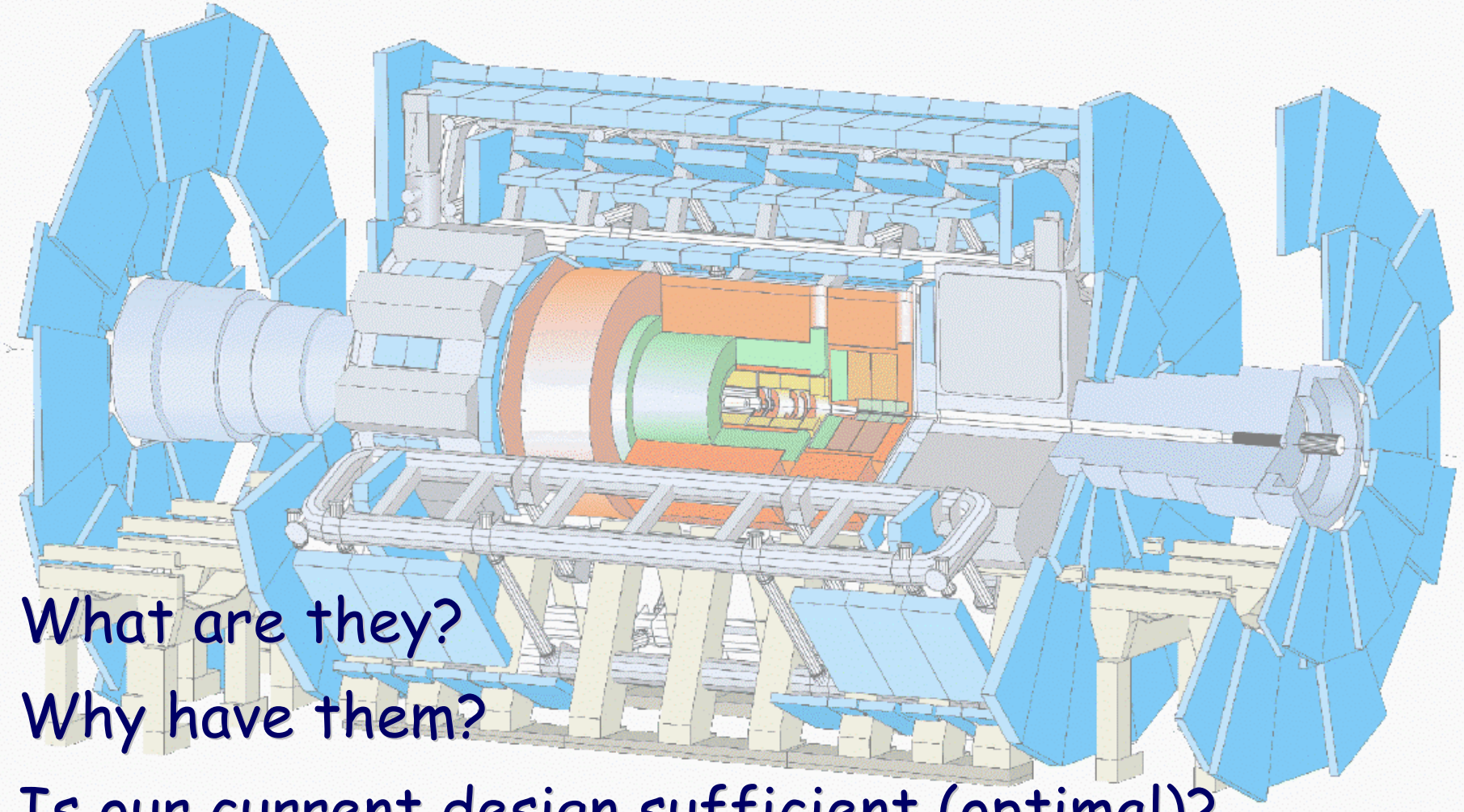
Secondary RoIs



What are they?

Why have them?

Is our current design sufficient (optimal)?

What is a "secondary RoI"?

Any RoI not involved in trigger decision

- 2E15I $\rightarrow$ both e/γ RoIs "primary"
- 1MU6 + 1E15I $\rightarrow$ e/γ RoI would be "secondary"

An RoI may be intrinsically secondary:

- Low-E_T object (probably unisolated)
- Not used anywhere in CTP trigger menu
- Used purely to guide additional selection in Level-2
  - use secondary e/γ or jet RoI to guide LVL2 B triggers
  - use secondary e/γ to ensure full readout of H $\rightarrow$ 4e at high lumi (where may prescale Z $\rightarrow$ ee)

Implementation

Nothing Special

- Just set desired thresholds
- Will send multiplicity to CTP (which will ignore it)
- Our electronics makes no distinction between "primary" and "secondary" selections

Is there a problem?

- Uses 1/8 of our thresholds & Calo → CTP bandwidth
- Not a problem provided have spare capacity
- This was included in estimates of required no. thresholds
  - only an issue if we've underestimated requirements

Could Requirements be Underestimated?

Current design

- 8-16 e/γ + 0-8 τ/h classifications (E_T + isol^n)

Why so many?

- May need > 1 classification for single trigger menu item
  - isolation should be loosened for higher E_T objects
  - conversely, 1 classification may have > 1 use in trigger menu

But even so?

- Hard to imagine need > 16 e/γ classifications
  - could add more by restricting multiplicity, FPGA capacity permitting
  - pressure could arise if t trigger more important than expect

What might demands be?

e/γ

- Inclusive
  - 2-3 classifications
- Pair
  - 2 classifications
- Multielectron
  - 1 classification?
- Secondary RoI
  - 1 classification
- $e+E_T^{miss}$
  - 1 classification
- $e+\mu$, $e+\tau$, e+nJet
  - ≤ 1 each

τ/h

- Inclusive
  - 2 classifications
- Pair
  - 1-2 classifications
- Secondary RoI
  - 1 classification
- Calibration (prescaled)
  - 1 classification
- $\tau + E_T^{miss}$
  - 1 classification
- $\tau+\mu$, $\tau+e$, τ+nJet
  - ≤ 1 each

- Even if all needed, can reuse some classifications for > 1 purpose

Is there an alternative?

Yes (in principle)

- add extra e/γ & τ/h thresholds
  - cluster E_T only, no isolation
- do not output CTP "hits" for these
  - those 48 (16×3) bits are a finite resource
- these additional thresholds only generate RoIs
  - RoI with no threshold bits set could indicate secondary (but could not distinguish e/g and t/h)

Is it possible?

- Would require "only" software & firmware changes ☺

A Radical Extension (just a bit of fun!)

Classify objects by function, not E_T + isol^n

- e.g. output 1 hit type for "inclusive e/γ", rather than 2-3
  - same number of hit classifications would go further

How could this work?

- within FPGA, encode RoI E_T & isolation separately
  - E_T is natural, though no exact hierarchy for isolation
- input E_T + isol^n codes to small LUT
  - output all functional classifications matched
- gain more with > 16 E_T thresholds (need fewer isolation)
  - but some gain just from mixing & matching E_T & isolation

Drawbacks?

- might need bigger FPGA
- would add a little latency

Leave this for the upgrade ☺

Summary

The issue is "necessarily secondary" RoIs

- some RoIs types may be primary or secondary in different events

Our current design can accommodate these

- by treating them as any other selections

There is some inefficiency

- "wastes" 6/48 of the bits we send to the CTP

There is an alternative

- which we can use if we need it
- hard to assess need in advance (but we don't currently believe there is a problem)