The ECAL+ HCAL problem

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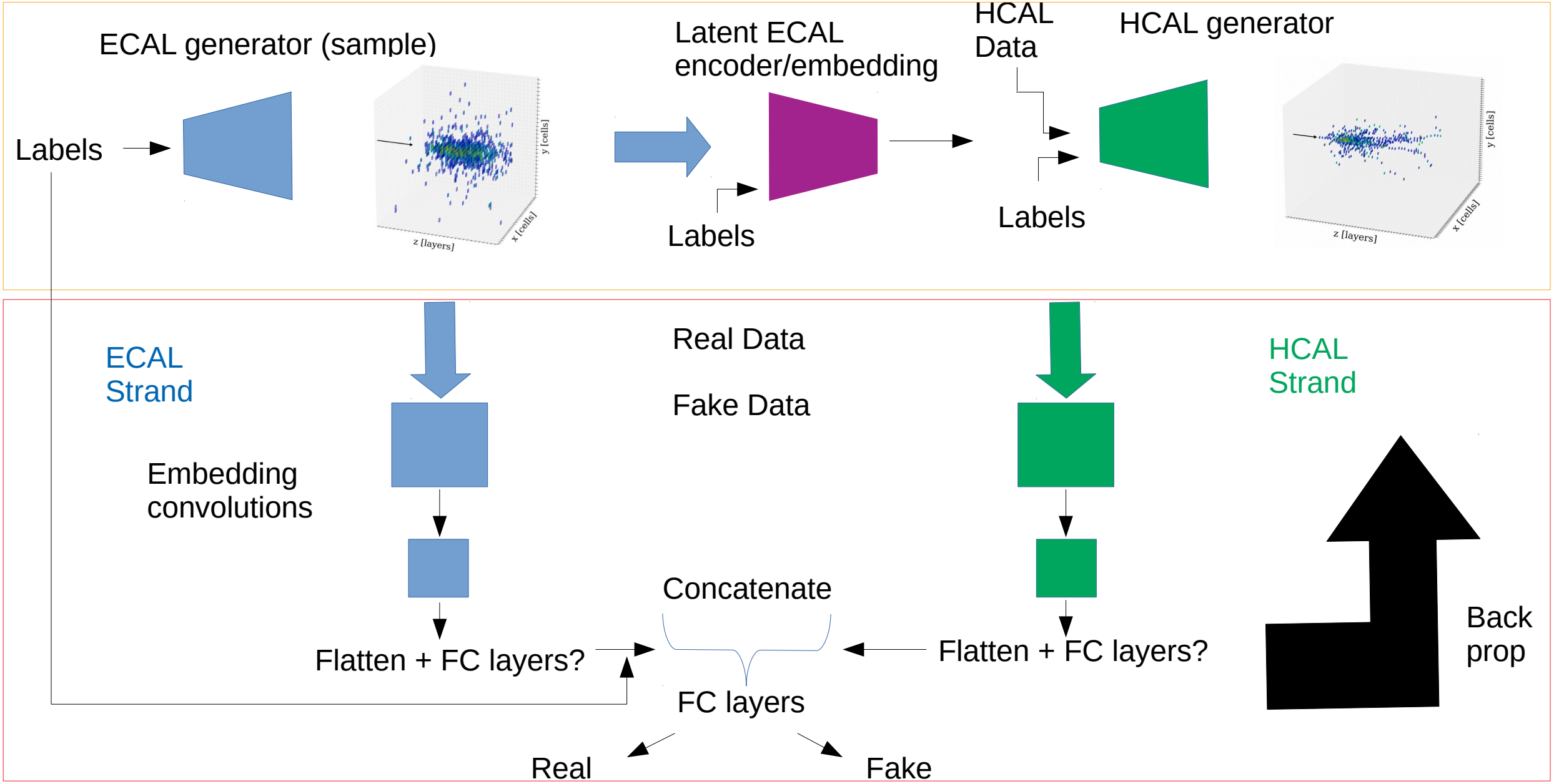
ECAL + HCAL – which approach is best?

- So far, aim is to combine highly granular HCAL with ECAL into one large “shower image”
- However, this approach has a number of possible limitations:
  - Much larger data space and much larger sparsity than any generator we have trained previously
  - Poor scaling in terms of sparsity in the future once angles are added
- Proposal of a **modular** approach:
  - Based on idea from Sascha on Monday- rely on passing an embedded/latent representation of ECAL showers to HCAL generator
  - Would allow you to leverage previous work on Electromagnetic/Hadronic shower simulation that we know works
- A few words of caution: Not sure about how sound this idea is from an information theoretical stand point
- Apparently not the first to have this idea (in this case for local regions in images): https://ieeexplore.ieee.org/document/8883161

GAN-ception

An architecture of nested GANs

Nested GAN idea



ECAL + HCAL – GAN-ception approach

- I believe the problem factorizes
  - Can pretrain the ECAL generator part (only conditional on labels)
  - Then train HCAL part (which is conditional on labels and the ECAL shower)
  - Just need to back prop up to the latent ECAL embedding
- Proposed procedure:
  - Sample ECAL, embed for HCAL generator, back prop gradients within that sub architecture
  - Generate HCAL sample
  - Then proceed with discriminator step, and back prop over whole thing (like a normal GAN trianing)
- Potential issues:
  - Is the backprop idea theoretically sound?
  - ECAL has more difficult job than previously (might just have MIP track)
  - A lot comes down to the ECAL embedding to capture the relevant info for the HCAL to produce reasonable output