

diμ combinatoric background

– Assume the formula

$$N_{+-} = 2 \sqrt{N_{++} N_{--}}$$

– 3 estimation methods

- The simplest : no smoothing
- Gaussian smoothing (a la Mike)
- Exponential smoothing

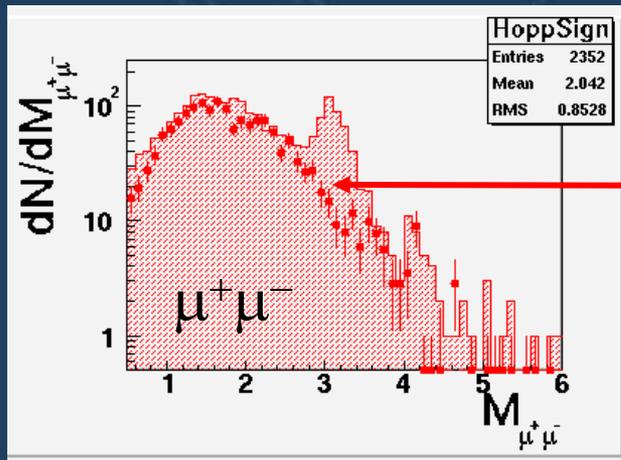
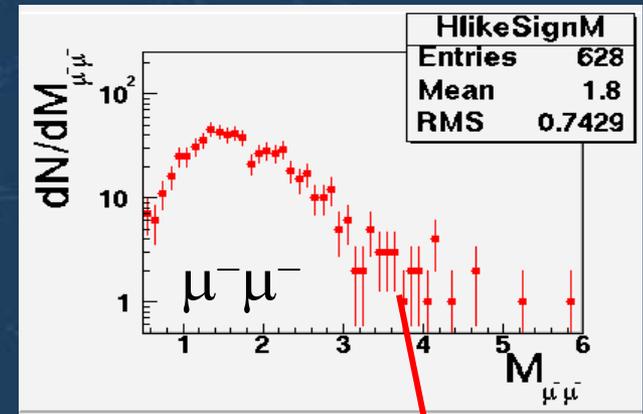
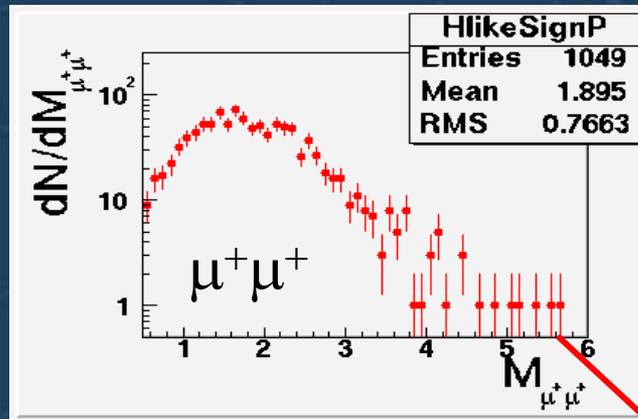
– a method to produce background

- Event mixing

Note : study made with dAu (north /2 deep) data

With no smoothing

- The simplest method
 - Based on like sign dimuons, compute N_{+-} bin per bin

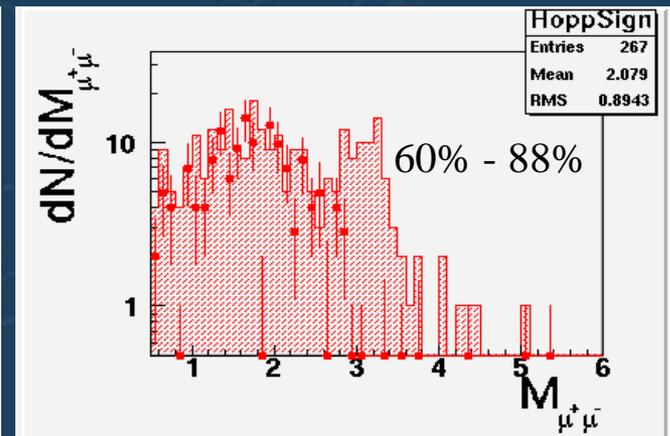
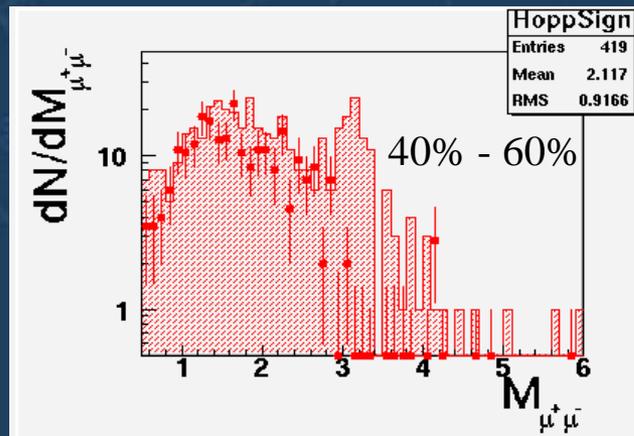
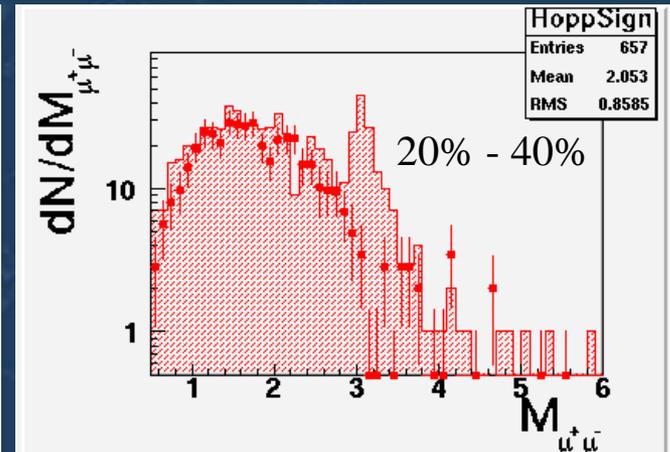
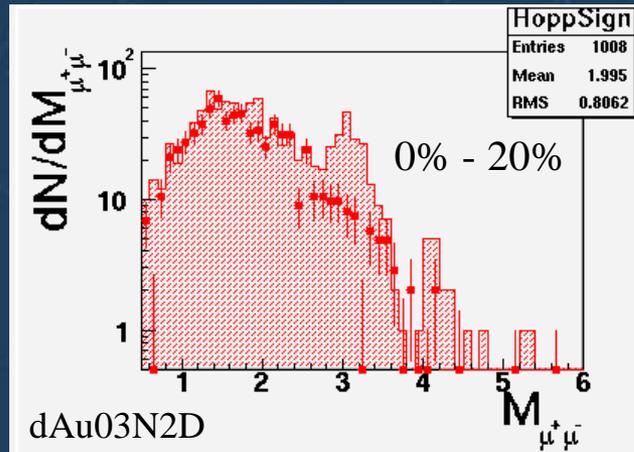


$$N_{+-}(M_{\mu^+\mu^-}) = 2 \sqrt{N_{++}(M_{\mu^+\mu^+}) N_{--}(M_{\mu^-\mu^-})}$$

With no smoothing

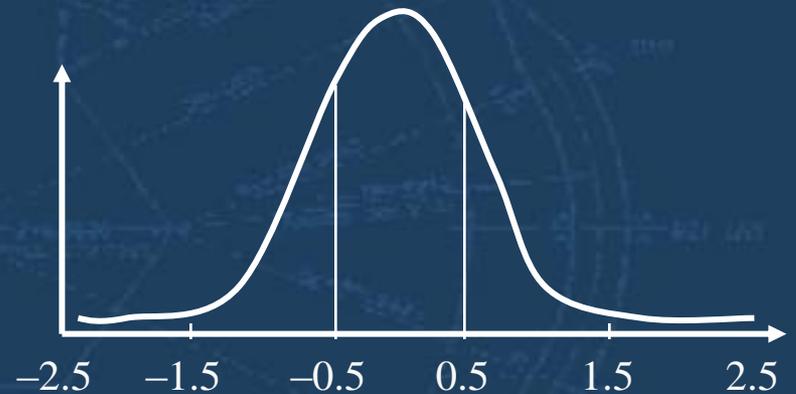
- Study per bin of centrality
 - Limit of the method : small statistics

4 bins of centrality

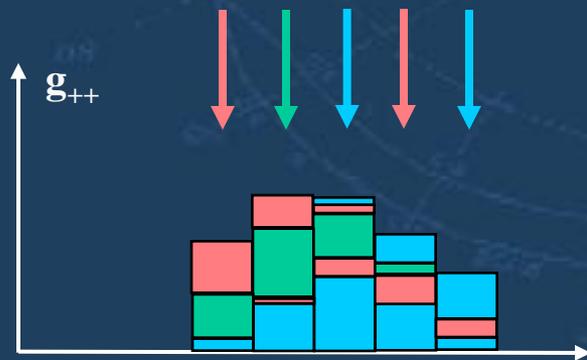


Gaussian smoothing

- Distribute bin content over adjacent bins following a gaussian shape



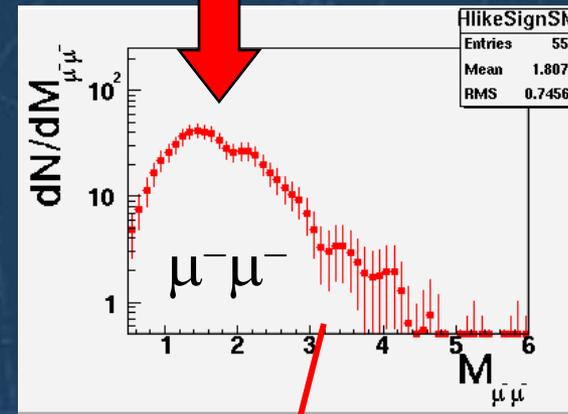
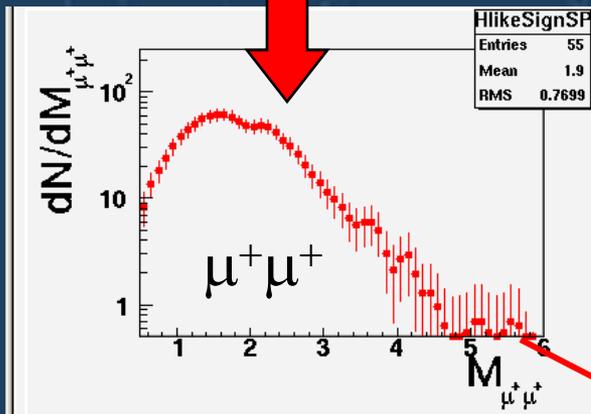
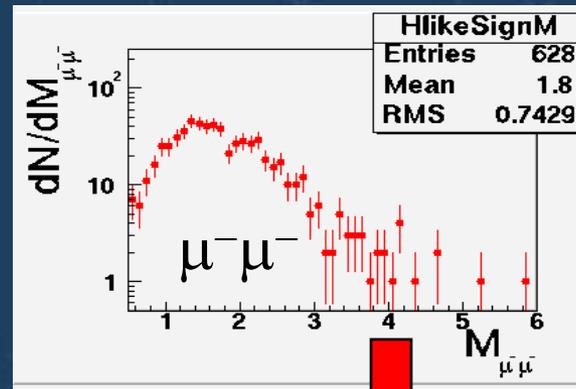
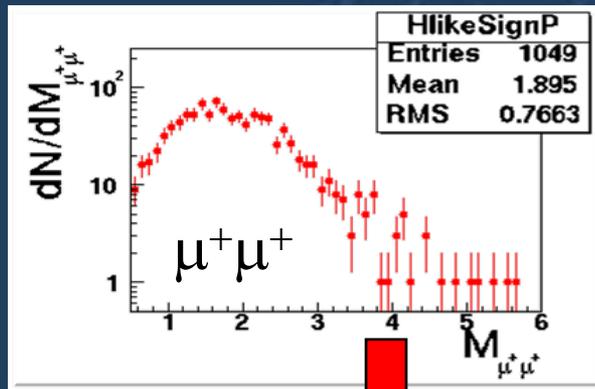
$w(k)$	0.06	0.24	0.38	0.24	0.06
k	-2	-1	0	1	2



$$g(i) = \sum_{k=-2}^{+2} w(k).N(i+k)$$

Gaussian smoothing

- results

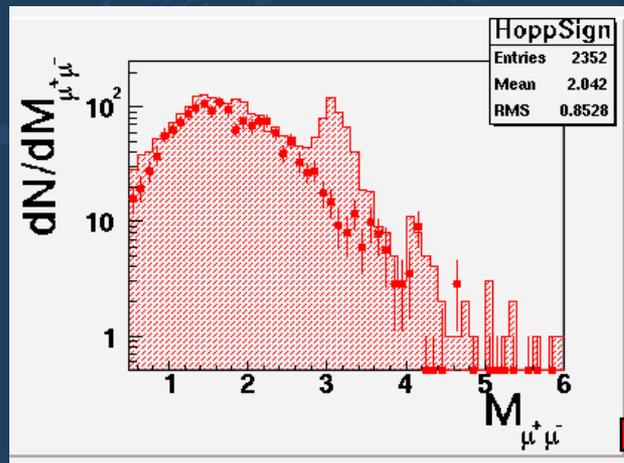


$$N_{+-}(M_{\mu^+\mu^-}) = 2 \sqrt{N_{++}(M_{\mu^+\mu^+}) N_{--}(M_{\mu^-\mu^-})}$$

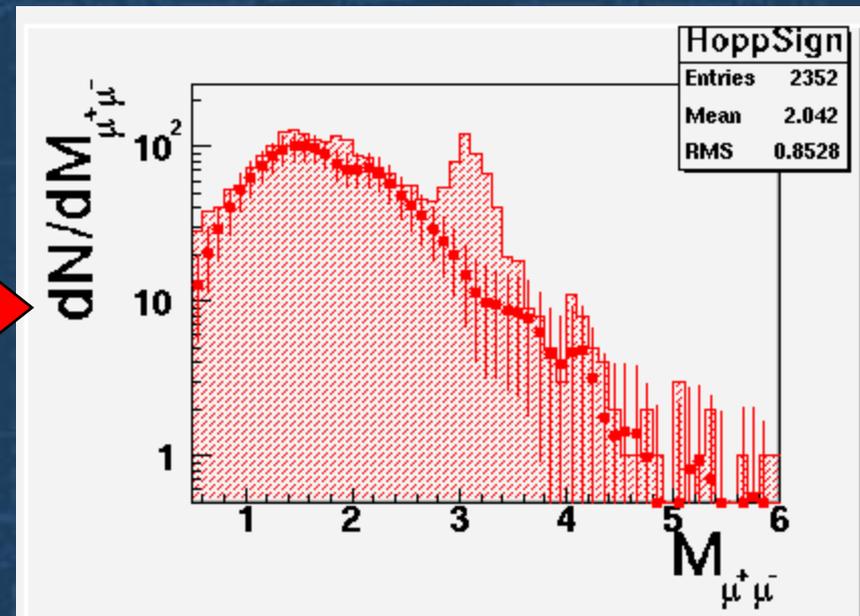
Gaussian smoothing

- Results
 - Reduce the fluctuations

No smoothing



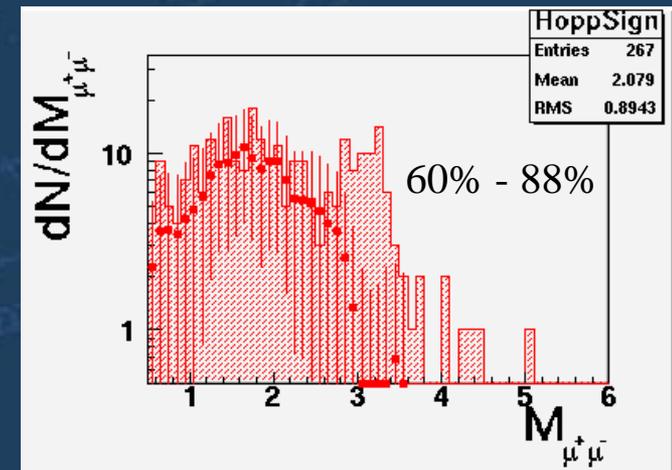
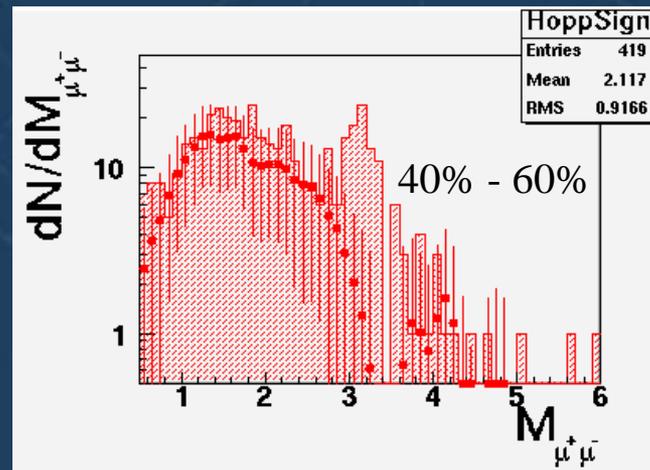
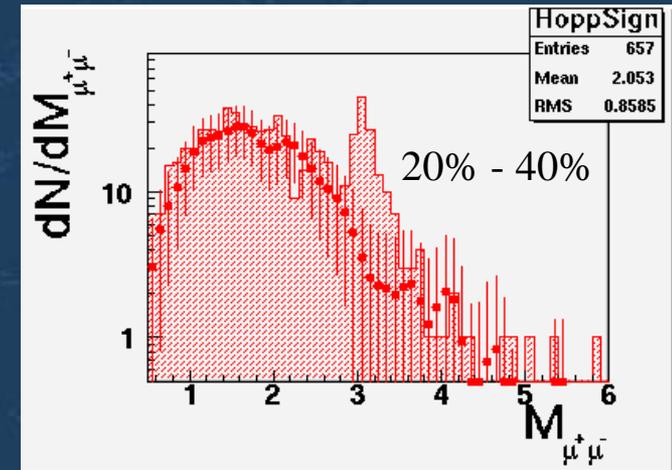
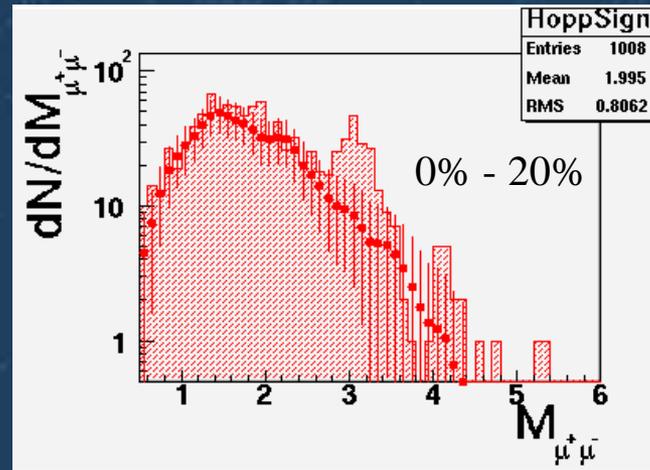
Gaussian smoothing



Gaussian smoothing

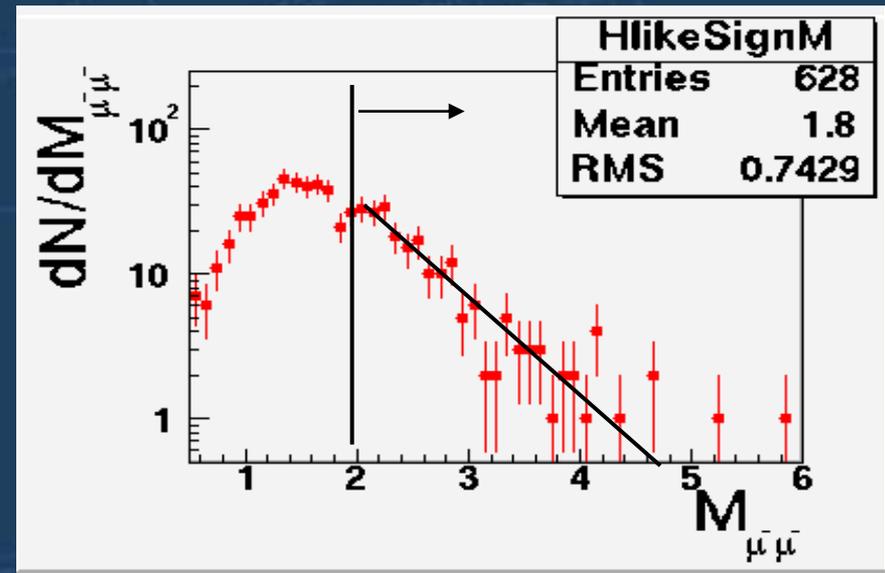
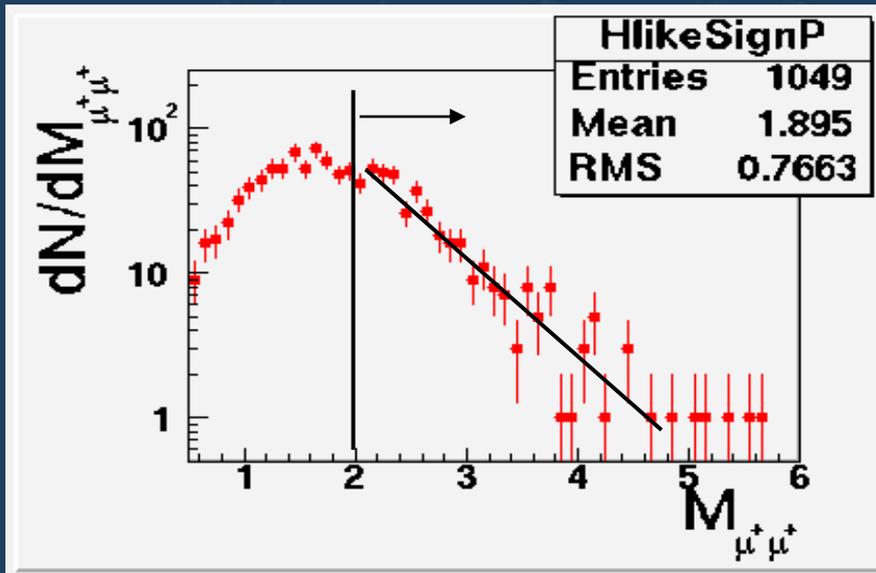
- Study per bin of centrality
 - Limit of the method : small statistics

4 bins of centrality



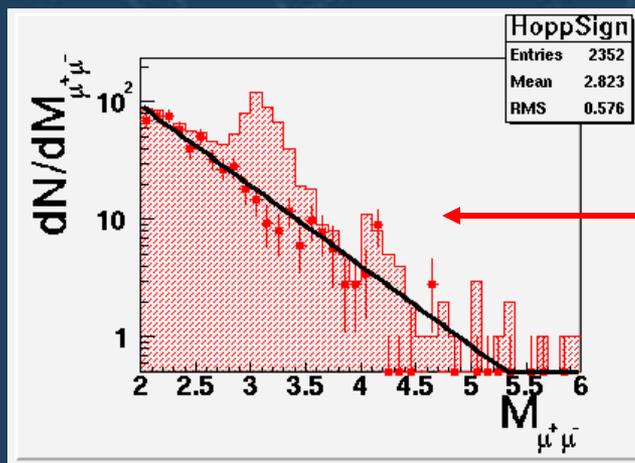
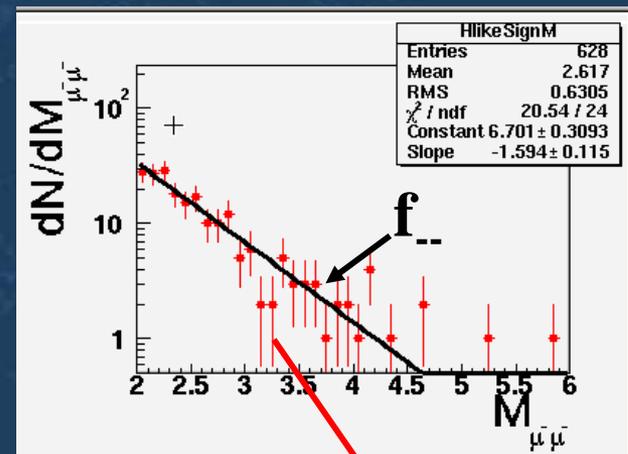
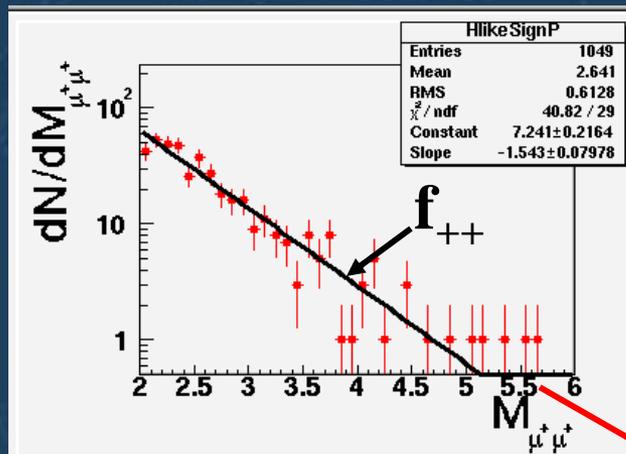
Exponential smoothing

- Hypothesis : above a given value, (++) and (--) spectra are exponential
- method : fit (++) and (--) spectra, then build the (+-) spectrum.



Exponential smoothing

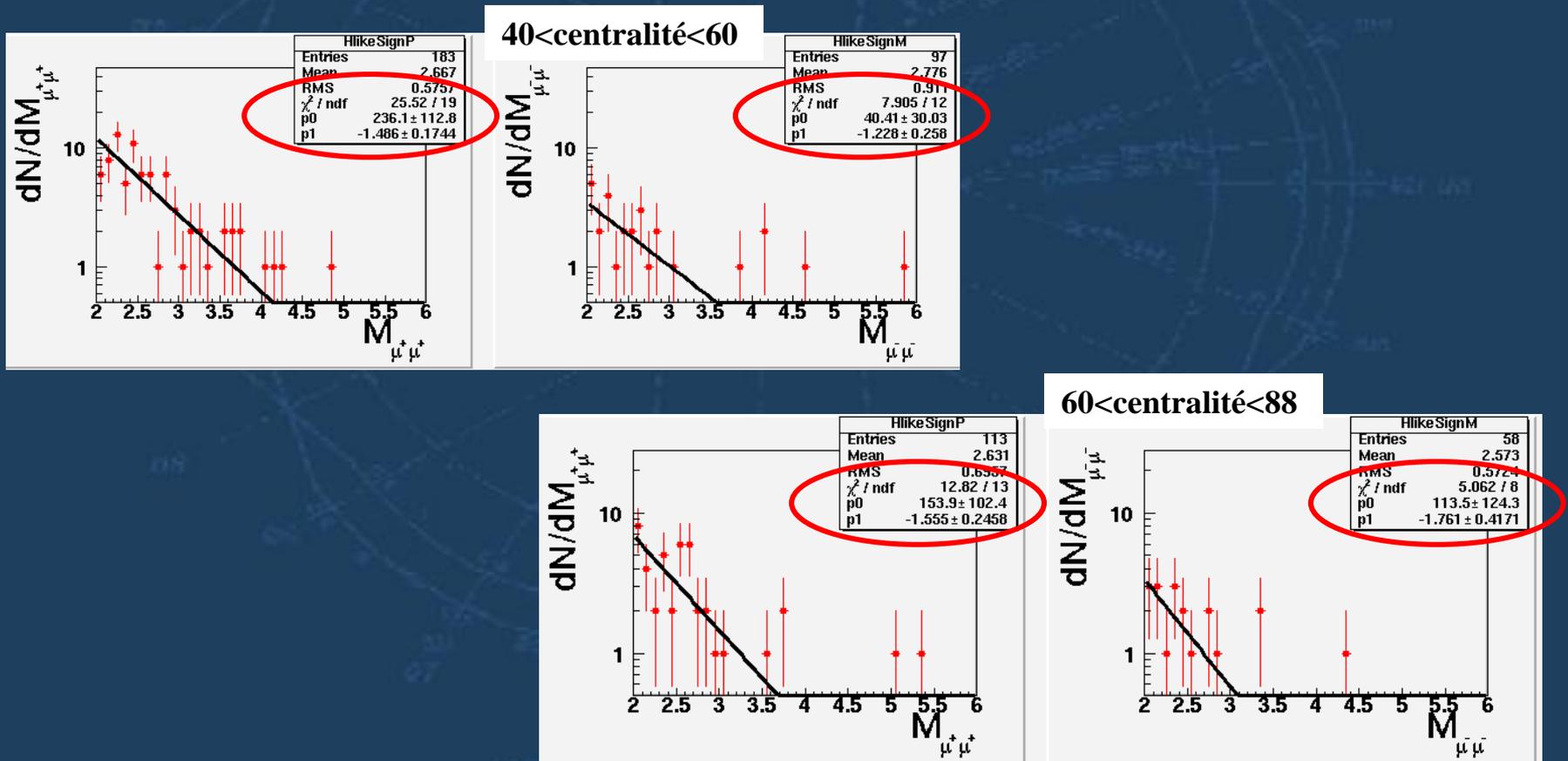
- method : fit (++) and (--) spectra, then build the (+-) spectrum.



$$f_{+-}(M_{\mu^+\mu^-}) = 2 \sqrt{f_{++}(M_{\mu^+\mu^+}) f_{--}(M_{\mu^-\mu^-})}$$

Exponential smoothing

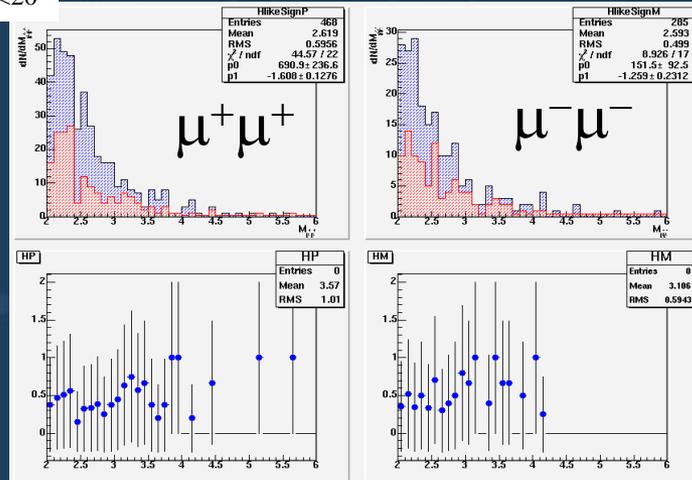
- Study per bin of centrality
 - Small statistics \rightarrow problem to fit



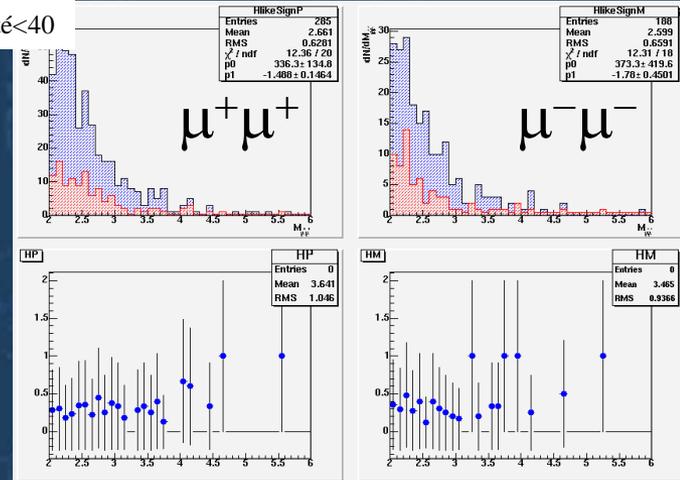
Exponential smoothing

- Study per bin of centrality
- Solution : spectra slopes ~ independent of the centrality

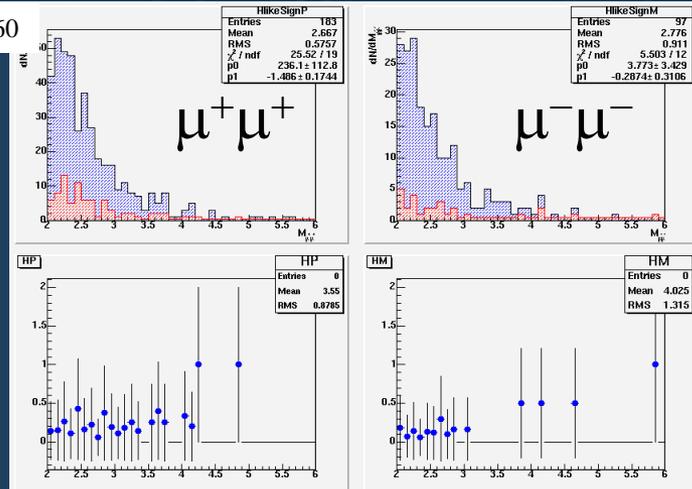
0<centralité<20



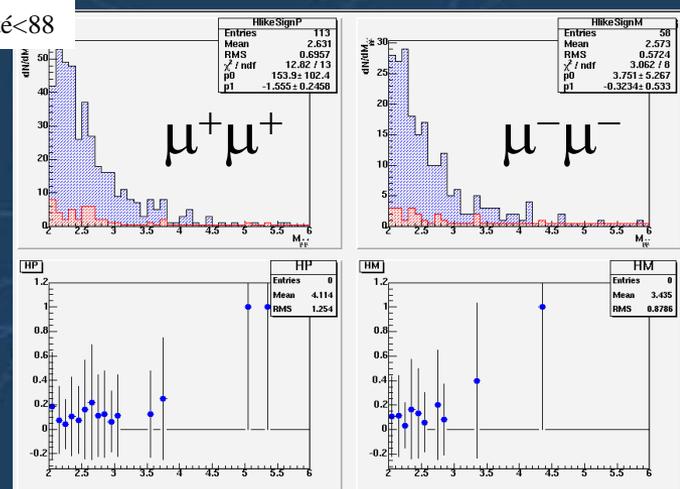
20<centralité<40



40<centralité<60



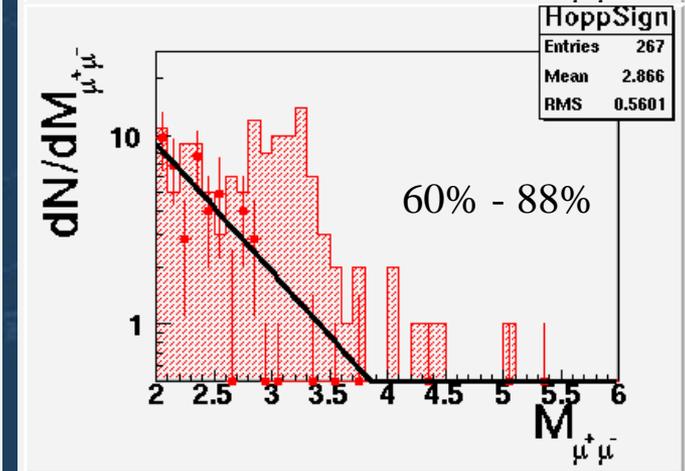
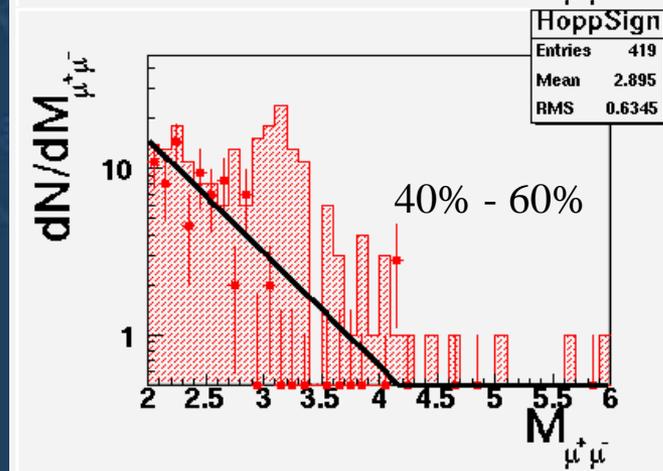
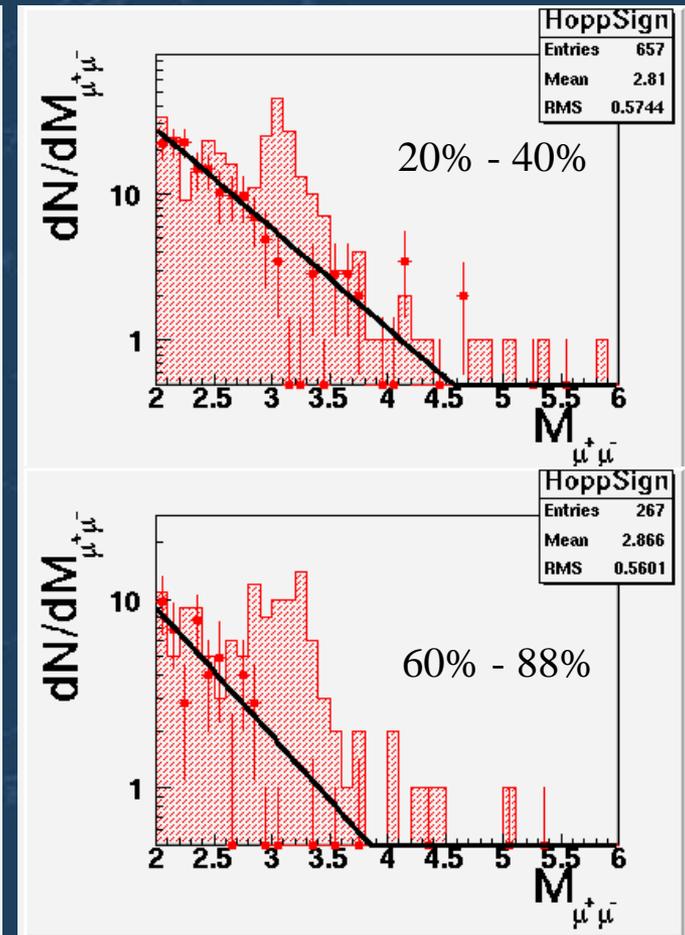
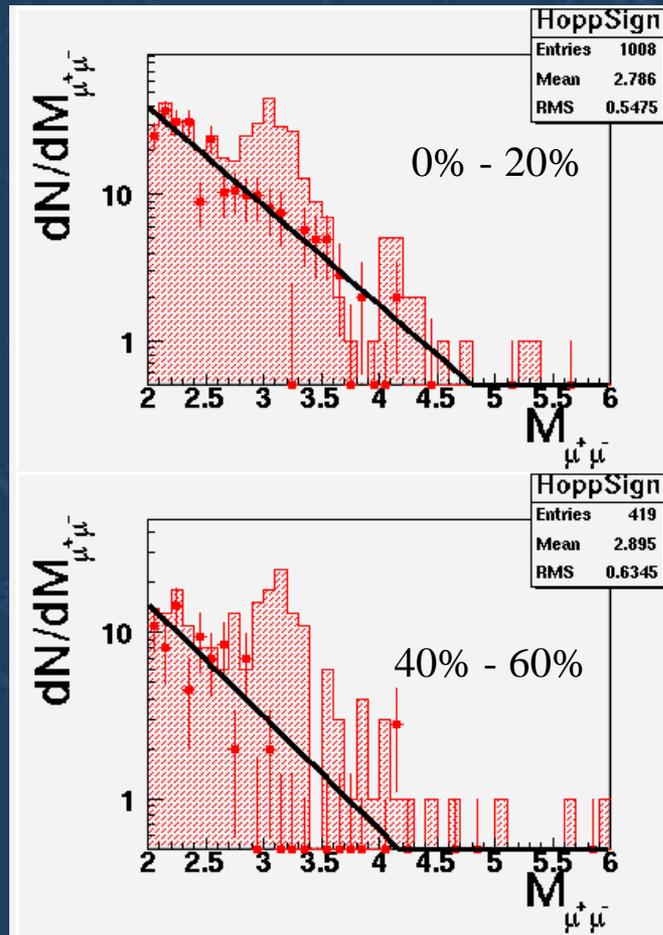
60<centralité<88



Exponential smoothing

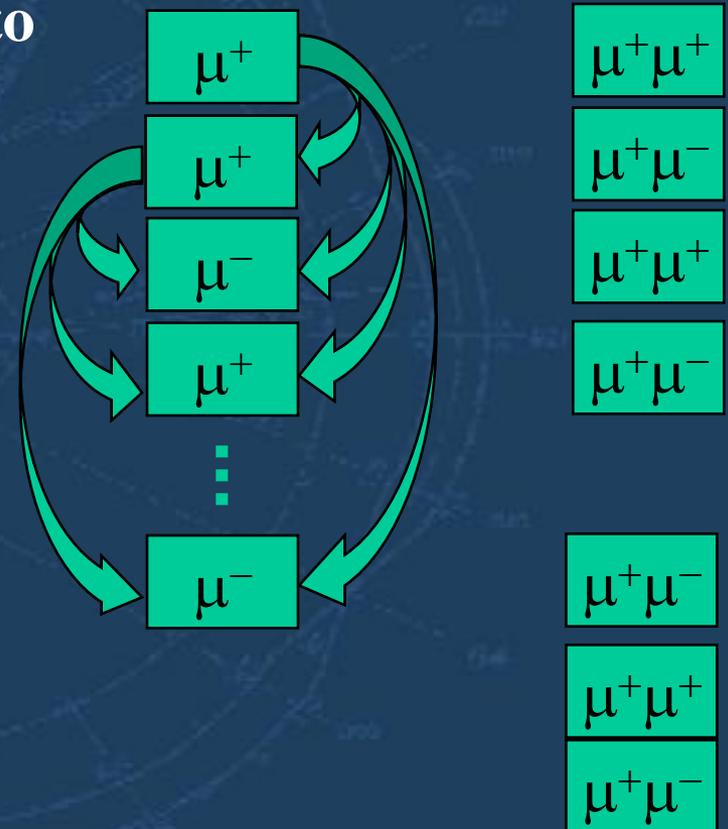
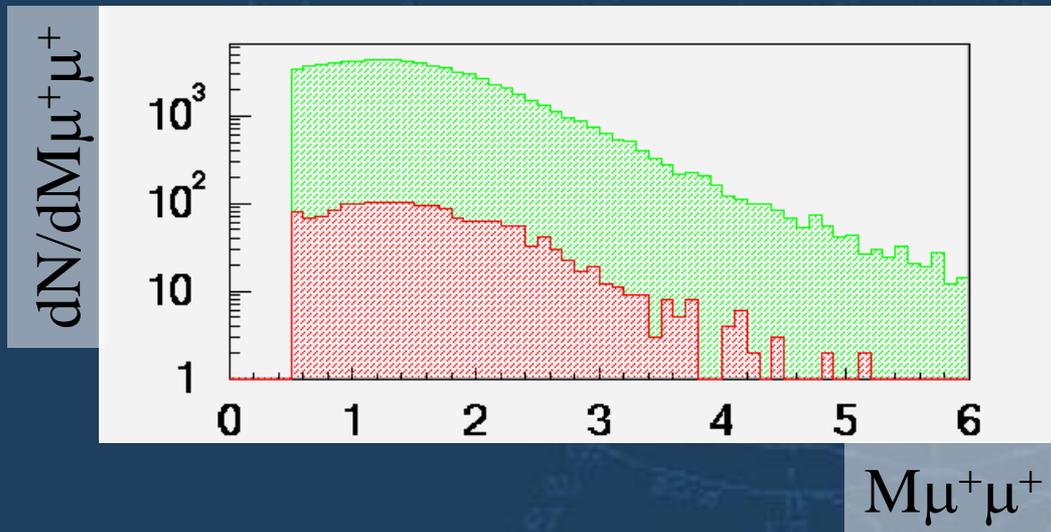
- Study per bin of centrality
 - Fit with fixed slopes

4 bins of centrality



Event mixing

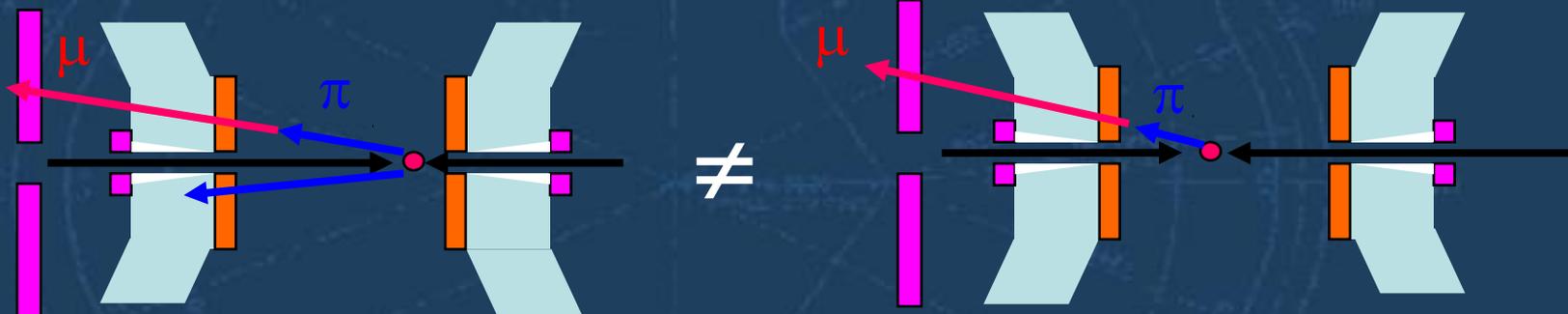
- **method**
 - Associate μ from different events to build di- μ
- **Advantage**



Event mixing

- **Event characteristics**

- **Vertex**



- $|Z_{\text{ver}}(\text{evt1}) - Z_{\text{ver}}(\text{evt2})| < 2 \text{ cm}$

- **Centrality**

- Associate events belonging to the same centrality bin

Event mixing

- checks

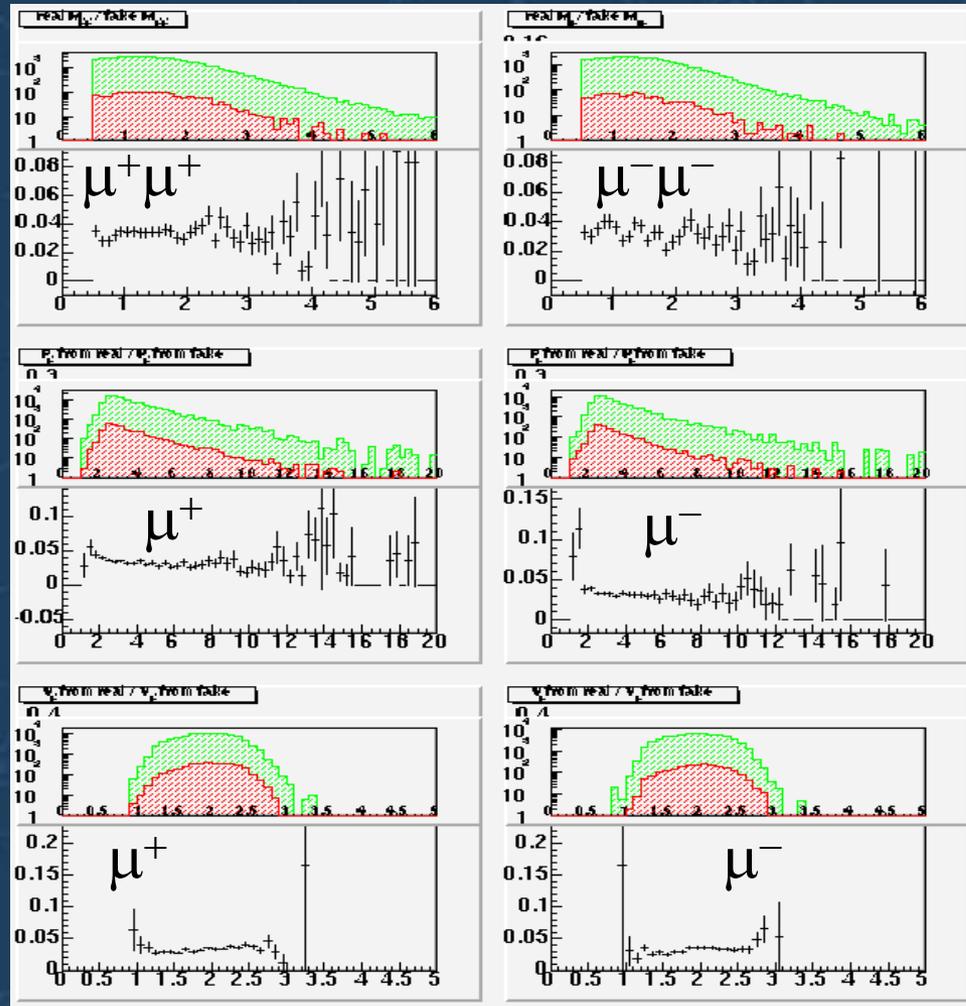
Invariant mass

$$\frac{N_{++}^{fake}}{N_{++}^{true}} = \frac{53477}{1805} = 29.6$$

$$\frac{N_{--}^{fake}}{N_{--}^{true}} = \frac{34431}{1122} = 30.7$$

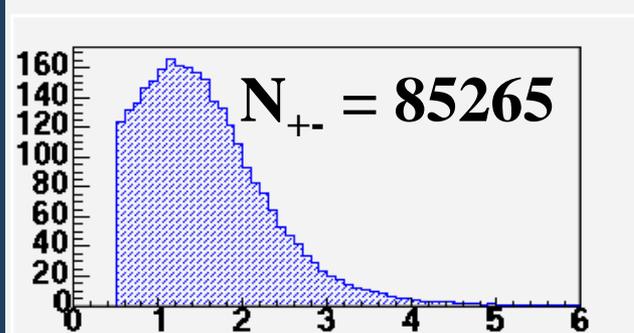
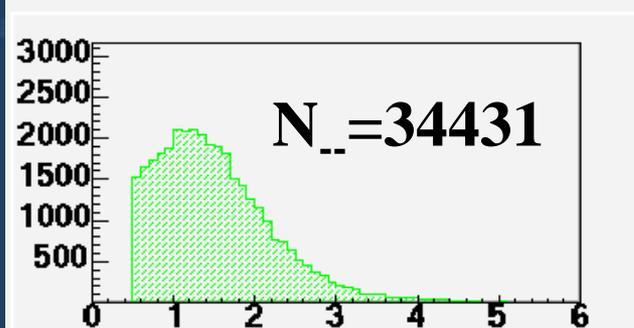
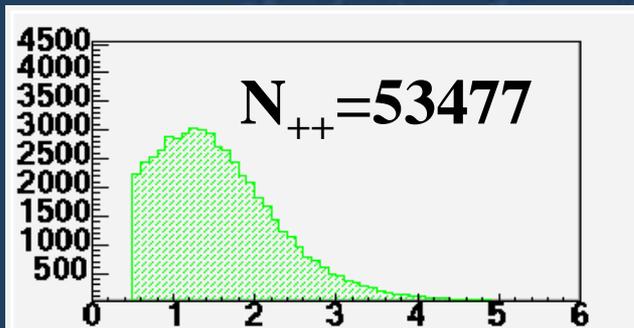
momentum

Rapidity



Event mixing

- Normalisation : fake dimuons

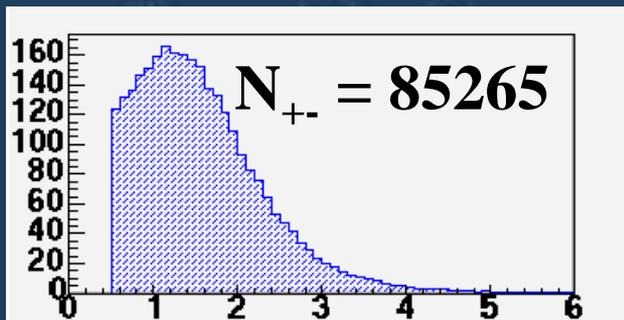
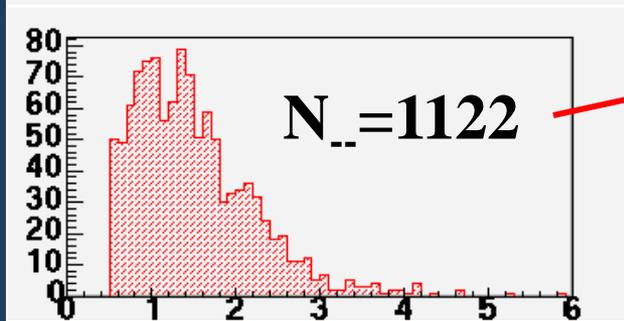
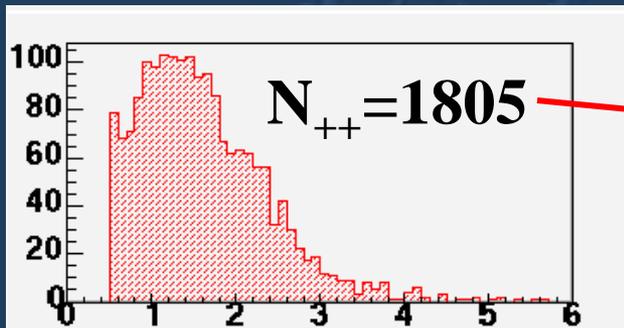


Fake dimuons :
 N_{++} , N_{--} , N_{+-} are known.
One can determine the
relation between like-sign
dimuons and opposite-sign
dimuons

$$N_{+-} = 0.994 \times 2 \sqrt{N_{++} N_{--}}$$

Event mixing

- Normalisation : true dimuons



$$N_{+-} = 0.994 \times 2 \sqrt{N_{++} N_{..}}$$

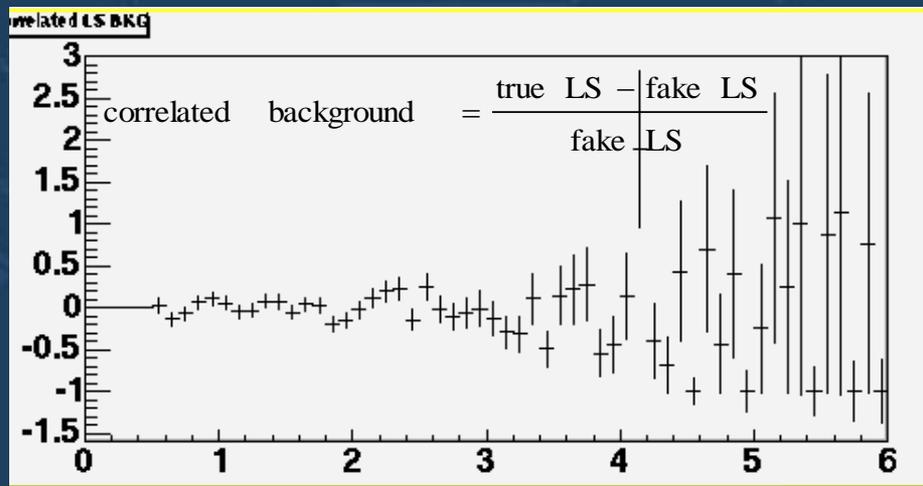
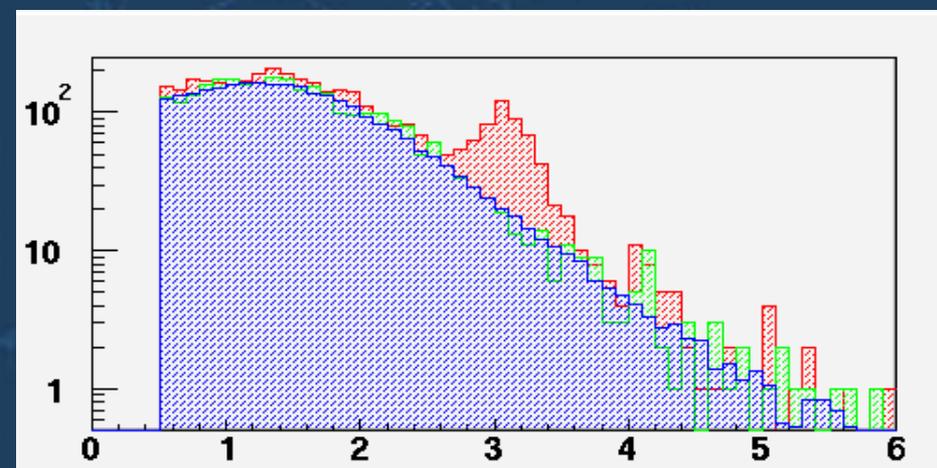
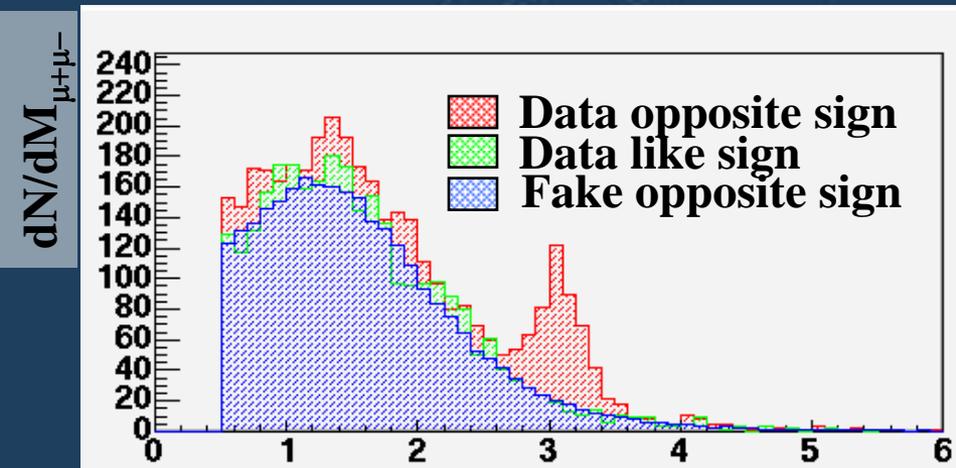


True dimuons :
Give the normalisation for the
fake dimuon spectrum



Event mixing

- Results

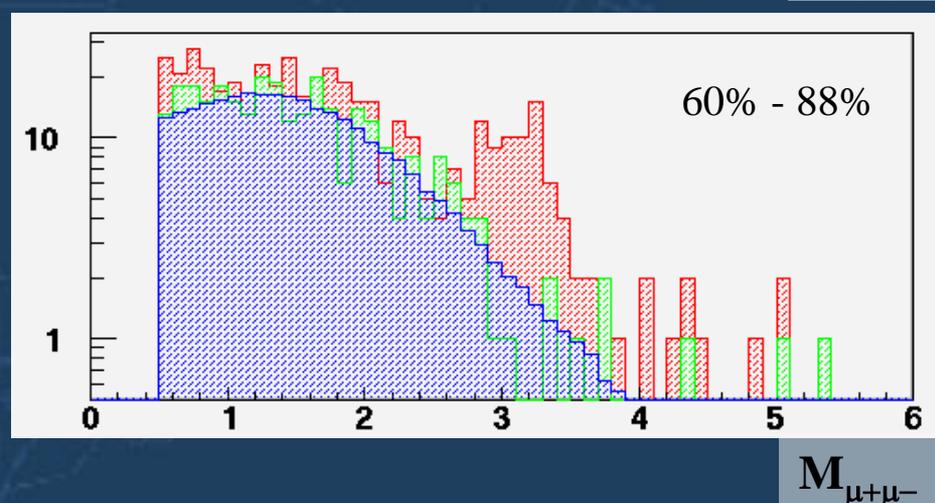
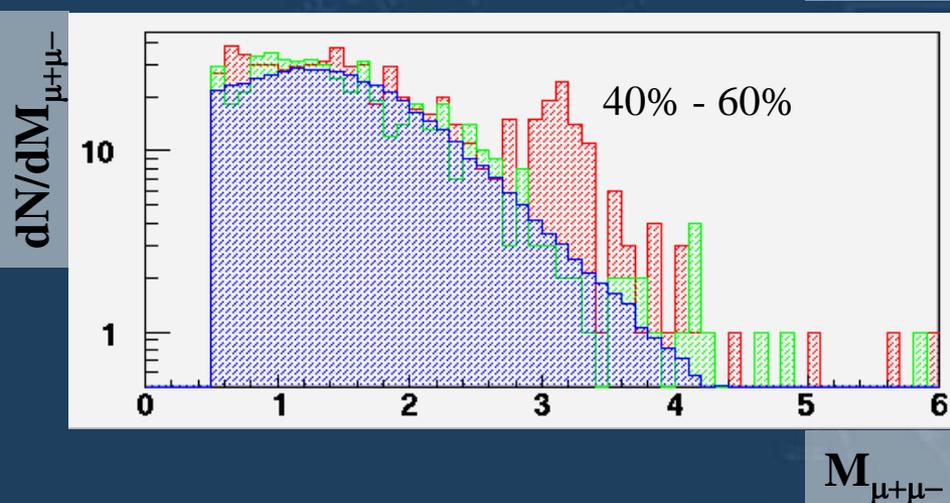
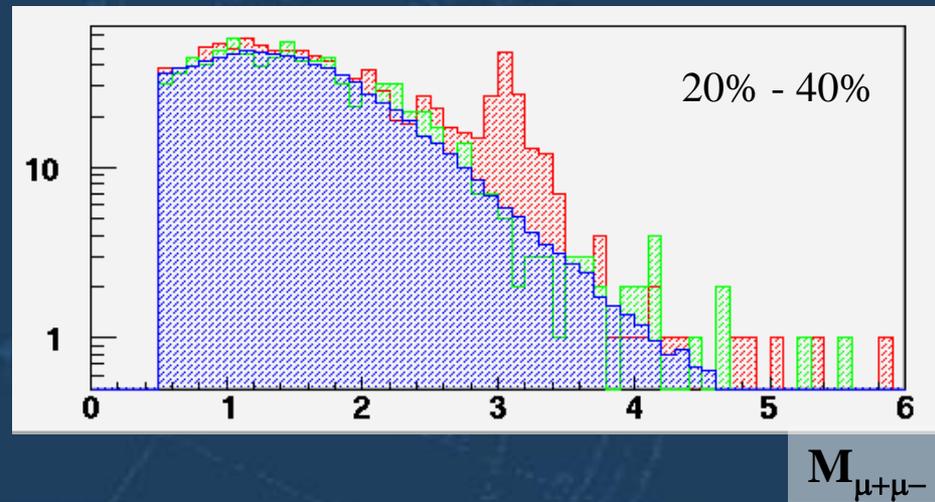
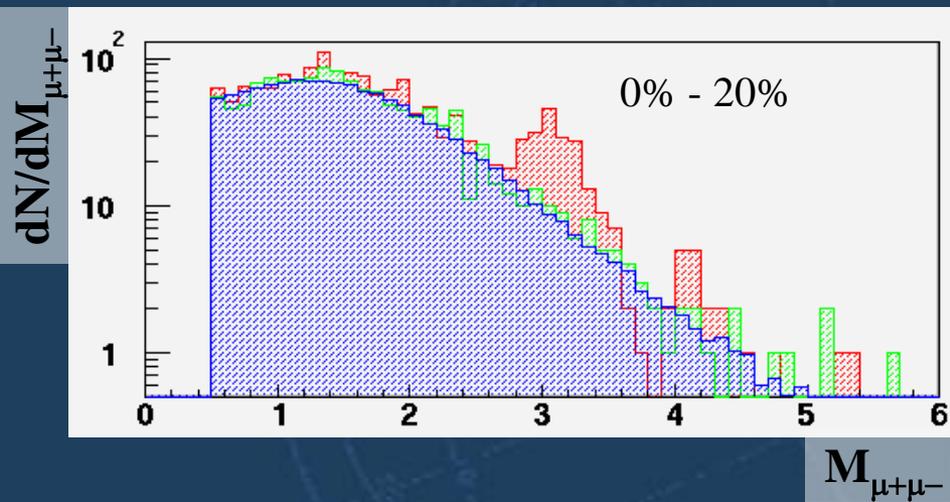


$M_{\mu+\mu-}$

$M_{\mu+\mu-}$

Event mixing

- Centrality study



Conclusion

- **3 estimation methods**
 - **No smoothing**
 - **Gaussian smoothing**
 - **Exponential smoothing**
 - **Advantages :**
 - **fast**
 - **Easy to use**
 - **disadvantages :**
 - **Problems at low statistic...**
- **Event mixing**
 - **Advantages :**
 - **Very efficient**
 - **~ independant of statistic**
 - **Disadvantages :**
 - **be very careful when use it**