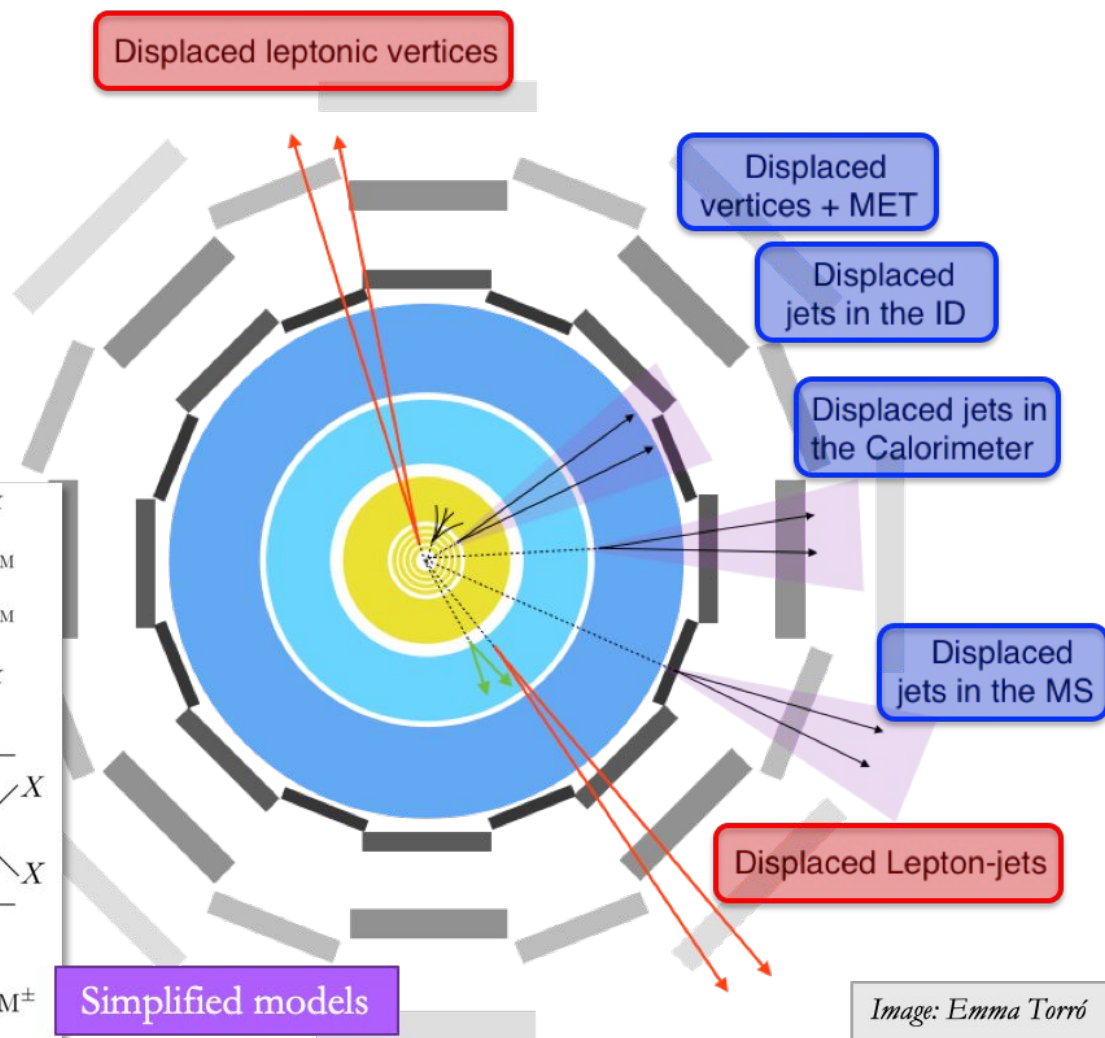
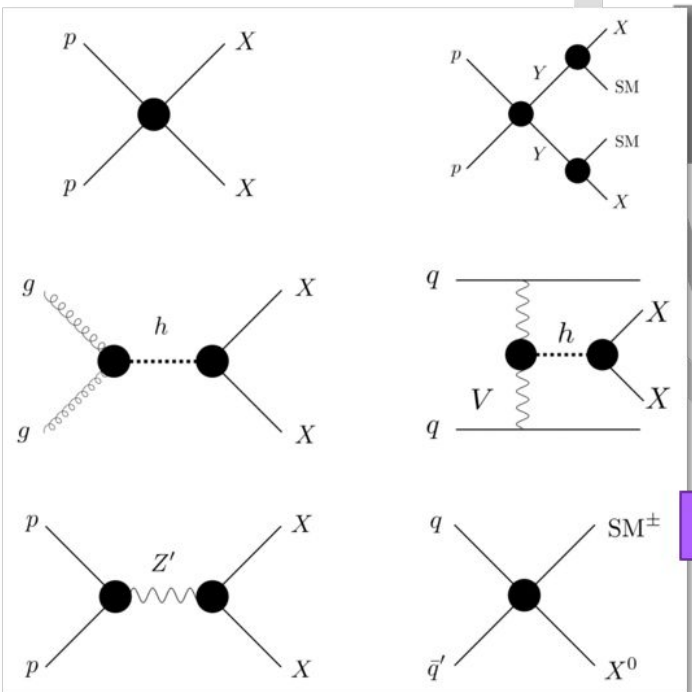


# LLP/Unconventional signatures

- ..... neutral particle
- ▶ jet
- charged particle
- highly ionizing particle
- electron
- muon
- photon



Simplified models

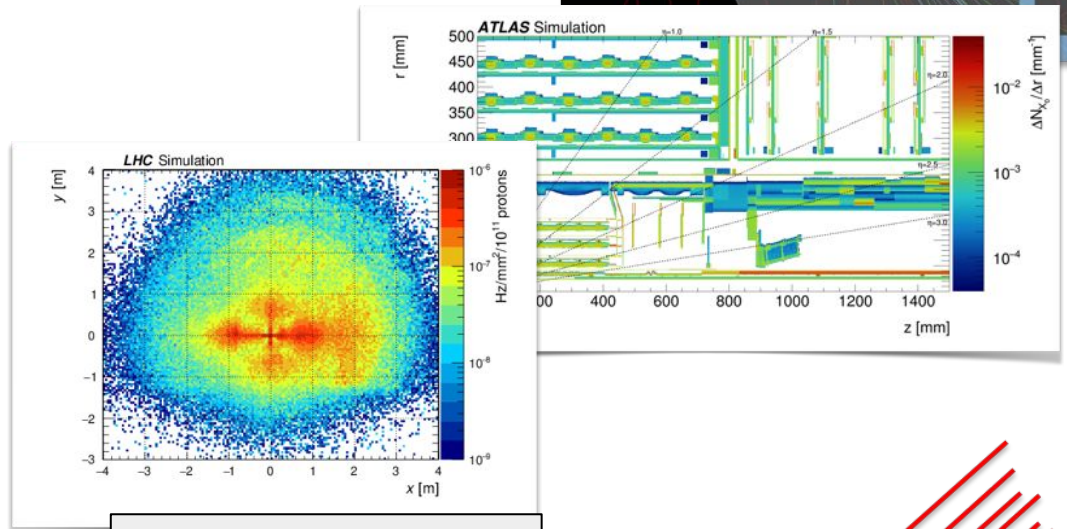
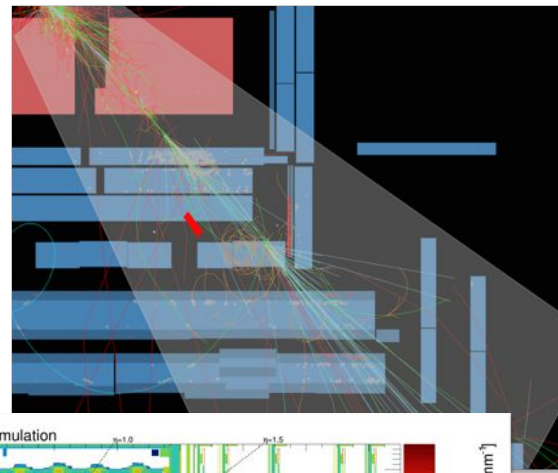
Image: Emma Torró

Are we covering already SVJ signatures?

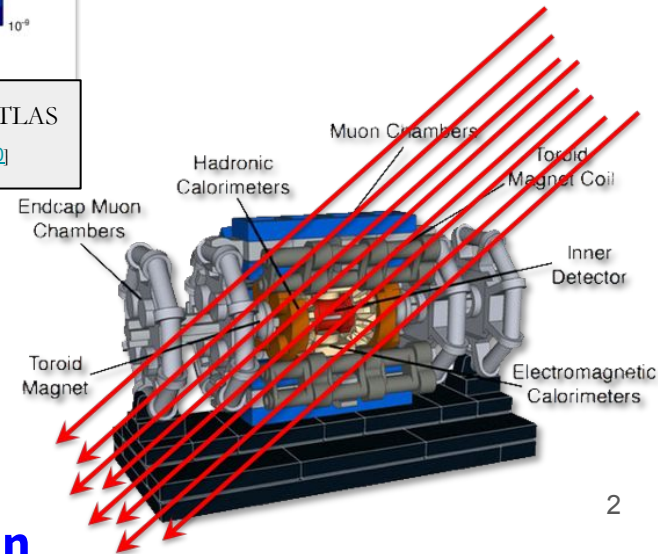
# Main Detector Challenges

## LHC detectors are optimised to detect prompt SM particles

- BSM particles can produce **final states** that might be **very difficult to study** due to **complicated backgrounds**
  - Instrumental backgrounds
  - Large QCD jet production
  - Pile-up problems
  - Material interaction
  - Beam induced background
  - Cosmic background
- Need to develop
  - **Dedicated triggers**
  - **Custom reconstruction tools**
  - **Very robust background modelling and rejection**



muons ( $E > 20$  GeV) entering ATLAS at  $z = 22.6$  m [[arXiv:1810.04450](https://arxiv.org/abs/1810.04450)]



# Some Thoughts (mostly from an ATLAS perspective)

Many searches for LLP at the LHC

- Are we (partially) covering already the SVJ signatures?
  - **Example:**
    - Search for **displaced hadronic jets in the muon detector** (from neutral LLPs)
    - Background rejection requires that the **displaced vertex is “isolated” wrt any prompt track and jet activity**
      - **If SVJ has some (very) long-lived components, part of the activity in the area where SVJ is produced is reconstructed as prompt, part as displaced** → this is basically what the analysis is currently calling “the main background”
      - The same can apply to other LLP searches in the calorimeters and inner tracking detectors
- Are we missing LLP SVJ in the online selection of the events (trigger)?
  - Probably we have already a good coverage
    - “Hit multiplicity triggers”, i.e. counting the number of hits (tracking detector) not associated to “standard” (i.e. prompt) tracks
    - Cluster triggers (e.g. ATLAS displaced hadronic jets in the MS), i.e. triggering on detector activity “clusterized” in a certain region