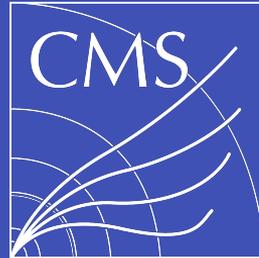
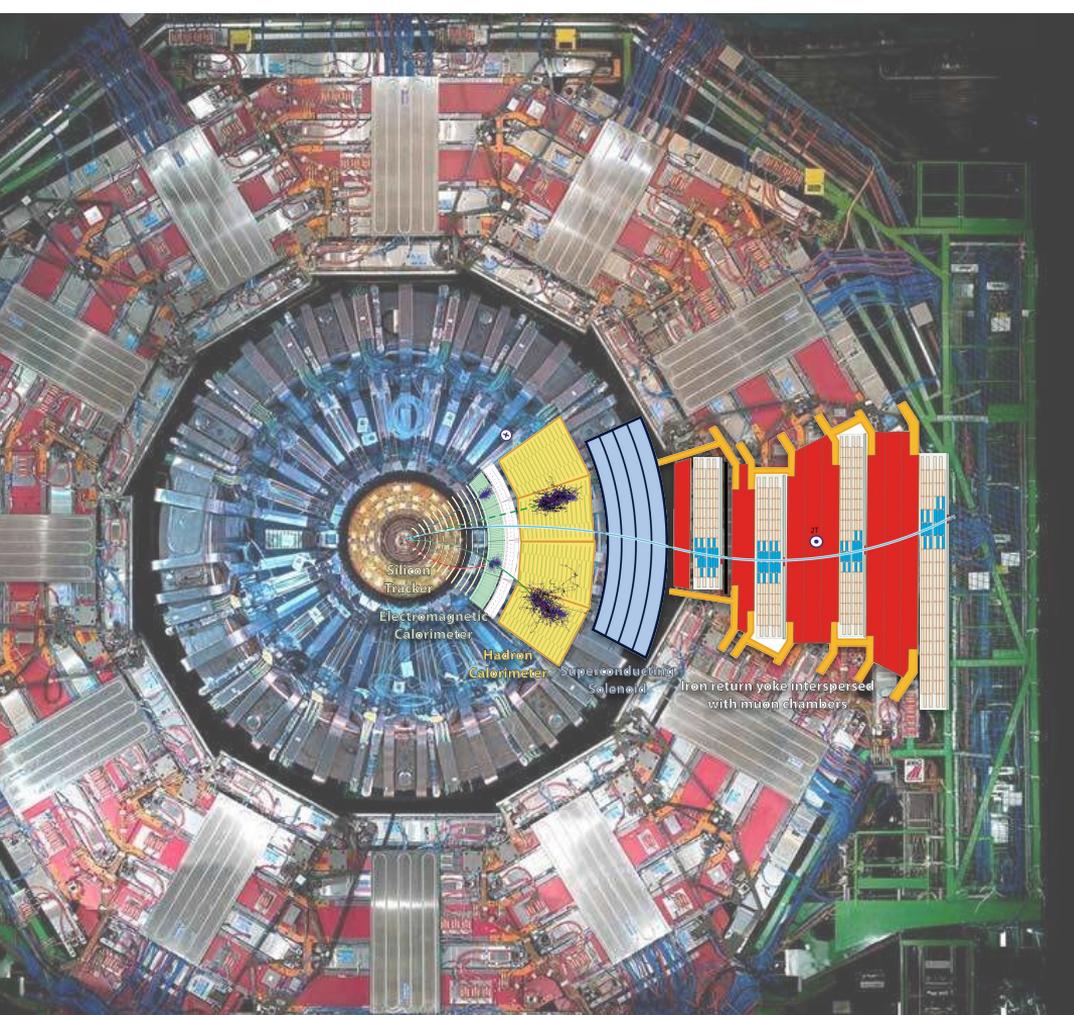


# Distributed Computing at the CMS Experiment

From the point of view of a physicist  
- The Portuguese group in the CMS experiment -

Diogo de Bastos - 25 • 09 • 2019





# CMS: Compact Muon Solenoid

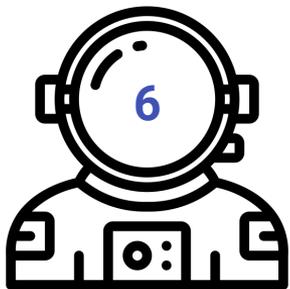
14.000 tons

Particle detector at CERN

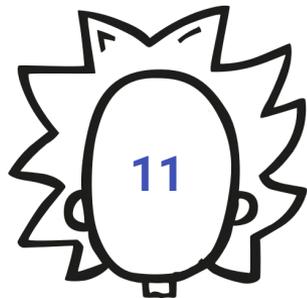
Study the Standard Model

Look for evidence of physics beyond SM

# The Portuguese Collaboration in CMS



Students



Researchers

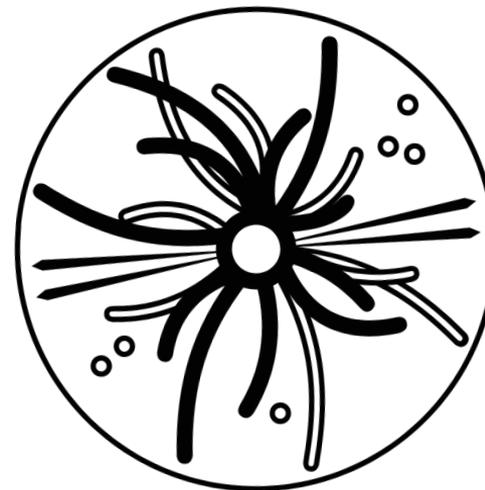


External

SUSY

Top

Quarkonia

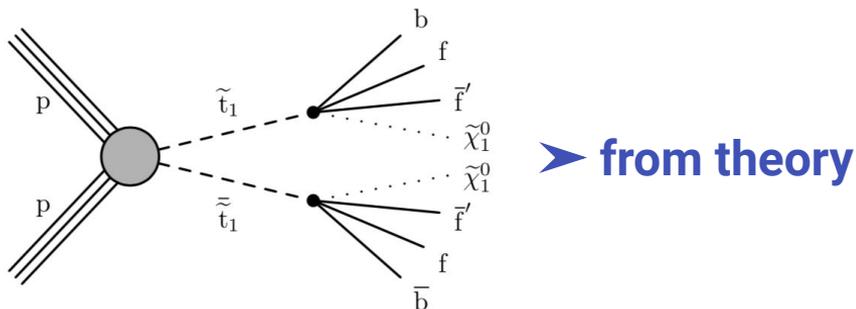


Detector  
development

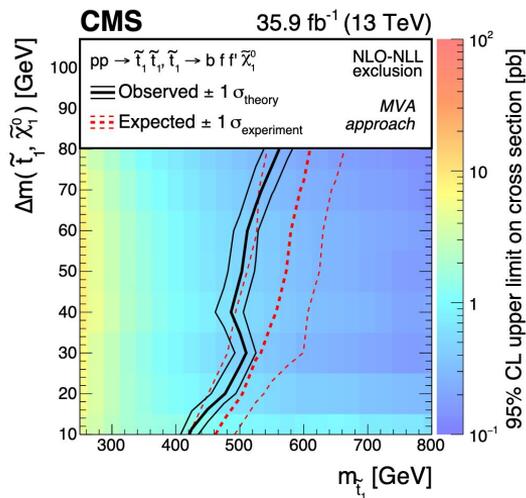
HIGGS

Heavy Ions

# The tools we use to do physics



to results



git

C++

ROOT

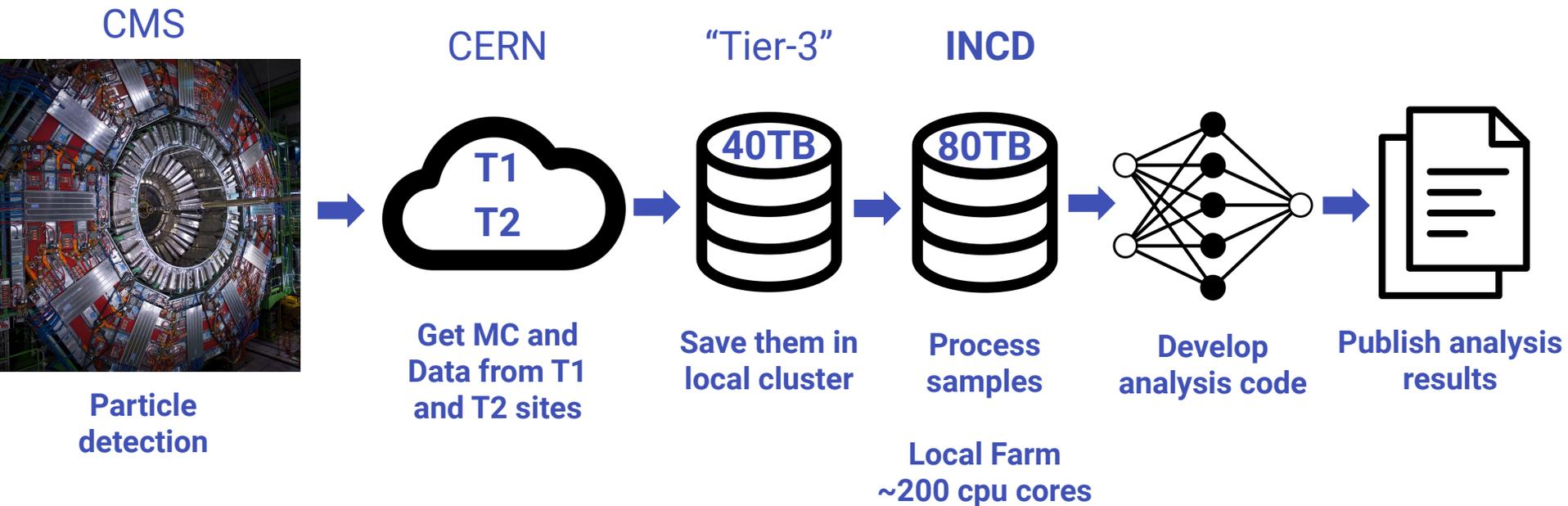
Python

Shell scripting

Tensorflow/PyTorch

Computational power

# One “day” as an experimental particle physicist



# Highly dependant on LIP's cluster

## The good

- complexity analysis
- ∞ complexity code
- quicker to deploy new software
- more storage and backups

## The ugly

- CMS doesn't provide enough tools for our analysis

## The bad

- cluster serves all LIP users, might have to wait in queue
- Recently we had no free storage space (+80TB)

# Computational needs: future

## RunII 2015-2018

CMS Recorded  
luminosity:  $150 \text{ fb}^{-1}$   
Storage: 120TB  
CPU: ~200  
GPU: 3

## RunIII 2021-2023

Nominal luminosity:  
 $300 \text{ fb}^{-1}$   
Storage: 300TB  
CPU: 250+  
GPU: 6

## HL-LHC 2026-2038

Nominal luminosity:  
 $3000 \text{ fb}^{-1}$   
Storage: 2PB  
CPU: 400+  
GPU: 12

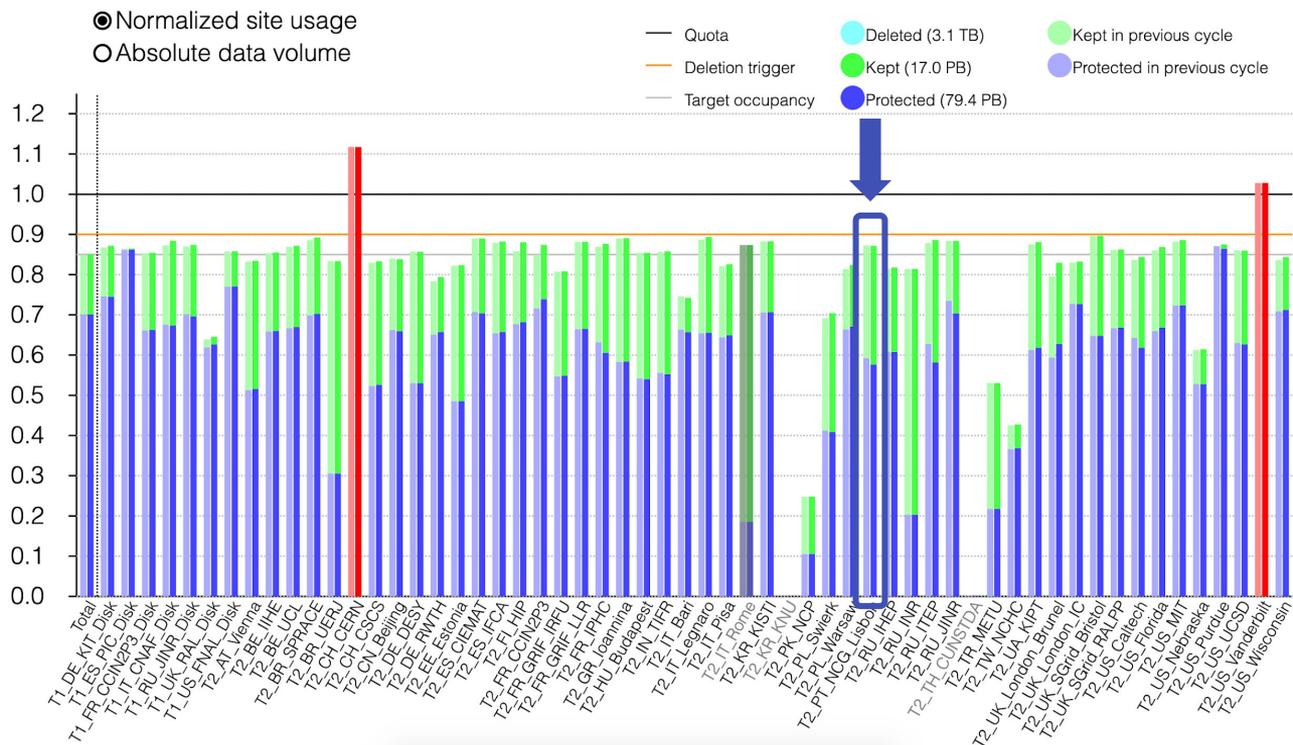
# Tier-2 management duties

- Site correctly [configured](#)
- Manage [PhEDEx](#) deletion and submission requests
- Space provisioning and quota management - 200TB

# CMS site readiness

T2_PT_NCG_Lisbon																						
LifeStatus:	✓																					
Site Readiness:	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
Maintenance:	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up								
HammerCloud:	87%	87%	84%	96%	100%	99%	100%	99%	100%	100%	98%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
SAM Availability:	99%	98%	98%	89%	96%	99%	97%	100%	99%	99%	95%	97%	100%	54%	87%	100%	79%	52%	89%	100%	99%	
Good T2 links from T1s:	14/15	15/15	15/15	15/15	15/15	14/15	15/15	6/7	14/15	14/15	14/15	13/14	14/14	14/14	14/14	14/14	14/14	10/14	12/14	12/14	11/14	
Good T2 links to T1s:	13/15	14/15	15/15	14/14	14/14	14/14	14/14	6/6	14/14	14/14	15/15	14/14	12/13	13/14	14/14	12/13	13/13	12/13	13/13	12/13	11/13	
Active T2 links from T1s:	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
Active T2 links to T1s:	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	
	23	24	25	26	27	28	29	30	31	01	02	03	04	05	06	07	08	09	10	11	12	13
	Aug									Sep												

# Quota management



## Wrap up

- CMS infrastructure **does not provide** all the necessary tools for our daily analysis
- Dependent on local cluster - **INCD**
- Local cluster **currently** satisfies our needs
- Future is uncertain, computing/storage will **exponentially grow** and so will our needs

**Thank you!**