Higgs studies with ATLAS

modeling the transverse Higgs mass distribution

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NIKHEF

Higgs & ATLAS

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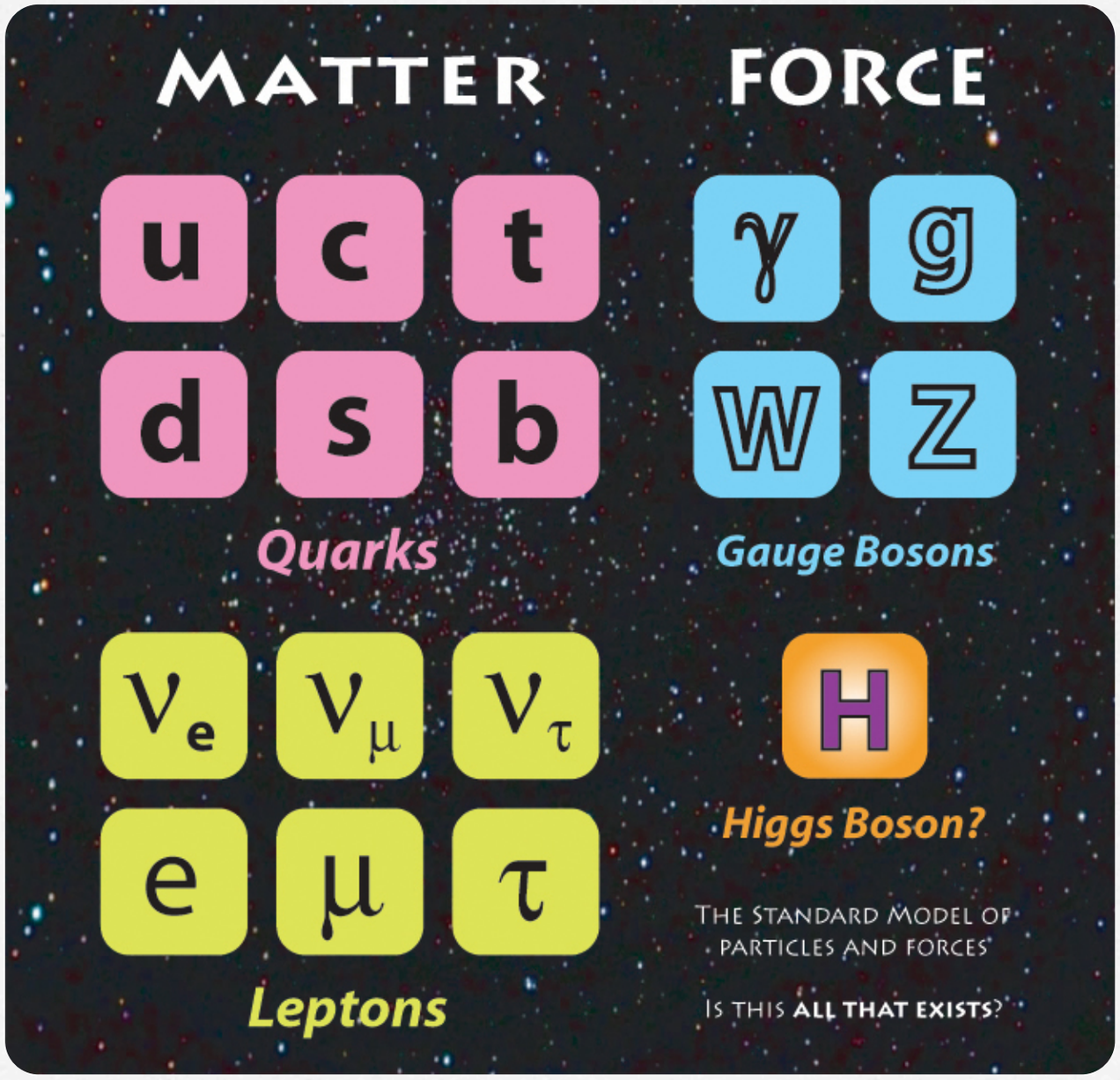
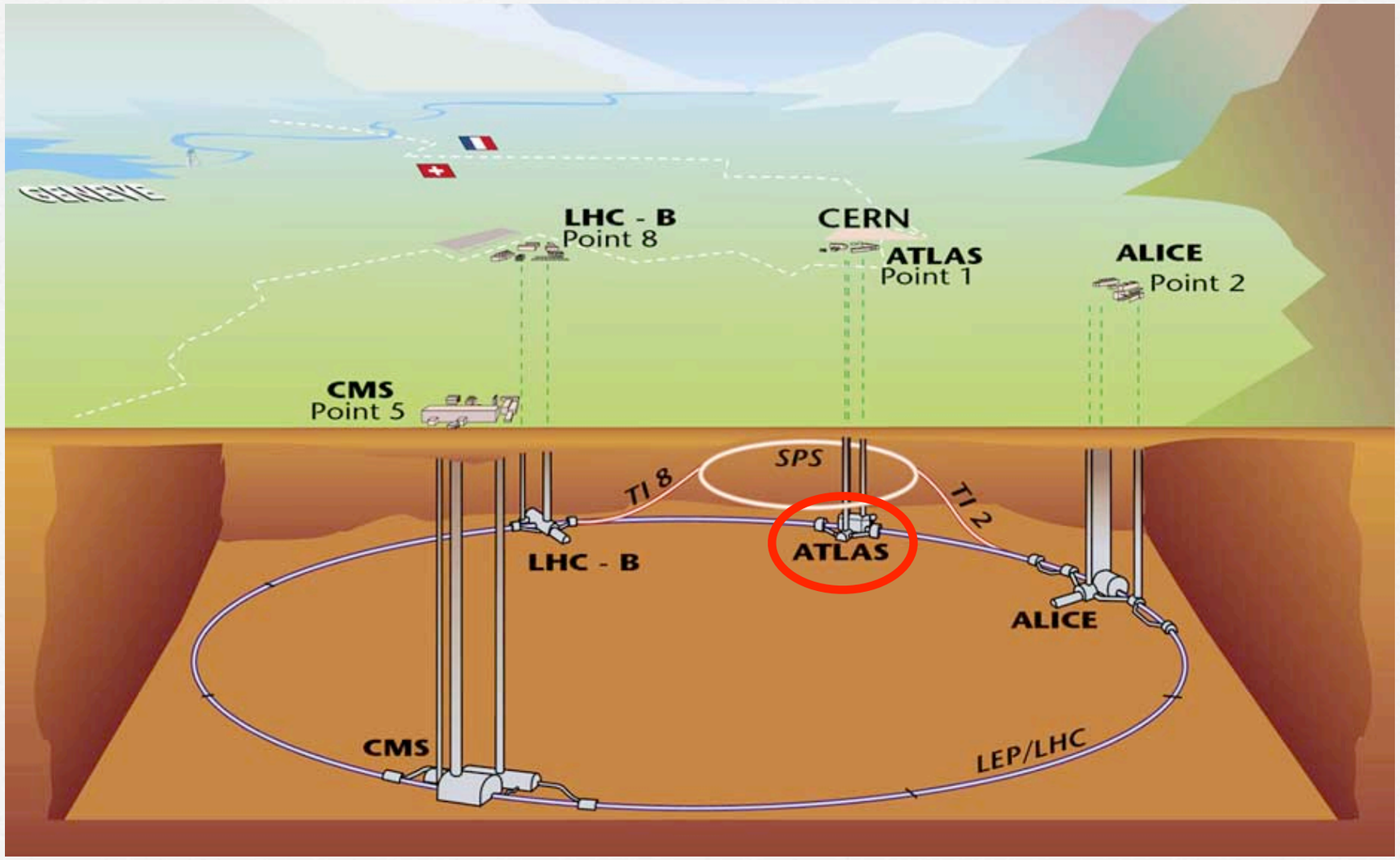


Standard Model of Particle Physics works great, but where is the particle that gives mass to all other particles?!?

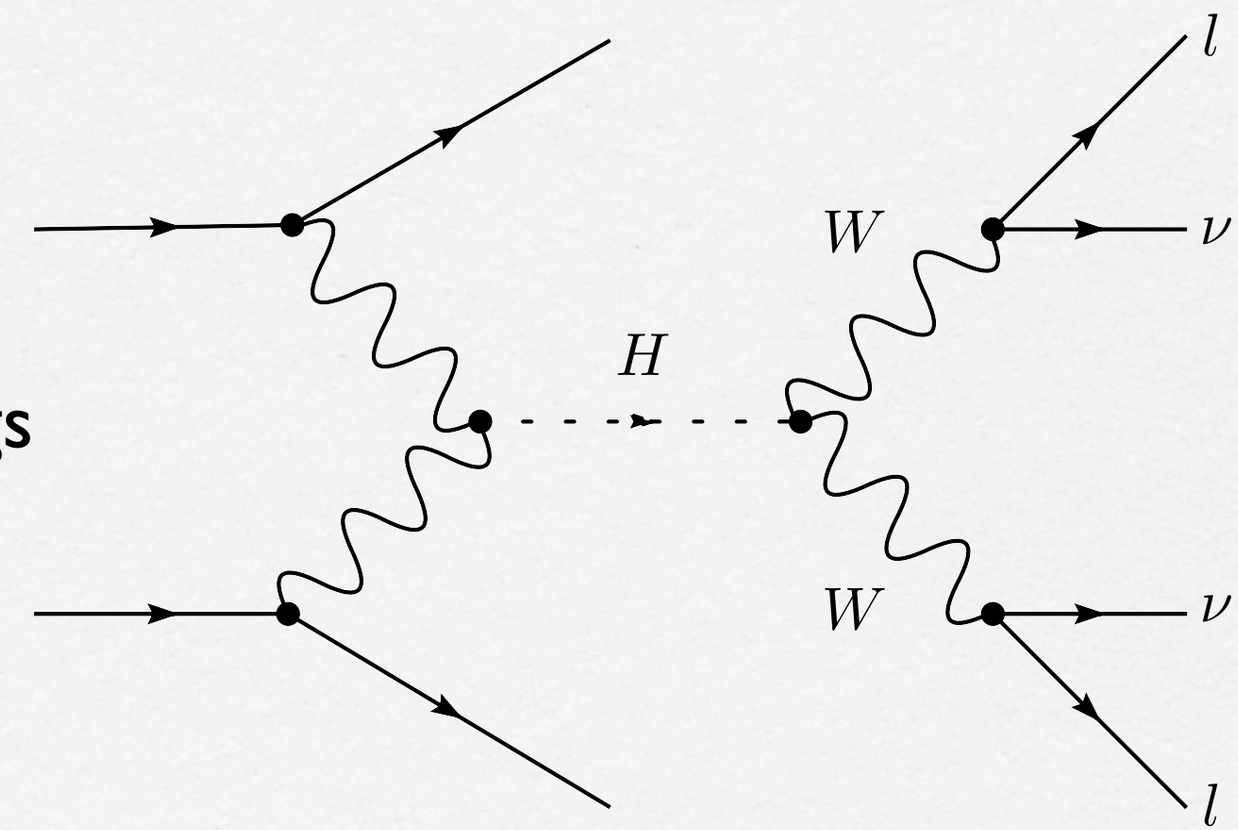
LHC & ATLAS

- 27 km circumference
- 14 TeV collisions p-p-collisions at 40Mhz
- 4 Experiments, 2 multi purpose (ATLAS, CMS)

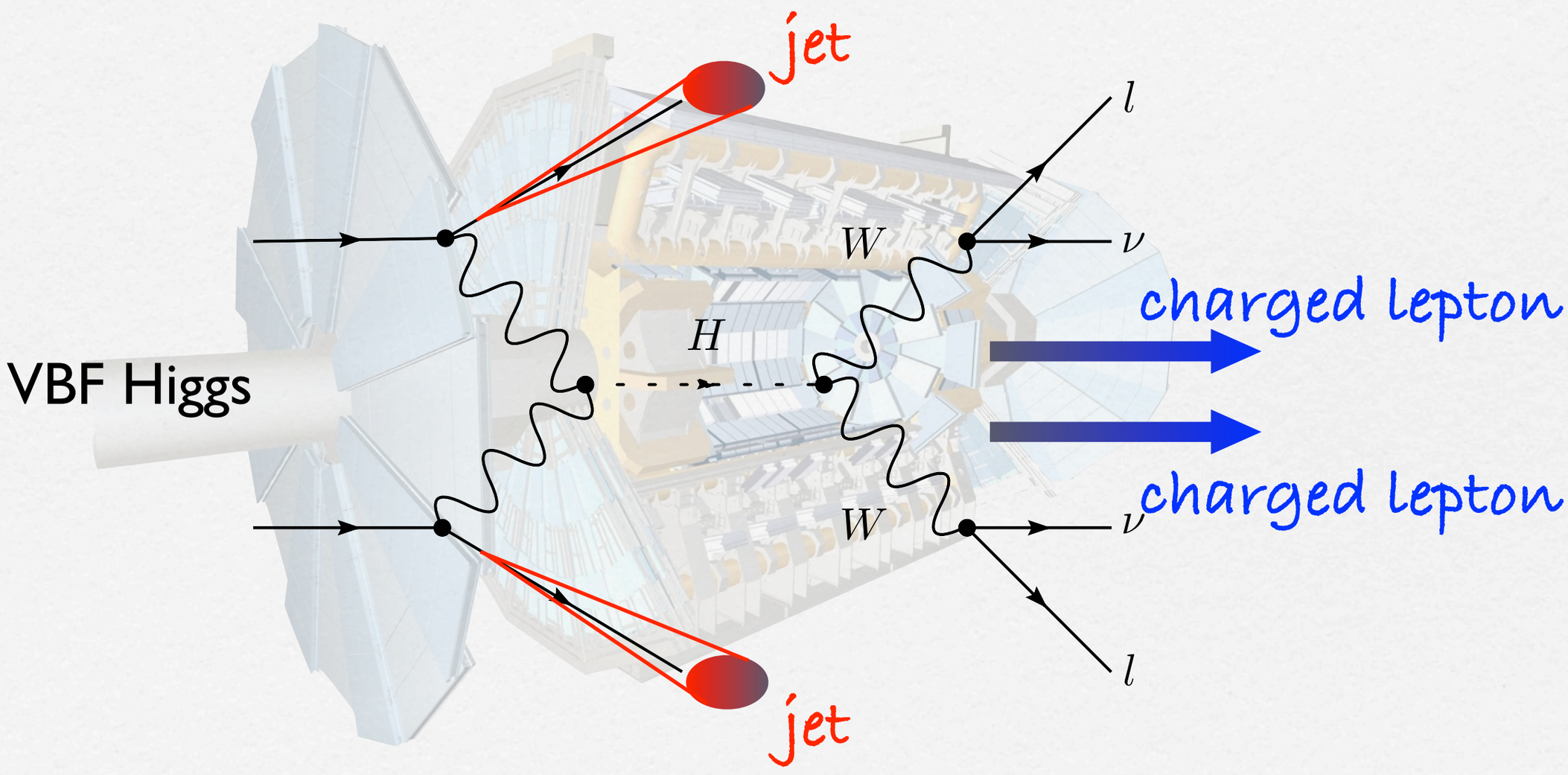


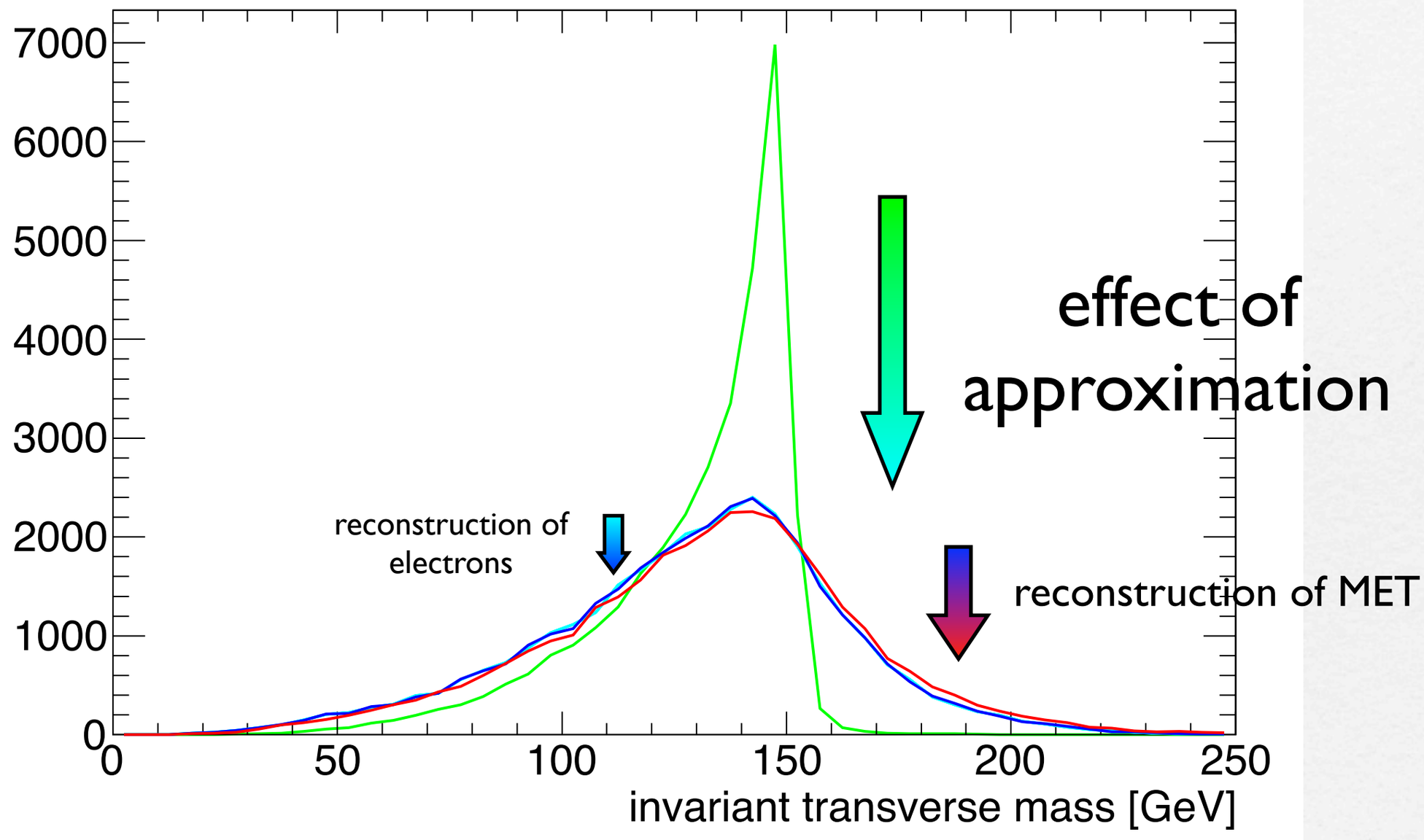
looking at

VBF Higgs



looking at




7000
6000
5000
4000
3000
2000
1000
0
0
50
100
150
200
250
invariant transverse mass [GeV]
effect of approximation
reconstruction of electrons
reconstruction of MET

ideas and aim

- fit the transverse Higgs mass as a convolution of true shape, reconstruction effects and background
- split up reconstruction effects to allow input of additional information from third measurements

issues ...

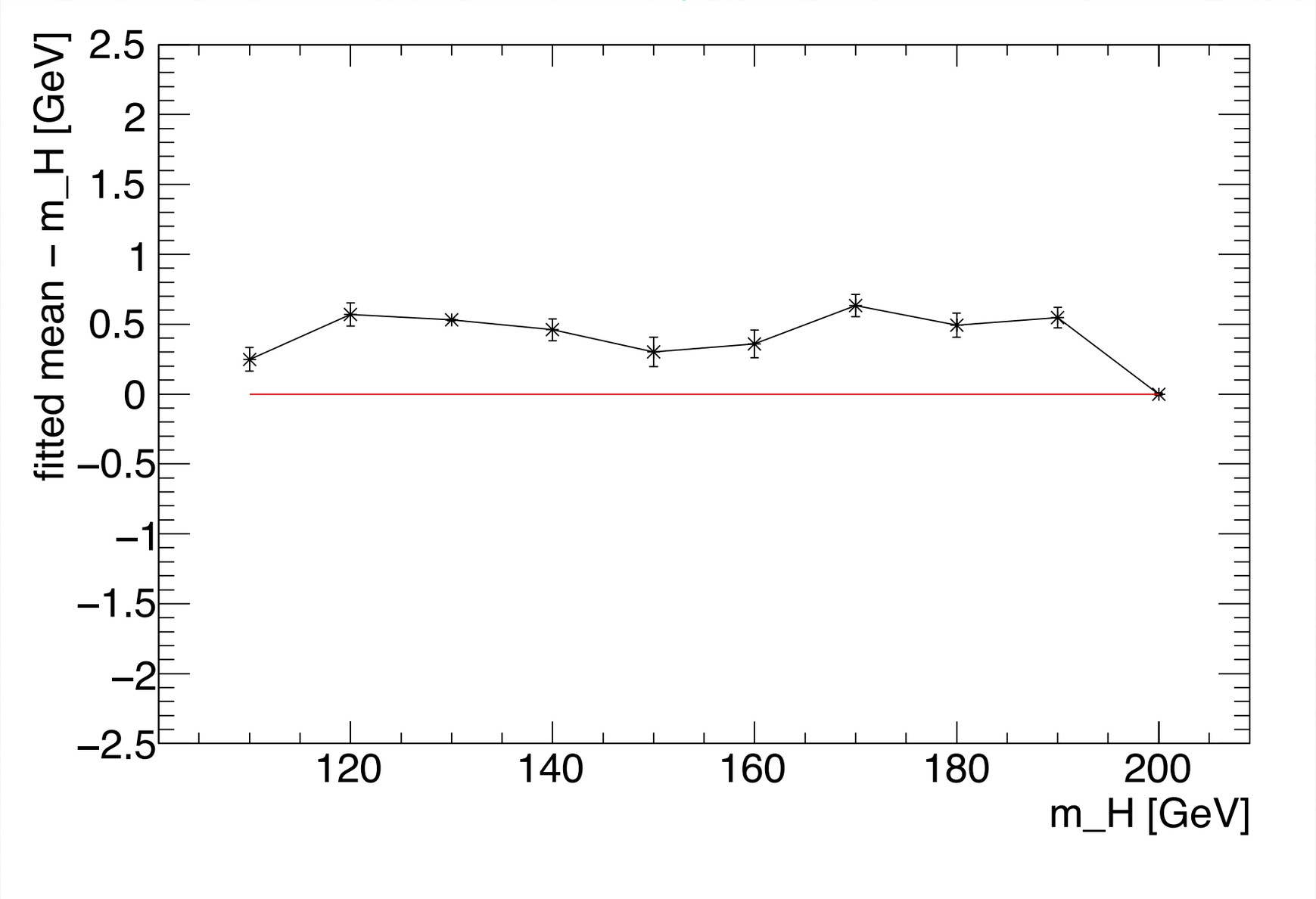
- there is no analytical description of the true transverse Higgs mass shape
- computing time is essential: models that go into the convolution should be as simple as possible

the true shape

$$m_{true}(x) = \beta \cdot \left(\left(\alpha \cdot e^{\frac{x}{\tau_1}} + (1-\alpha) \cdot e^{\frac{x}{\tau_2}} \right) \otimes e^{-\frac{(x-\mu)^2}{2\sigma^2}} \right) + (1-\beta) \cdot Landau(x, \mu, \sigma)$$

- universal (works for a broad range of Higgs masses)!
- stable and robust fit results!
- analytical

$$< \chi^2 > \approx 1.7$$

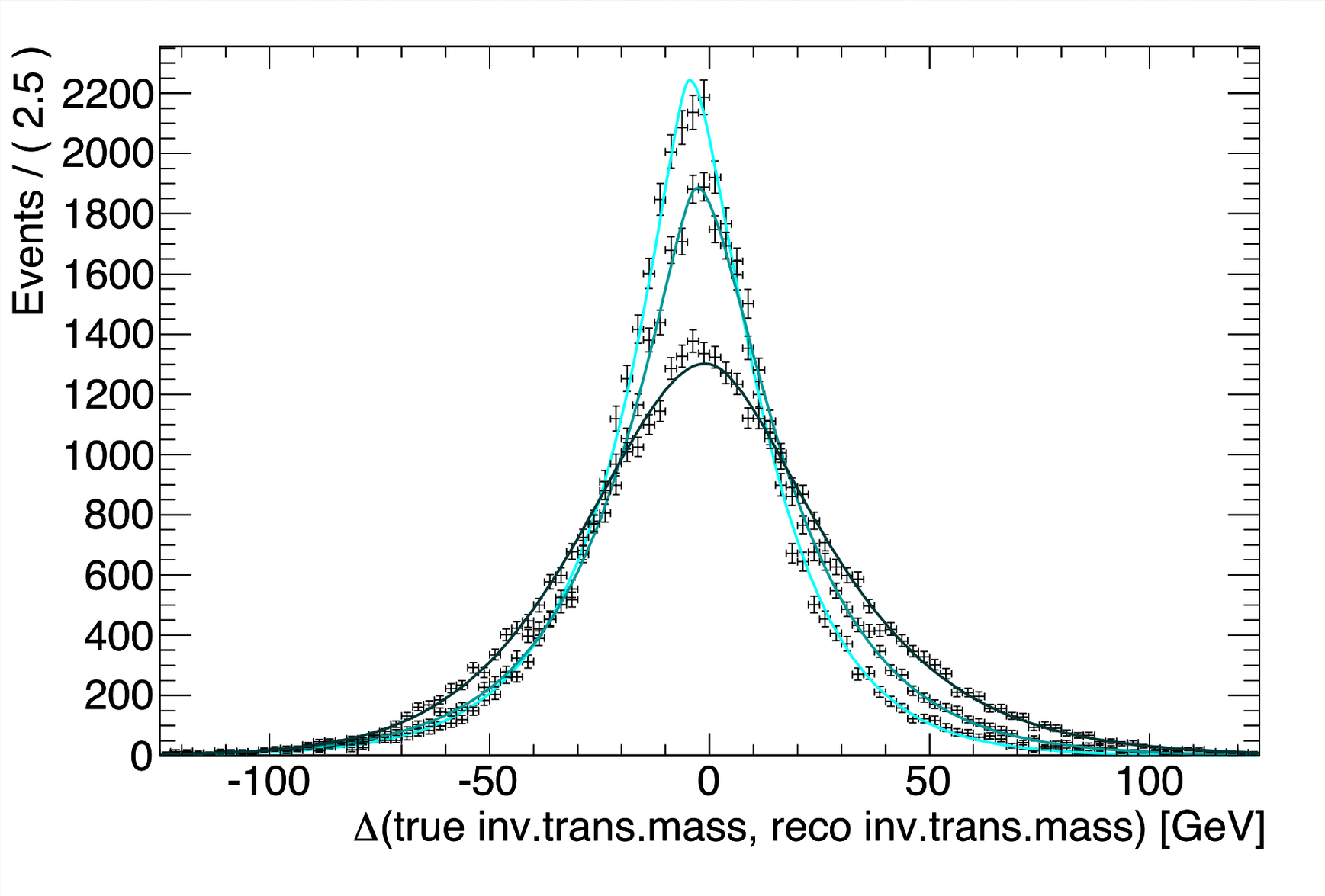


reconstruction effects

$$r_{approx}(x) = e^{\frac{(x-x_0)^2}{2\sigma^2+\tau|x-x_0|}}$$

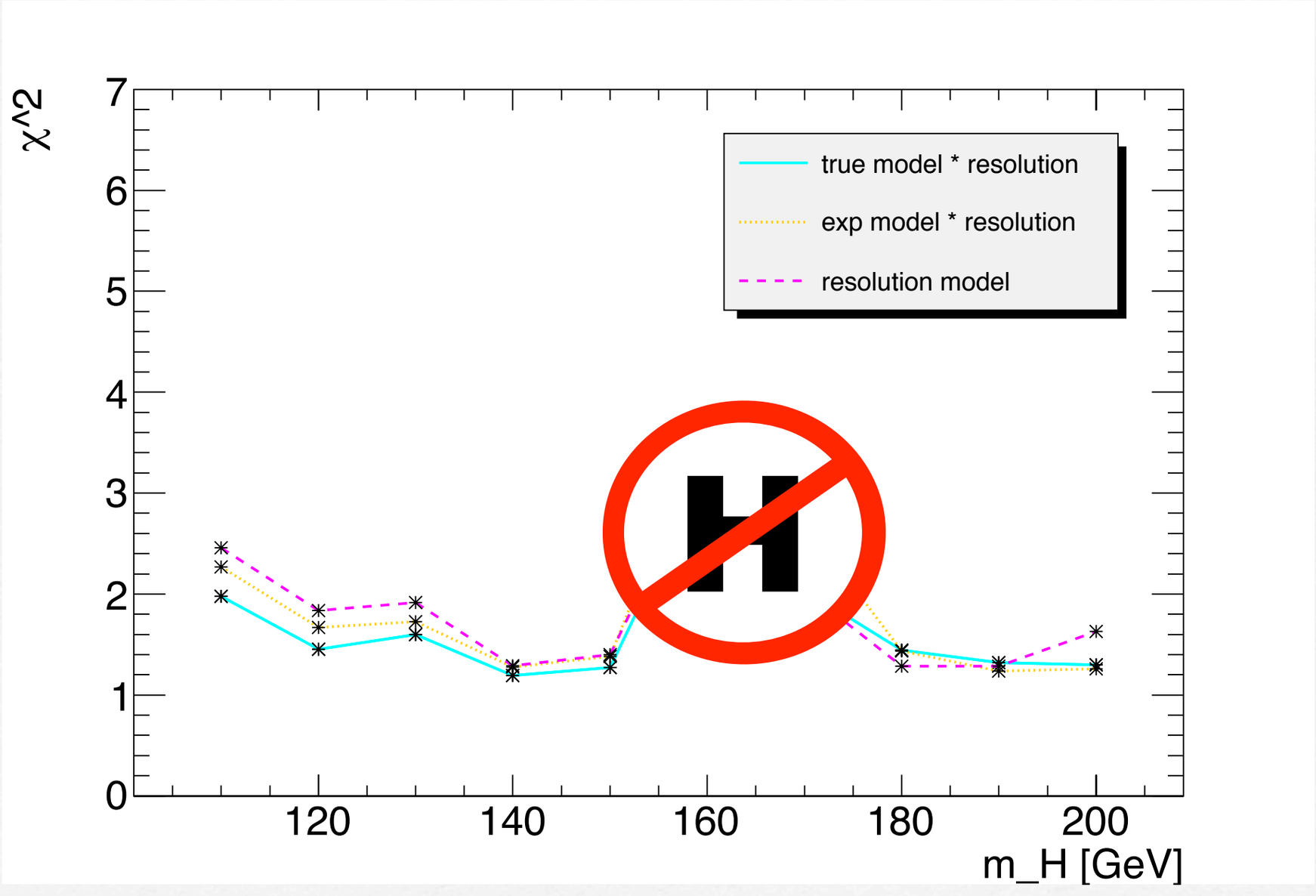
- universal (distribution broadens with increasing Higgs mass)
- stable fit results!
- analytical

$$< \chi^2 > \approx 1.2$$



the convolution

- using Fast-Fourier-Transformation ⇒ very efficient/ fast (suitable for future NNW usage)
- stable fit results!



summary

- a precise, analytical description of the transverse Higgs mass could be developed
- reconstruction/resolution effects have been studied and modeled
- working fit on the reconstructed Higgs signal could be set up
- Atlas note is on its way