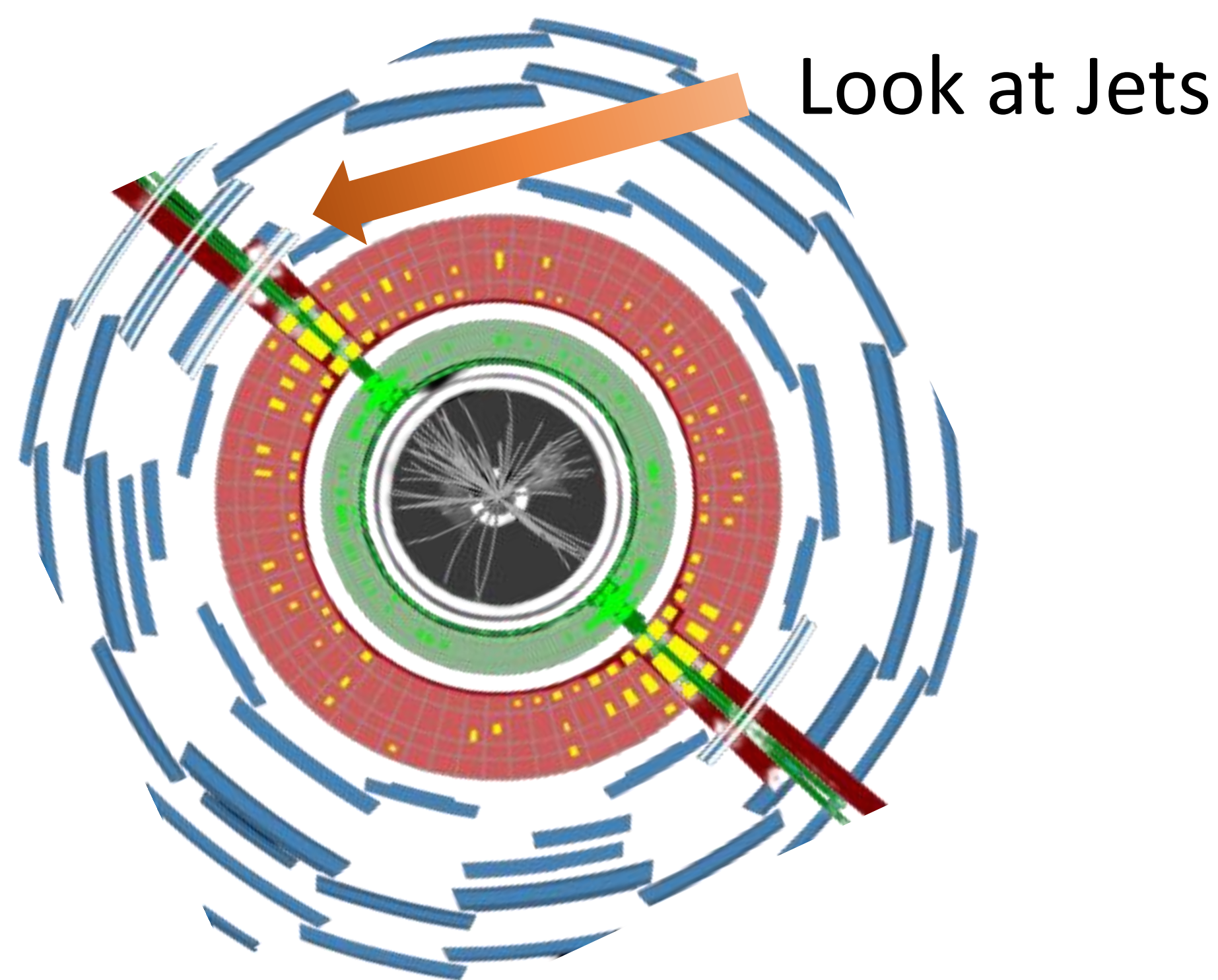


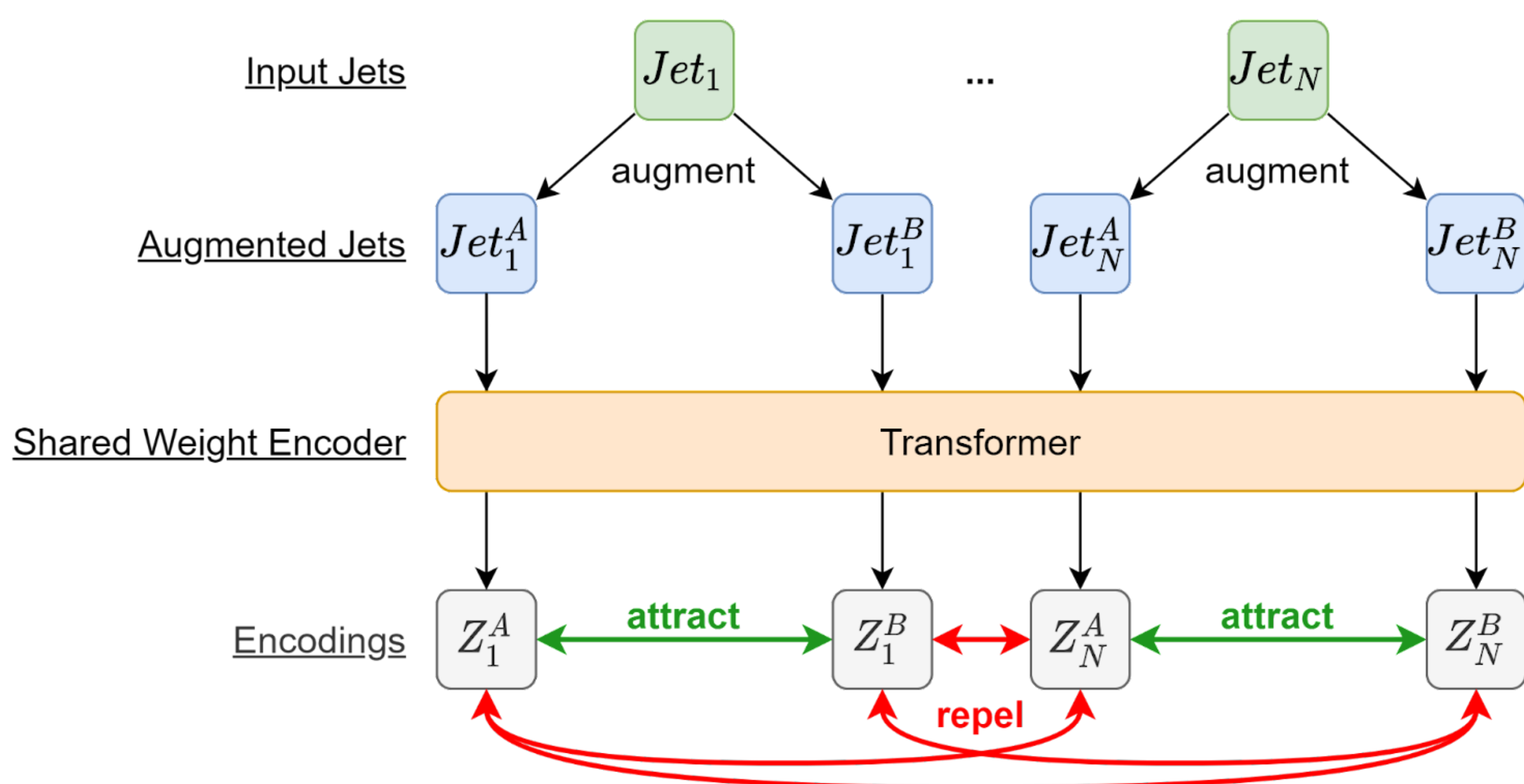
Fantastic New Physics and how to find them

Where do we look?



- Very common in Collision Experiments
- Unordered collection of particles –constituents: characterized by *position* and *kinematic* features
- Some known and several exotic jets! – window to new physics!

Training Scheme



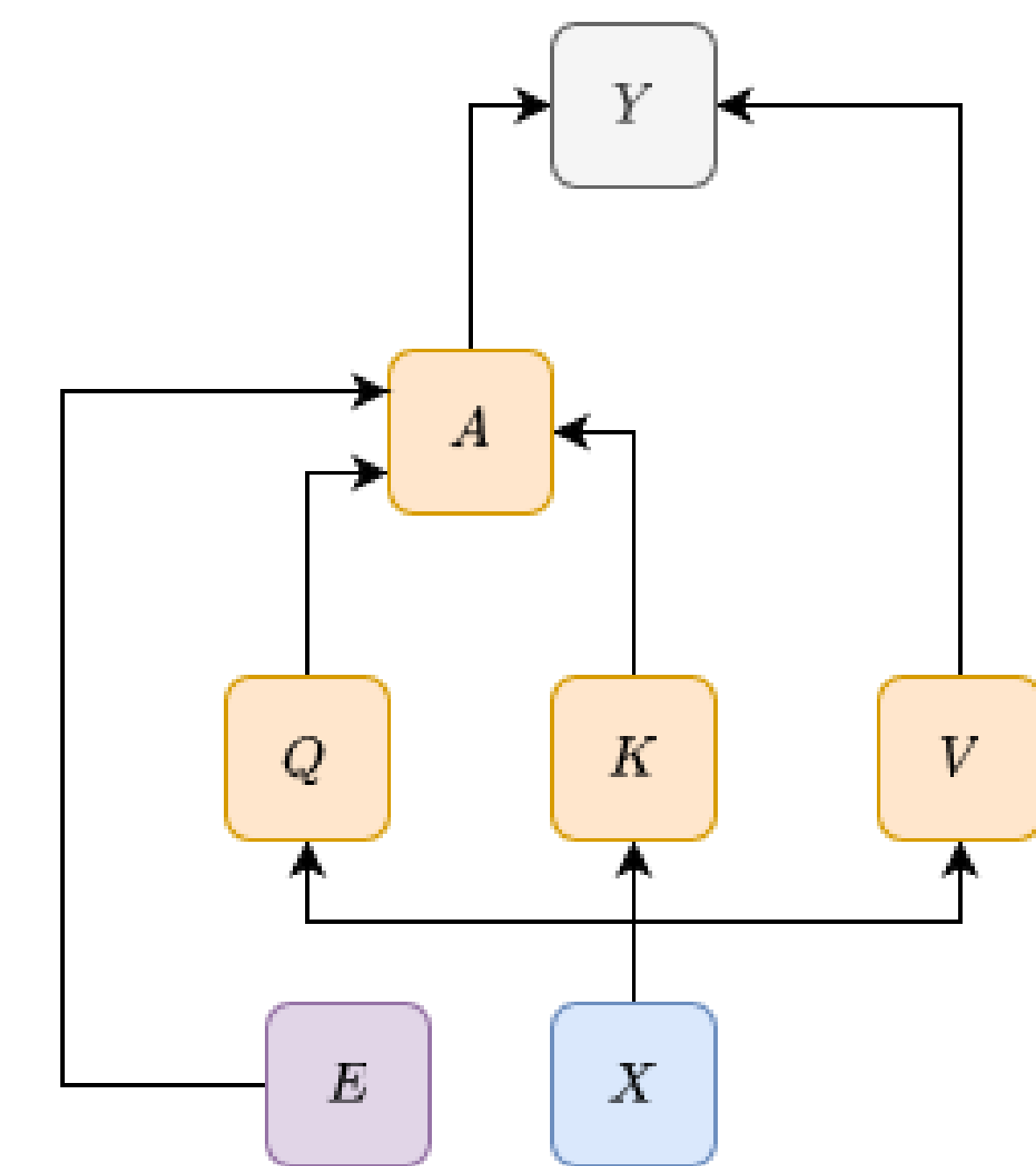
Contrastive Learning (CLR)

- Our jets have symmetries : Rotation, translation, and more!
- Apply these symmetric transformations to the jets – ‘augmented’ jets!
- Symmetry preserving representation of Jets: Pull jet and its augmentation closer – push everything else apart.

Can use this embedding for binary classification!

Machinery

$$\begin{aligned}
 Q &= W^Q X \\
 K &= W^K X \\
 V &= W^V X \\
 A &= \text{softmax}\left(\frac{QK^T}{\sqrt{d}} + E\right) \\
 Y &= AV
 \end{aligned}$$

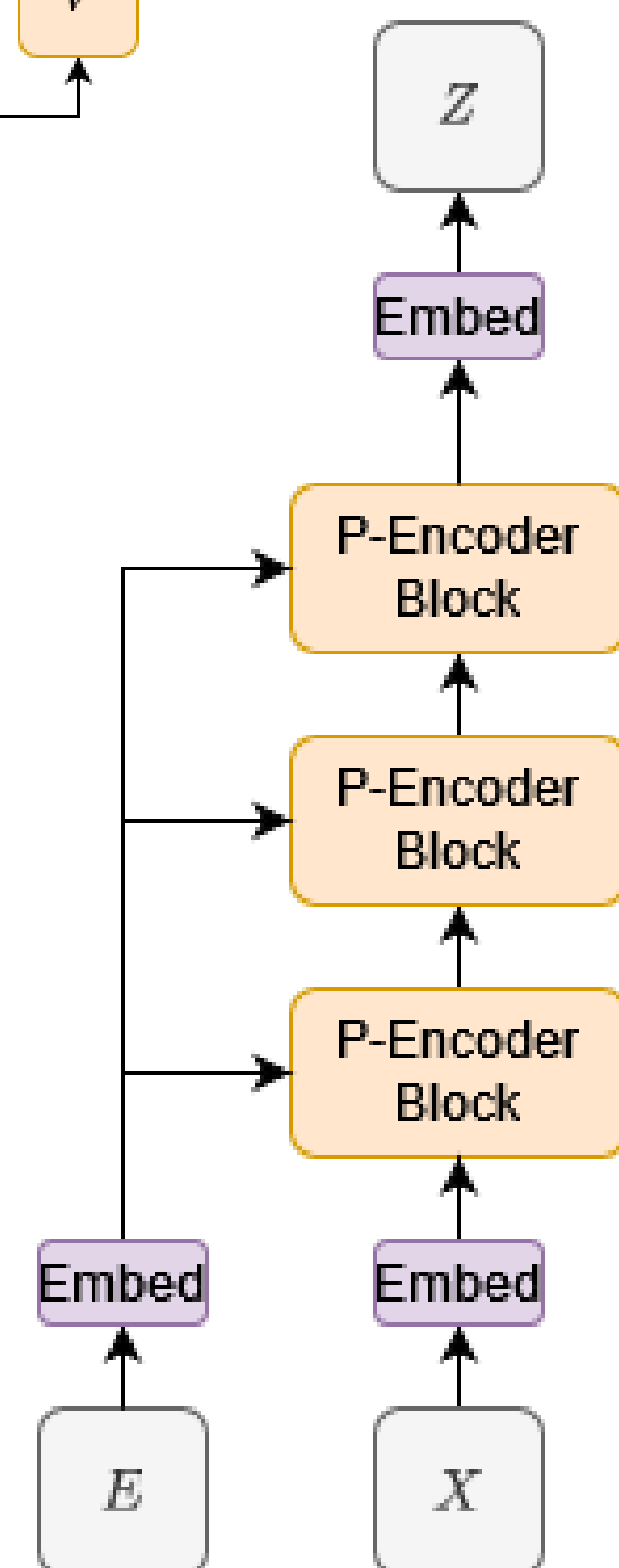


Self Attention Blocks

- **Transformer Encoders:** State of the art sequence to vector encoders
- Inputs: Jet constituent level info
- Output: nD Vector

Attention: Learn to attend to important bits.

Perform Binary Classification on output: Background vs Signal



Results

Goal: Be sensitive to a wide variety of new physics possibilities.

Can we generate a feature set that generalizes to a larger set of jets better than hand-crafted variables?

Jet Classes	AUC: CLR Features	AUC: Hand Crafted Features
QCD vs Top	0.938	0.898
QCD vs W	0.917	0.793
QCD vs H2	0.939	0.929

CLR Features generalize to different signals better!