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My research:
Standard Model measurements, searches for Beyond the Standard Model particles at the CMS Experiment
Trigger and data-acquisition, Software & Computing

I enjoy:
Working on challenging tasks in a collaborative setting

Beyond research, I am particularly interested in:
Outreach, science communication and improving diversity and inclusion

I've got my eyes on:
Learning to cook gourmet meals and play the piano

CMS Compact Muon Solenoid

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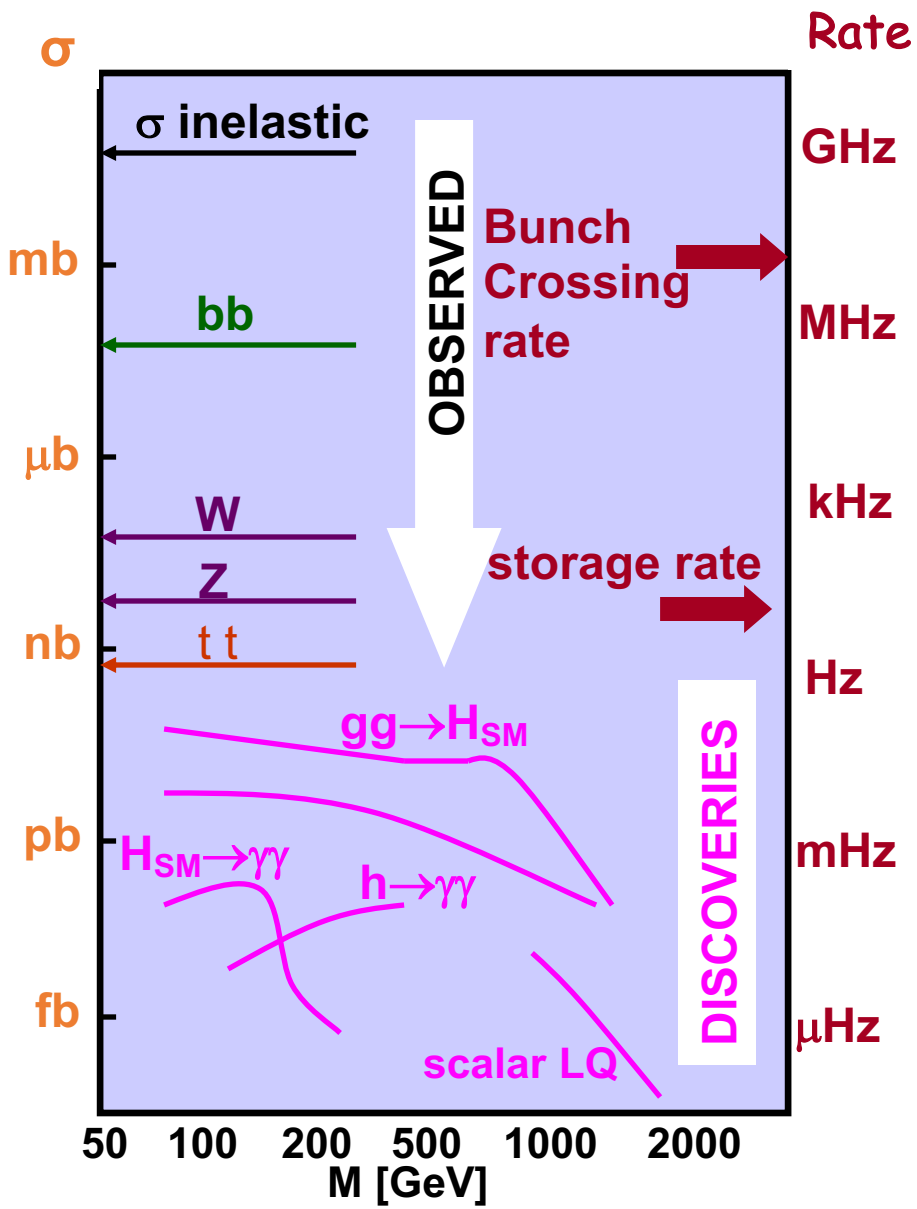
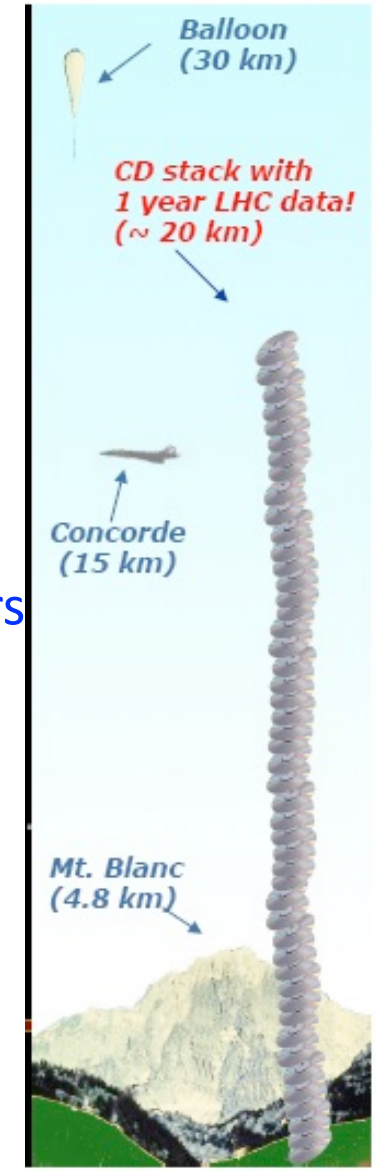
The Challenge at the LHC



LHC: ~10^9 interactions/s

Bunch crossing frequency: 40MHz
Storage rate ~ 1000 Hz

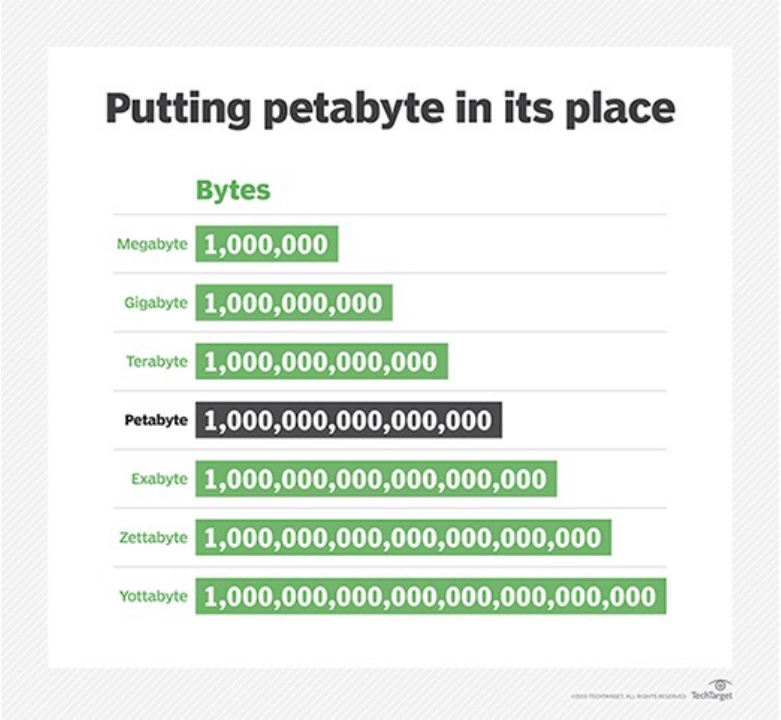
Discoveries require rare signal extraction in huge data samples of complex detectors – large-scale processing and data management



Software & Computing challenge

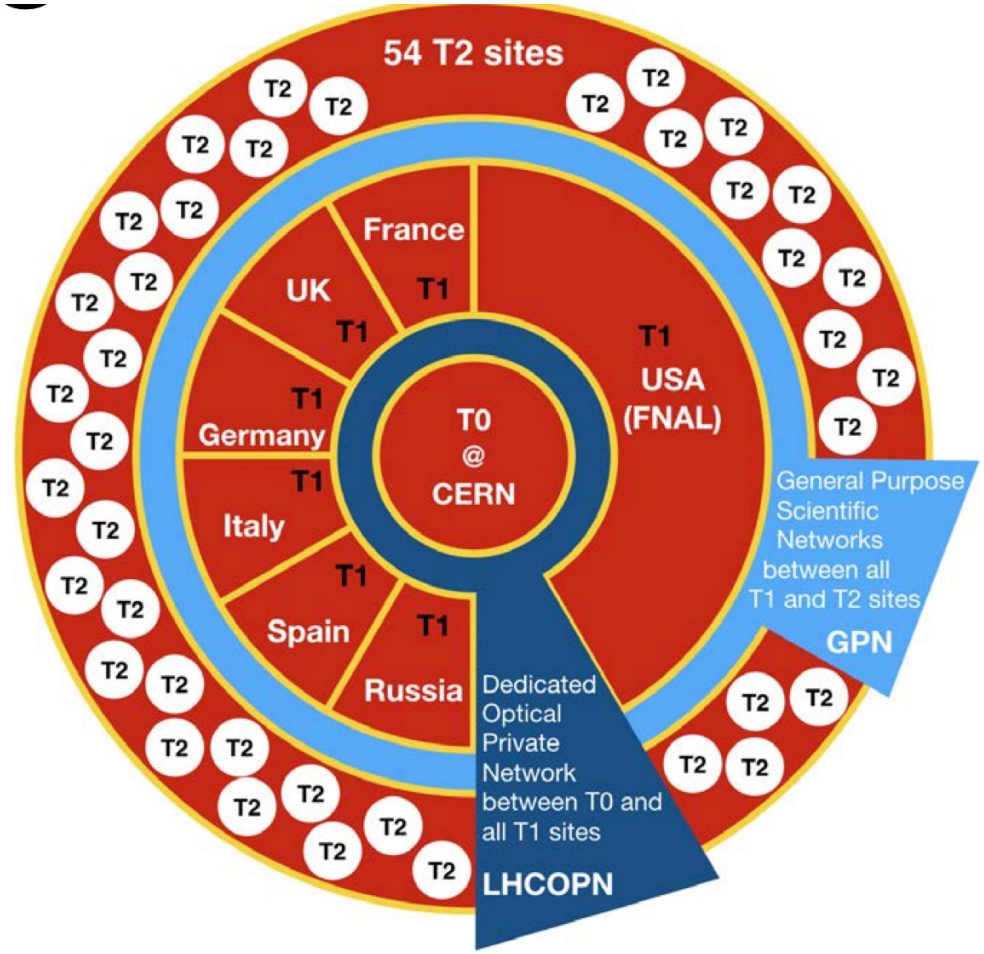
- LHC datasets are big and getting bigger
  - Yearly data volume: 200 PetaByte (PB)!
    - 2 PB data comprises information from all US academic research libraries.
    - Facebook storage capacity: 300 PB
  - Yearly data volume for the LHC run starting in 2029 (HL-LHC): 1 Exabyte!
    - 1 Exabyte: record of every word ever spoken by every human being that ever existed.

- Software enables us to interact with data
  - CMS software: ~6M lines of code!
  - Modules written in **C++**, configuration in Python
  - *Release cycles* named CMSSW_*A*_*B*_X
- Traditionally, HEP analysis has used ROOT
  - object-oriented toolkit for data analysis, provided by CERN
    - Can use C++ or Python
    - ROOT is evolving
- Alternate ecosystem becoming popular: uses scientific Python

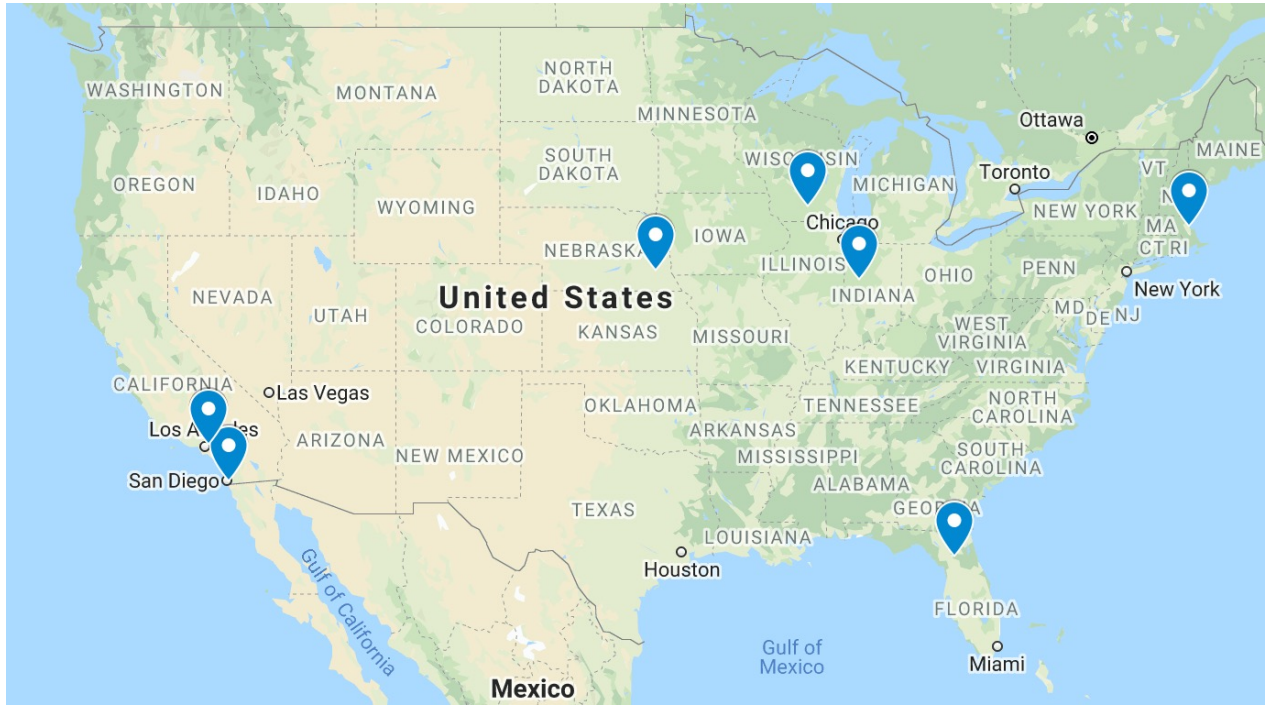


Software & Computing challenge

Worldwide LHC Computing Grid

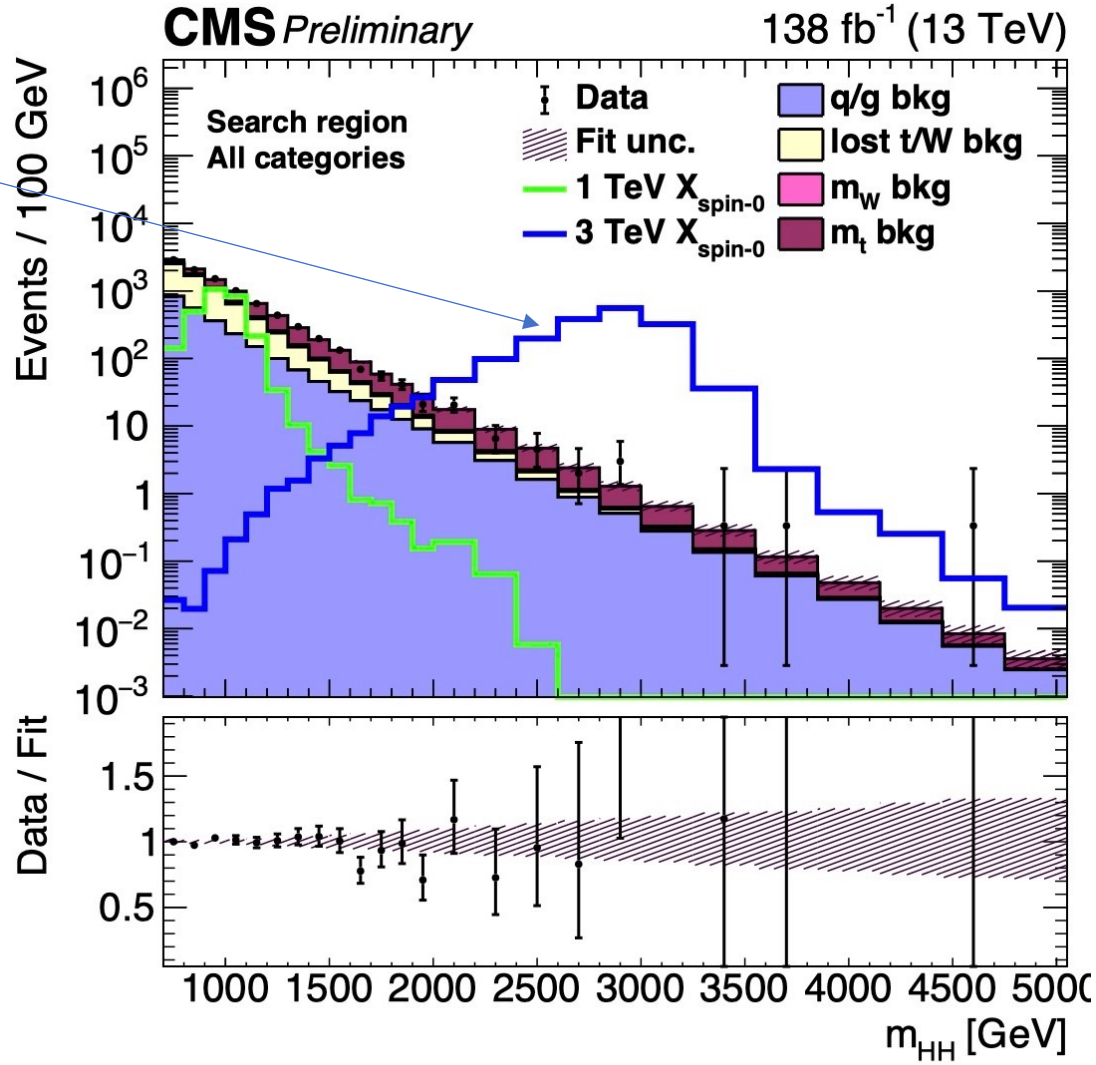


T0 (CERN): Prompt reconstruction, calibrations
T1 (e.g. Fermilab): Re-reconstruction, Simulation
T2: Simulation and user analysis



Simulations

- Simulations enable precision studies of Standard Model particles and searches for **new exotic particles**
  - Compare data and simulation and look for deviations from Standard Model expectations
- Simulations involve generation of physics processes, modeling of detector response (i.e. how particles interact w/ the CMS detector) and reconstruction of particle momenta and energies
- Simulated 4 billion collision events in 2021!



The future: lots of opportunities!

- Lots of R&D ongoing to meet the challenges of the HL-LHC run in the areas of innovative algorithms, facilities and infrastructure
  - Provide infrastructure and software to address issues related to code performance in order to reduce computational needs for HL-LHC
    - R&D into novel algorithms, including those based on Machine Learning, that promise dramatic increases in processing speed
    - Convert or extend existing algorithms to run on hardware accelerators (e.g. Graphics Processing Units or GPUs)
    - Design analysis facilities to meet the needs of users as **datasets grow in complexity and by order-magnitude in size** over the next few years.