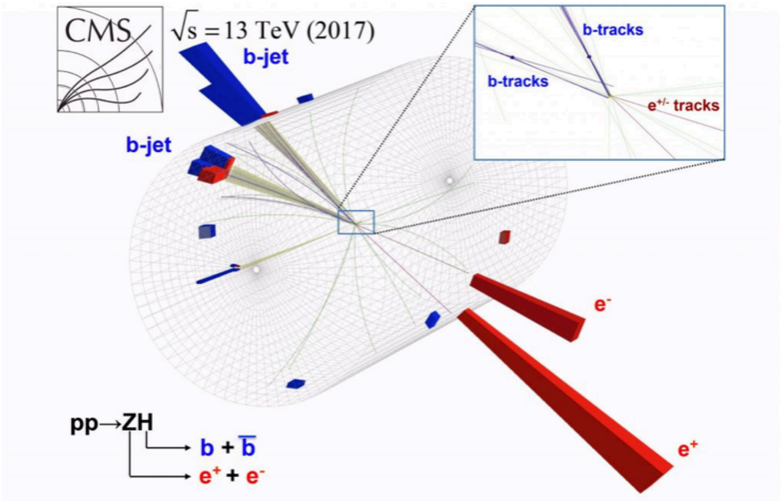
Systematics

Signal and background events in the detector **(Poisson counts)**

Physics parameters of interest, e.g. rate of H production



MVA techniques to enhance s/b

Test-statistics, e.g. event counts, likelihood function L

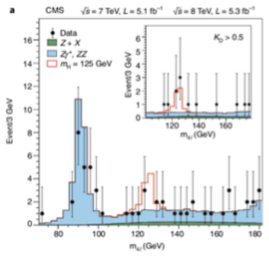
MC simulations:
generator events + detector simulation
—> s and b template histograms

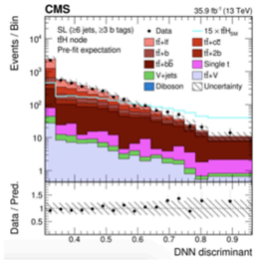
Statistical inference:
- L asymptotics
- Frequentist
- Bayesian

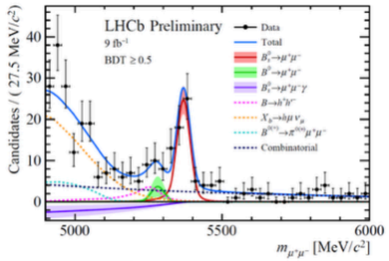
empirical parameterisations of s and b shapes

Systematic uncertainties: **nuisance parameters, map them to templates or shapes and profile or marginalise them or do external ±1σ variation and repeat analysis**

Discovery of a signal

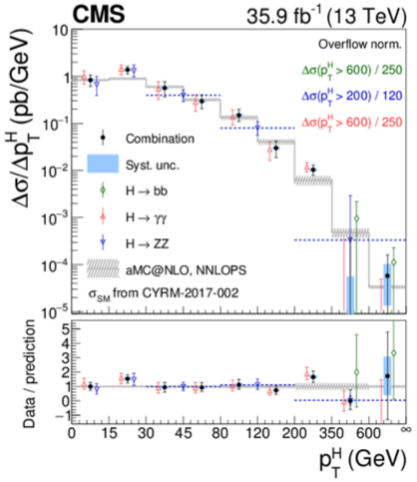




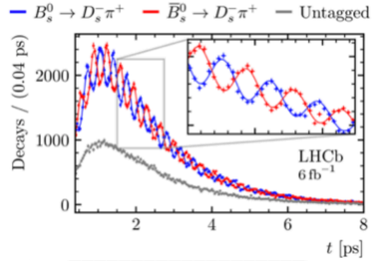


Differential measurements

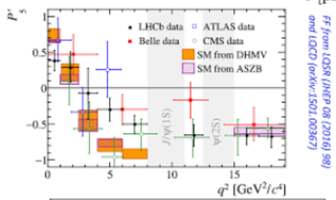
unfolding H pT spectrum: correcting for detector smearing and efficiences; Combination of channels



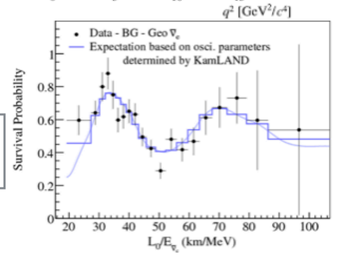
time dependent rates; CP violating rate asymmetries



B meson decay angle analyses



Neutrino oscillations



Fitting higher level parameters, e.g neutrino mixing angles and mass differences to measurements

Nuisance pars:

Luminosity

Detector:
- **Acceptance**
- **Efficiency for specific particles**
- **Energy scales**
- **Resolutions**

Signal process template:
- **Theory modelling uncertainties**
- **Limited MC statistics**

Background processes template:
- **Theory total cross section uncertainty**
- **Theory modelling uncertainties**
- **Limited MC statistics**

Empirical s and b shape modelling;
- **Parameterisations**
- **Non-parametric**
- **smoothing and morphing of MC templates**

Nuisance parameters can be constrained from:
- **Detector calibration data**
- **Control samples with different event selection**
- **from the data distributions**
- **measurements from other experiments**
- **theory calculations**