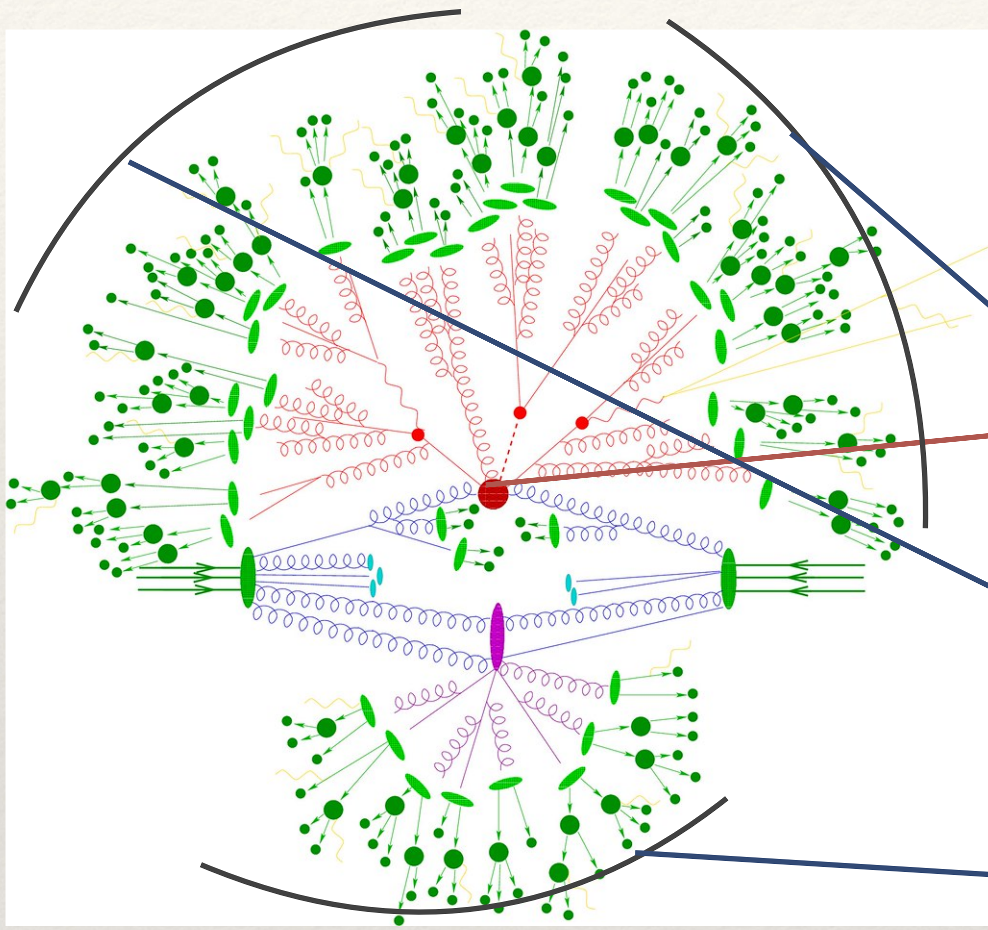
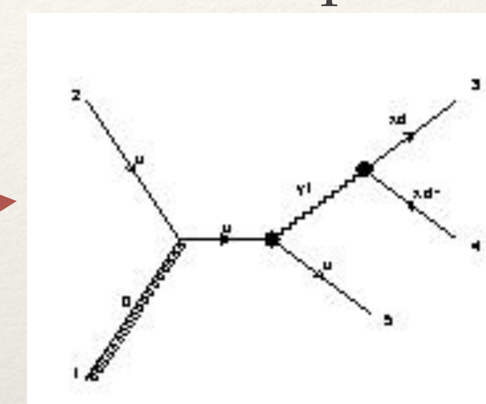
ML ideas (I)

1) <u>Mapping parton to reconstructed level collider objects</u>
   Problem: simulation of collider events requires sequential steps: hard process (MG5, CalcHEP, etc) + shower (Pythia, Herwig, Sherpa) + fast detector simulation (Delphes, PGS?)



Collider event (includes parton shower, hadronization, secondary hard scatter)

2->3 hard process



$R^{4*(2+3)}$

$R^{4*(j+l+g+1)}$

<u>Reconstructed:</u>
3 (j) jets
+ missing energy
+ 0 (l) leptons
+ 0 (g) photons

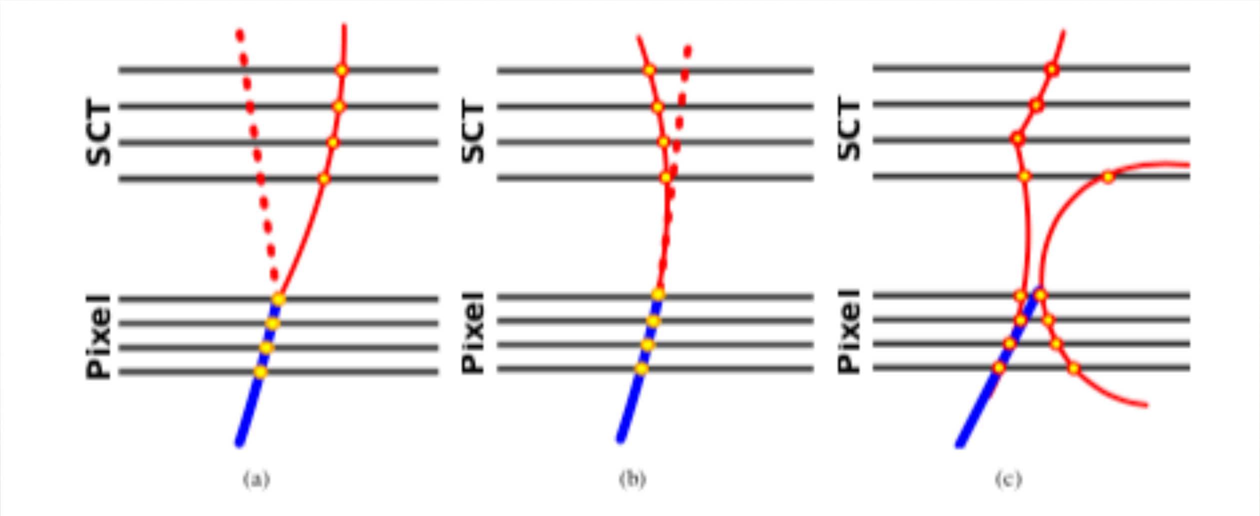
Goals:
#1: Reduce computing time by mapping parton into reconstructed events
#2: Use AI maps to transfer information (encoding detector details not present in fast sim!)

ML ideas (II)

2) *Camera triggers:*
Problem: Certain LHC triggers are highly inefficient for New Physics signals
(mostly true when looking for macroscopically lived particles, LLPs)

Example: ATLAS
Disappearing track
(DT)
JHEP 06 (2018) 022

Signal: few hits in pixel, SCT
(innermost detector components)



Actually these are all backgrounds

Due to the high rate of interactions, LHC can not save all events, only those of "interest".
Currently no trigger for "a few-pixel track". Additional hard jet is required: low acceptance.

IDEA: what if we take pictures of the detector, and save those that contain a few pixel track?

Supposedly it works great for cats and dogs (or all ML introductions are blatantly lying)
If it works for DT, one can apply it to low HT hadronic LLP decays (EHD, ALPS, dark photon)

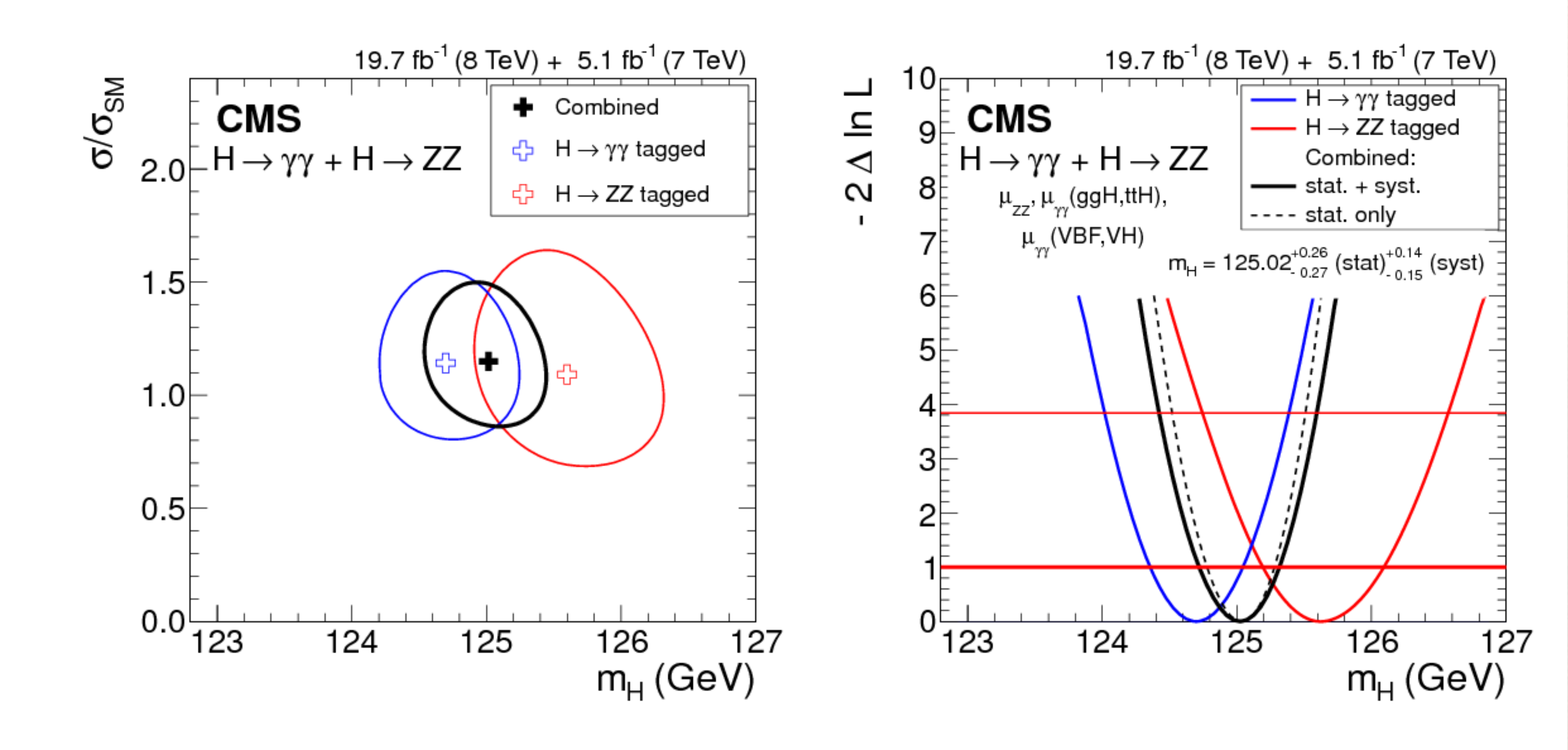
(not much WIP yet, please be kind!)

ML ideas (III)

3) *ML uncertainty propagation*

Problem: We are never quoting an error (systematic) for our ML method.
But we have errors all round us (PDFs, energy / momentum measurement, etc)

Higgs mass (2012) from H->ZZ, H->$\gamma\gamma$: 2 1-D inv mass distribution with clean objects.



Goals:
#1: How to quantify the error of a parameter extraction from ML-based analysis?
(e.g: di-Higgs production, determination of the self-coupling from 4b, bbWW, bb$\tau\tau$)
#2: Answer #1 establishing a generic and well-defined recipe to apply to e.g: EFT coefficients.