THE MASS-IVE ISSUE: ANOMALY DETECTION IN JETS

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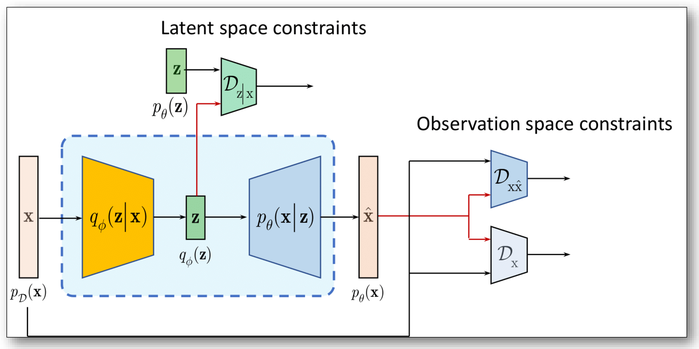
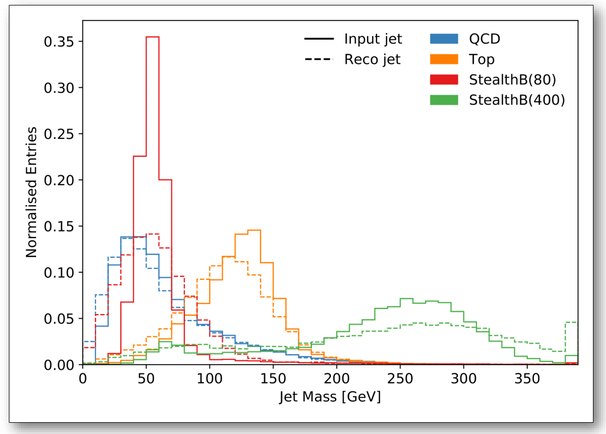
Goal: 1) Learn Standard Model Physics with NN.
2) Detect Anomalies – New Physics!

- Potential new Physics phase space – Huge!!
- Need Model Independent methods – look at physics objects – Jets!
- QCD jets – Parton initiated
- Dominant background!
- **Learn QCD – tag jets unlike QCD – enhance signal!**
- Test sample – Top, Stealth Boson



NN Architecture – VAE + Discriminator

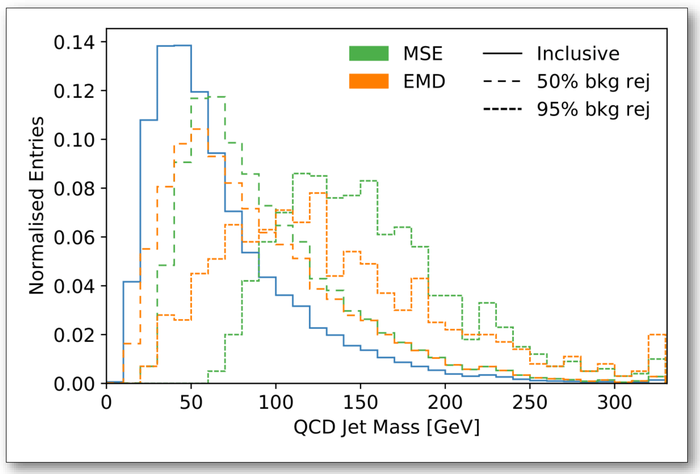
Reconstruction Performance

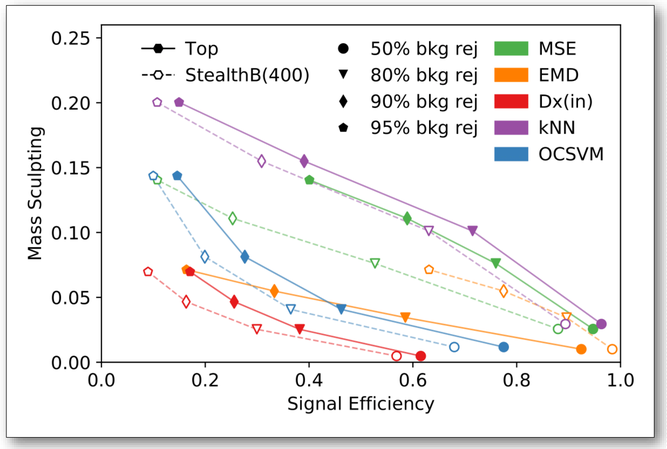


- Bump hunt to find new physics – **Mass is key**!
- Model able to reconstruct QCD mass well, reasonably captures Top+StealthBoson masses!
- Use learnt representation of QCD – Define anomaly metrics – Apply cuts – Tag anomalies!
- Metrics computed in – **Observation space**, **Latent Space**, + **Discriminator loss**

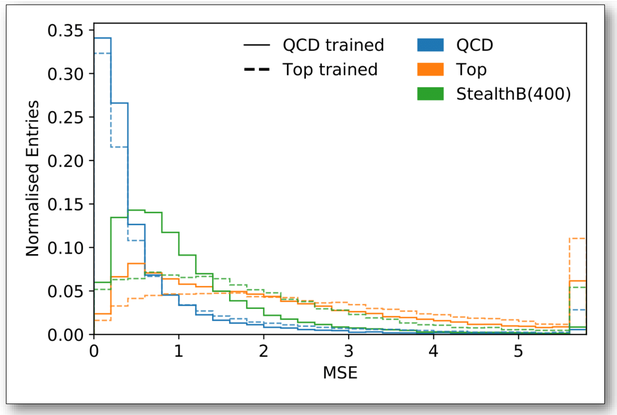
What happens when we cut on metrics?

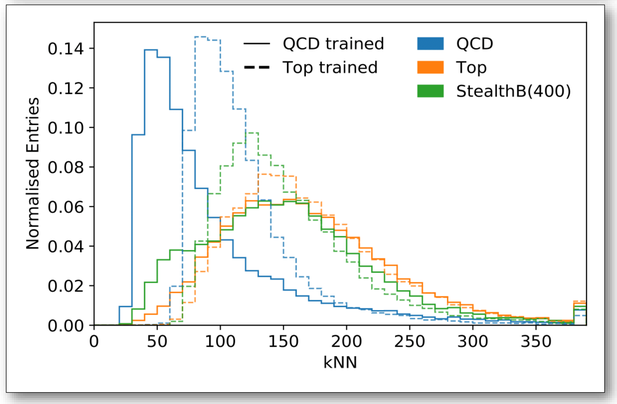
- **METRICS SHOW HEAVY SCULPTING**.
- Background tends to look like Signals at tight cuts!





- Sculpting vs Signal efficiency for all metrics studied – **WITH HIGHER REJECTION COMES HIGHER SCULPTING!**





Are we detecting anomalies? Or just picking up on mass?

- Train with Top (massive compared to QCD) – **QCD still nominal!**
- Similar trend in all metrics

- New Physics can be anywhere! – Need to be sensitive to a range of signals + performance decorrelated with mass.
- Similar checks required when considering new Anomaly Detection methods!