Systematics

Nuisance parameters:
- Luminosity
- Detector:
  - Acceptance
  - Efficiency for specific particles
  - Energy scales
  - Resolutions
- Signal process template:
  - Theory total cross section uncertainty
  - 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

Signal and background events in the detector (Poisson counts)

Detection parameters:
- 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

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

MVA techniques to enhance s/b

MC simulations:
- Generator events + detector simulation
  - > s and b template histograms

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

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

Differential measurements

unfolding H pT spectrum:
correcting for detector smearing and efficiencies;
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