

My internship at LAPP

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Hryn'ova

Background

-2020/2022: Lycée Camille Julian, Bordeaux, 2 years of classe préparatoire aux grandes écoles, specialized in physics and chemistry

-2022/Today: Ecole des Mines de Saint Etienne (ingenior school), currently in my second year (equivalent M1)

-August-December 2023: Erasmus at the University of Bergen, Norway



Finding an internship



-Time of the internship: 10-14 weeks between June and September

-Position of the internship: Ingenior Assistant

-My criteria: Research field, particles physics, in France

-How I found LAPP: In2p3 institutes and ATLAS

The beginning of the internship : First Day

-No time to stop !

-arrived 9h30 am

-Quick overall of the idea of this internship, getting my computer

-DITTO meeting at 10h am !

In the afternoon:

-configuring the computer

-first contact with the work of Timoty



Learning about LAPP



Laboratory under the joint supervision of

- the CNRS
- and the Université Savoie Mont Blanc

subject to the rules applying to the French administration.

Within the CNRS, it belongs to the National Institute of Nuclear and Particle Physics (IN2P3).

Management team :

Giovanni Lamanna: Director
 Stéphane Jezequel: deputy director of scientific projects
 Gilles Maurin: higher education and training
 Françoise Dupraz: administration

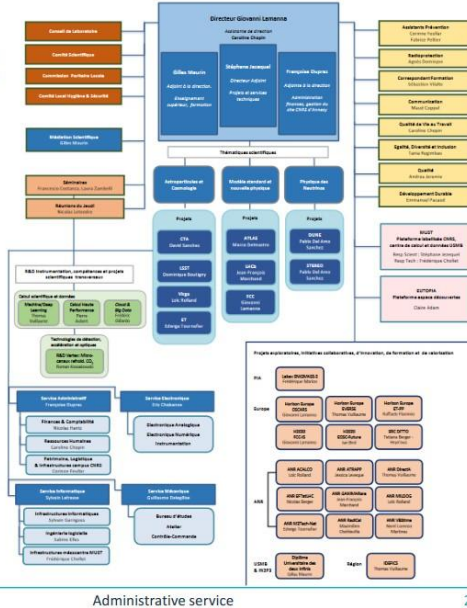
4 research support services: electronics, mechanics, IT and administration

1 datacenter MUST

Engineers and researchers taking part in projects in 3 main areas:

- Astroparticles and cosmology
- Standard model and new physics
- Neutrino physics

1. LAPP presentation



03/10/2023

Administrative service

2

Outils RH CNRS

1 Janus → 2 Agate-Tempo → 3 Ariane → 4 ENSAP → 5 CPAM-MGEN

Compte Janus

Sésame
Management de Janus user accounts

Votre compte Janus permet de vous connecter à l'ensemble des Outils CNRS

Connexion avec votre adresse e-mail **Prenom.Nom@lapp.in2p3.fr**

Creation du compte possible uniquement après réception De l'e-mail RH

[RH] Accès aux outils RH / Access to CNRS tools

- ✓ Votre contrat signé
- ✓ PVI installation signé
- ✓ Pièces admin complètes

Agate-Tempo

Outil de gestion des absences, du temps et des activités via le calendrier annuel

C'est l'outil de gestion des congés, du télétravail, des missions et des absences.

Chaque demande est soumise à la validation de votre gestionnaire

Ariane

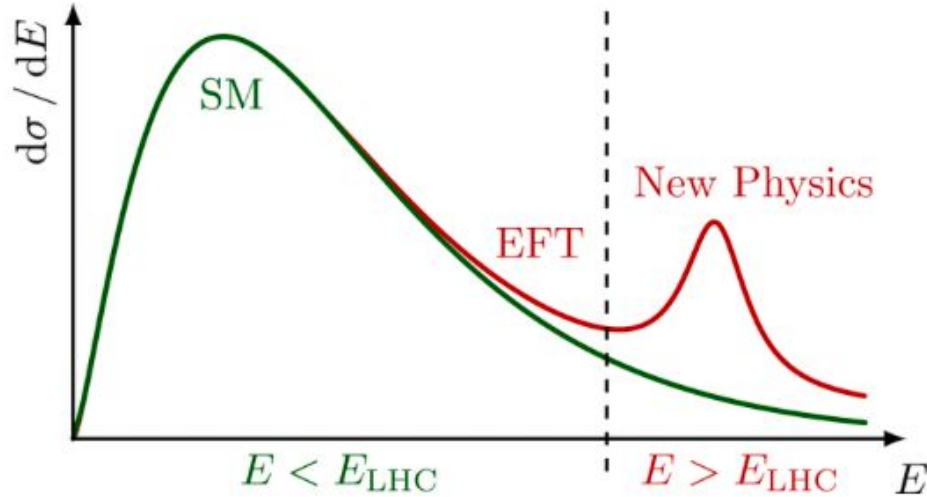
Plate-forme pour les demandes RH :

- ✓ arrêt de travail
- ✓ accident du travail
- ✓ déclaration de grossesse
- ✓ changement de numéro de compte bancaire
- ✓ remboursement des frais de transport
- ✓ mobilité durable ...

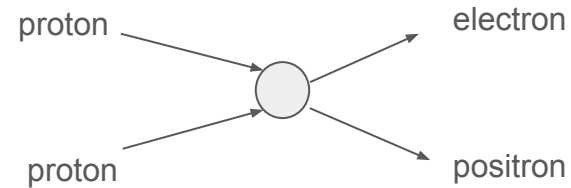
V. January 2023

Topic of the internship

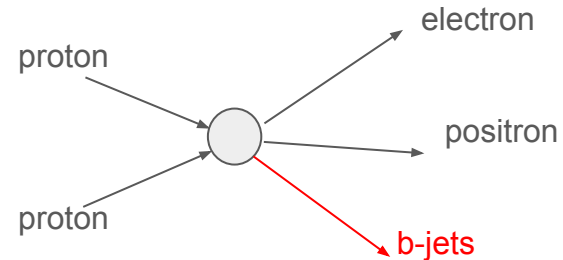
Searching for new physics



Drell Yan process



Drell Yan process with b-jets



Objectives of the internship

- Defining the process in the code
- Generating Drell-Yan + b interactions on the computer
- Sorting these generated interactions depending on their characteristics
- Storing these data in histograms so that we can analyse them
- Comparing these results with the current theory (Standard Model) and with results of other studies

Discovering the setup and the code

```
> OPEN EDITORS 4 unsaved
▼ PRIVAT...
  > .vscode
  > gitlab
  ▼ SMEFTgen
    > .vscode
    > batch
    > batch_submiss...
    > build
    > custominputs
    > diagnostics
    > diagrams
    > EVNT_outdir
    > models
    > python
    > rivet
    > scripts
    > test
    ≡ _afs543D U
    ≡ .asetup.save U
    ◆ .gitignore
    ≡ .swp U
    ≡ .swp U
    ≡ ced_1p0_380.y... U
    M CMakelists.txt
  > OUTLINE
  > TIMELINE
```

```
[ararnaud@lxlplus925 private]$ cd SMEFTgen/
[ararnaud@lxlplus925 SMEFTgen]$
[ararnaud@lxlplus925 SMEFTgen]$ python3 scripts/genJO.py --out /eos/user/a/ararnaud/batch/ee/SM/130_150/ --symmetry U35 --writeSubmit
bsub --rivet-file MY_ANALYSIS --run-tag 130_150 --coefficients SM --n-jobs 10 --write-EVNT --jobFile run_SM_ee_2.sh --interference-
terms --no-square-terms --no-cross-terms --nevents 2000 --standalone --custom-input custominputs/ee_bj_130_150.json && python3 conver
tToCERNBatch.py run_SM_ee_2.sh && cd batch_submission/run_SM_ee_2 && condor_submit batch_run_SM_ee_2.submit && cd /afs/cern.ch/user/a
/ararnaud/private/SMEFTgen;

bsub -J mc.MGPy8EG_SMEFT_cHe_1p0_500_700.py "source /afs/cern.ch/user/a/ararnaud/private/SMEFTgen/setupGeneration.sh /eos/user/a/arar
naud/batch/ee/cHe/500_700/ee_bj/cHe_1p0_0 batch /afs/cern.ch/user/a/ararnaud/private/SMEFTgen/models && mkdir -vp 100000 && cp /eos/
user/a/ararnaud/batch/ee/cHe/500_700/JOs/ee_bj/mc.MGPy8EG_SMEFT_cHe_1p0_500_700.py 100000/ && Gen_tf.py --ecmEnergy=13000 --firstEven
t=1 --randomSeed=2 --jobConfig=100000 --outputEVNTfile=evnt.root --maxEvents=2000 ; export HIGGS_PROD_MODE='NONE' && cp $RIVETJOPATH/MY
_ANALYSIS*.* ./ && rivet-buildplugin RivetMY_ANALYSIS.so MY_ANALYSIS.cc && athena.py -c 'inFileName="/eos/user/a/ararnaud/batch/ee/c
He/500_700/ee_bj/cHe_1p0_0/test/evnt.root"; histoFileName="rivetfile"' $RIVETJOPATH/RivetAnalysis.py ; rm -rf MGC_LHAPDF/ PROC_*/
env.txt histoFile.yoda jobReport.json lhpdf-config* mem.full.generate mem.summary.generate.json proc_card_mg5.dat py.py runargs.gen
erate.py runwrapper.generate.sh tmp_LHE_events tmp_LHE_events.events 2014Inclusive_17.dec AtRndmGenSvc.out Bdecays0.dat Bs2Jpsphi.D
EC config.pickle DECAY.DEC eventLoopHeartBeat.txt events.lhe tmp_LHE_events.events G4particle_whitelist.txt inclusiveP8DsDPlus.pdt nt
uple.pmon.gz ParticleData.local.orig.xml ParticleData.local.xml PDGTABLE.MeV pdt.table PoolFileCatalog.xml PoolFileCatalog.xml.BAK Se
ttings_after.log Settings_before.log susyParticlePgid.txt TestHepMC.root ; cd /eos/user/a/ararnaud/batch/ee/cHe/500_700/JOs/ee_bj/;
"
```


First contact with an analysis tool: Rivet

=> allow to treat the events generated and produce plots

How do we use it ?

=> informatic language

What can it do ?

-determine the types of particles:photons, electrons..., calculate characteristics of the particles : speed, mass, energy...

-get rid of the events that doesn't match the criteria that we can define

-sort all of these characteristics in differents plots

Rivet Analyse Example

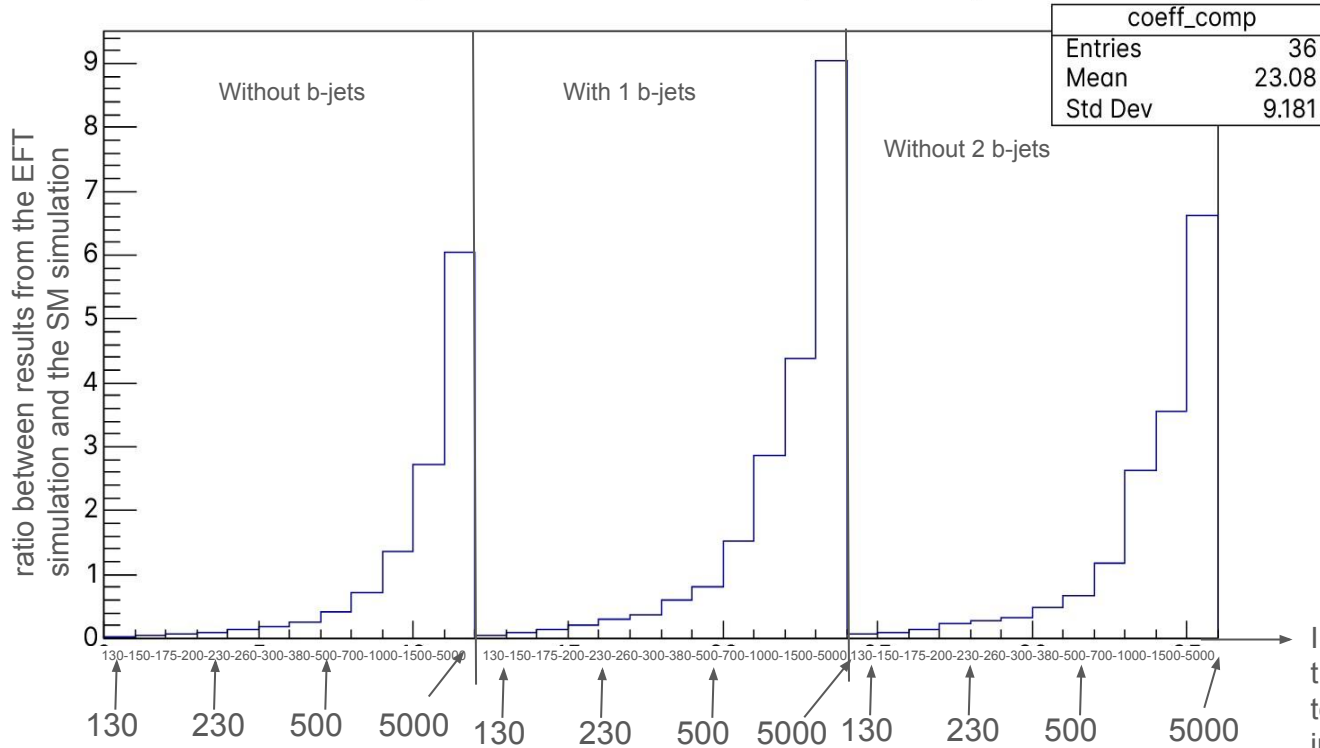
```
namespace Rivet {
public:
  void analyze(const Event& event) {
    //both leptons with 30 GeV < pT < 40 GeV
    //both lepton with eta > 2.5
    //130 < mll
    //removing all leptons found within deltaR < 0.4 of a jet
    //removing all jets found within deltaR < 0.2 of a lepton
    if (leptons[0].pT() > leptons[1].pT() && leptons[0].pT() < 40*GeV && leptons[1].pT() < 30*GeV) {
      { cout << "pt_leading < 40GeV or pt_subleading < 30GeV " << endl; vetoEvent;}
    }
    After_V3 ++;
    _h_cutflow["cutflow"] -> fill(3, 1.0);

    if (leptons[1].pT() > leptons[0].pT() && leptons[1].pT() < 40*GeV && leptons[0].pT() < 30*GeV) {
      { cout << "pt_leading < 40GeV or pt_subleading < 30GeV " << endl; vetoEvent;}
    }
    After_V4 ++;
    _h_cutflow["cutflow"] -> fill(4, 1.0);

    if (leptons[0].eta() > 2.5 || leptons[1].eta() > 2.5 )
    { cout << "eta > 2.5" << endl; vetoEvent;}
    After_V5 ++;
    _h_cutflow["cutflow"] -> fill(5, 1.0);
    |
    if(mll < 130)
    {cout << "mll= " << mll << "< 130" << endl; vetoEvent;}
    After_V6 ++;
    _h_cutflow["cutflow"] -> fill(6, 1.0);
  }
};
```

Some results

Comparison EFT with SM (coeff ced)



The greater the ratio between results from the EFT simulation and the SM simulation
=> greater difference between those two theories
=> greater chance to find new physics studying the process

Graspa School: Summer summer school on particles and astroparticles

-really interesting lectures,
good overview of the
subjects

-possible to interact with the
teachers/searchers during
coffee breaks or lunch

=> Learned in a formal way about the theories behind what I was doing for
example about the Standard Model or the EFTS

=> Learned more about some objects I was using for my internship



Thank you for welcoming me !