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Measurement of the spurious signal
7 TeV

Outline

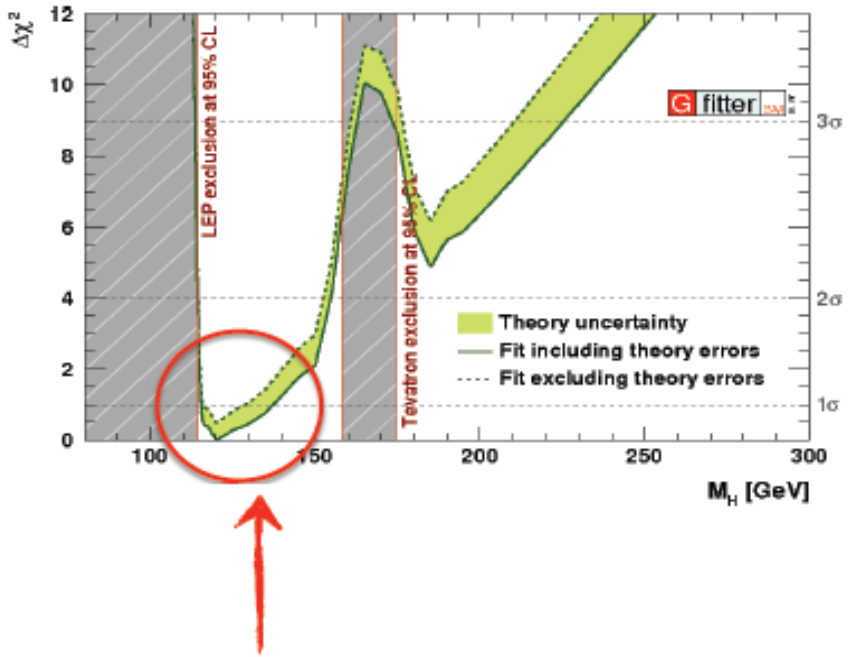
- General presentation about Higgs research
- Background modeling
- Fit the background
- Influence of the fitting range
- Conclusion

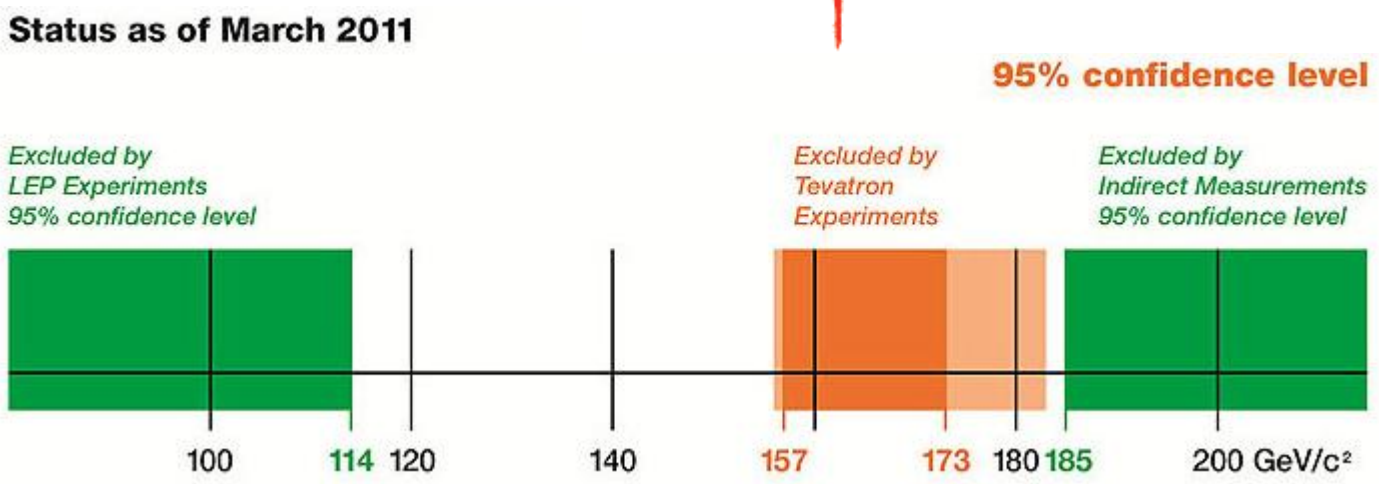
I – General presentation about Higgs research

Missing Higgs

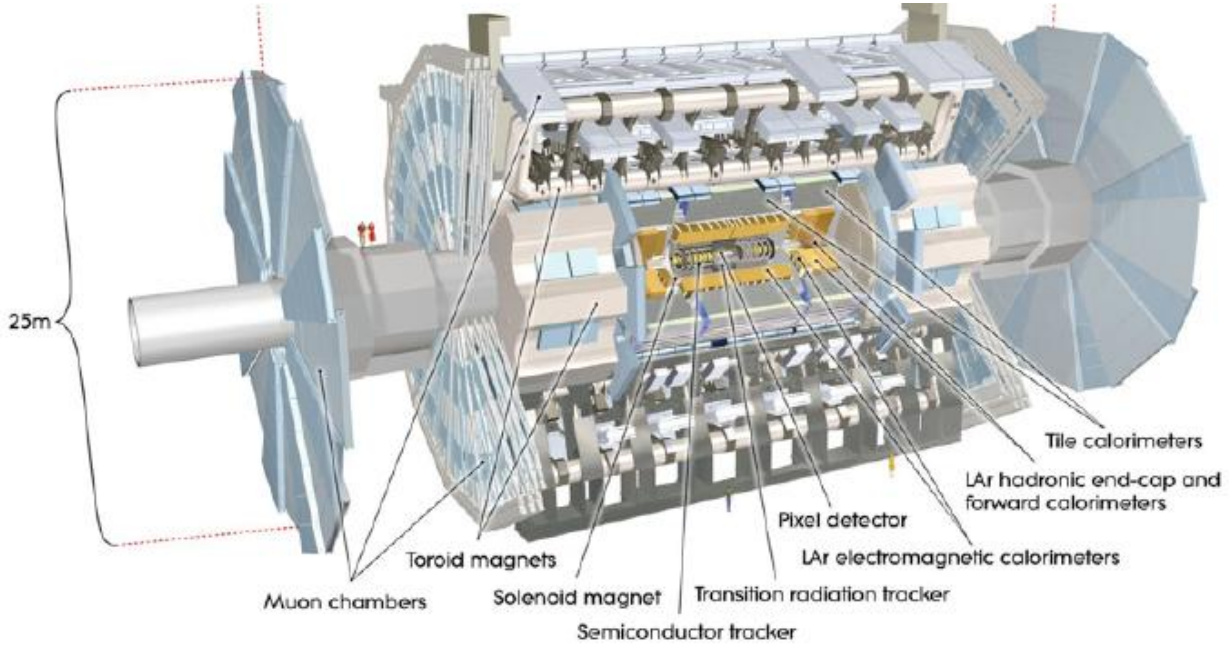
- The problem
- The method
- Previous experiments :

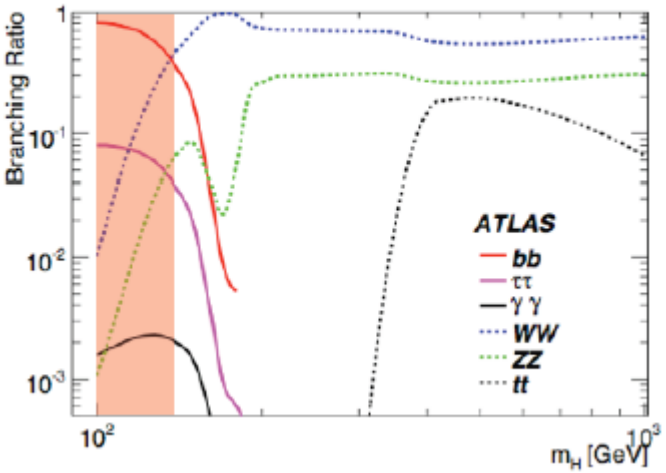
  Exclusion domains

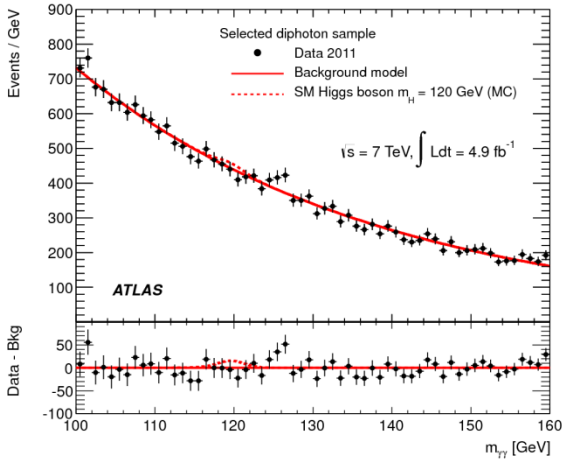




The ATLAS experiment







II – Background modeling

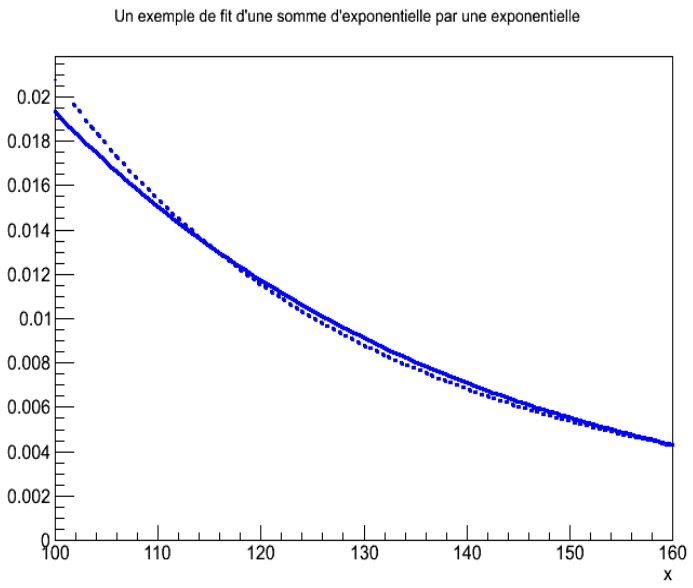
About fitting error

Background function is too complicated to be known

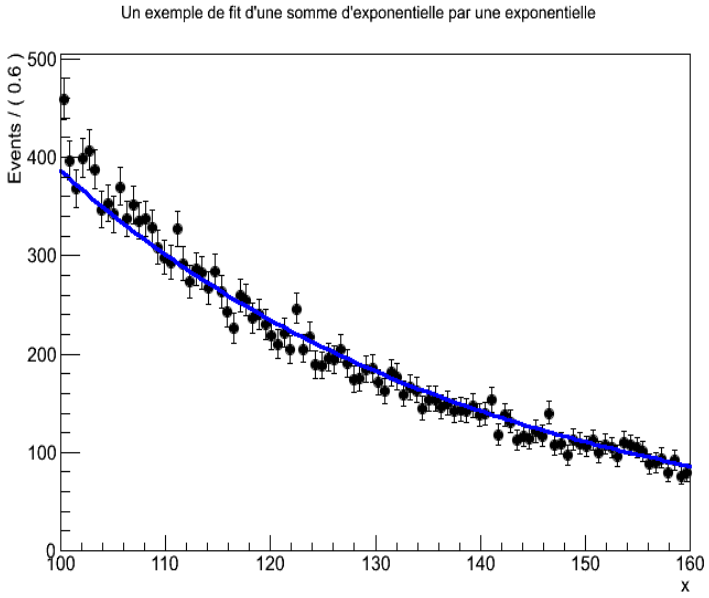
-> we do not know the exact shape of the fit function

Expected number of Higgs events : QCD -> apprx 200 events / 20000 background events

-> fitting error becomes significant



Obvious !



Less intuitive…

Objectives

- Find a method to estimate these error
- Find the best fit for a chosen shape of the background
- Estimate the influence of the fitting range

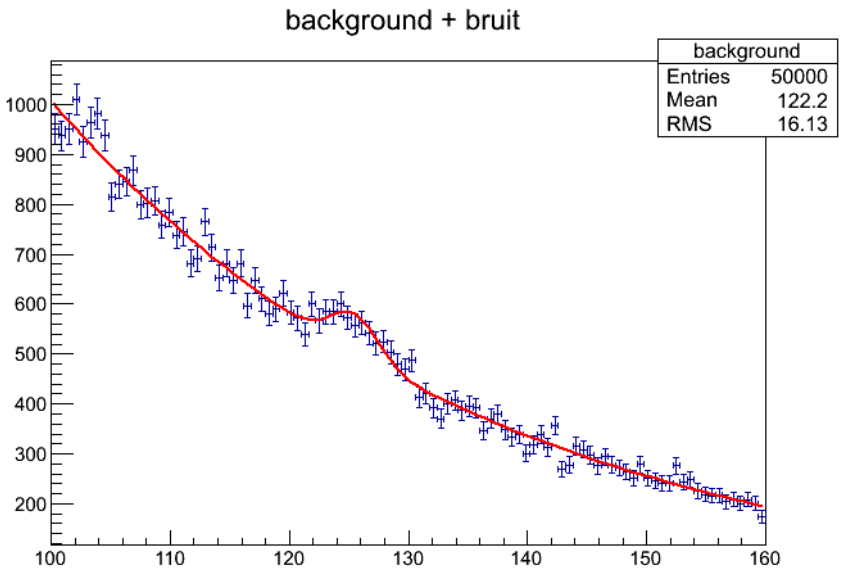
III – Fit the background

The method

- Produce toys with a given background model,
- fit with a given function (possible model of the background) + a Gaussian signal (fixed origin and sigma)
- measure the number of event of the Gaussian signal

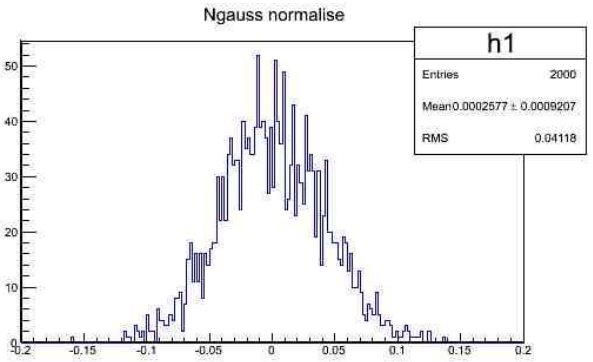
Perfect fit : Gaussian norm = 0

Imperfect fit : bias on the Gaussian norm



The method

- In order to measure the uncertainty caused by noise, we did a statistical study on 2000 toys :



Ex : toys generated with a double exponential fitted with a single exponential + Gaussian

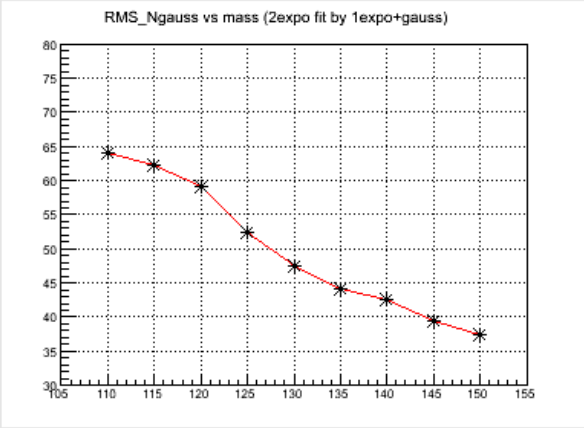
- Distribution of the number of signal events obtained per toy
  - Mean = bias = systematical uncertainty
  - RMS = statistical uncertainty

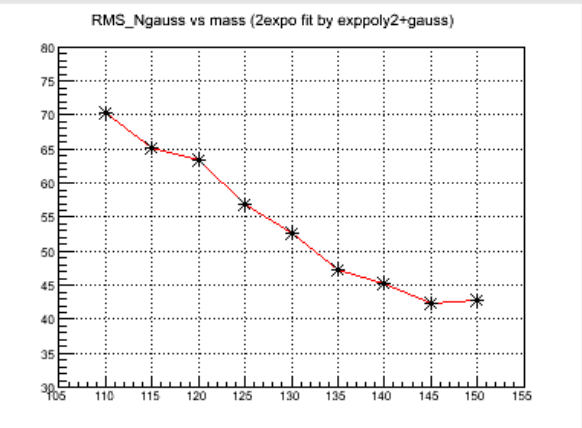
Study of an example

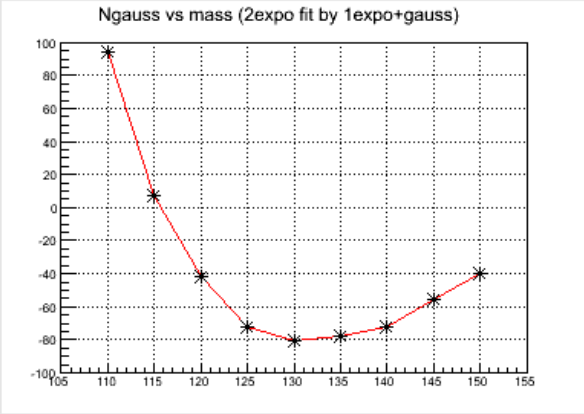
- Distribution generated from a double exponential
- Fit with :
  - Exponential
  - Exponential of 2 order polynomial
- Study

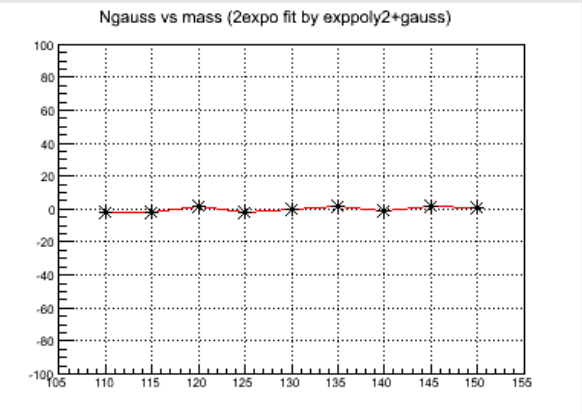
Fit of a double exponential by :

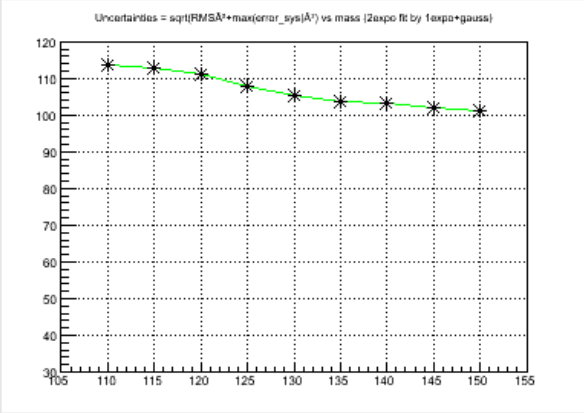
- A single exponential (right)
- A exponential of a 2nd order polynomial (left)

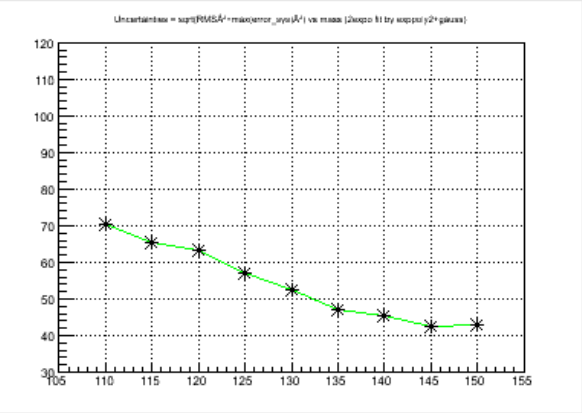












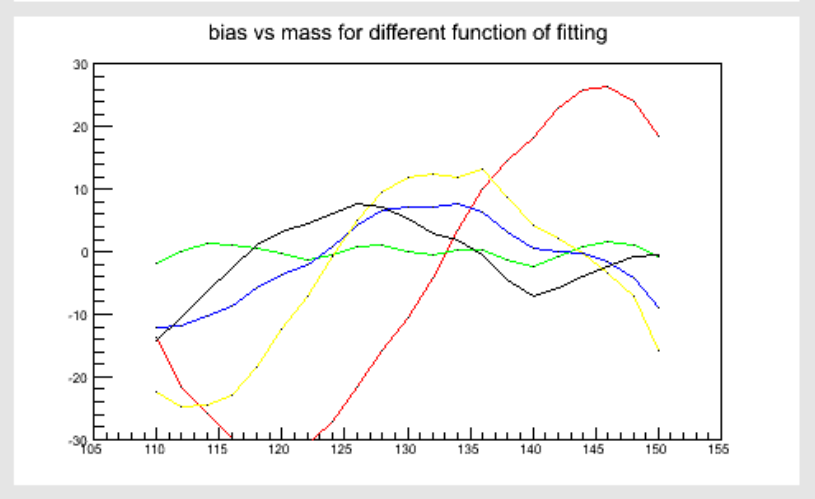
Conclusion

- The exponential of 2nd order polynomial provides a better fit than the single exponential

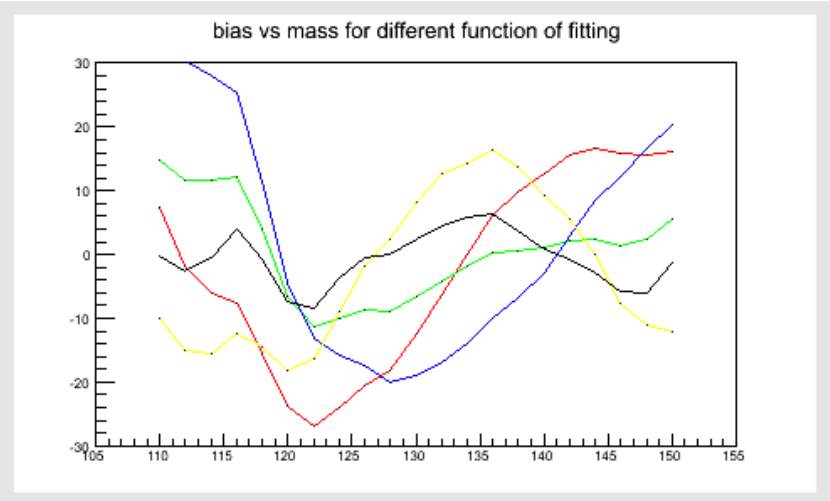
Test on DIPHOX, RESBOS and SHERPA

- We test different background models (DIPHOX, RESBOS, SHERPA)
- We try to estimate :
  - The RMS associated with the model choice.
  - The possible bias
  - The global uncertainty
- We also look at possible ways for reducing the systematics uncertainties associated to these biases.
- We tested :
  - Polynomials (2, 3, 4, 5, 6 order)
  - Bernstein polynomials (3,4, 5, 6 order)
  - Single – double exponentials + exponential of 2^{nd} order polynomial

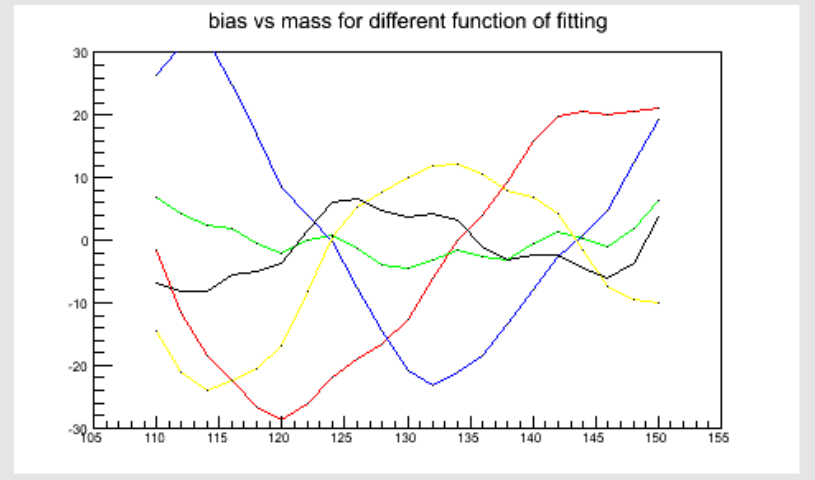
Bias : Polynomials



Diphox



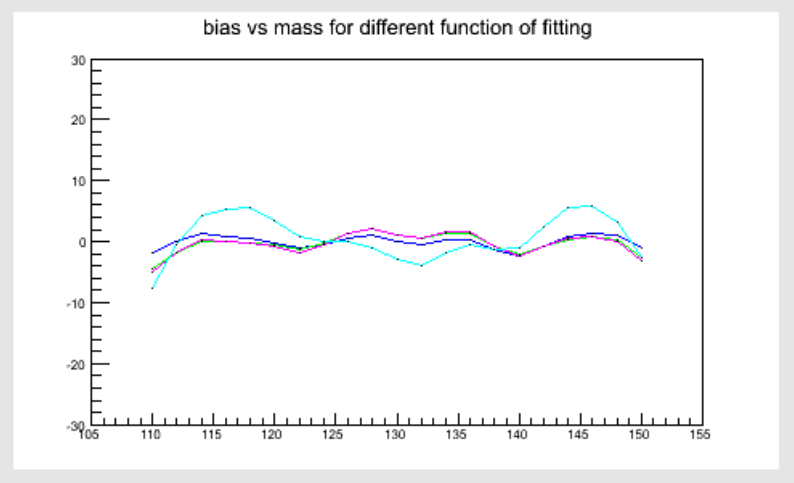
Resbos



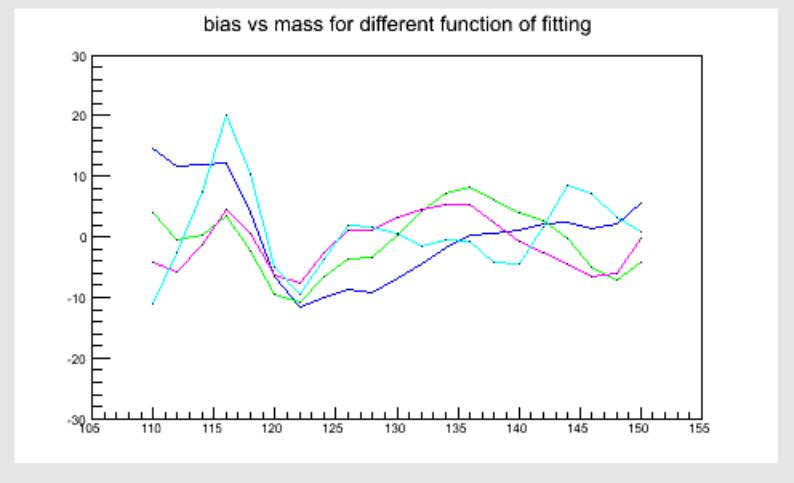
Sherpa

	2nd degree polynomial
	3nd degree polynomial
	4nd degree polynomial
	5nd degree polynomial
	6nd degree polynomial

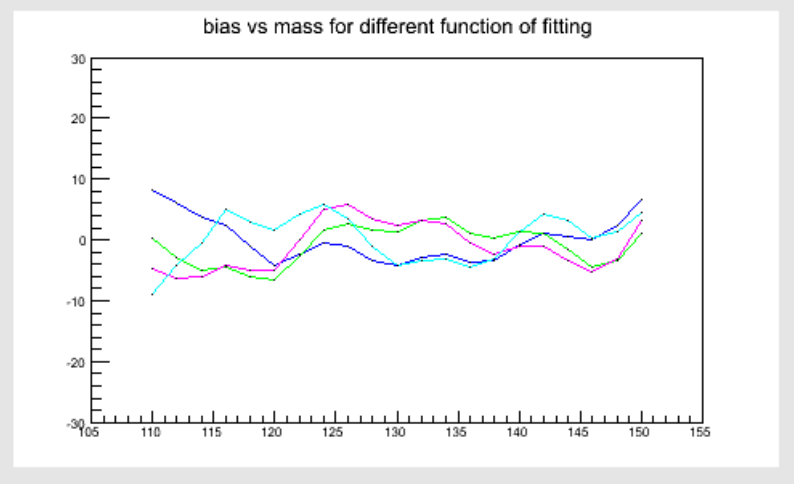
Bias : Bernstein polynomials



Diphox



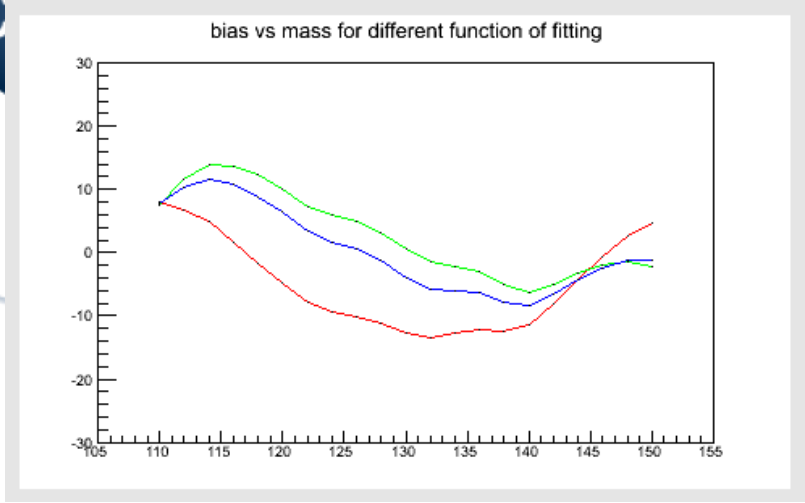
Resbos



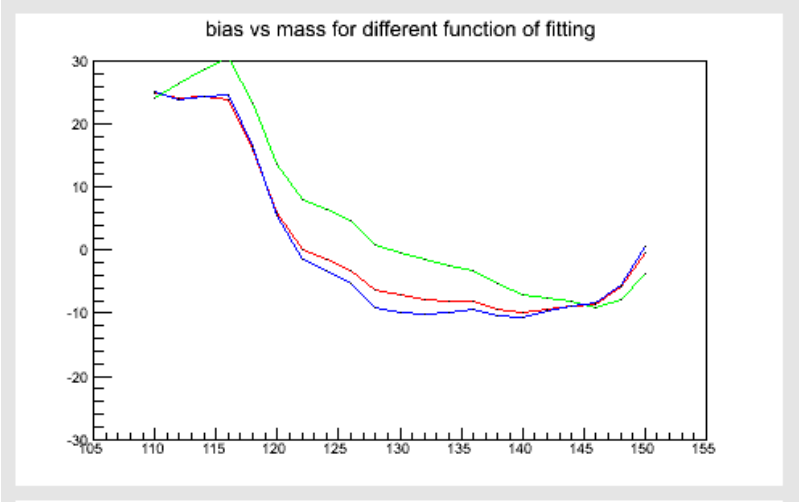
Sherpa

	3 bernstein's polynomials
	4 bernstein's polynomials
	5 bernstein's polynomials
	6 bernstein's polynomials

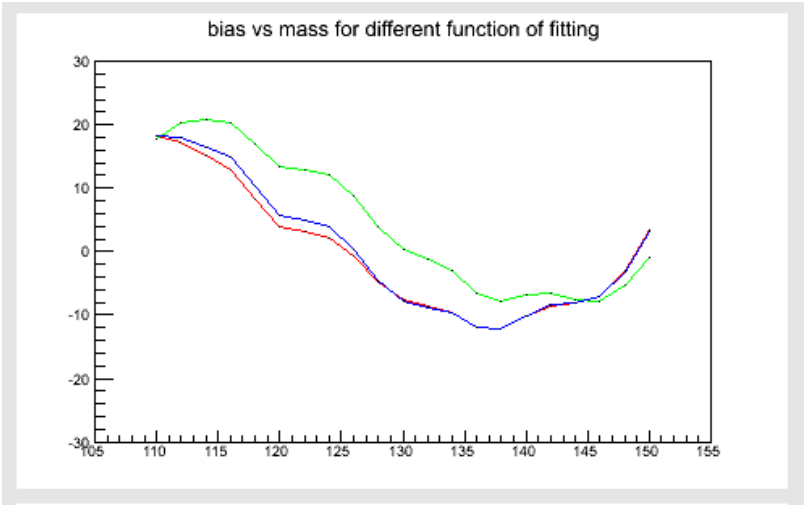
Bias : Exponentials



Diphox



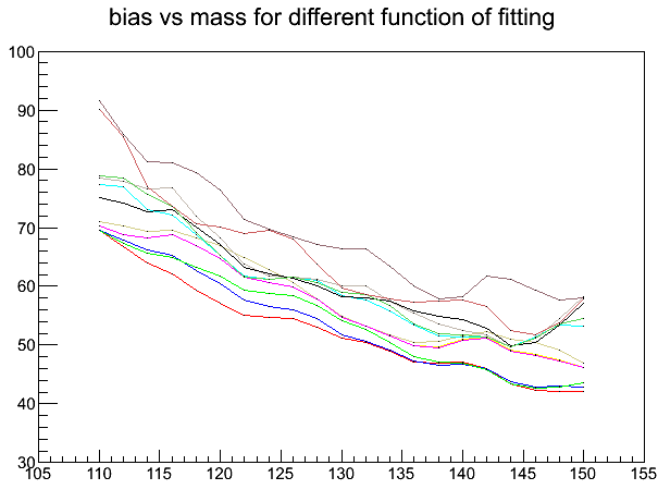
Resbos



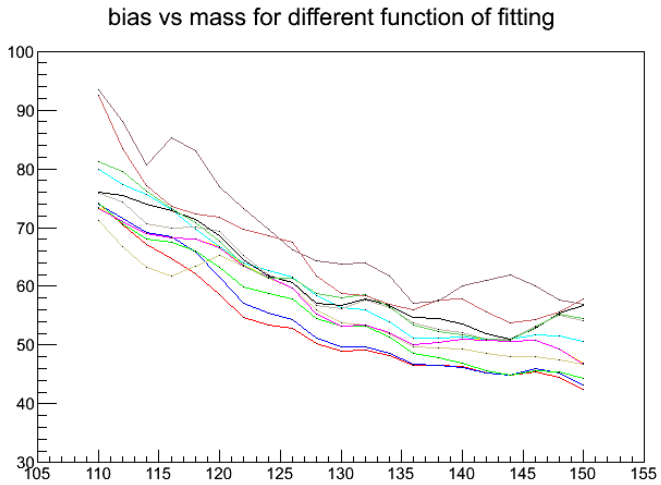
Sherpa

	Single exponential
	Double exponential
	exponential(2nd degree polynomial)

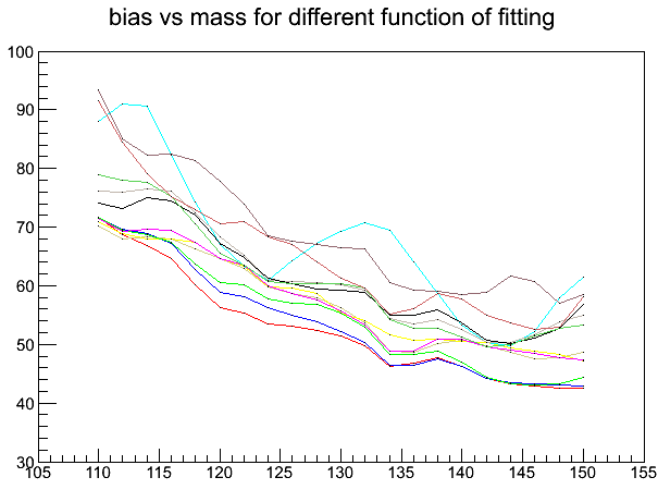
Global uncertainty



Diphox



Resbos



Sherpa

	2^{nd} degree polynomial
	3^{nd} degree polynomial
	4^{nd} degree polynomial
	5^{nd} degree polynomial
	6^{nd} degree polynomial
	exponential(2^{nd} degree polynomial)
	Double exponential
	Single exponential
	3 bernstein's polynomials
	4 bernstein's polynomials
	5 bernstein's polynomials

Analysis

- The uncertainty is essentially due to the RMS influence
- Important global uncertainty (about 70 events) for 200 expected events for the Higgs

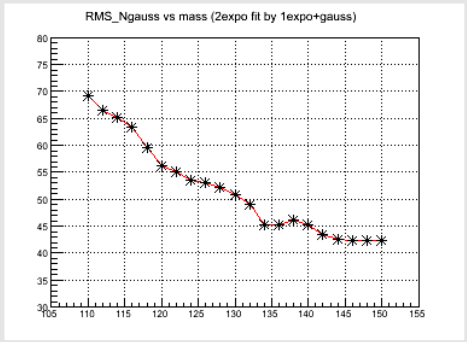
- Comparison with Heberth's result form the C1 decay

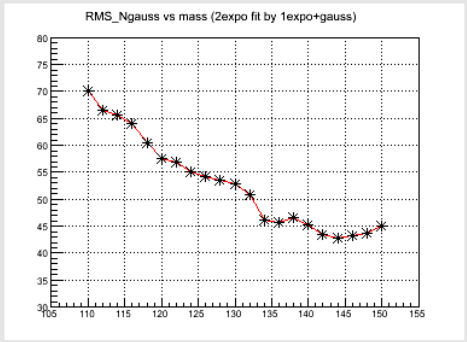
mass_Higgs = 125 GeV	Heberth		Jean	
	1 Expo	2 Expo	1 Expo	2 Expo
bias	- 5,20	0,13	- 3,7	0,12
RMS	13,57	14	13,90	13,9

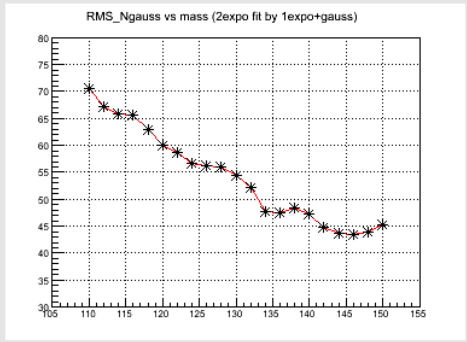
- Validation of the model ?

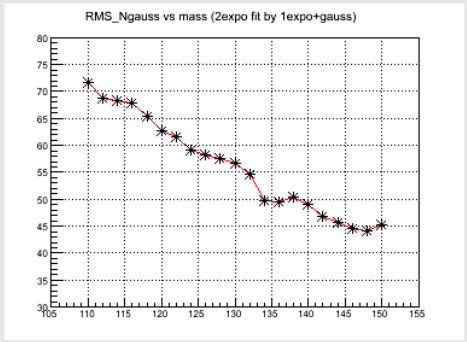
III – Influence of the fitting range

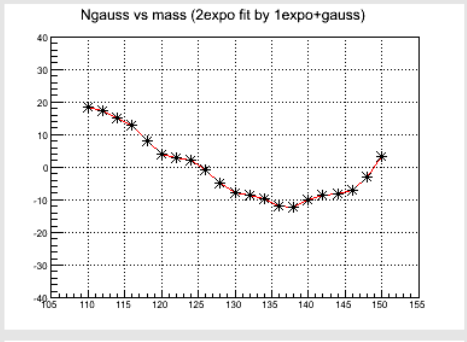
Test on sherpa for single exponential fit

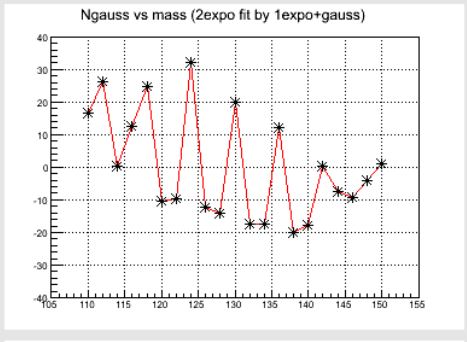


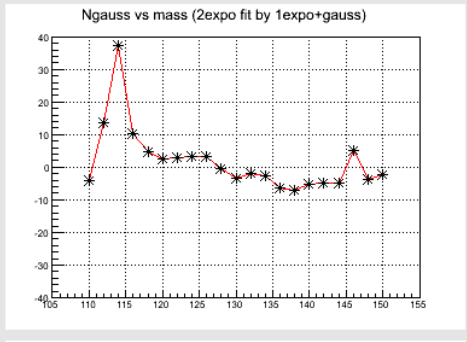


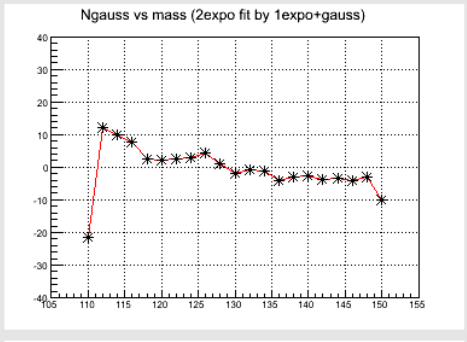


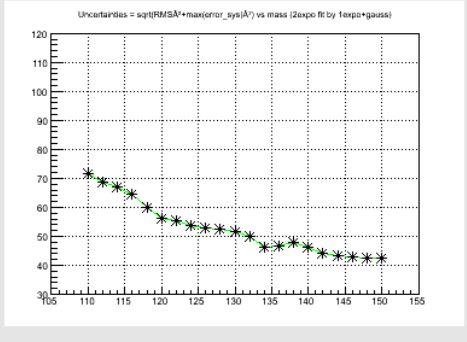


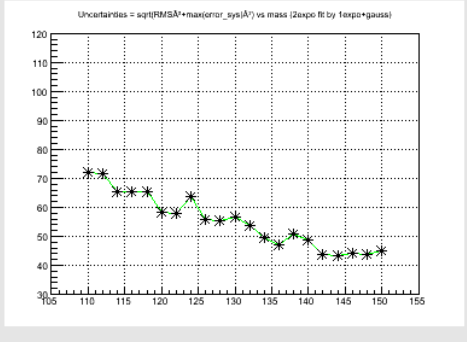


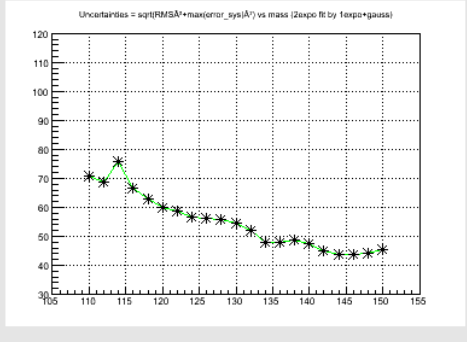


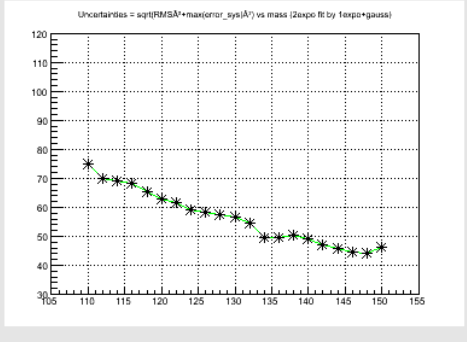












No range **-/+ 20 GeV** **-/+ 15 GeV** **-/+ 12 GeV**

Analysis

- No real influence of the fitting range : the RMS compensate the bias modification
- Instability of the fit for little fit range (< +/- 10 GeV)

Conclusion

- Validation of the method to study the error of the fit functions
- Huge uncertainty mainly due to the RMS
- Differences of fit between Resbos, Diphox and Sherpa depending on the functions
- No real influence of the fit range

Merci de votre attention