# Update on Kinematic Fits in the Leptonic Channel

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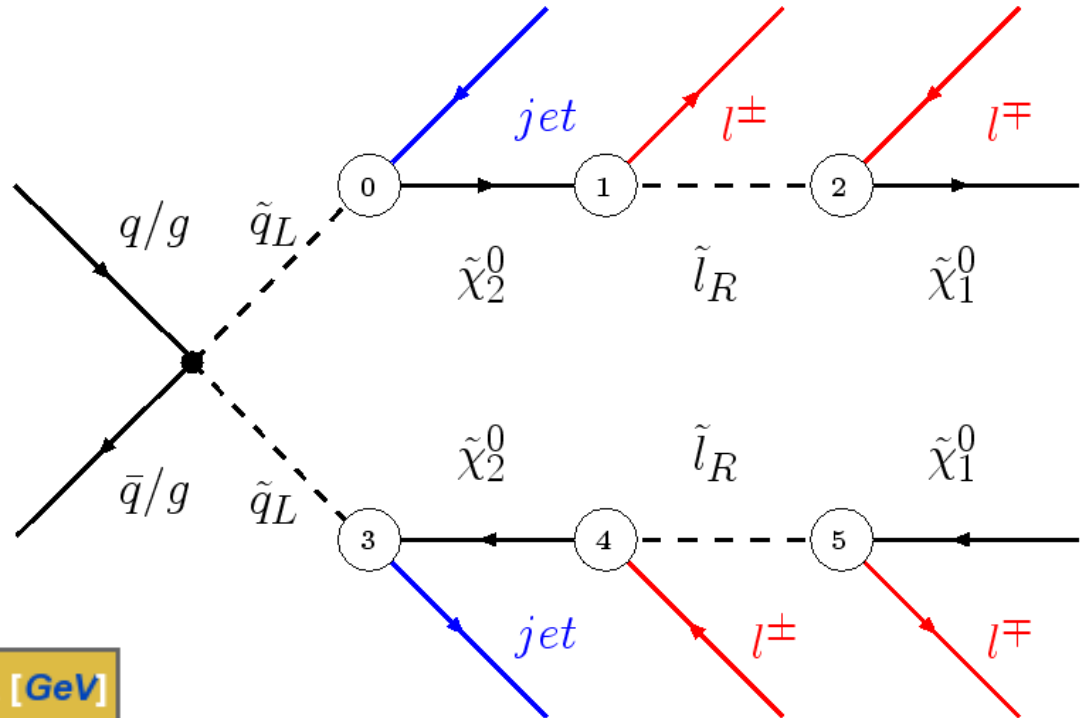
# Benchmarkpoint & Cascade

mSUGRA Parameters

|  | SPS1a |
|---|---|
| $m_0$ | 100 GeV |
| $m_{1/2}$ | 250 GeV |
| $A_0$ | -100 GeV |
| $\tan(\beta)$ | 10 |
| $\mu$ | >0 |



| Particle | Mass [GeV] | $\Delta M$ to next [GeV] |
|---|---|---|
| $\tilde{g}$ | 606 | 39 / 44 |
| $\tilde{q}_L$ | 567 (ud) / 562 (cs) | 387 / 382 |
| $\tilde{\chi}_2^0$ | 180 | 37 |
| $\tilde{l}_R^{\pm}$ | 143 | 46 |
| $\tilde{\chi}_1^0$ | 97 | |

X-section: ~36 pb @ 14 TeV

Leptonic Cascade

- 2 jets + 2x2 OSSF leptons
- 16/32 possible combinations
- BR = $1.7*10^{-3}$

# Likelihood Definition



correct masses
(560,180,143,79)



wrong hypothesis
(680,200,150,97)
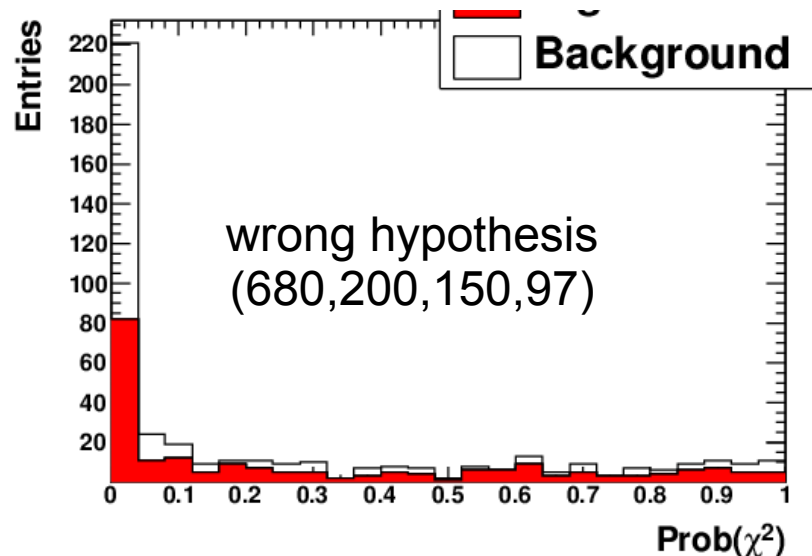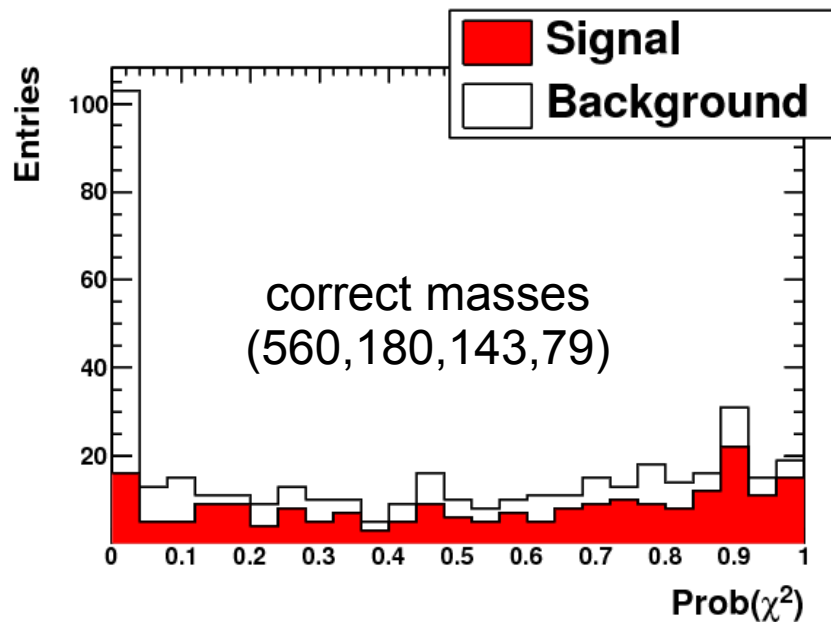
- Hypotheses close to true masses fit on average better

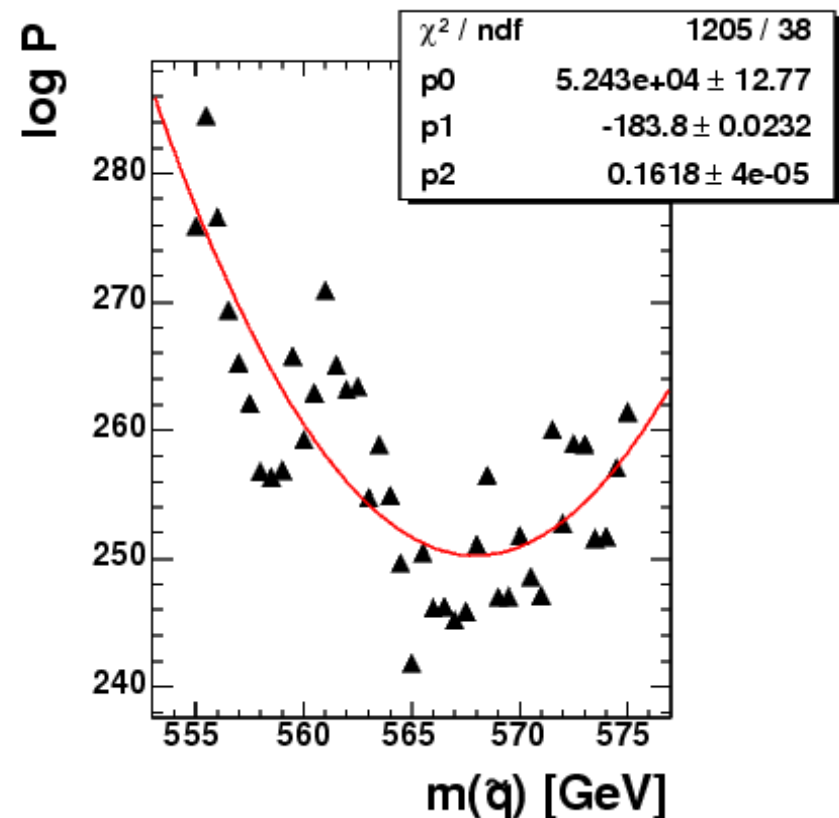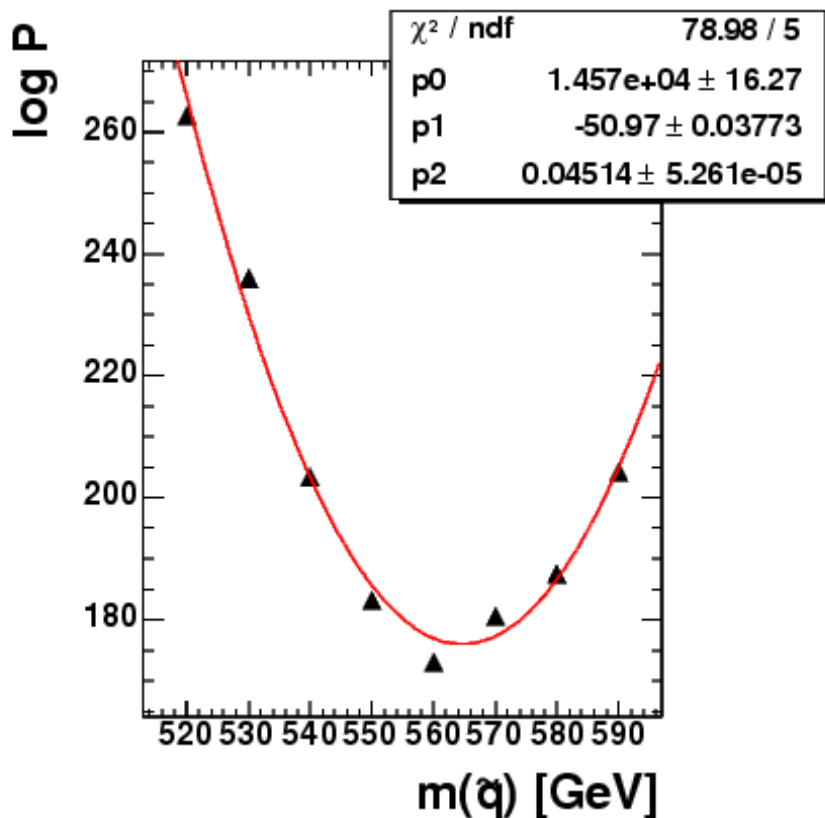- Use events' combined fit probability to quantify how good the assumed masses fit.

$$\log \mathcal{P} = \sum_{i}^{N} \log P(\chi_i^2)$$

$$P_i = P_{\text{cut}} \ \text{for} P_i < P_{\text{cut}}$$

- Cut-off to avoid numerical fluctutations
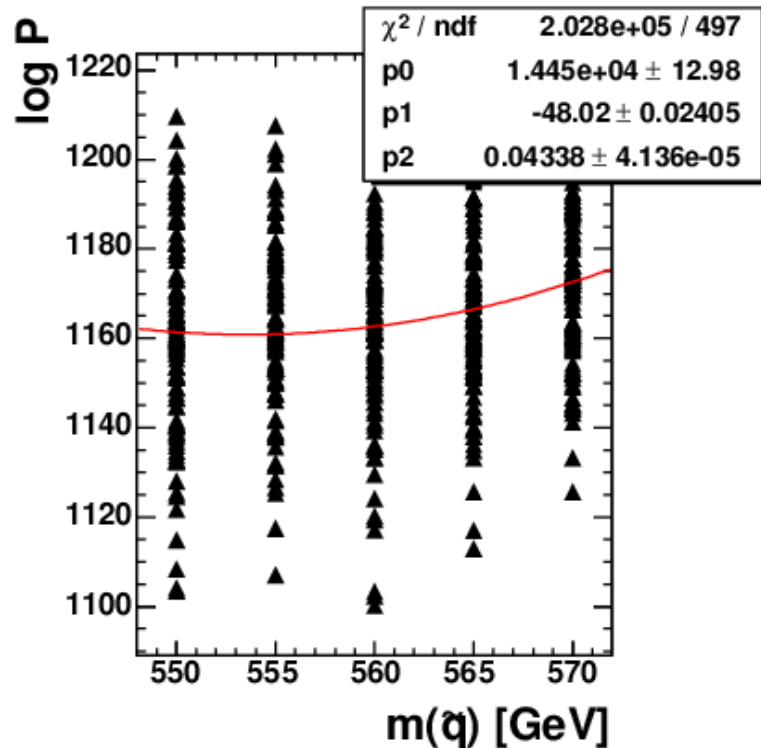- $P_{\text{cut}}=0.01$

# Squarkmass Scan

- Likelihood approaches parabola on large scales

- Fluctuations at small scales
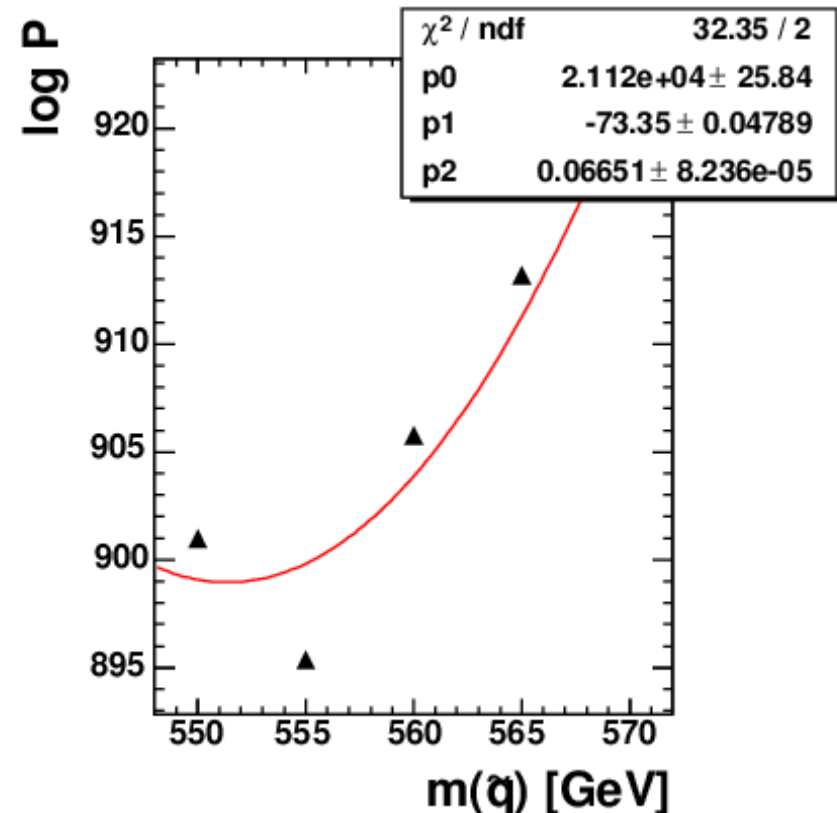  - Reduce them and determine size of the spread

# Repeated Fit

- Repeat the fit several times for each event with different starting values



- Need to select best fit for each event before building likelihood

- This 'best' likelihood values still have fluctuations

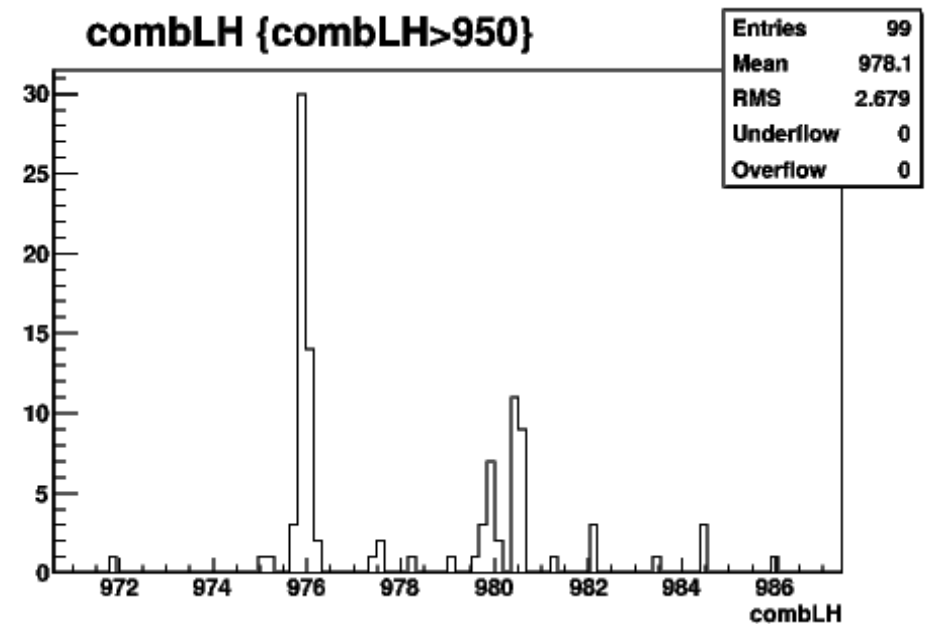  - repeat the experiment to assess uncertanties

# Spread after repeated Fit

- Fit each event 498 times (for true masses here)
  - Calculate likelihood from best probability of each event
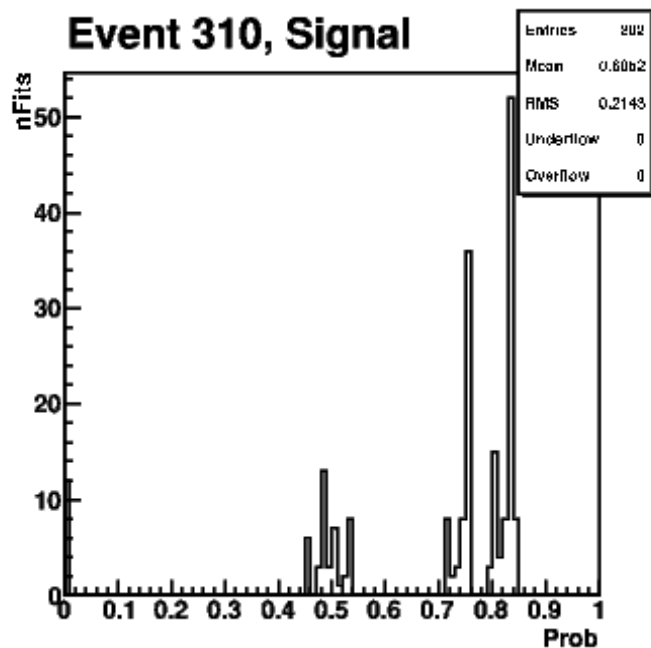
- Repeat this 100 times

- Some Likelihood P:
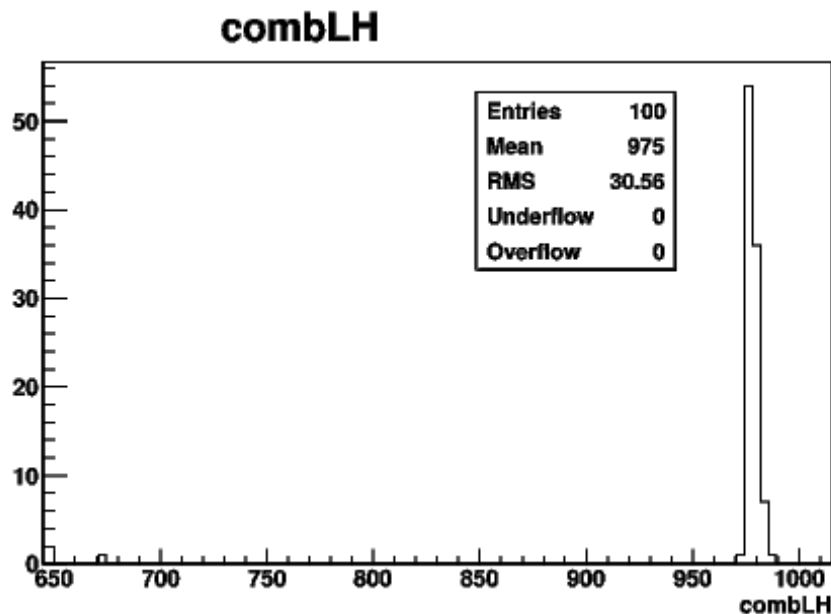
Zoom:

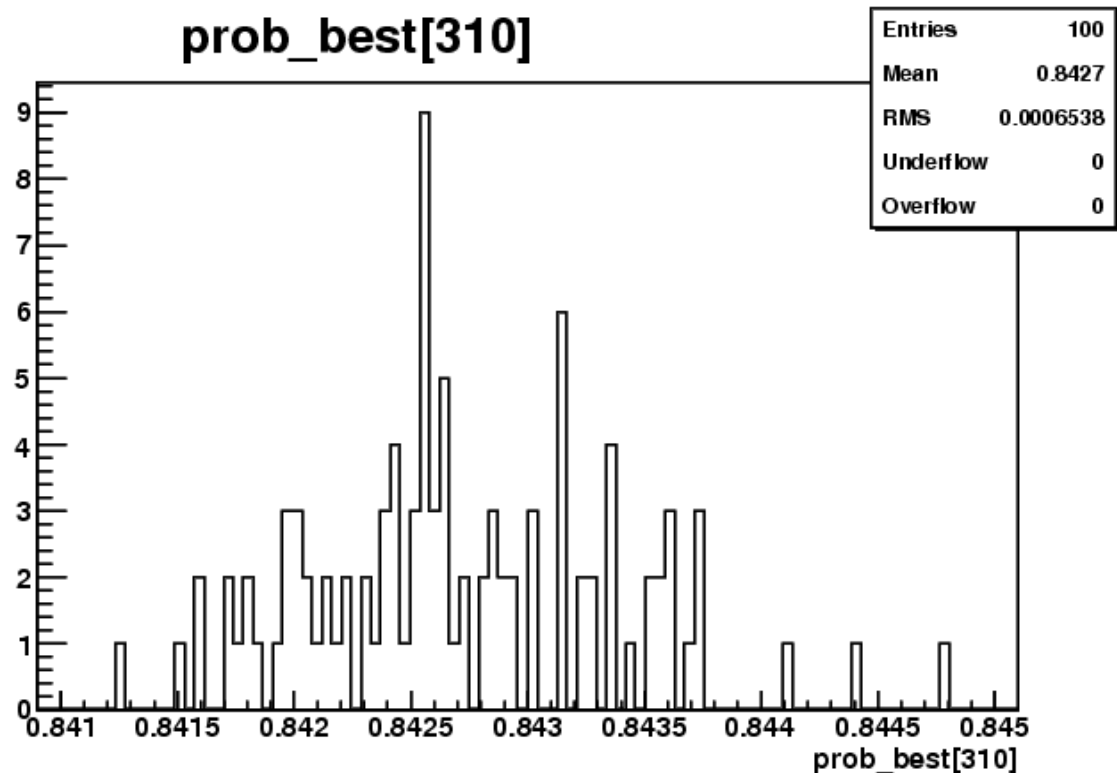



- Large Spread
  - Expected one peak…
  - Outlier: bug?

# Spread for a single Event

- Examine a single event:

Probability distribution for 498 Fits:



- – Fit finds several minima
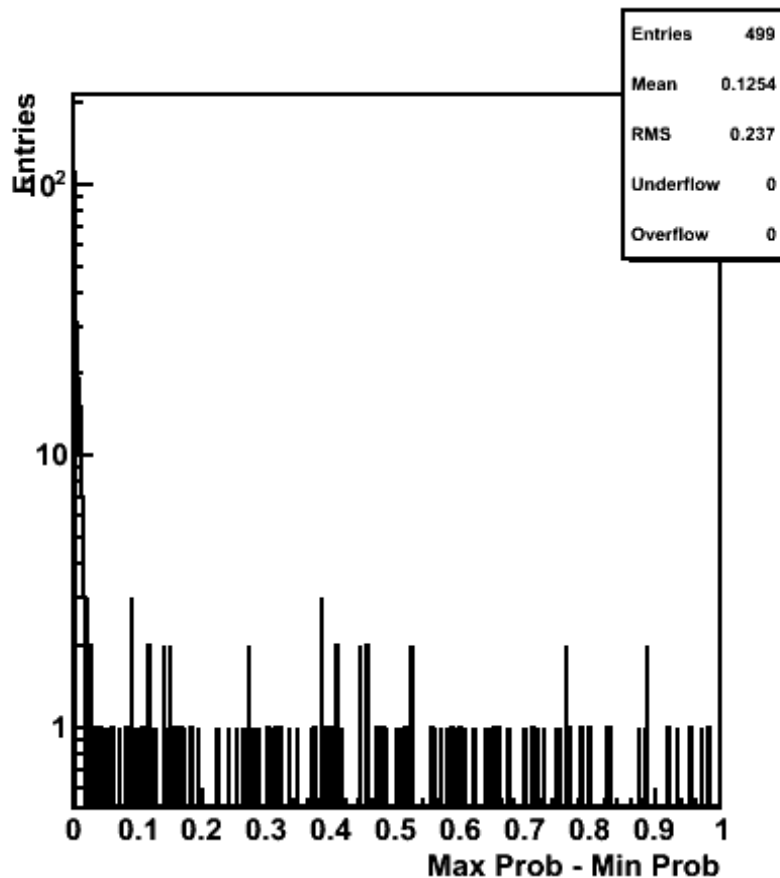- – Cut-off at some (high) probability

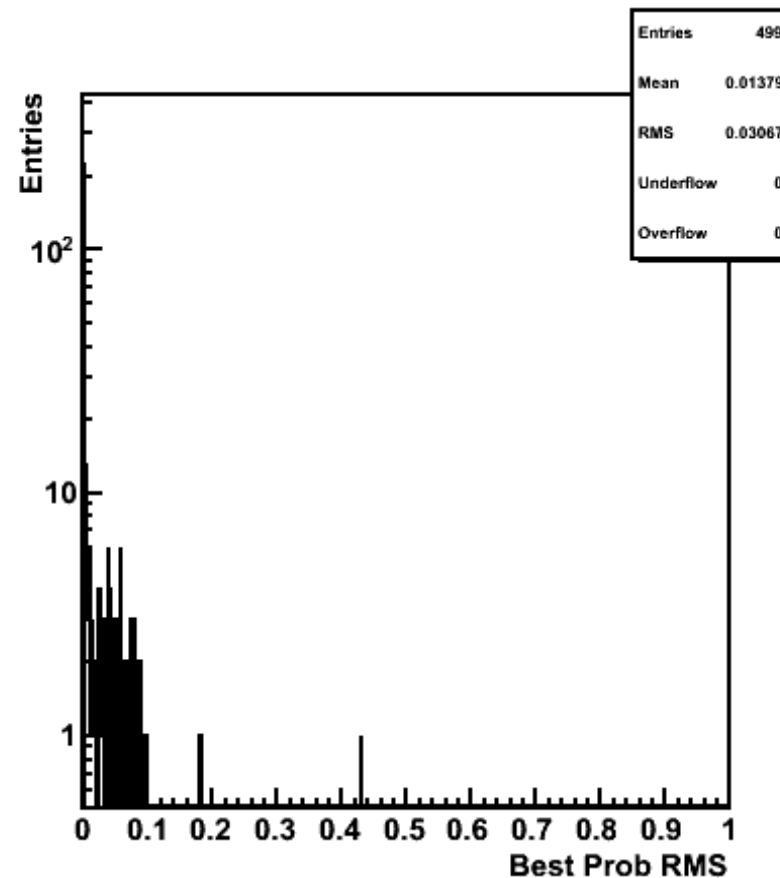- Best probabilities from 100 repetitions:



- Small spread for this event – look at all events:

# Event-wise Spread

- From 498x100 Fits of all events:

  – Max. difference: find some event with really large values
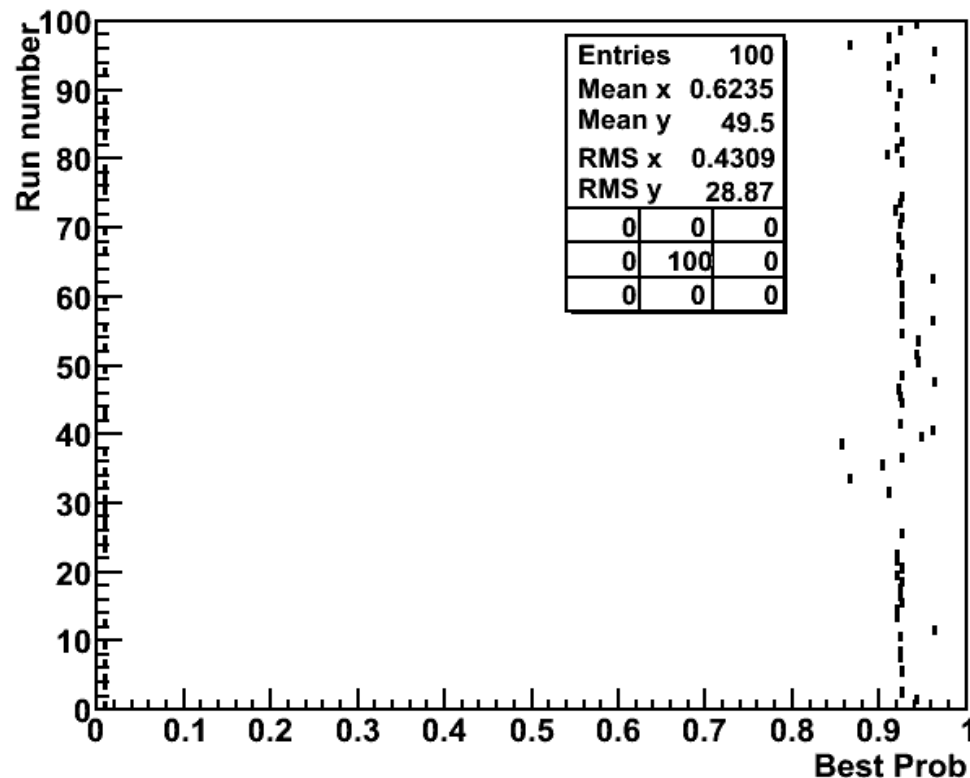
  – RMS of distribution

    - rather small values

    - study 2 outliers



Entries 499
Mean 0.1254
RMS 0.237
Underflow 0
Overflow 0

Max Prob - Min Prob



Entries 499
Mean 0.01379
RMS 0.03067
Underflow 0
Overflow 0

Best Prob RMS

# Outlier Event

- Best probability from the 100 runs (vs. run number)
  - two 'populations' around 0.93 and at lower bound

- How to deal with this?
- Maybe an effect of a low convergence rate?
  - some runs do not have converging or only badly converging fits.

...



| Entries | 100 |
| --- | --- |
| Mean x | 0.6235 |
| Mean y | 49.5 |
| RMS x | 0.4309 |
| RMS y | 28.87 |

| 0 | 0 | 0 |
| --- | --- | --- |
| 0 | 100 | 0 |
| 0 | 0 | 0 |