PhD proposals at LAPP

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For Master 2 NPAC - Paris

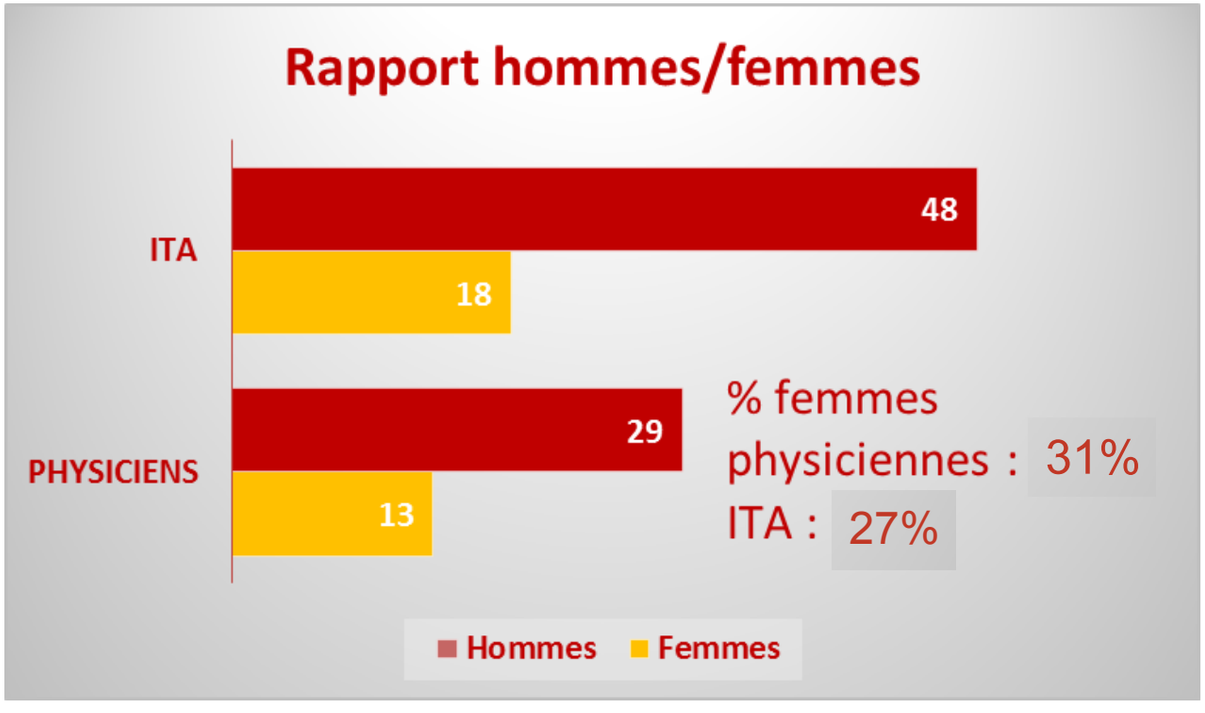
December 4th, 2019

Where is LAPP ?

- LAPP : Laboratoire d'Annecy de Physique des Particules

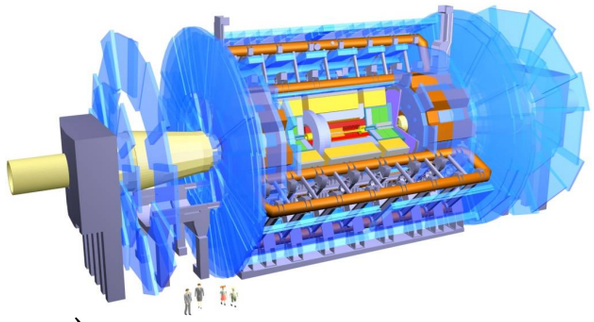
Who works at LAPP ?

- **About 150 persons work at LAPP**
  - 42 CNRS researchers and university professors
  - 15 PhD students
  - 15 post-doctorants
  - 70 engineers and technicians:
    - Mechanics, electronics and computing
  - 10 administratif staff
  - A few students (internships)
- **Medium age at LAPP:** 48 years old



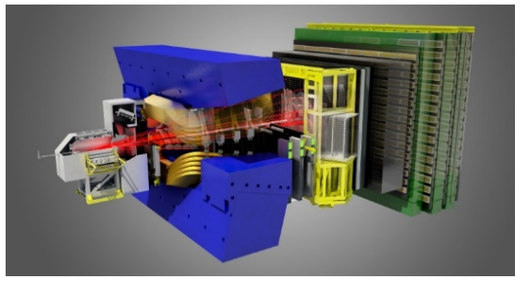
What do we do at LAPP ?

- Understanding of the two infinites…

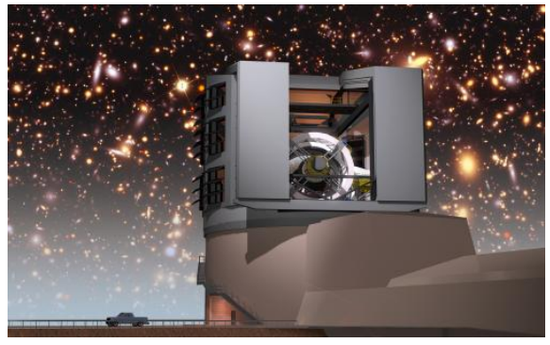


ATLAS (Cern)

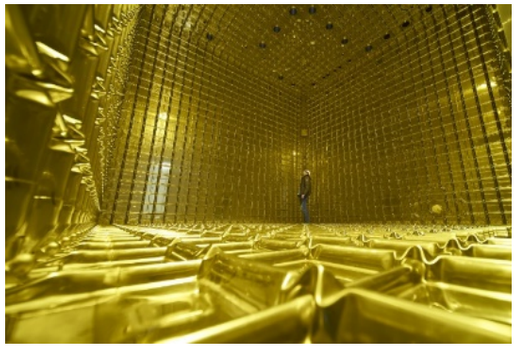
Virgo (Italy)



LHCb (Cern)

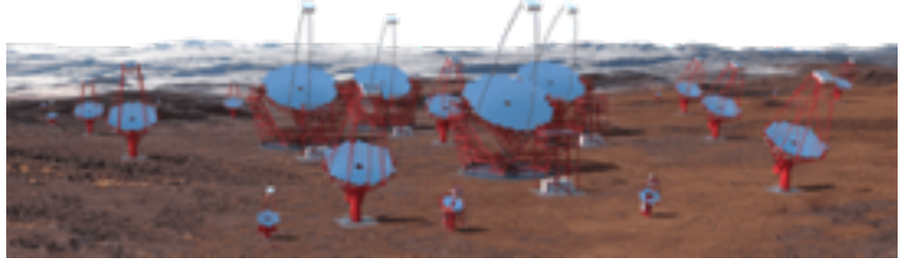


LSST (Chile)



DUNE (Cern/US)

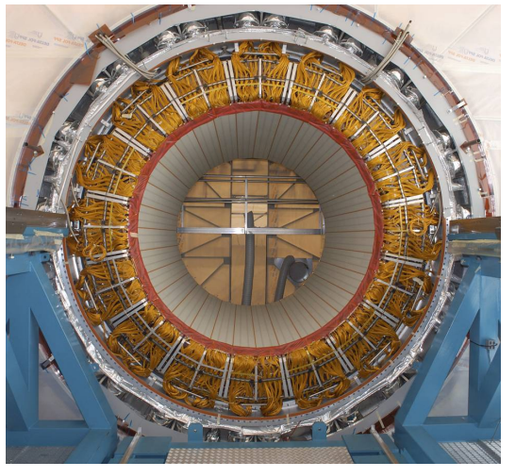
STEREO, SuperNEMO (Grenoble, Modane)

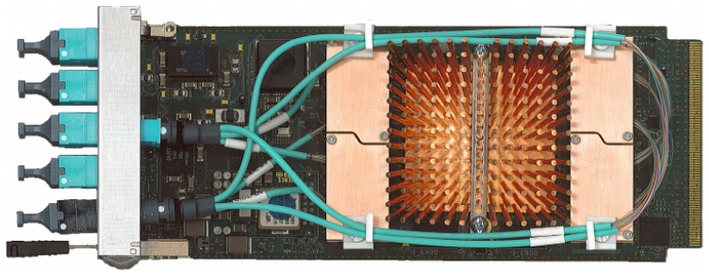


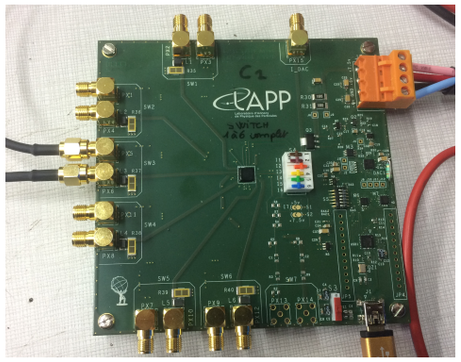
HESS/CTA
(Namibie, Chile, Spain)

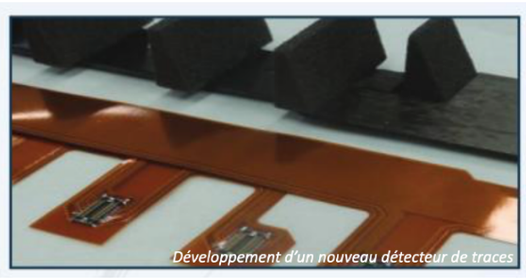
What do we do at LAPP ?

- And the concrete work R&D, detector conception and construction to build giants « detectors »

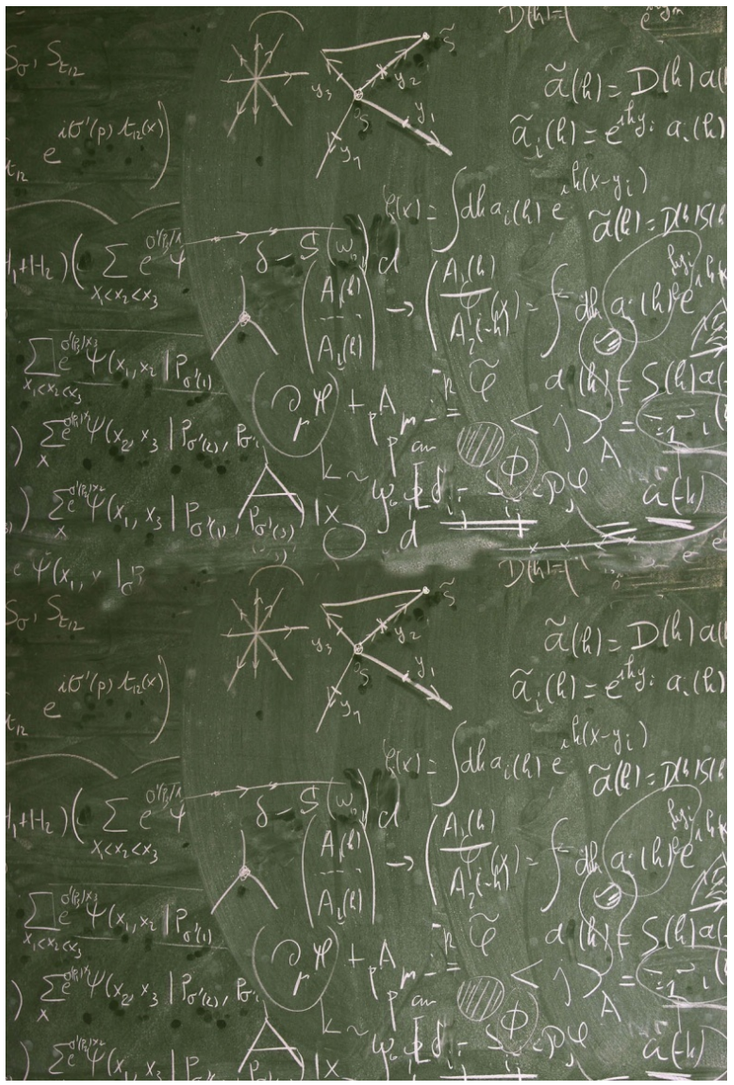








LAPTh just in the next door



Three search topics:

- particle physics
- Astroparticles/cosmology
- mathematical physics (field theory, symmetries)

Also proposing phDs, check here !
http://lapth.cnrs.fr/fr/offres-de-stages-et-de-theses

Practicalities:

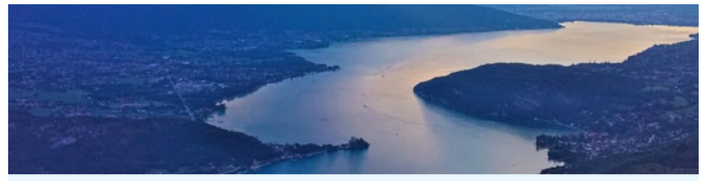
- **Doctoral school**: école doctorale de physique de Grenoble
  - https://www.adum.fr/as/ed/page.pl?site=phys
  - Selection of PhD candidates
  - doctoral training (tool training, summer school, professional insertion, cultural opening)
  - Follow up during the PhD

- **Funding** : minimum 6 grants this year at LAPP/LAPTh !
  - 2-3 grants from the Université Savoie Mont Blanc (USMB)
  - 1 grant from IN2P3/CNRS
  - 2 grants from an ANR (ATLAS and LHCb/theory)
  - 1 grant from Enigmass
  - Possibilities of co-tutelle

- **Possibility to teach in IUT close to LAPP, at Polytech or at Chambery University (practical exercises, lab experiments)**

Laboratory Life

- **Frequents meetings to learn more about other's work**
  - Regular seminar on Friday on general topics
  - AnimaScience meeting regularly on Friday where people from the lab present something they find interesting
  - Thursday meeting almost every week to learn about general information of the lab
  - We also organise workshop regularly



CAES Annecy

- **CAES:**
  - Lot of activities proposed with reduced prizes (yoga, cooking, gym, theatre, ski, Christmas event, …)

fête de la Science

- **phD students are meeting together frequently**, and there is a representative to defend their interests: Celine Armand

- **Transmission of knowledge to public and students**: organisation of Masterclasses, Fete de la Science, laboratory open doors, GrasPA school, …

Reasons to come/not to come in Annecy

- **Pros**:
  - Annecy beautiful and cosy city
  - Cheese place :-)
  - Quiet place, surrounded by nature
  - Sport: lake, mountains and snow
  - Close to CERN: very interesting for people working in an experiment located at CERN !

- **Cons**:
  - No big university nearby (closest is Chambery)
  - Annecy not a big city !

6 phDs proposed in 2020 at LAPP

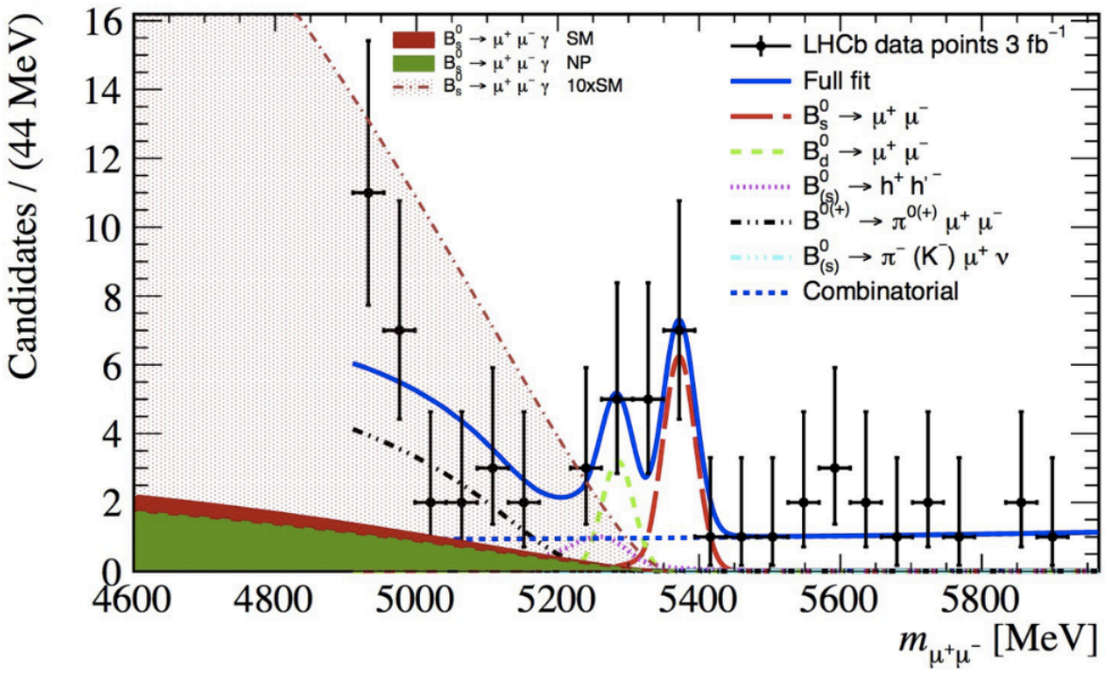
- Toward a precise reconstruction of gravitational waves signal with VIRGO -> **no more available**
- Stochastic analysis of signals enriched in binary coalescences in gravitational waves detector Virgo and LIGO -> **no more available**
- Indirect search for new physics from the study of vector boson scattering at LHC -> **about to choose a candidate**
- A search for a new heavy neutral gauge bosons in dilepton final state in association with two jets and commissioning of the Phase-I Liquid Argon trigger electronics -> **about to choose a candidate**
- Rare an radiative decays: a hands-on, TH & EXP introduction -> **candidacies welcomed**
- Study of the weak lensing in galaxy clusters with LSST -> **candidacies welcomed**
- **More details: https://lapp.in2p3.fr/spip.php?rubrique53**

Rare an radiative decays: a hands-on, TH & EXP introduction

- Contacts: Diego Guadagnoli & Jean-François Marchand

- Rare and radiative decay particularly interesting:
  - Challenging experimentally
  - Big deviations wrt Standard Model observed

- New method proposed in Dettori-DG-Reboud, PLB 2017 to measure B->μμγ using B->μμ



- Intership: theoretical and experimental study of this process
  - TH: Standard Model prediction, control of theory uncertainties, sensitivity to deviations
  - EXP: measurement strategy, background/signal discrimination with LHCb detector

- To be continued in phD ideally

- **phD funded by an ANR grant « GammaRare »**

Study of gravitational lensing in galaxy clusters with LSST

- **Contact**: Dominique Boutigny

- **LSST: Large Synoptic Survey Telescope**
  - In construction in Chili, will start collecting data in 2022, for 10 years
  - Full scan of the sky in 3 days (take image every 40s)

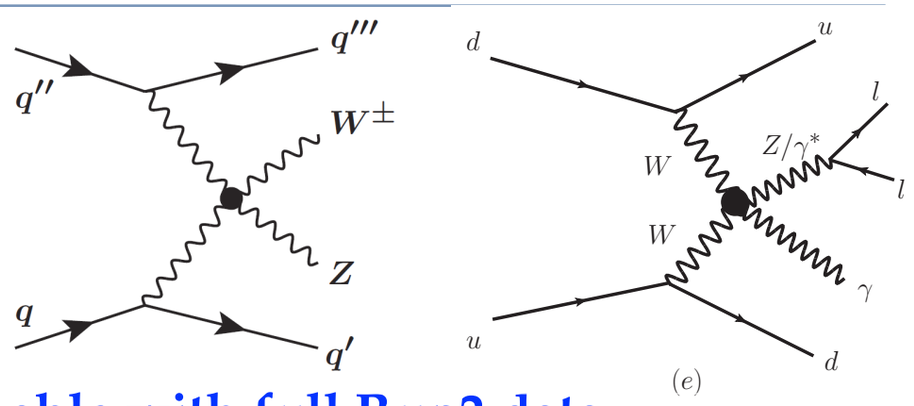
- **Galaxy clusters used as cosmological probes, sensitive to:**
  - Structure growing
  - Gravitational models (General relativity or not ?)
  - Total mass of neutrinos
  - Dark energy

- **Topic of internship: measurement of cluster masses**
  - can be estimated via a statistical study of the deformation of images due do gravity effect (weak lensing)
  - challenging because of very noisy measurements
  - study and compare two techniques of measurement of weak lensing using real data and simulated data and study the systematic bias associated to each method

- **Possibility to pursue with a phD, grant from Doctorol School**

Study of Vector Boson Scattering with ATLAS

- **Contact**: Narei Lorenzo Martinez



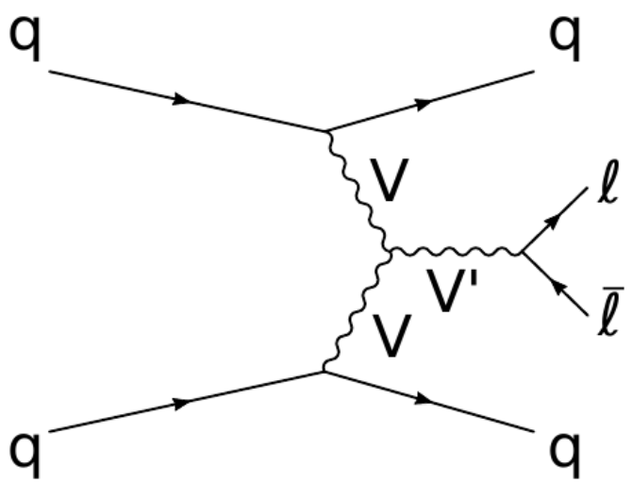
- **No sign of new physics after 10 years of data taking at LHC**
  - Indirect search can probe larger new physics scales
- **Vector Boson Scattering rare process at LHC, start to be reachable with full Run2 data**
  - Very sensitive to presence of new physics
  - Process not precisely measured, everything still to be done !
  - Several final states to be studied
- **Intership**: put constraints on new physics using Effective Field Theory (EFT) using 140fb-1 of data.
- **To be pursued in phD:**
  - Machine learning techniques for signal/background discrimination, jet reconstruction, pileup rejection, etc…
  - Aim at first observation of VBS Zγ process
  - Design of future electronic for HL-LHC for ATLAS calorimeters
- **Funded by an ANR (VBStime)**

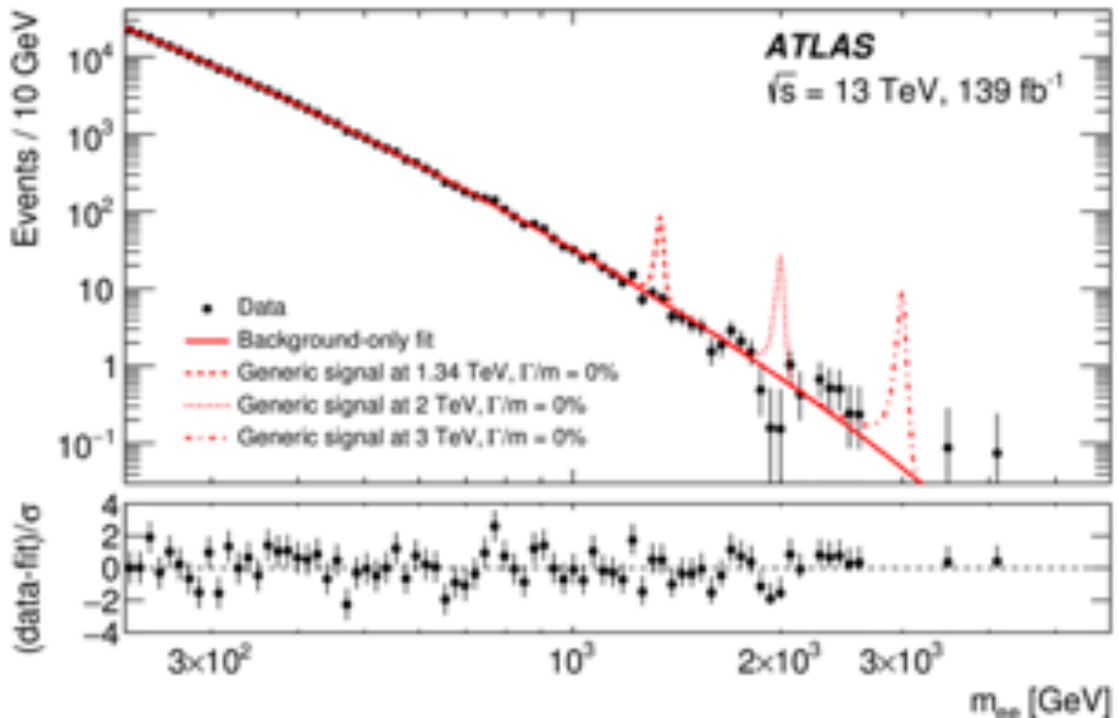
Search for a new heavy neutral gauge bosons in dilepton final state in association with two jets…

- **Contact**: Tetiana Hryn'ova

- **Di-lepton spectrum rich in resonant structure**
  - J/psi, Z, H->μμ
  - Something else ? (heavy spin-1 Z' bosons, quantum black holes, gravitons, …)
  - Nothing seen so far, limits are set:
    - 139fb^{-1} @ 13TeV: m(Z'$_c$)>4.8 TeV @ 95% CL

- **New search for dilepton resonances in association with two jets produced through Vector Boson Fusion**
  - Sensitive to Z' which does not couple to quarks which could have eluded earlier inclusive searches





… and commissioning of the Phase-I Liquid Argon trigger electronics

- Run 1-2 L1 Calorimeter Trigger configuration
- Run 3 & beyond (this PhD work)
- Super Cells allow for better discrimination between electrons/photons and their main background (jets)
- LAPP developed a fast and dense processing unit for the electronics upgrade of the calorimeter trigger system
- **During this PhD unique opportunity of hardware experience in ATLAS:**
  - commissioning of the new system
  - associated physics studies for improved triggering
- Frequent trips and extended stay (up to 6 month) in CERN are planned