



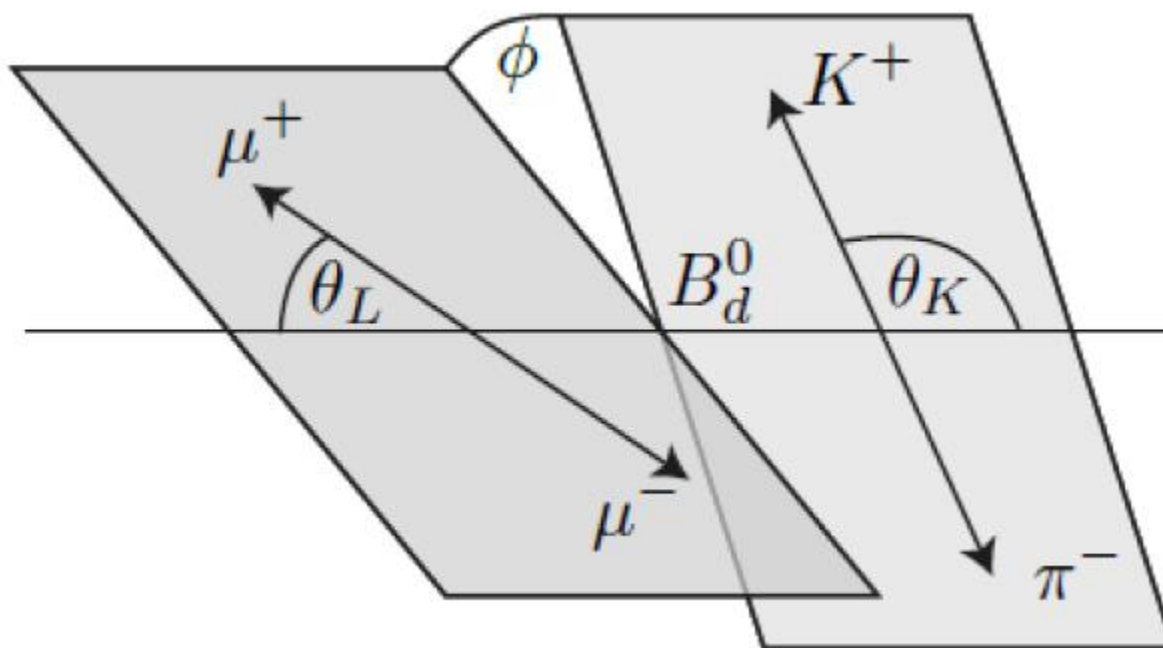
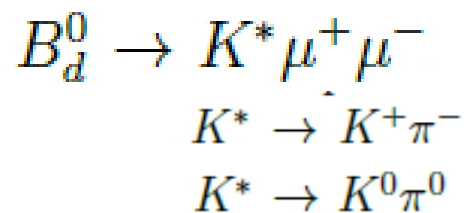
Study of rare B-meson decays at ATLAS

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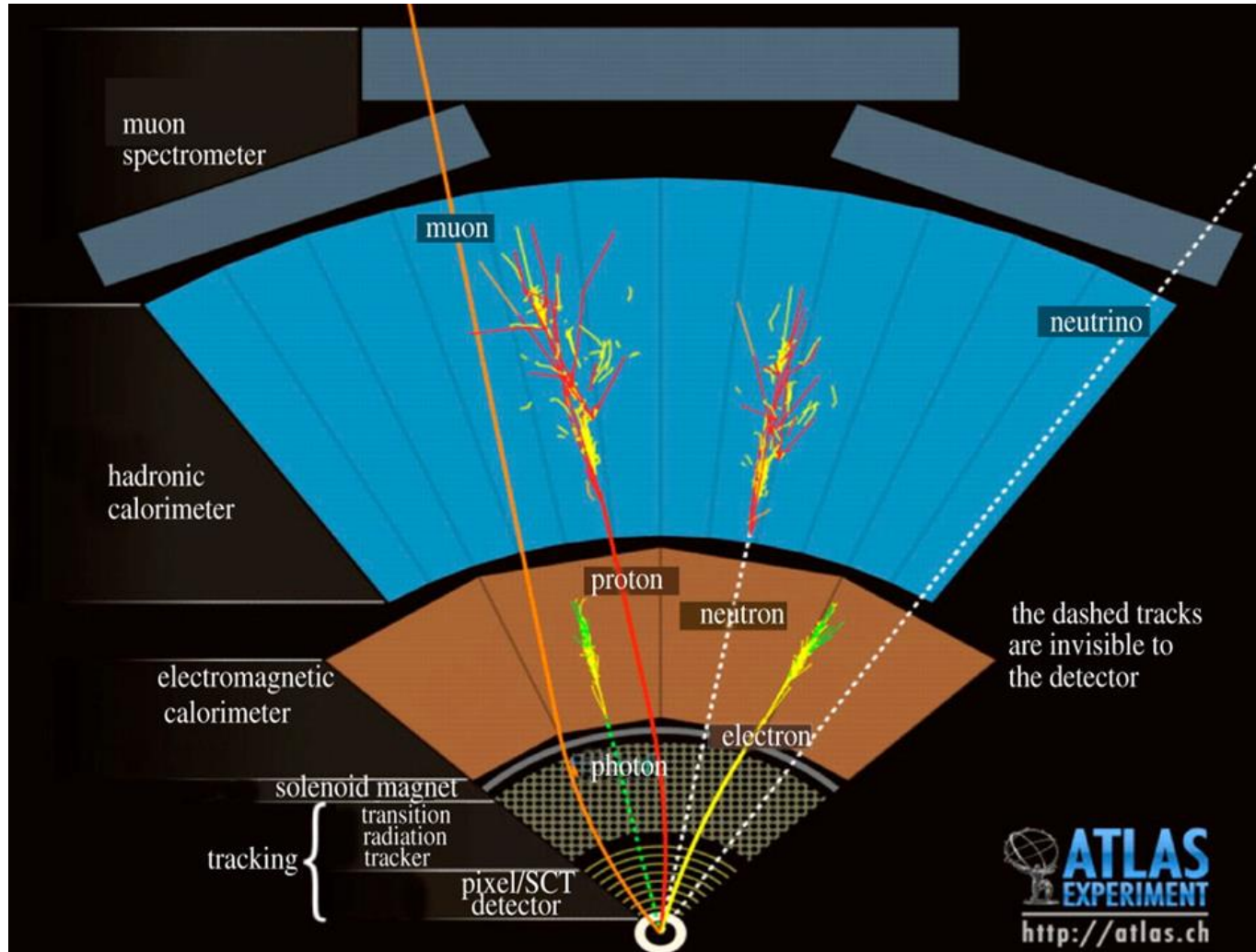
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- 2) Detector ATLAS
- 3) Decay's channels
- 4) Distribution of invariant mass K^*
- 5) Distribution of invariant mass B
- 6) Distribution of decay's angles

Motivation



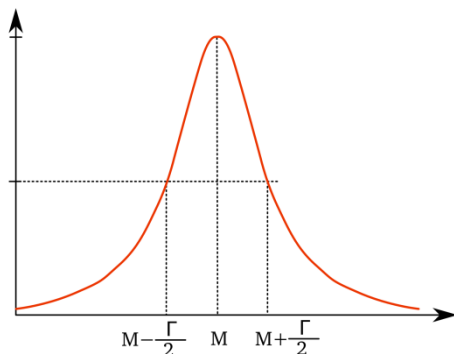
Detector ATLAS



Decay channels

- Signal decay

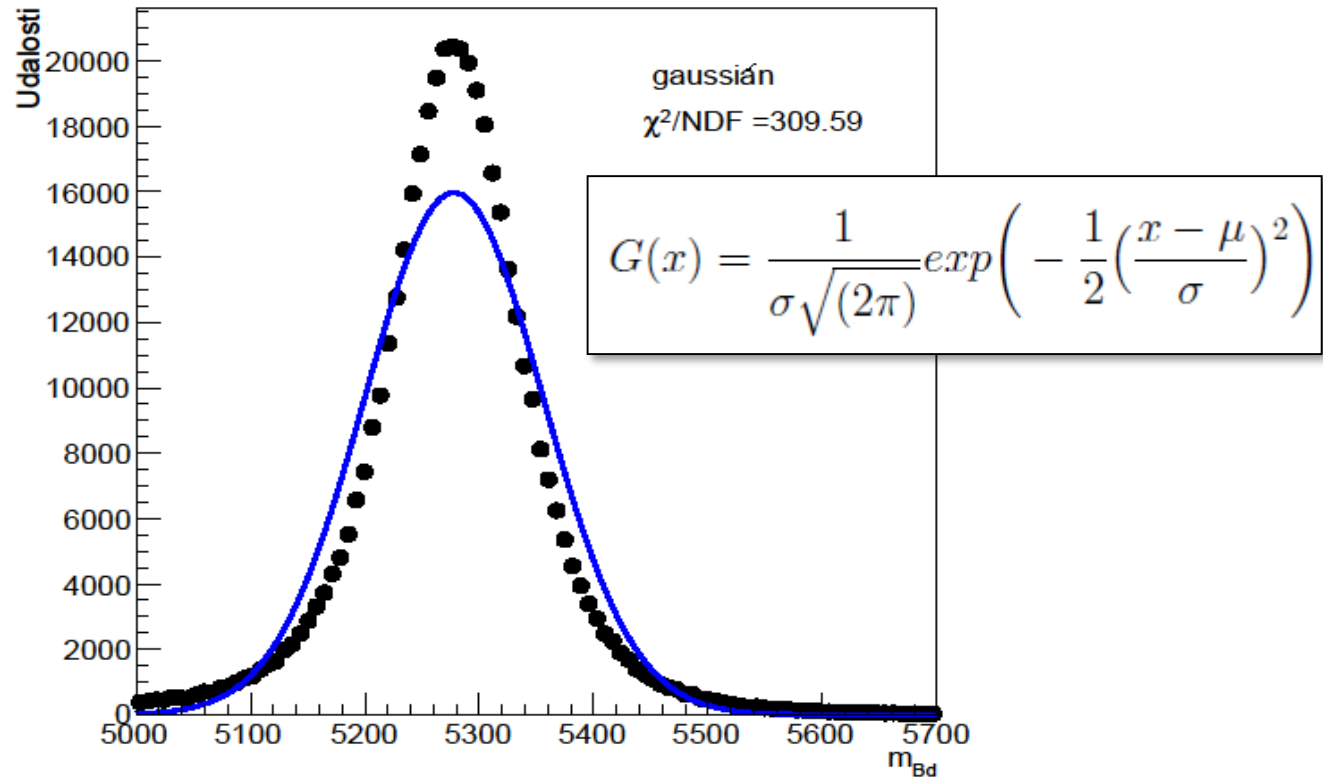
- $B_d^0 \rightarrow K^* \mu^+ \mu^-$
 - $K^* \rightarrow K^+ \pi^-$
 - $K^* \rightarrow K^0 \pi^0$
- $\bar{B}_d^0 \rightarrow \bar{K}^* \mu^- \mu^+$
 - $\bar{K}^* \rightarrow K^- \pi^+$
 - $\bar{K}^* \rightarrow K^0 \pi^0$



- Background

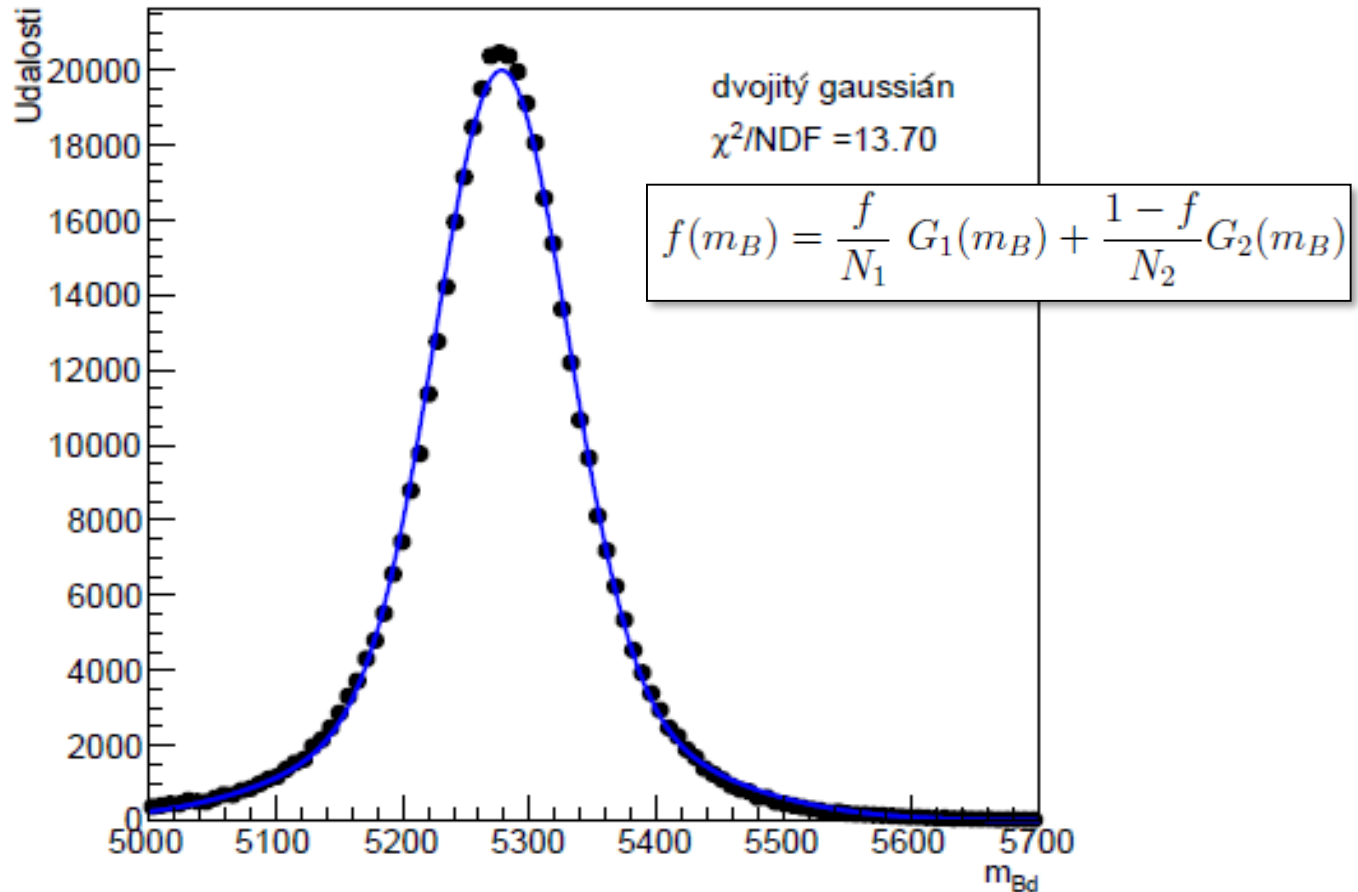
- similar decays
 - $\Lambda_b \rightarrow \Lambda(1520)(pK^-)\mu^+\mu^-$
 - $\Lambda_b \rightarrow pK^-\mu^+\mu^-$
 - $B_s \rightarrow \phi(K^+K^-)\mu^+\mu^-$
- misinterpretation of $K \pi$
 - m_{K^*} out and $m_{\bar{K}^*}$ okey
 - $m_{\bar{K}^*}$ closer than m_{K^*}
- combinatoric background

Distribution of invariant mass B



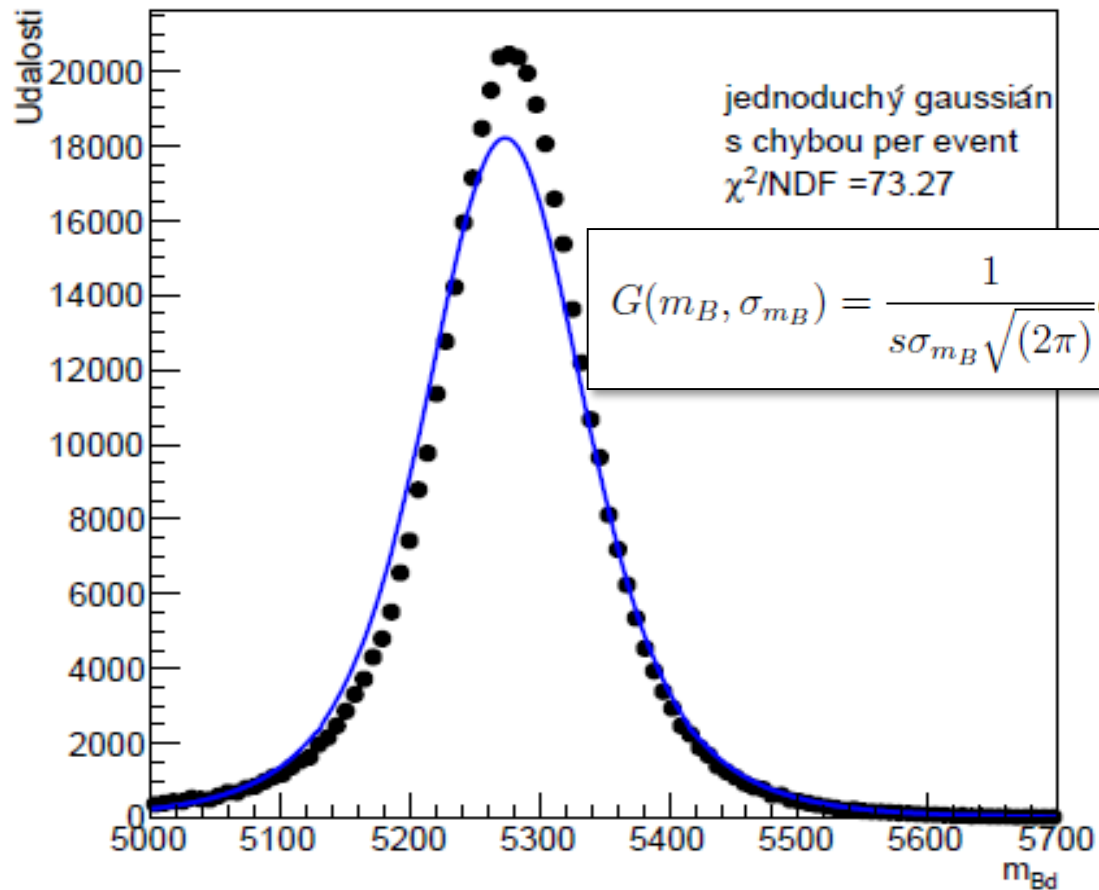
Gaussian

Distribution of invariant mass B



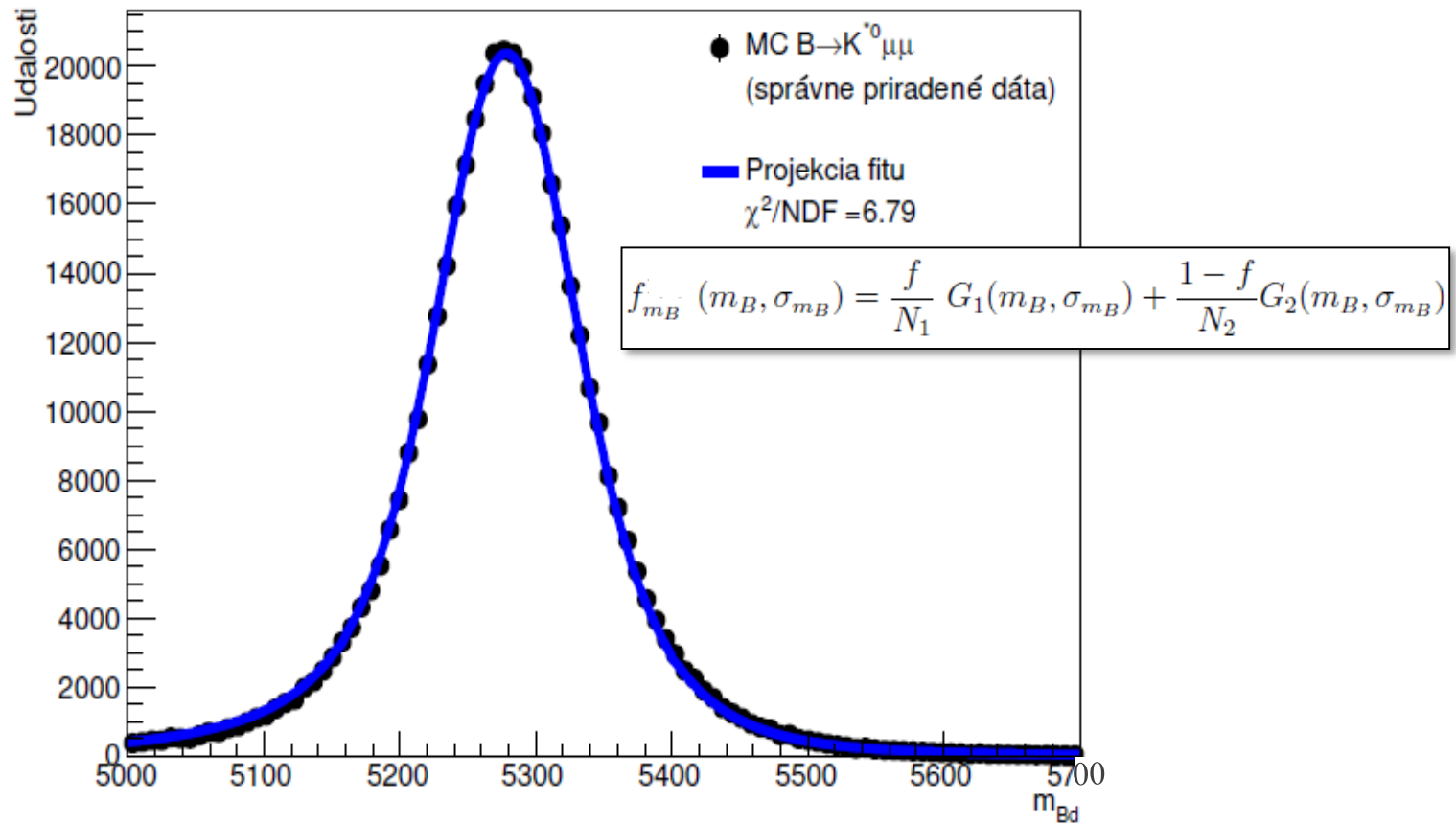
Double gaussian

Distribution of invariant mass B



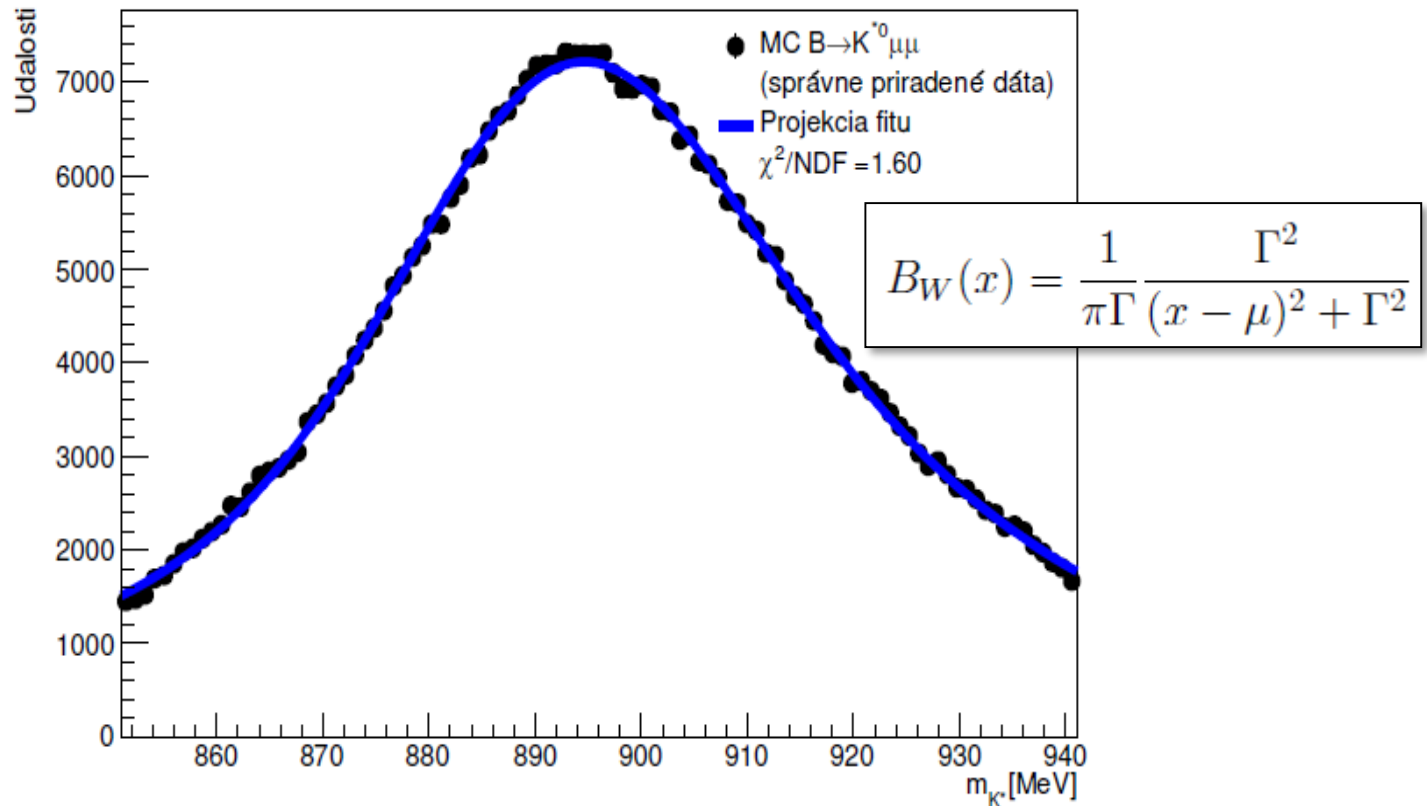
Per-event gaussian

Distribution of invariant mass B



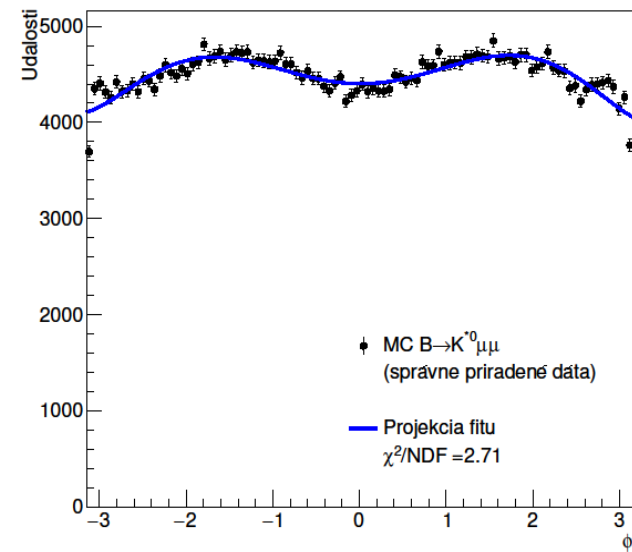
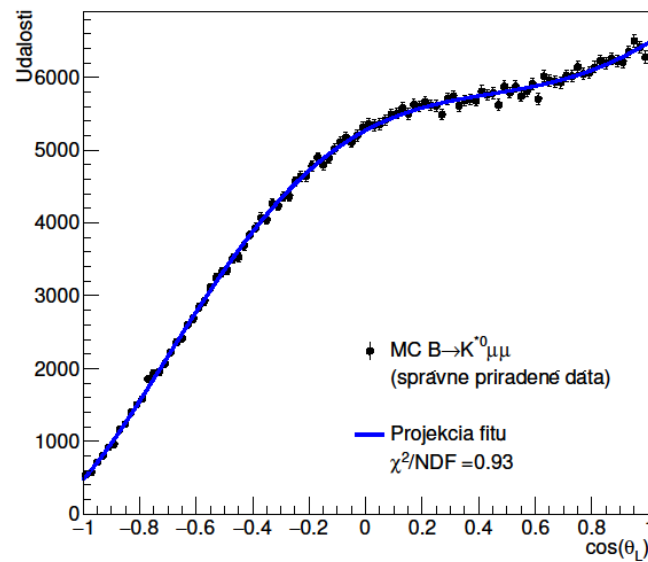
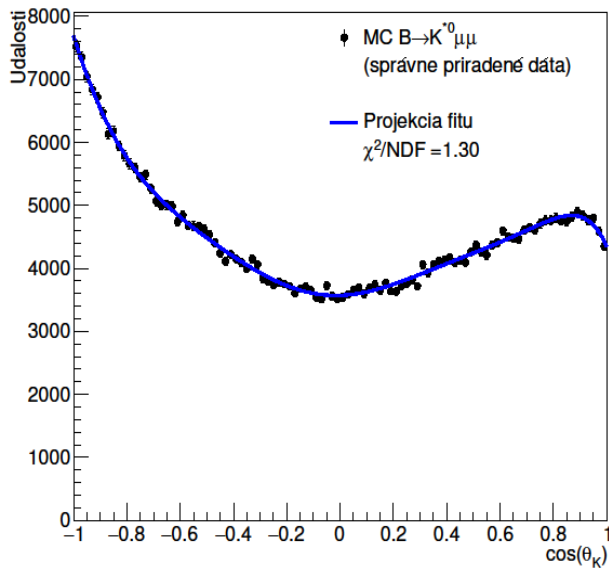
Double per-event gaussian

Distribution of invariant mass K^*



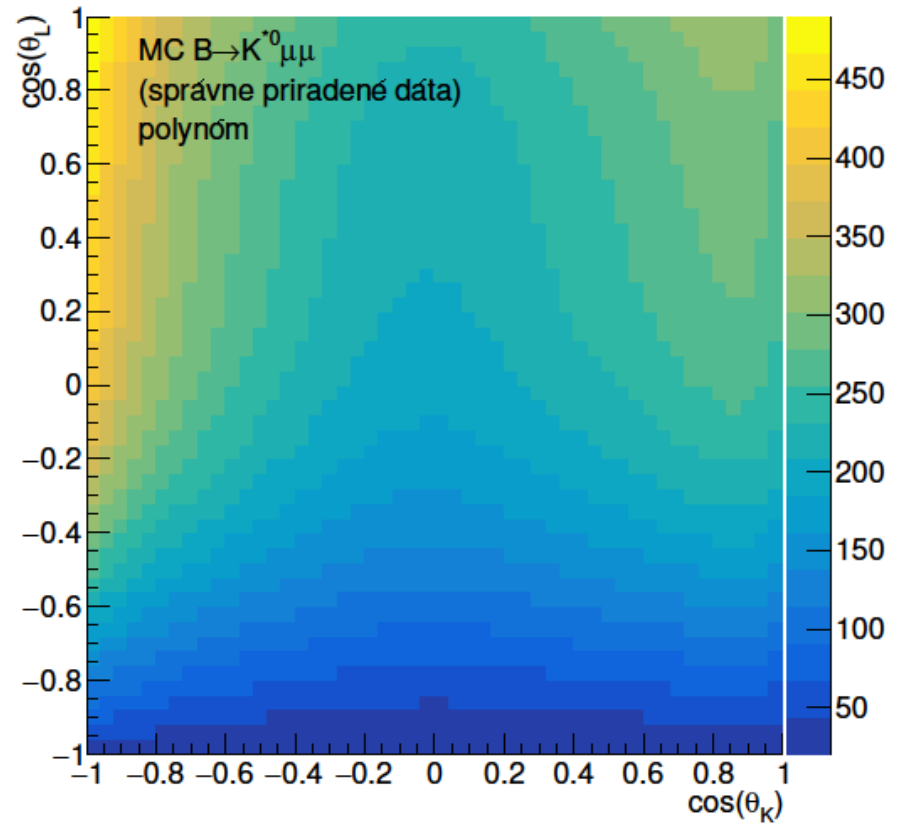
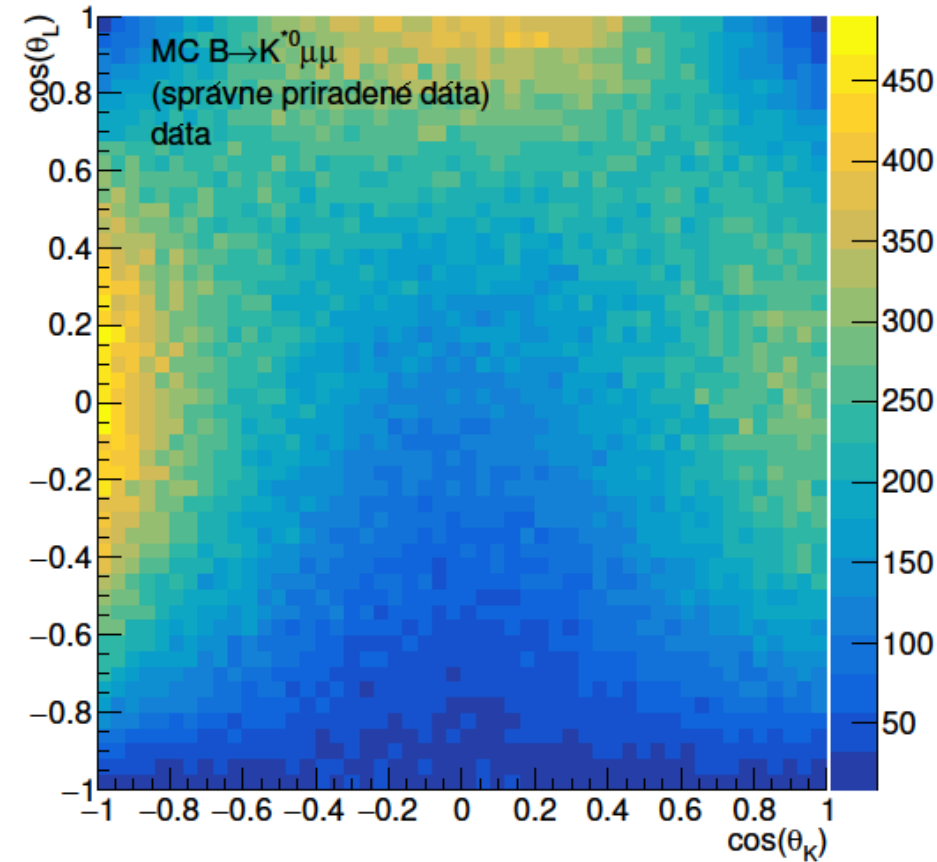
Breit-Wiegner * gaussian

Decay's angles distribution



1D polynomial fits

Decay's angles distribution



2D projections of final 3D polynom

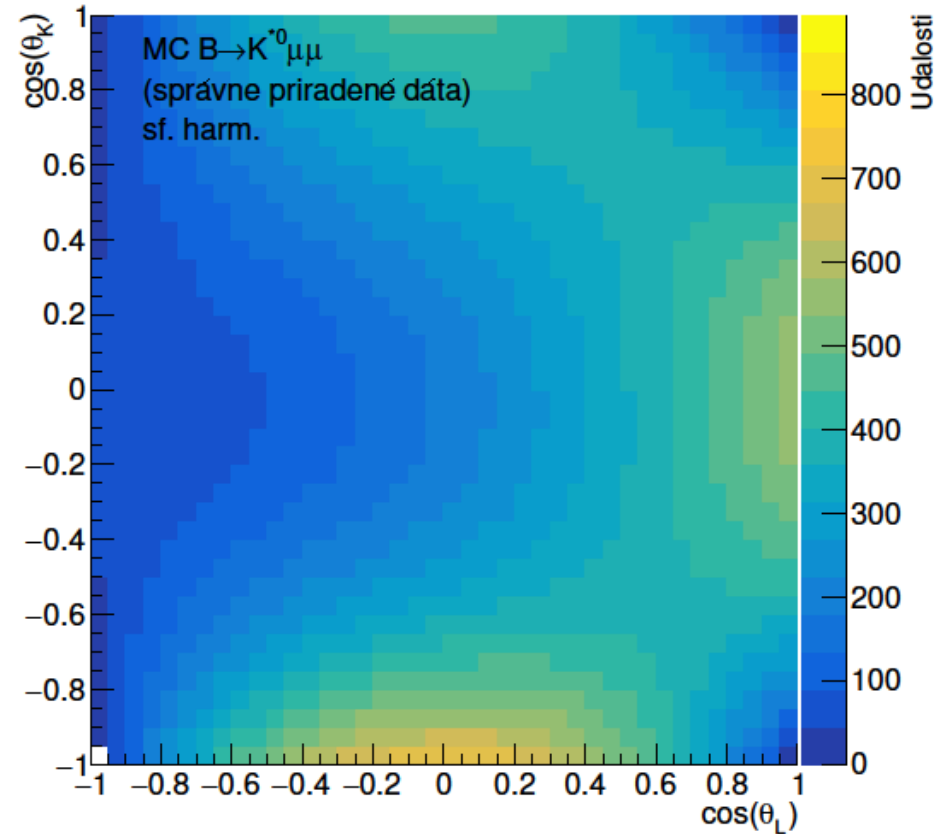
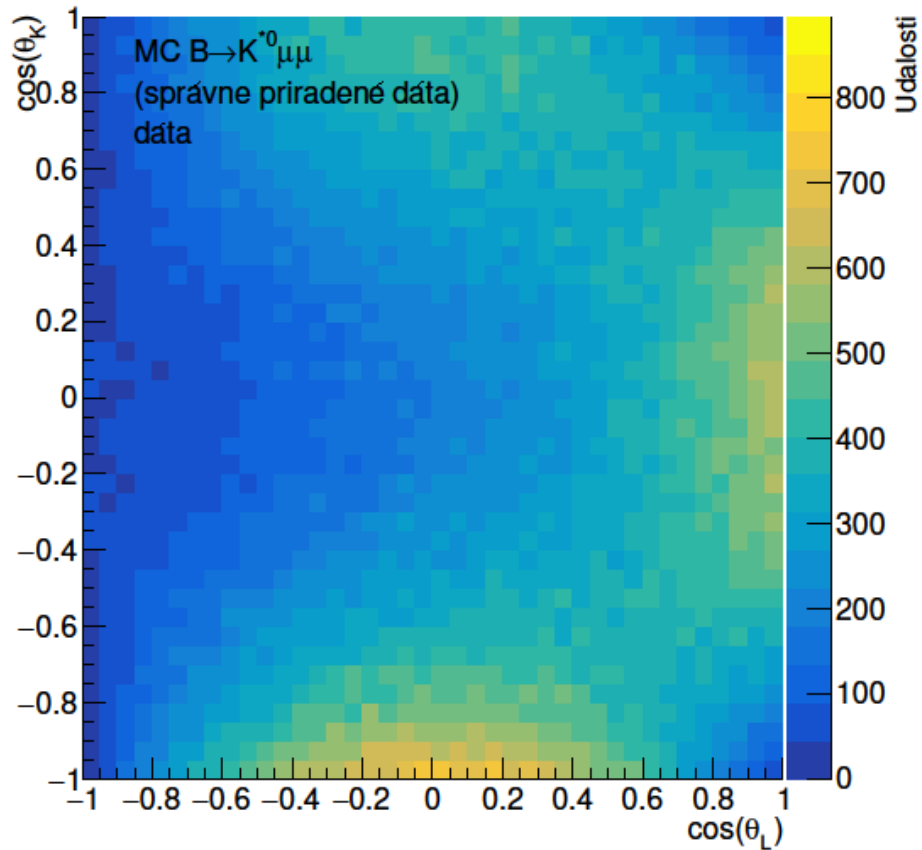
Decay's angles distribution

$$f_{\theta_K, \theta_L, \phi}(\cos \theta_K, \cos \theta_L, \phi) = \sum_{k=0}^{\infty} \sum_{l=0}^{\infty} \sum_{m=-l}^l f_{klm} Y_{lm}(\cos \theta_L, \phi) P_k(\cos \theta_K)$$

$$f_{\theta_K, \theta_L, \phi}(\cos \theta_K, \cos \theta_L, \phi) = \frac{1}{N} \sum_{k=0}^{k_{max}} \sum_{l=0}^{l_{max}} \sum_{m=-l}^l \sqrt{k + \frac{1}{2}} a_{klm} Y_{lm}(\cos \theta_L, \phi) P_k(\cos \theta_K)$$

Spherical harmonics expansion

Decay's angles distribution



2D projections of final function

Decay's angles distribution

Indices of non-zero parameters for each data sample																	
1			2			4			5			6			7		
k	l	m	k	l	m	k	l	m	k	l	m	k	l	m	k	l	m
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	1	0	0	1	0	0	2	0	0	2	0	0	2	0	0	2	0
0	2	0	0	1	1	0	2	2	0	2	1	1	0	0	0	2	1
0	2	2	0	2	0	1	0	0	0	2	2	2	0	0	0	4	0
1	0	0	0	2	1	1	2	0	1	0	0	3	0	0	1	2	0
1	1	1	0	2	2	1	2	2	1	2	0				1	2	1
1	2	0	0	3	0	1	4	0	1	2	1				1	2	2
1	2	1	0	3	2	1	4	1	1	2	2				2	0	0
2	0	0	0	4	1	2	0	0	2	0	0				2	2	0
2	1	0	1	0	0	2	2	0	2	2	1				2	2	2
2	2	0	1	1	0	2	2	1	2	2	2				3	0	0
2	2	2	1	2	0	2	2	2	3	0	0				3	2	0
3	0	0	1	2	1	2	4	1	3	2	1				4	0	0
3	1	1	2	0	0	3	0	0	4	0	0				5	0	0
3	2	0	2	1	0	3	2	0	4	2	2				6	0	0
3	2	1	2	1	1	4	0	0	5	2	2						
			2	2	0	4	2	0	6	2	2						
			2	2	1	5	0	0	7	0	0						
			3	1	0	5	2	0	7	2	2						
			3	2	0	6	0	0	8	0	0						
			4	0	0				8	2	2						
			4	1	1				9	0	0						
			4	2	1				9	2	1						
									9	2	2						
									10	2	1						

data	
1	sgnl
2	fake sgnl
3	fake sgnl
4	$B_s \rightarrow \phi \mu^+ \mu^-$
5	$\Lambda_b \rightarrow \Lambda \mu^+ \mu^-$
6	$\Lambda_b \rightarrow p K^- \mu^+ \mu^-$
7	comb. bckg

$$f_{\theta_K, \theta_L, \phi}(\cos \theta_K, \cos \theta_L, \phi) = \frac{1}{N} \sum_{k=0}^{k_{max}} \sum_{l=0}^{l_{max}} \sum_{m=-l}^l \sqrt{k + \frac{1}{2}} a_{klm} Y_{lm}(\cos \theta_L, \phi) P_k(\cos \theta_K)$$

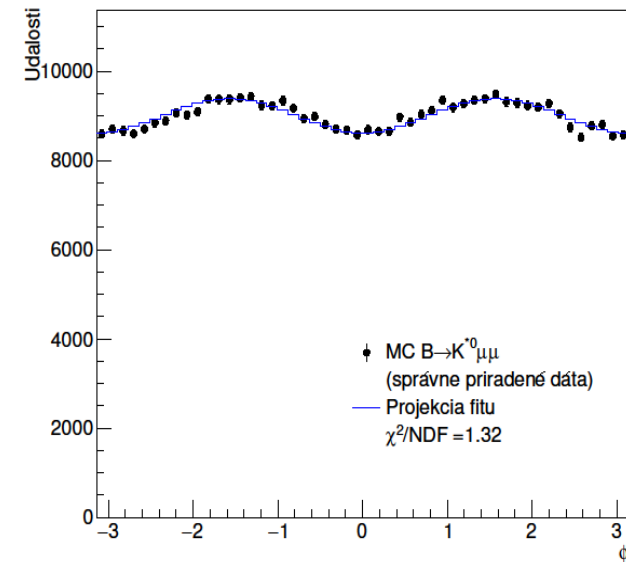
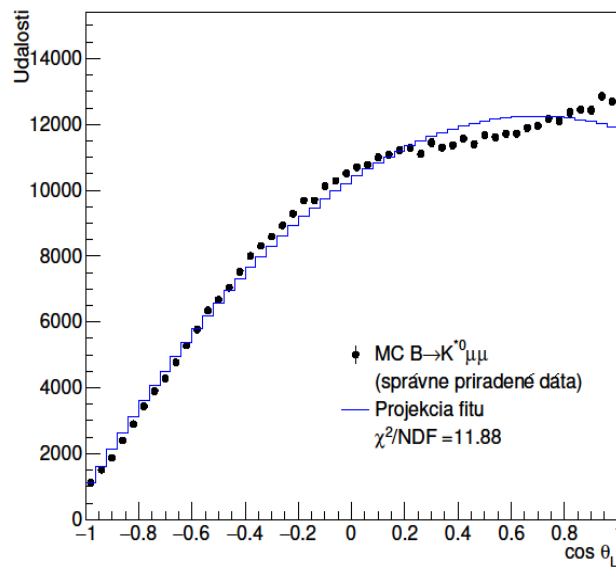
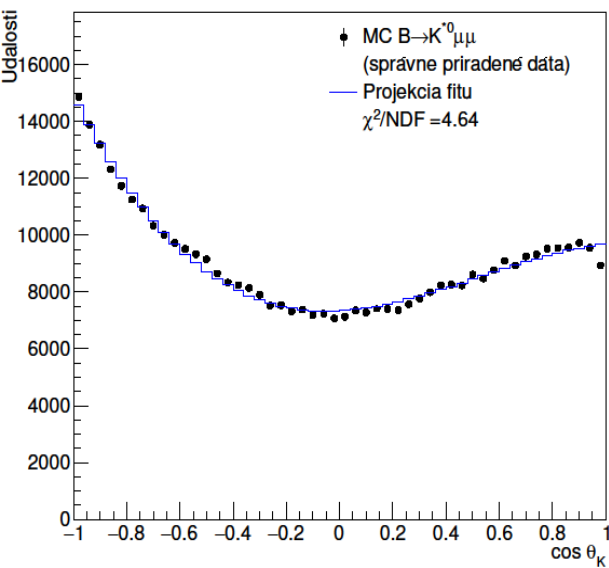
Conclusion

- Description of signal and background distributions
 - invariant mass of K^*
 - invariant mass of B meson
 - decay's angles
- Ready to use in RUN 2 analysis

Thank you for attention

Any questions???

Appendix - Decay's angles distribution



1D projections of fit function

Appendix - Decay's angles distribution

$$a_{klm} = \sqrt{k + \frac{1}{2}} \int_{\Omega} f_{\theta_K, \theta_L, \phi}(\cos \theta_K, \cos \theta_L, \phi) Y_{lm}^*(\cos \theta_L, \phi) P_k^*(\cos \theta_K) d\Omega.$$

$$a_{klm} = \frac{\sqrt{k + \frac{1}{2}}}{M} \sum_{i=0}^n Y_{lm}(\cos \theta_{Li}, \phi_i) P_k(\cos \theta_{Ki})$$

Spherical harmonics expansion

Standard Model

