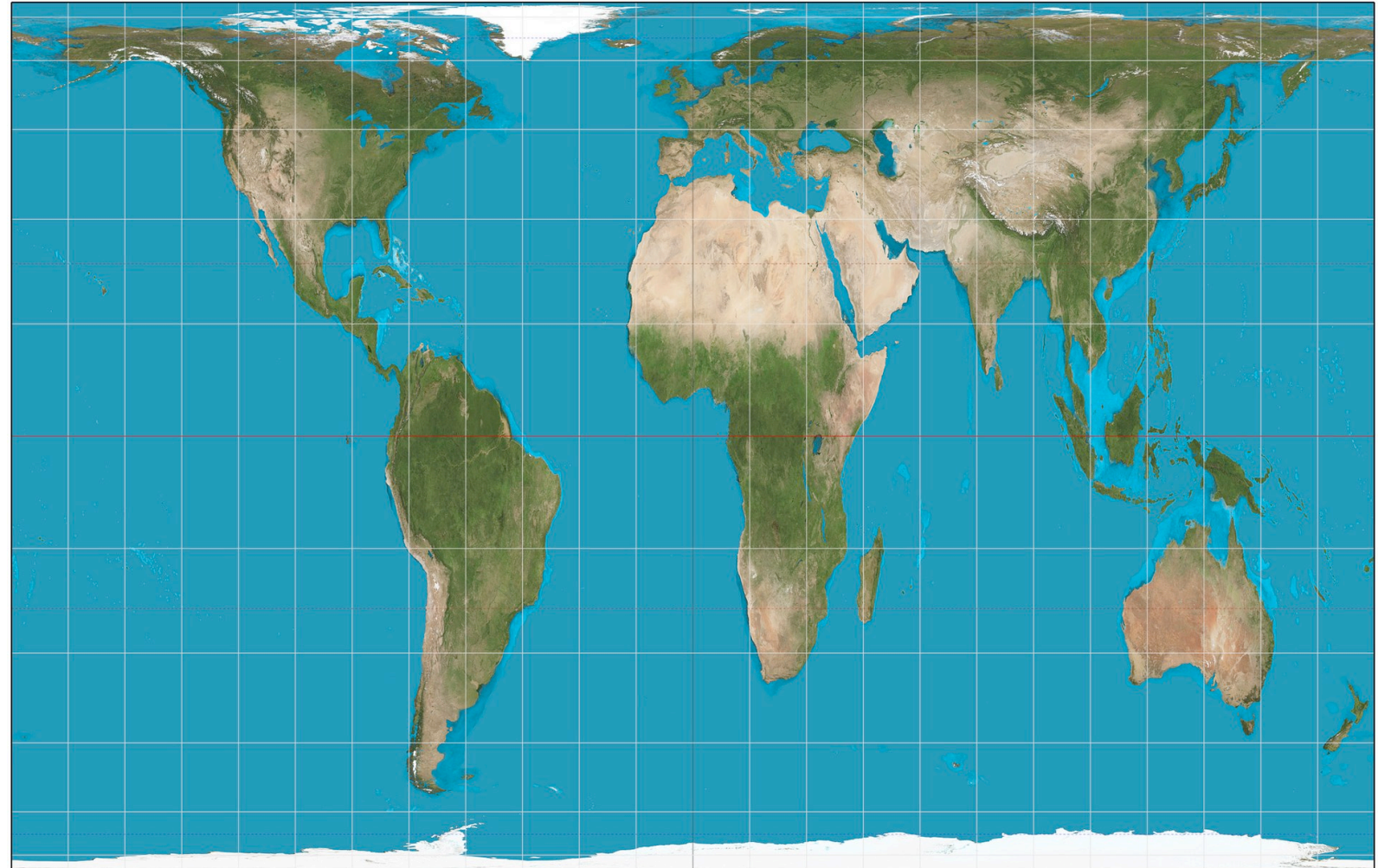
- Language: french lectures
 - University provides french lectures for foreign students (Centre Fleura)
 - They are offered by the iMAPP program. A special organisation with cultural activities is set up this year. A mail will be sent this week.
- Culture:
 - Music: Rock / Rap city: [check this:](#)
 - Music: Jazz festival: [check this:](#)
 - Sport: Football and Rugby elite: [check this:](#)
 - Theater (scène nationale): [check this:](#)
 - International Film Festival, short movies: [check this](#)

5) Who are you?

- Statistics:

- Europe: 8
- Asia: 15
- Africa: 3
- America: 1
- Oceania: 0
- Antartica: 0

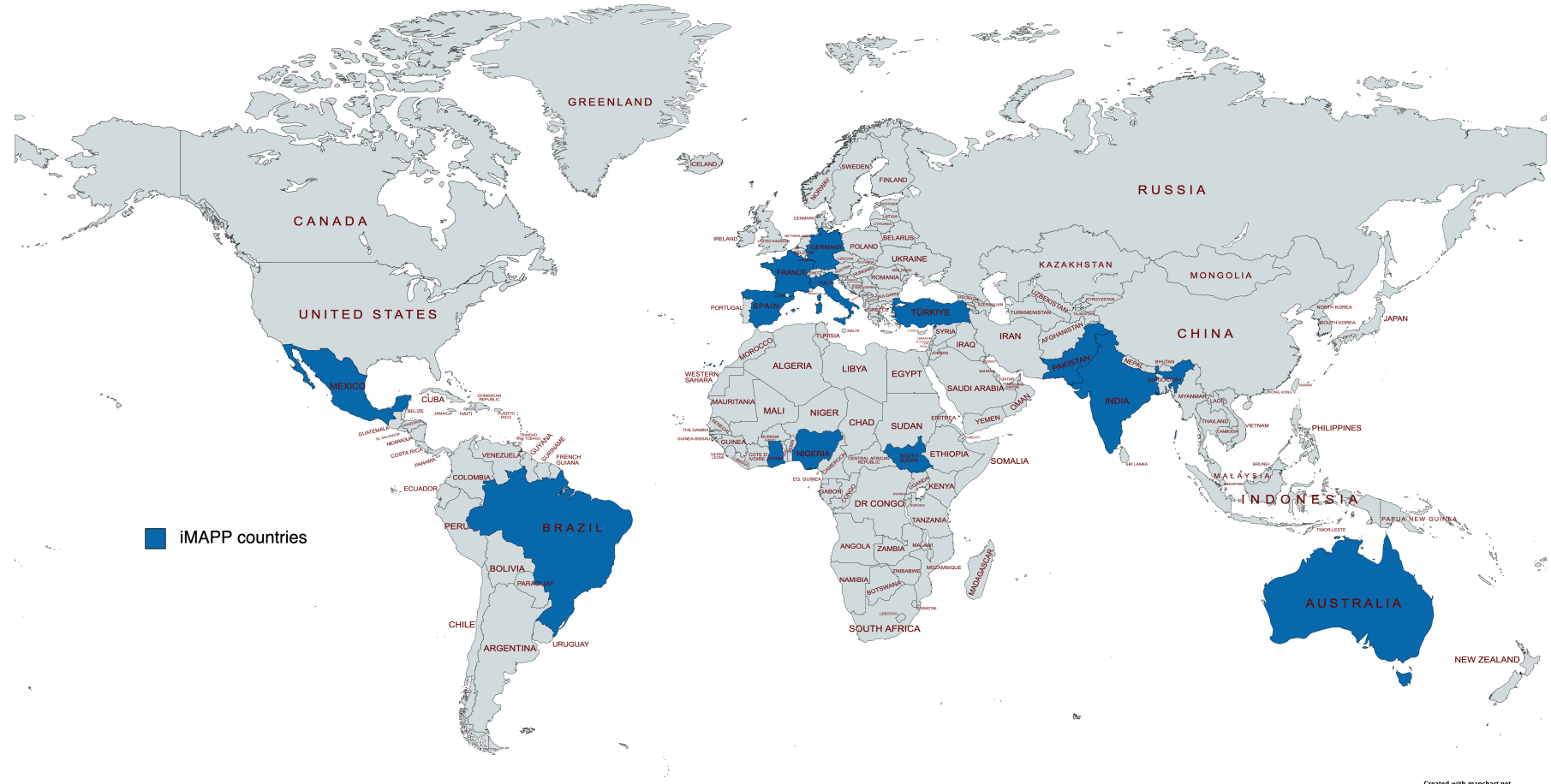
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5) Who were you? iMAPP 2023-2025

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- Europe: 19
- Asia: 10
- Africa: 5
- America: 3
- Oceania: 1
- Antartica: 0



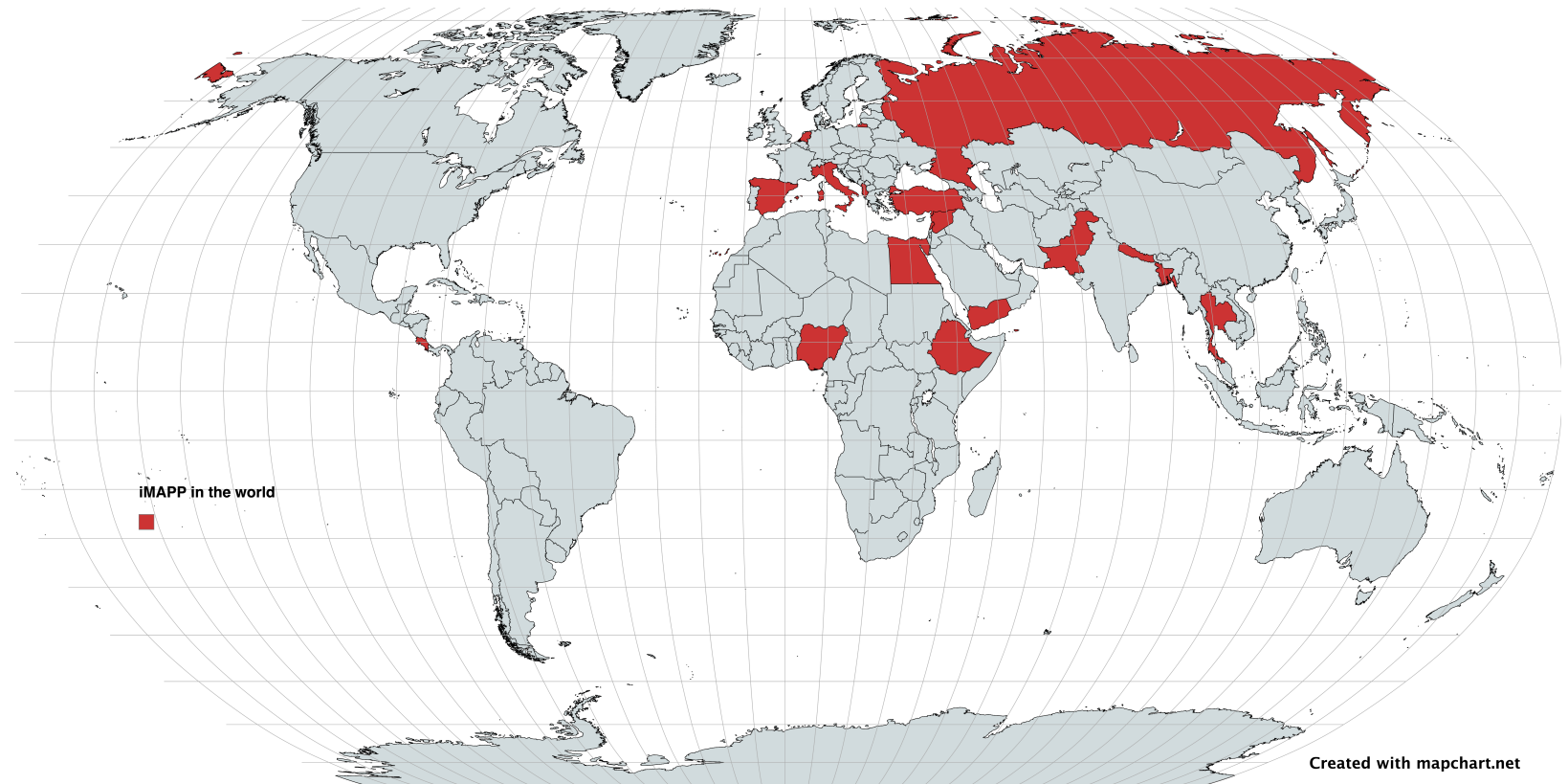
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5) Who are you? iMAPP 2024-2026

- Statistics:

- Europe: 8
- Asia: 15
- Africa: 3
- America: 1
- Oceania: 0
- Antartica: 0

© MapChart



6) Concluding remarks

- We are happy to welcome you in the iMAPP program at Clermont
 - This was envisioned 10 years ago and this joint degree has become a real and operative pedagogical and scientific system.
 - We have prepared hopefully a solid training program, with balanced technical skills and fundamental knowledge.
 - Hard work is needed from now on.
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- We wish you a transformative and successful experience here and across Europe!