

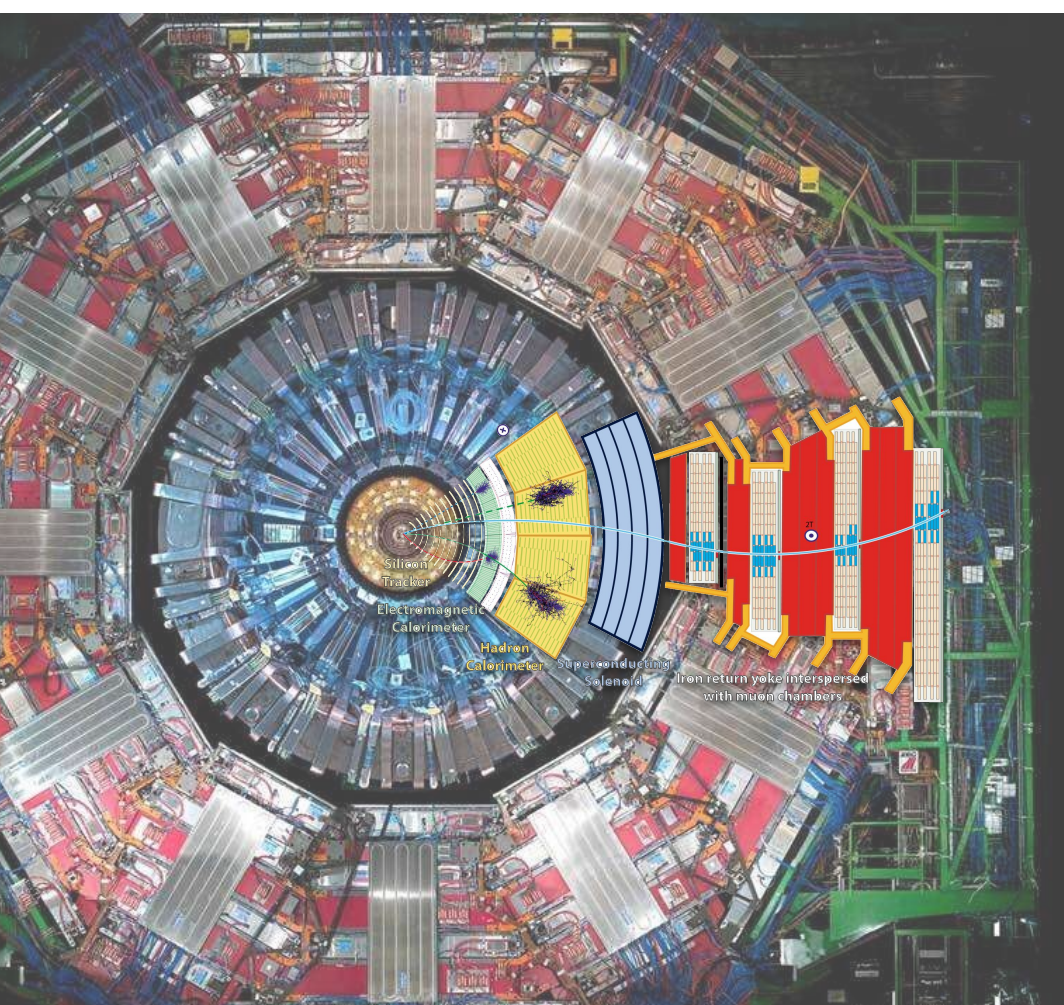
# Distributed Computing at the CMS Experiment

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

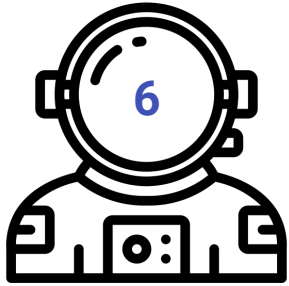
14.000 tons

Particle detector at CERN

Study the Standard Model

Look for evidence of physics beyond SM

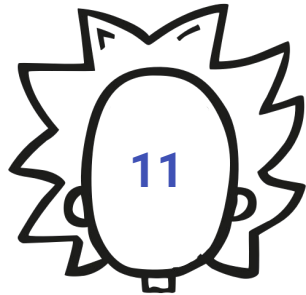
# The Portuguese Collaboration in CMS



Students



External



Researchers

**SUSY**

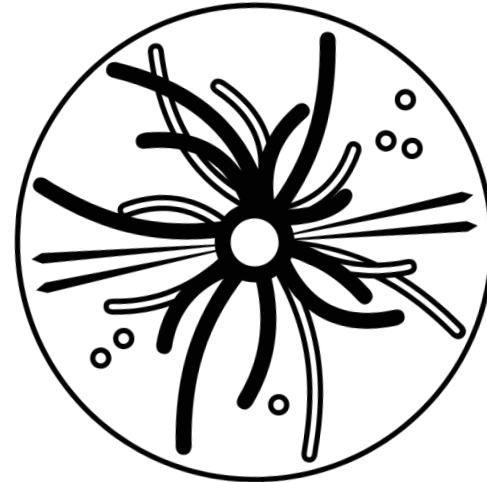
**Top**

**Quarkonia**

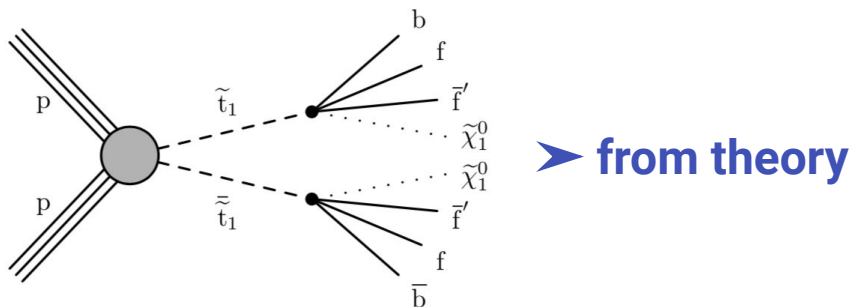
**Detector  
development**

**HIGGS**

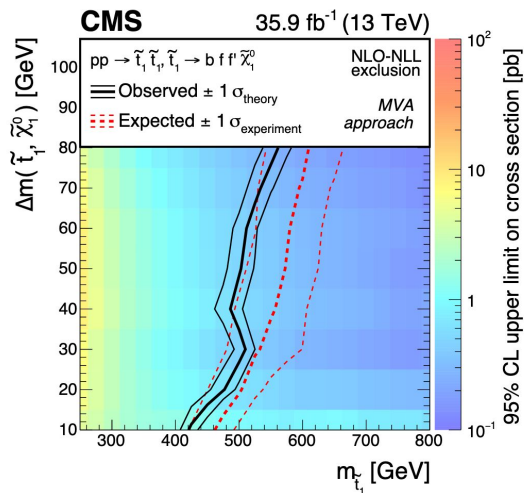
**Heavy Ions**



# The tools we use to do physics



to results ➤



git

C++

ROOT

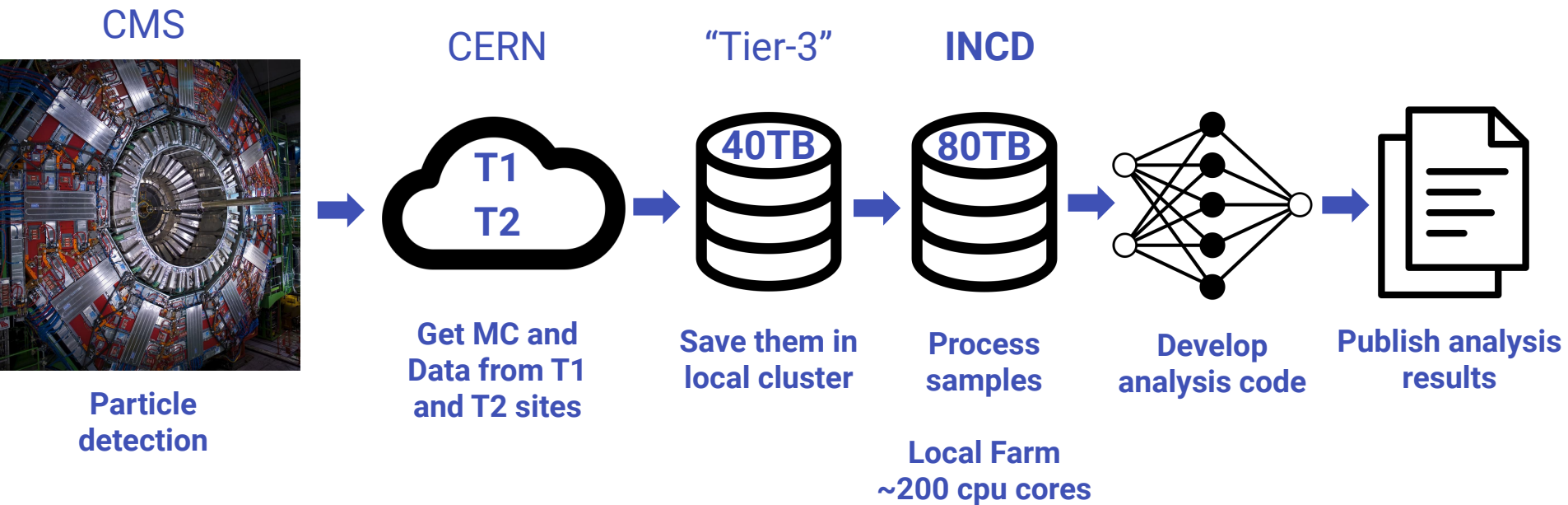
Python

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

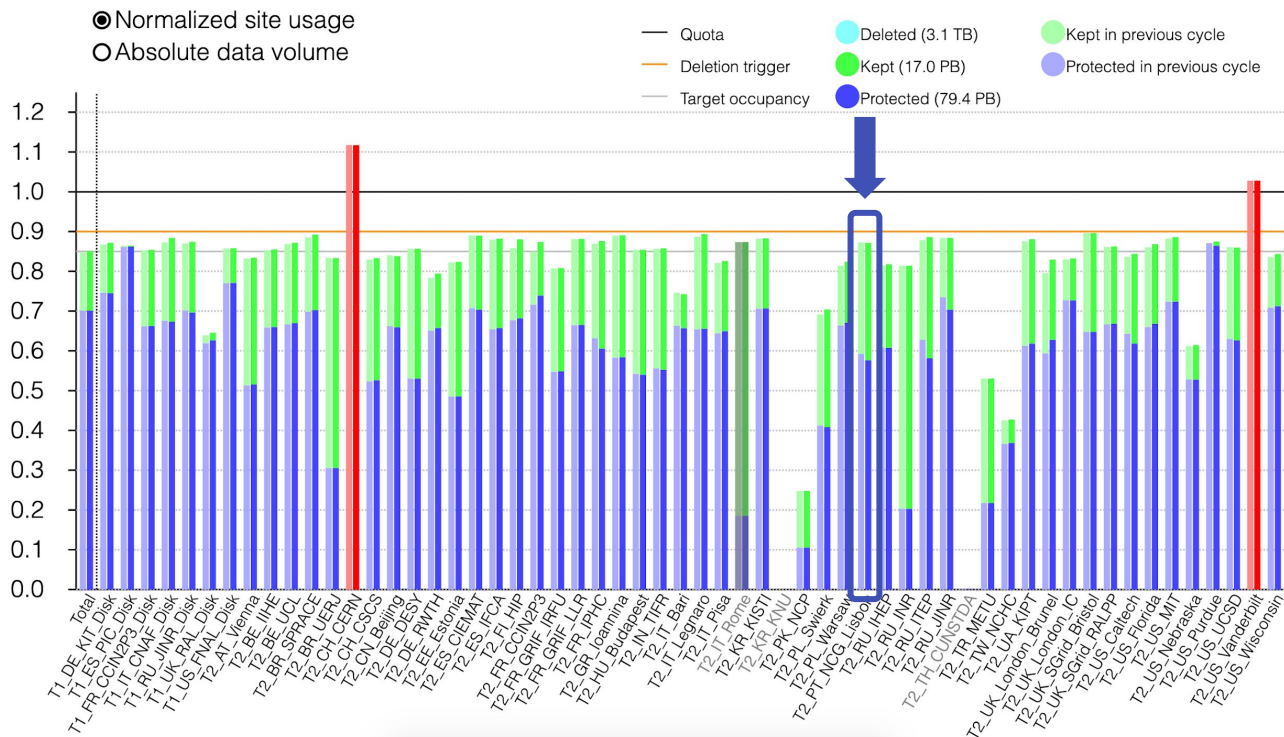
- Site correctly [configured](#)
- Manage [PhEDEx](#) deletion and submission requests
- Space provisioning and quota management - 200TB



# CMS site readiness

T2_PT_NCG_Lisbon																				
LifeStatus:	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Site Readiness:	O	O	O	O	O	O	O	O	O	O	O	O	O	E	O	O	E	E	O	O
Maintenance:	Up	Up	Up	Up	Up	Up	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%
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
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
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
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
	23	24	25	26	27	28	29	30	31	01	02	03	04	05	06	07	08	09	10	11
	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!**