

# Comparison of fits

for 4 different “typical” distribution

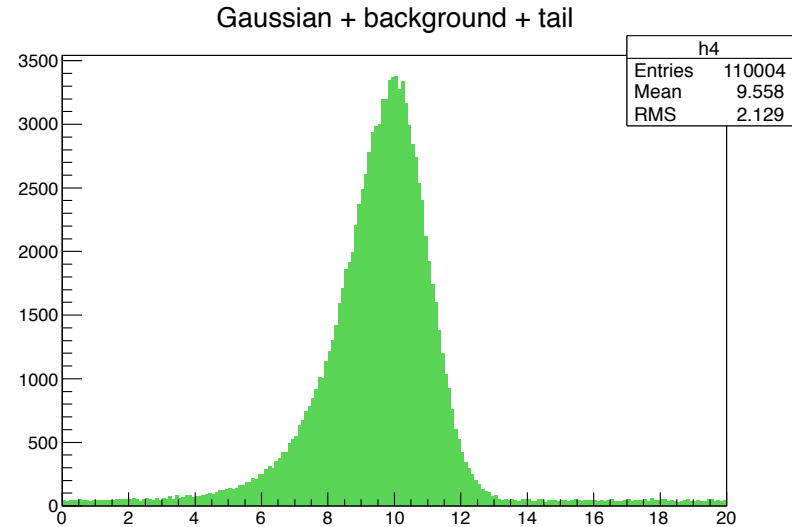
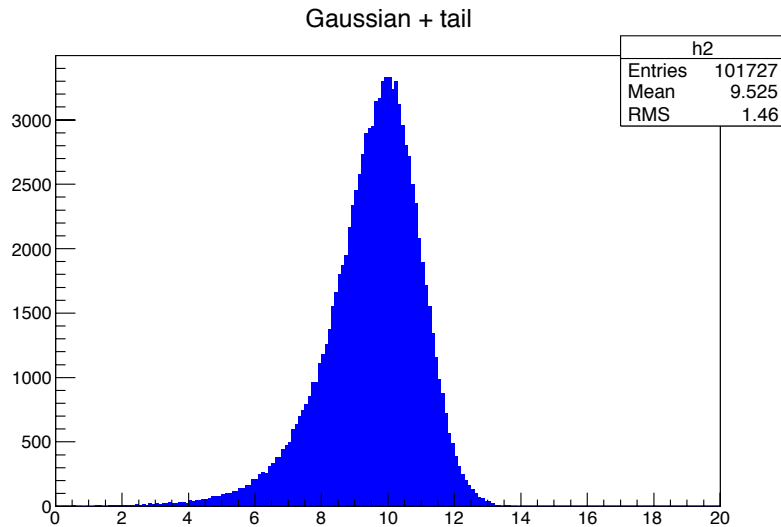
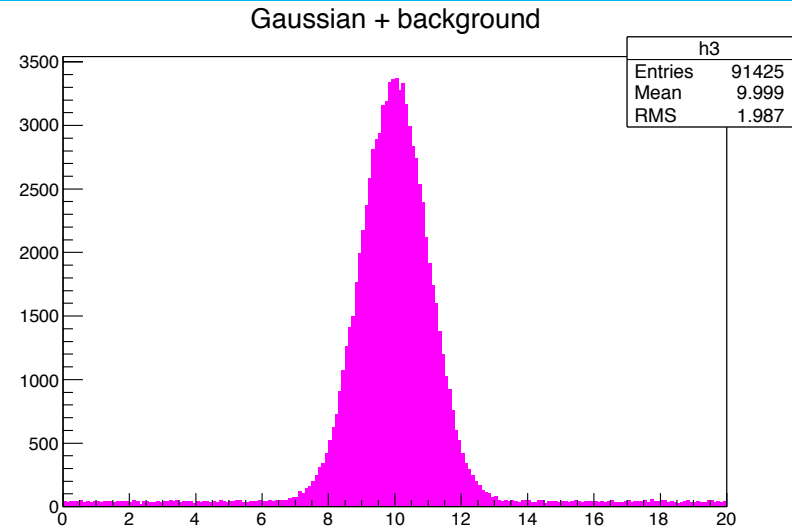
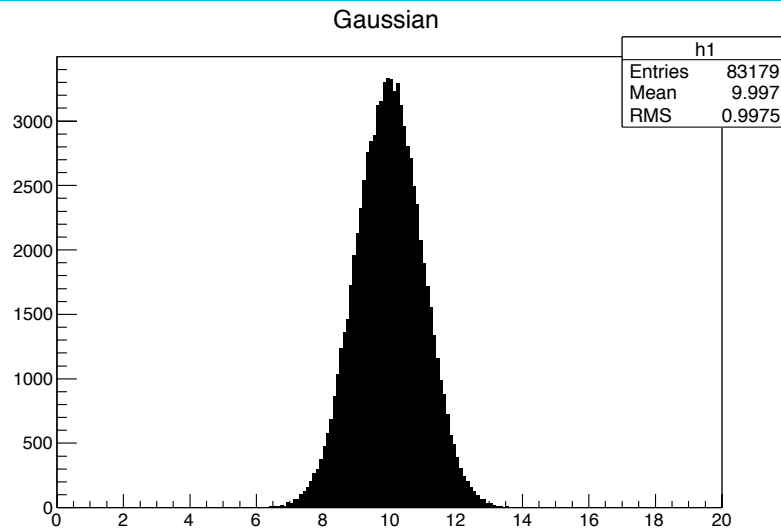


Coralie Neubüser & José Repond  
CALICE Collaboration meeting  
Argonne, 21.03.14



- Make resolutions of different CALICE technologies comparable
- To do that:
  - Understand asymmetries energy distributions
    - Due to leakage, intrinsic calorimeter properties, response?
  - Understand the influences of different fitting on results
- Now: Just first look into statistical influences...

# 4 “typical” distributions, $\mu=10$ & $\sigma=1$



~100.000 events, generated with Gaussian, Zeus function + constant BG



# Fits

Fit/Method	
1	RMS
2	RMS90
3	<b>Gaussian</b>
4	Gaussian $\pm 1.5\sigma$
5	Gaussian $\pm 2\sigma$
6	Gaussian $-1\sigma + 2\sigma$
7	<b>Novosibirsk</b> $f(x) = A \cdot \exp\left(-\frac{1}{2} \cdot \left(\frac{\ln^2[1 + \Delta \cdot \tau \cdot (x - \mu)]}{\tau}\right) + \tau^2\right)$
$\Delta \equiv \frac{\sin(\tau \cdot \sqrt{\ln 4})}{\sigma \cdot \tau \cdot \sqrt{\ln 4}}$	
8	<b>Crystal Ball</b> $A = \left(\frac{n}{ \alpha }\right)^n \cdot \exp\left(-\frac{ \alpha ^2}{2}\right)$ $B = \frac{n}{ \alpha } -  \alpha $ $f(x) = N \cdot \begin{cases} \exp\left(-\frac{(x - \mu)^2}{2\sigma^2}\right), & -\alpha < \frac{x - \mu}{\sigma} \\ A \cdot \left(B - \frac{x - \mu}{\sigma}\right)^{-n}, & -\alpha \geq \frac{x - \mu}{\sigma} \end{cases}$

- > “typical” CALICE fits
- > RMS versus RMS90
- > Full fit range 0 to 20
- >  $\mu$  and  $\sigma$  taken from fit parameters

## 9 Zeus

$$f(x) = N \cdot \exp\left(-\frac{1}{2} \cdot \left(\frac{x - \mu}{A}\right)^2\right)$$

$$x \geq \mu : A = \sigma$$

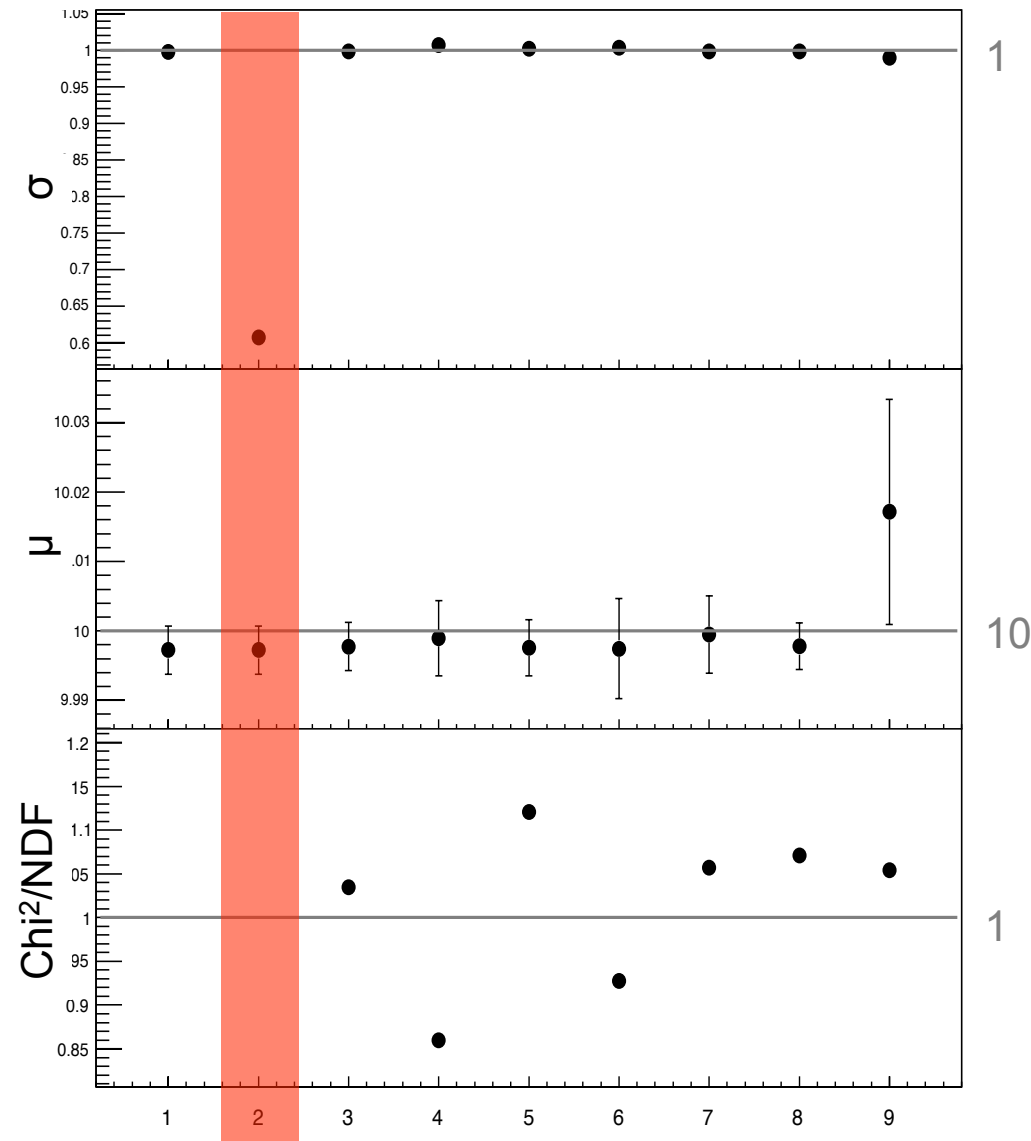
$$x < \mu : A = \sigma \left(1 + \alpha(\mu - x)^\beta\right)$$



# Results fitting a Gaussian

Fit/Method

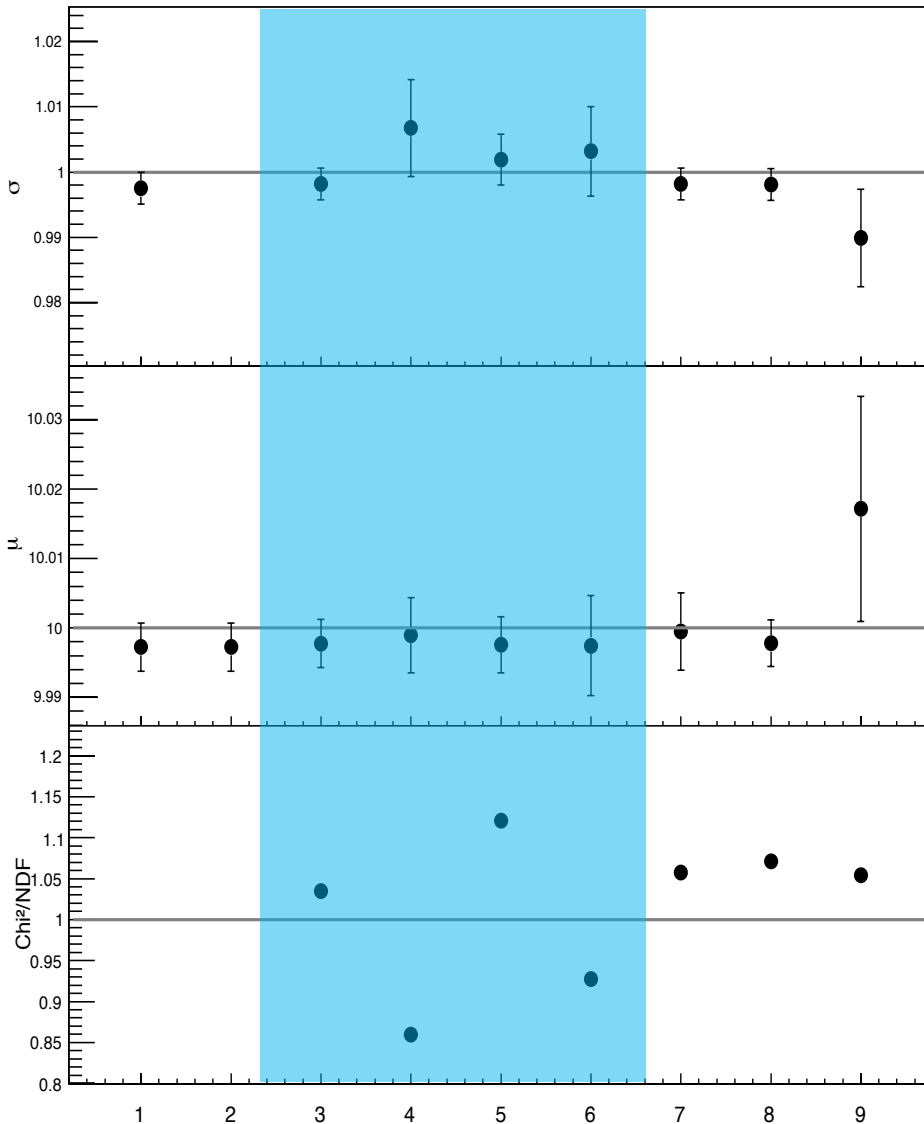
- |   |                               |
|---|-------------------------------|
| 1 | RMS                           |
| 2 | RMS90                         |
| 3 | <b>Gaussian</b>               |
| 4 | Gaussian $\pm 1.5\sigma$      |
| 5 | Gaussian $\pm 2\sigma$        |
| 6 | Gaussian $-1\sigma + 2\sigma$ |
| 7 | <b>Novosibirsk</b>            |
| 8 | <b>Crystal Ball</b>           |
| 9 | <b>Zeus</b>                   |



> RMS90 2/3<sup>rd</sup> of RMS



# Results fitting a Gaussian

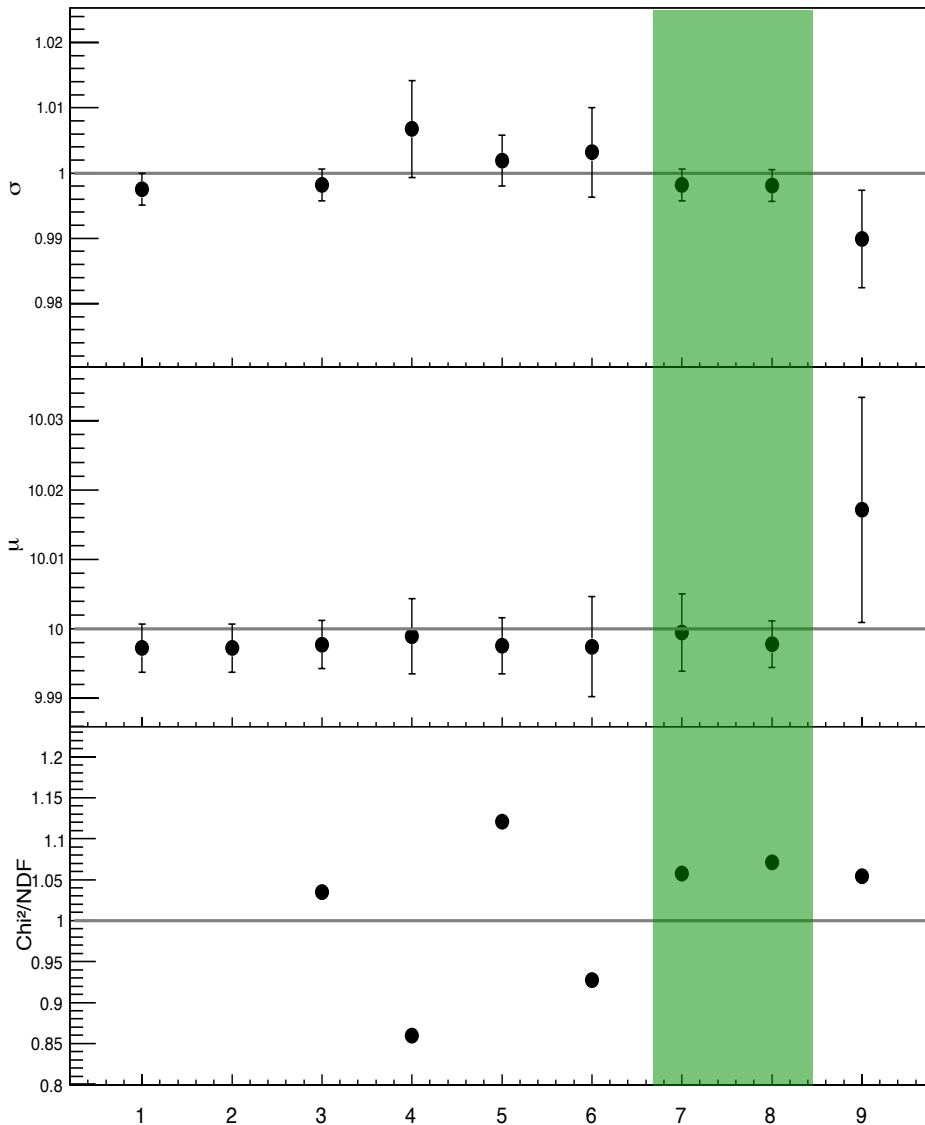


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- > RMS90 2/3<sup>rd</sup> of RMS
- > Fit Gauss with Gaussian
  - Limited fit range cause bigger errors



# Results fitting a Gaussian



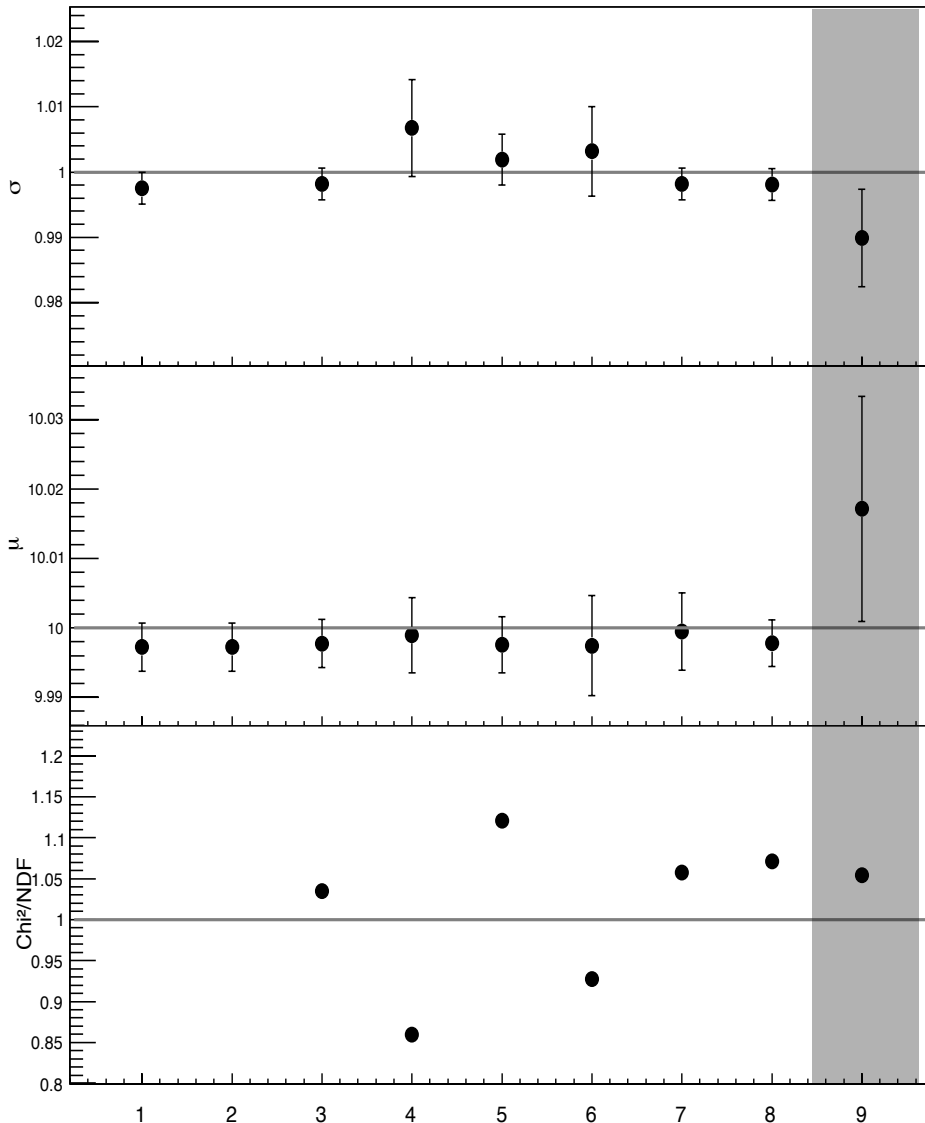
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- > RMS90 2/3<sup>rd</sup> of RMS
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- > Novosibirsk & Crystal Ball work



# Results fitting a Gaussian



## Fit/Method

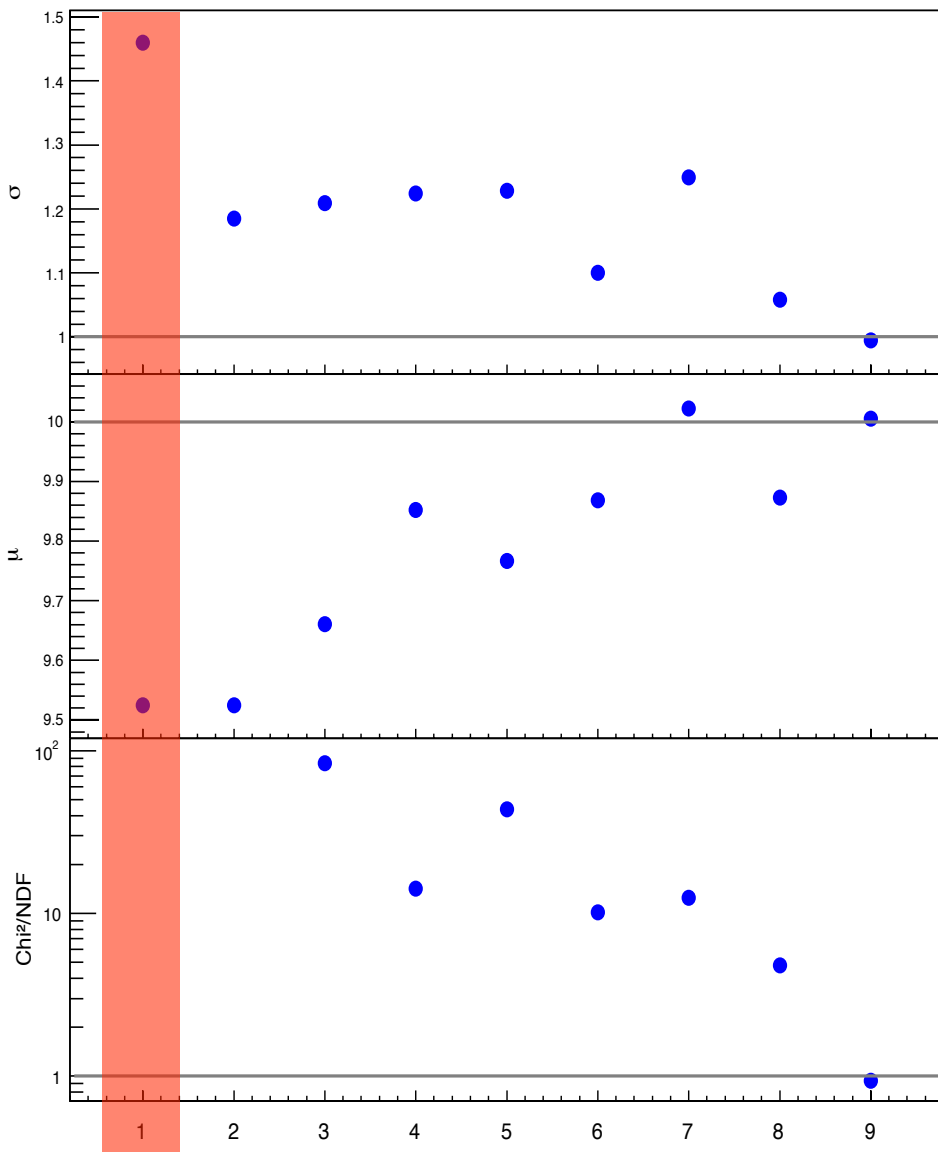
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- > RMS90 2/3<sup>rd</sup> of RMS
- > Fit Gauss with Gaussian
  - Limited fit range cause bigger errors
- > Novosibirsk & Crystal Ball work
- > Zeus shows huge errors





# Results fitting a Gaussian with tail

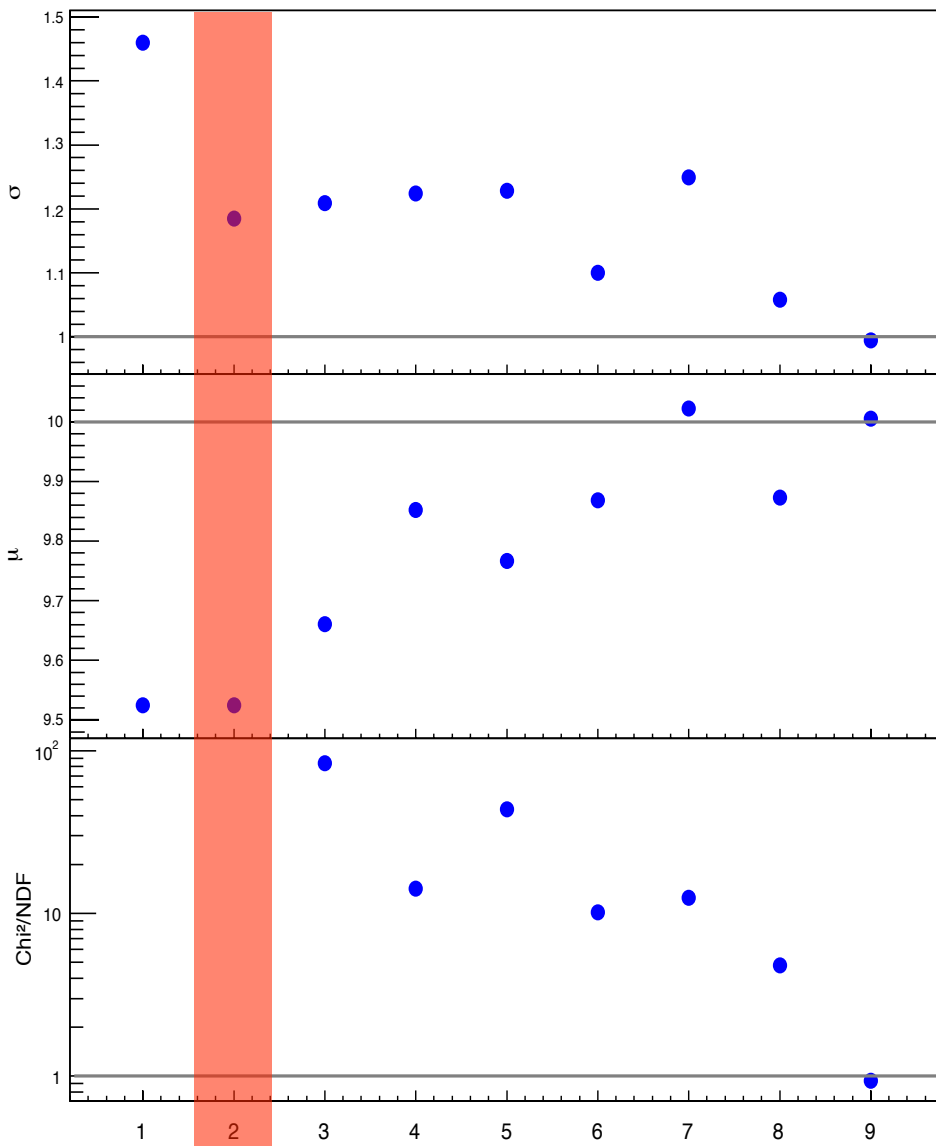


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➤ RMS 1.5 times larger width



# Results fitting a Gaussian with tail

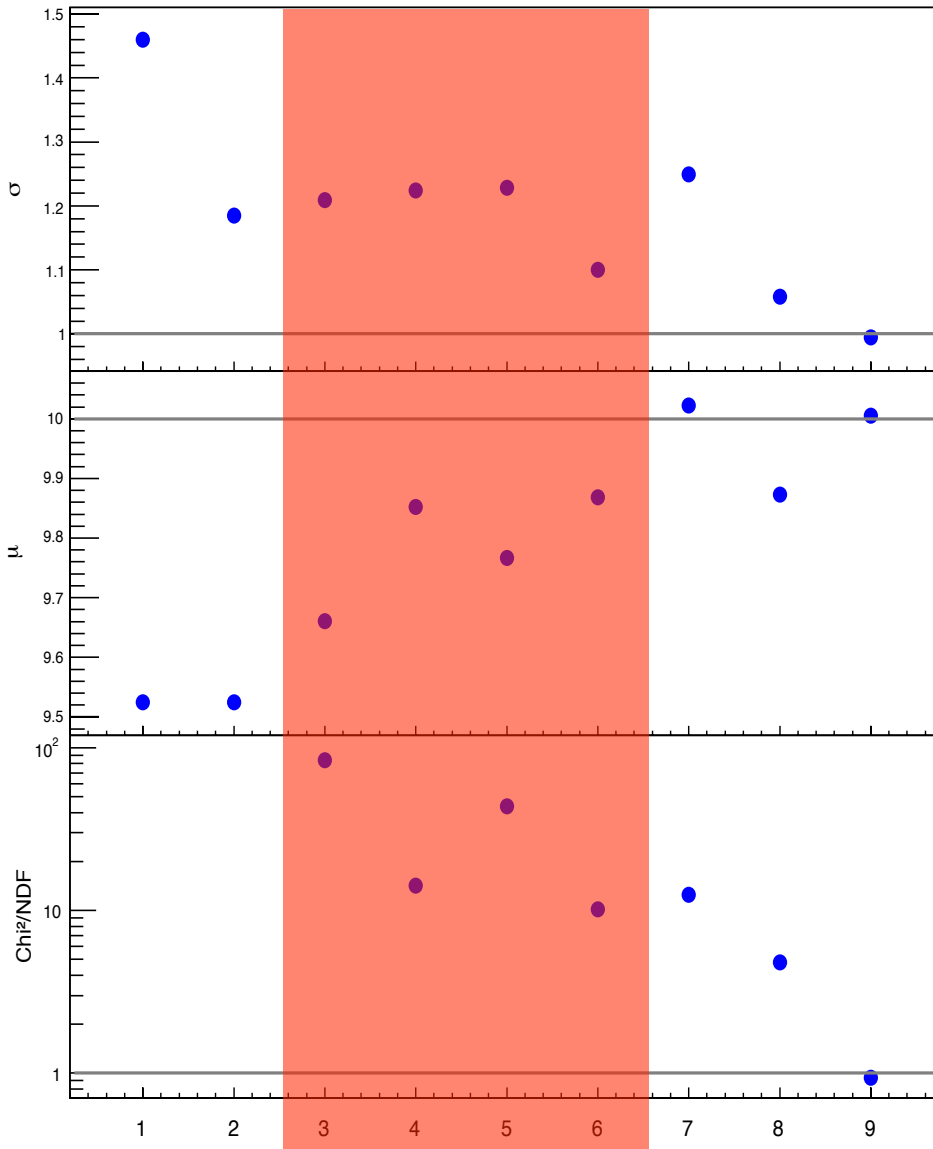


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- RMS 1.5 times larger width
- RMS90 improves



# Results fitting a Gaussian with tail

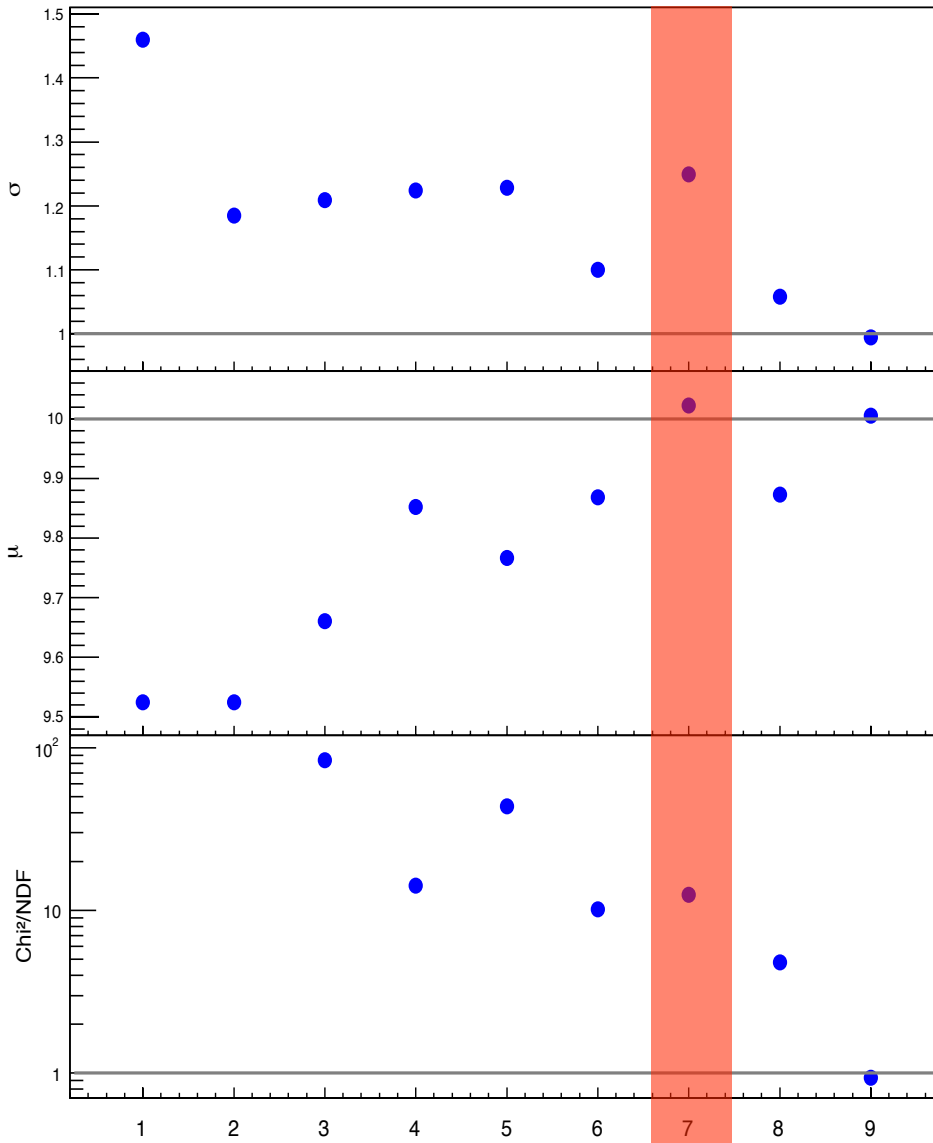


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- RMS 1.5 times larger width
- RMS90 improves
- Gaussians  $-1/+2\sigma$  gives parameters closest to Zeus function



# Results fitting a Gaussian with tail

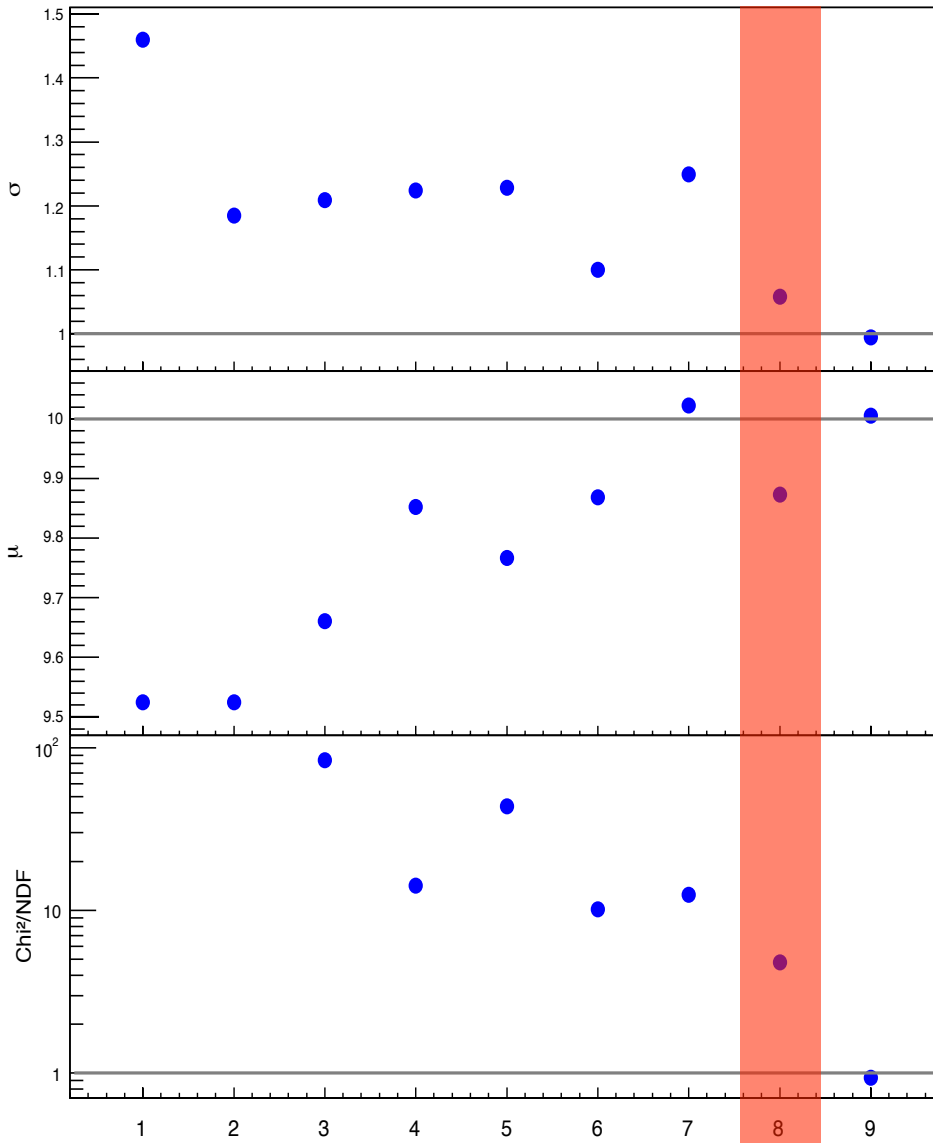


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- RMS 1.5 times larger width
- RMS90 improves
- Gaussians  $-1/+2\sigma$  gives parameters closest to Zeus function
- Novosibirsk good for  $\mu$



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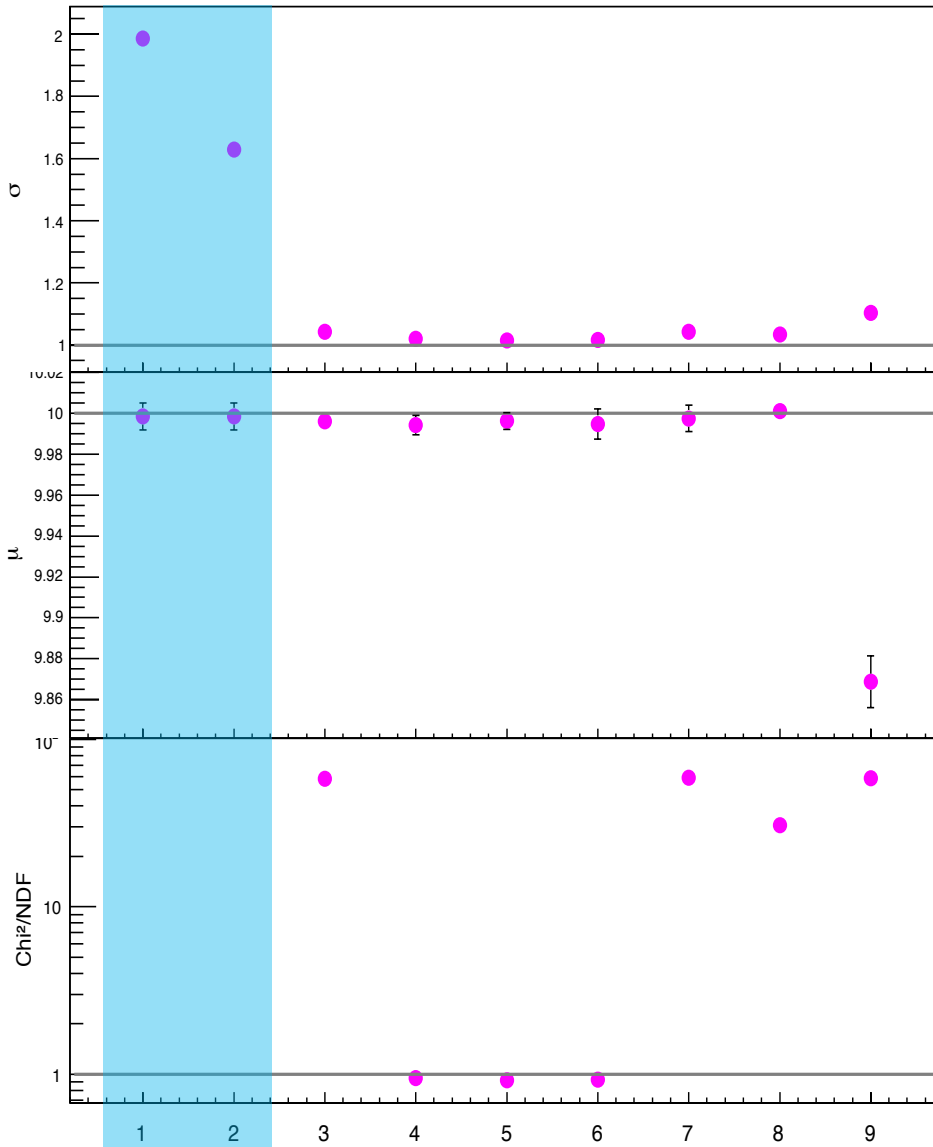


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- RMS 1.5 times larger width
- RMS90 improves
- Gaussians  $-1/+2\sigma$  gives parameters closest to Zeus function
- Novosibirsk good for  $\mu$
- CB  $\sigma$  close to Zeus & good  $\text{Chi}^2$



# Results fitting a Gaussian with background

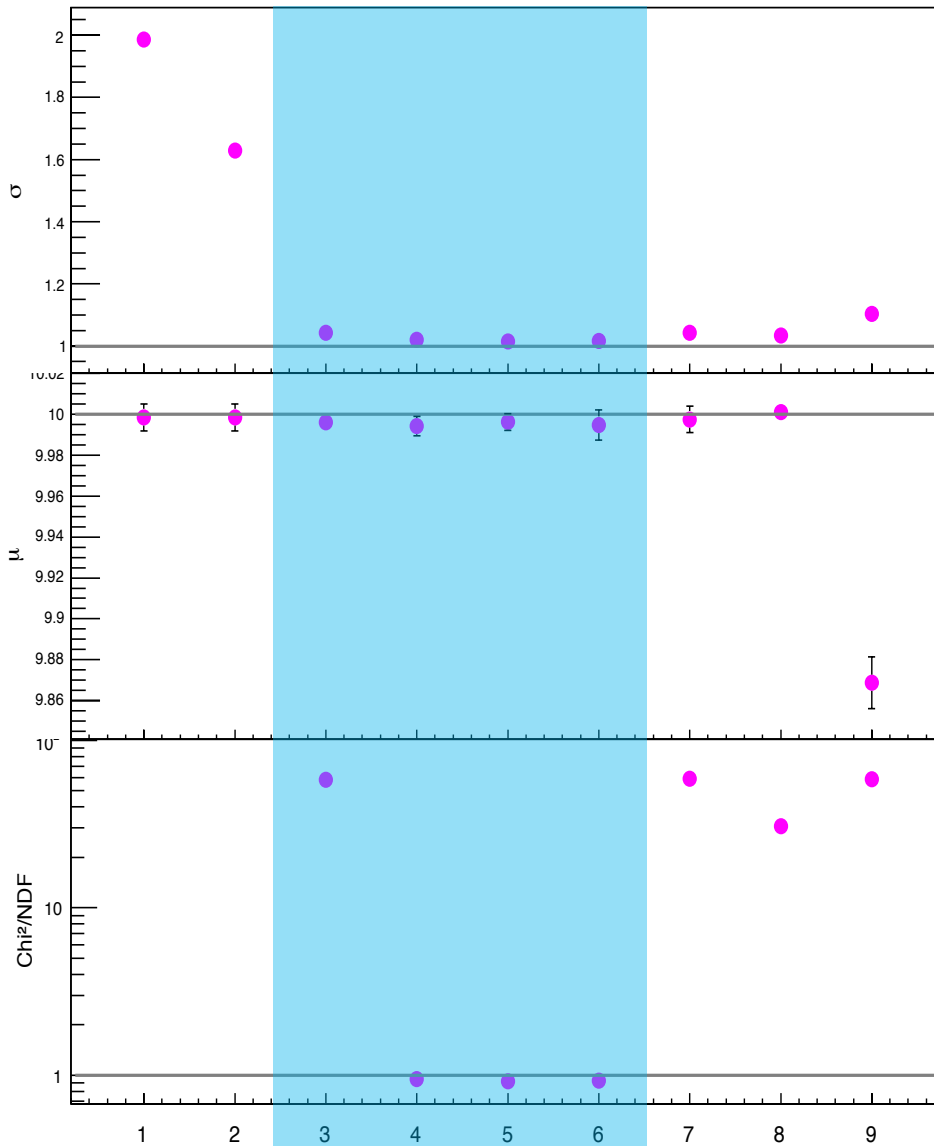


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➤ RMS/RMS90 way off



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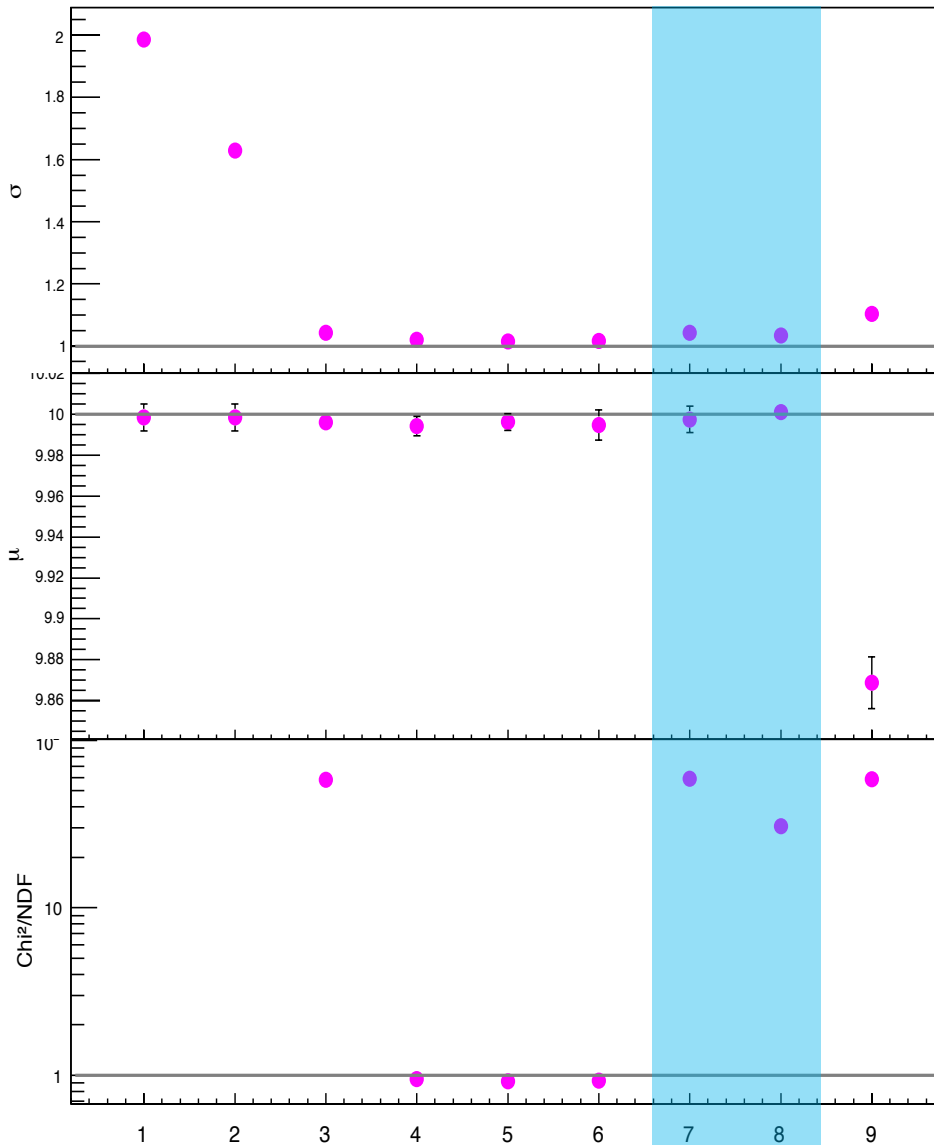


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- > RMS/RMS90 way off
- > All Gaussians work, but limited ranges work best



# Results fitting a Gaussian with background



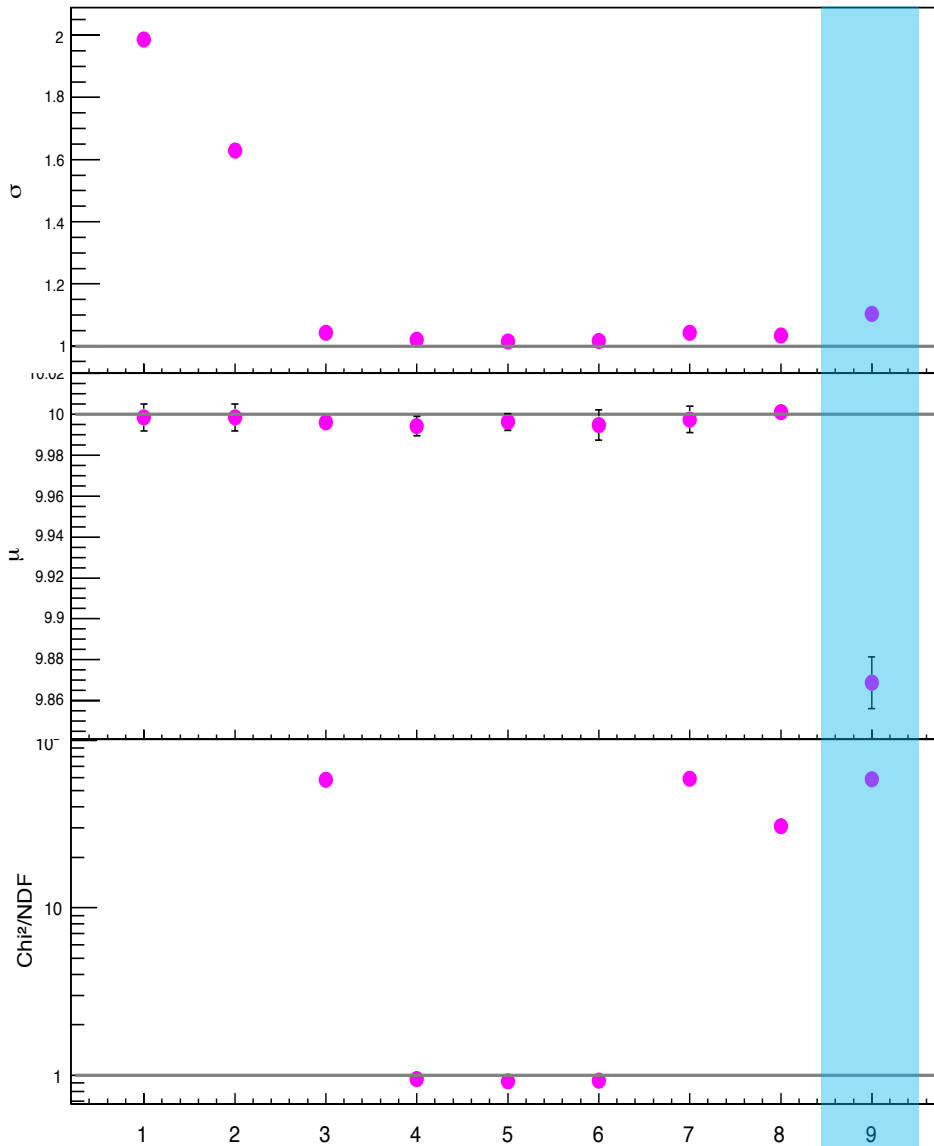
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- RMS/RMS90 way off
- All Gaussians work, but limited ranges work best
- Novosibirsk&CrystalBall show similar results, bad  $\text{Chi}^2$





# Results fitting a Gaussian with background

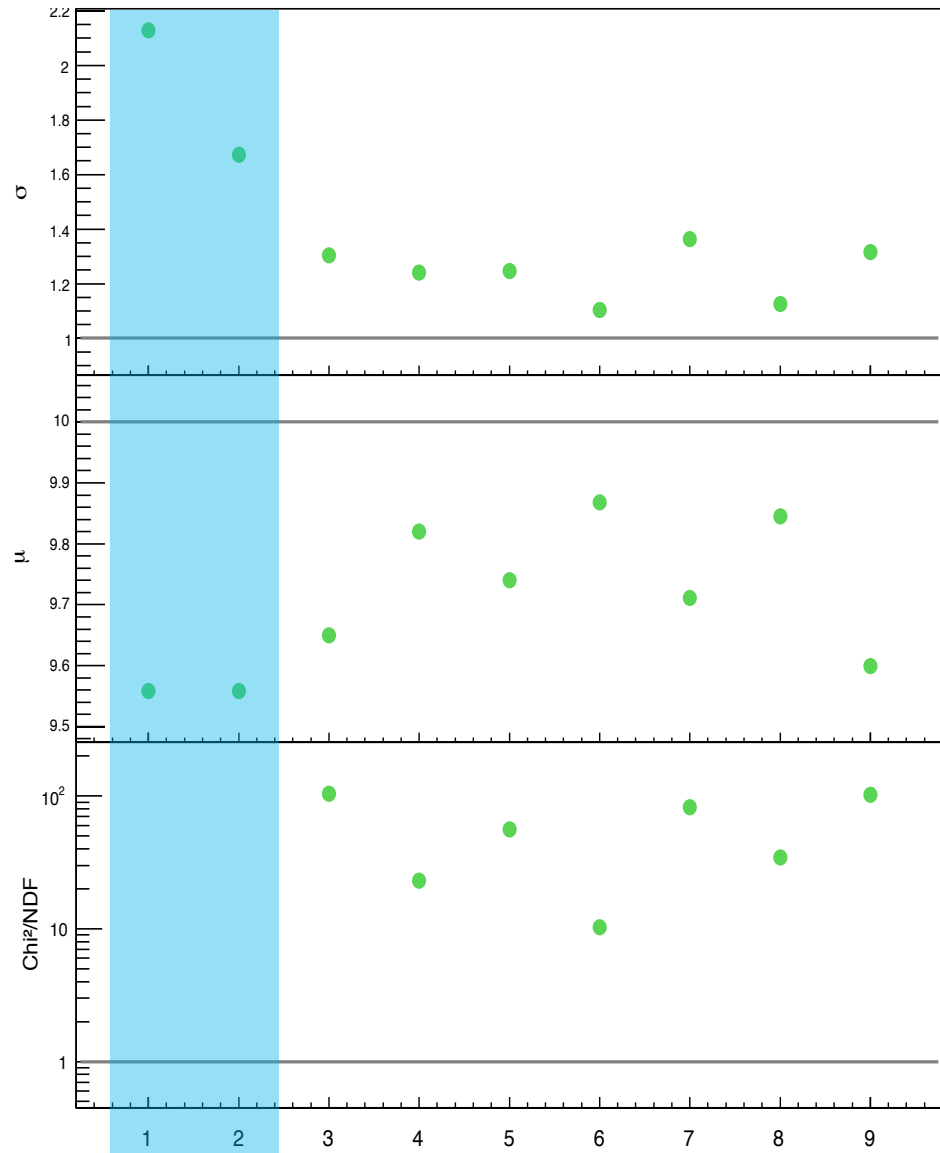


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- RMS/RMS90 way off
- All Gaussians work, but limited ranges work best
- Novosibirsk&CrystalBall show similar results
- Zeus  $\mu$  value off



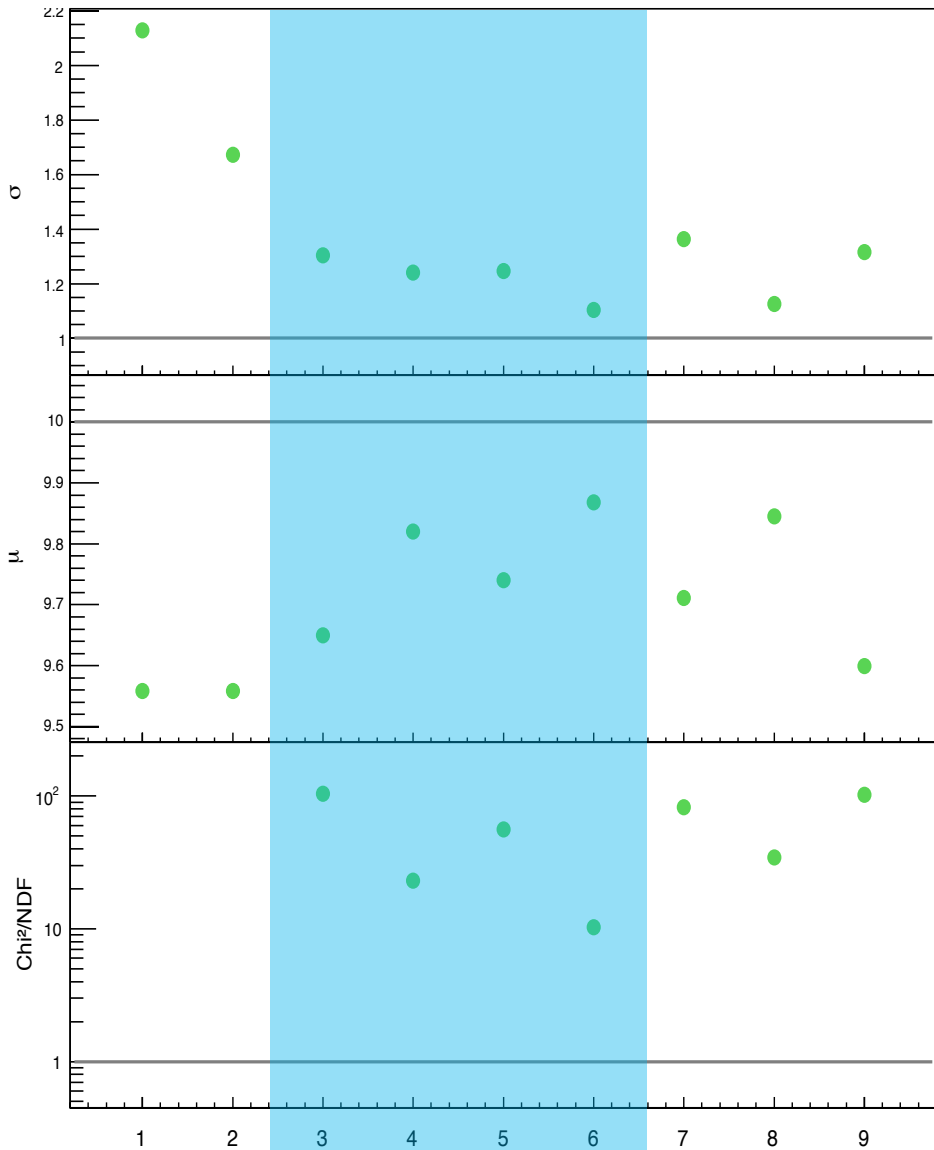
# Results fitting a Gaussian with background and tail



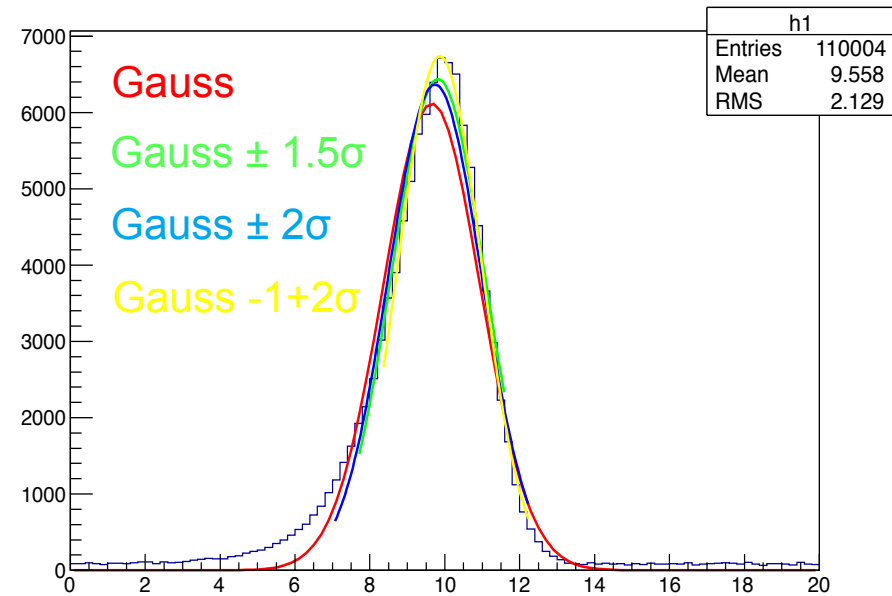
> RMS 2times /RMS90 1.6times width



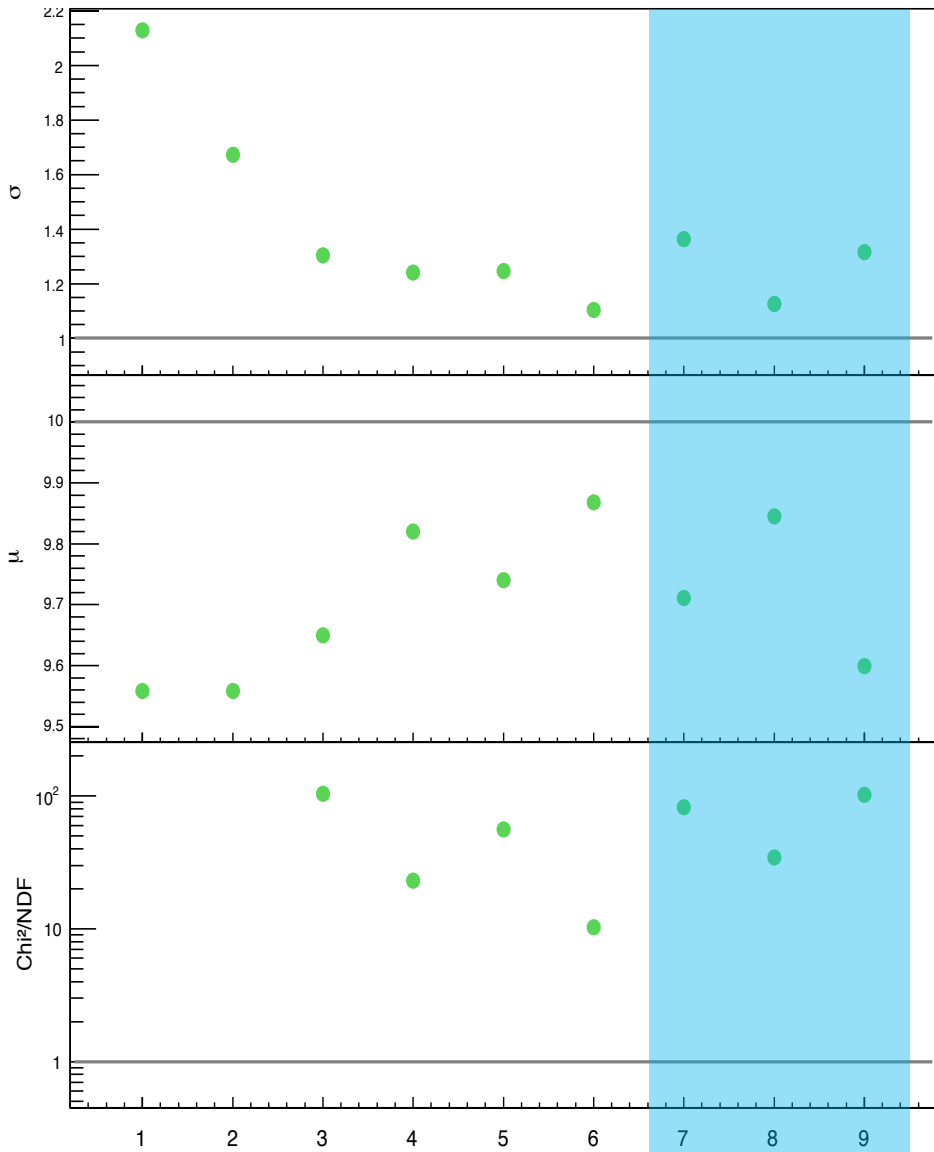
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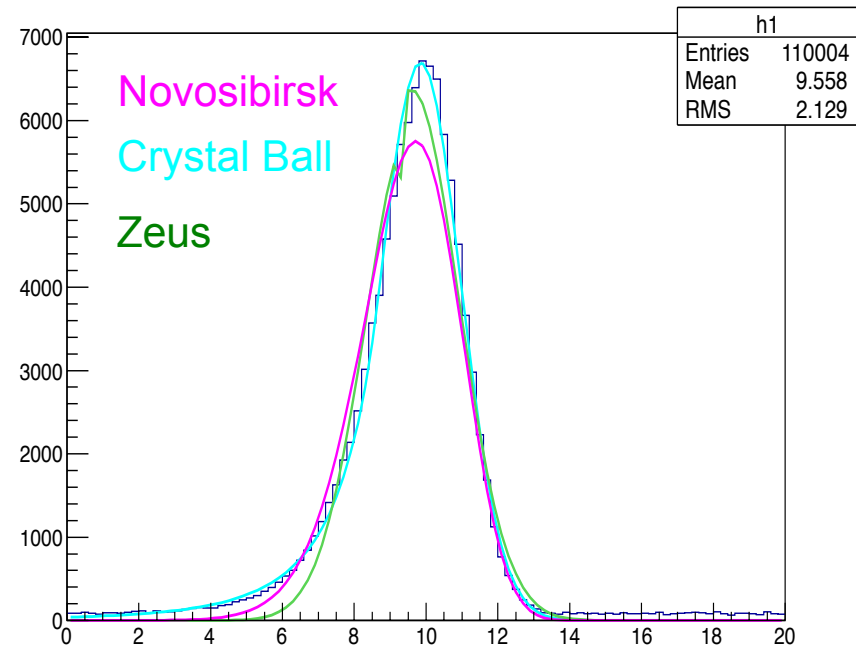
- RMS 2times /RMS90 1.6times width
- Gaussian with  $-1/+2\sigma$  fits Zeus parameters best



# Results fitting a Gaussian with background and tail



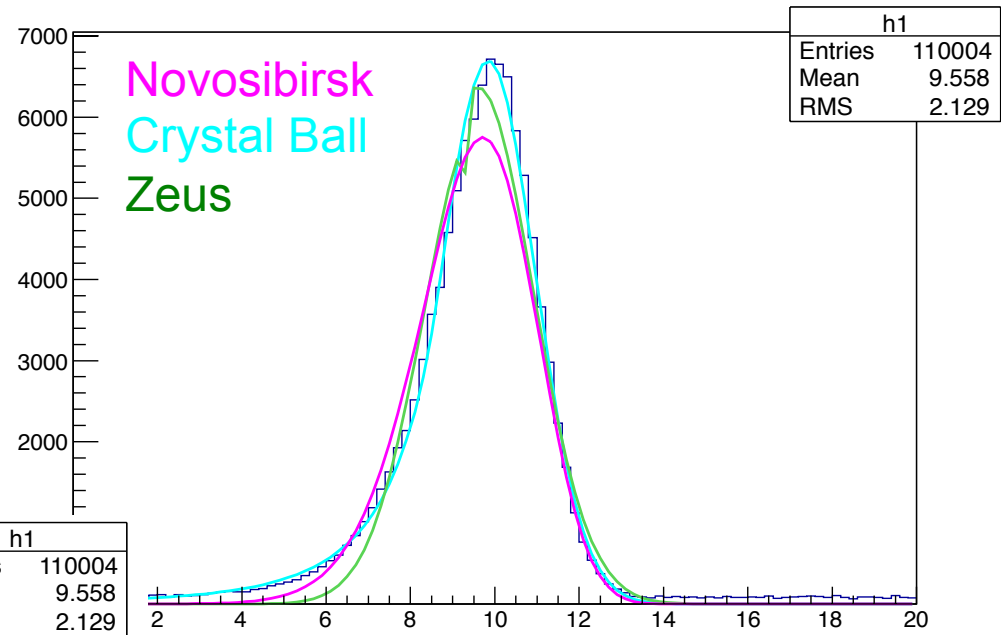
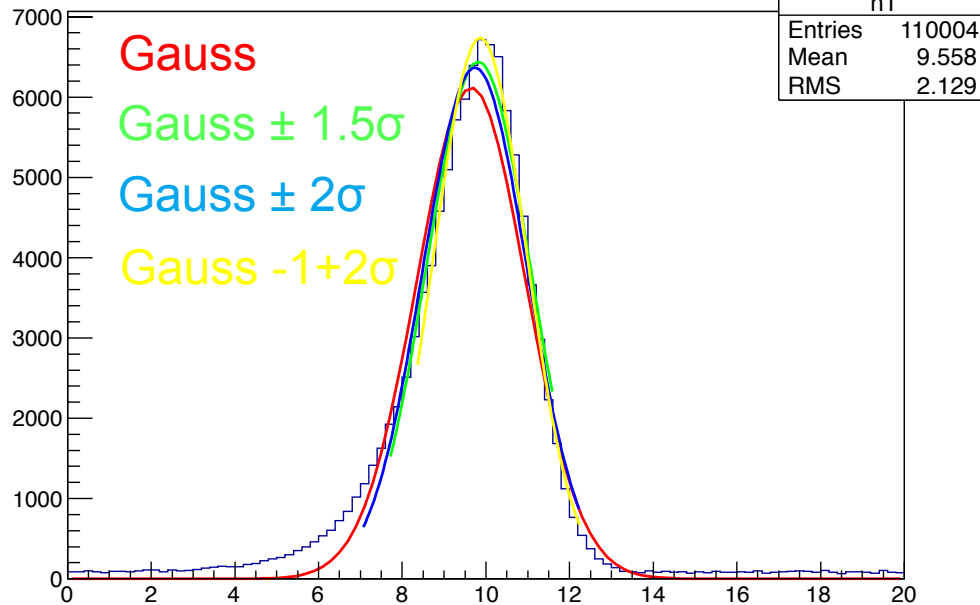
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- Gaussian with  $-1/+2\sigma$  fits Zeus parameters best
- ChrystalBall shows best  $\chi^2$



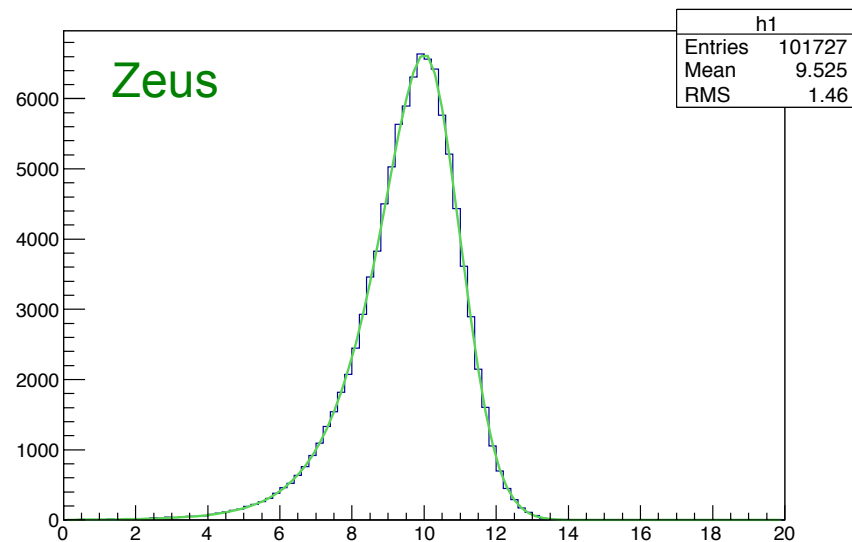
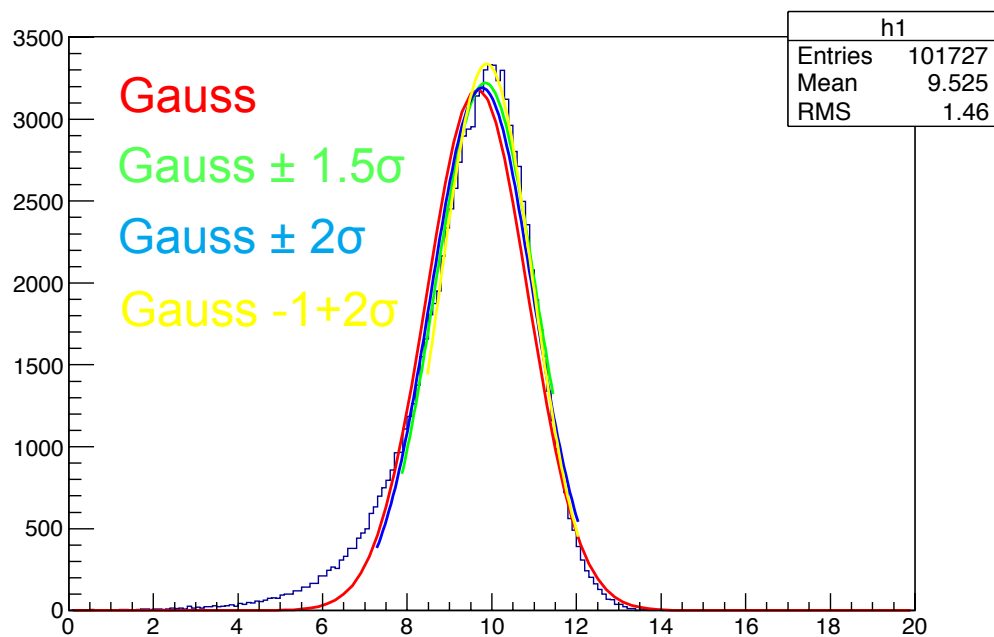
> What do we do?



# Fitted Distributions: Gauss with background and tail



# Fitted Distributions: Gauss with tail



# Fitted Distributions: Gauss with background

