

LABORATÓRIO DE INSTRUMENTAÇÃO E FÍSICA EXPERIMENTAL DE PARTÍCULAS partículas e tecnologia



Selection of B mesons at low transverse momentum

Rodrigo Ferreira

Supervisors

Nuno Leonardo Henrique Legoinha Simão Costa

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Project goal

Study the decay of B mesons with low transverse momentum (pT)

Quark Coalescence

Thought to play a more noticeable role in quark hadronization, when the b quark (and thus the resulting B hadron) travel with smaller momentum and may more easily bind with other quarks in the surroundings



Low pT region is characterized by a larger level of other physics processes mimicking the meson decay (background events)

Learn and apply machine learning techniques to optimally classify signal (B meson decays) from the more abundant background

Solution

Explore observable properties of the decay to optimize its selection (signal vs background separation) employing CMS data and simulation to train machine learning algorithms



B+->J/ψ K+

Feynman diagrams for B + \rightarrow J/ ψ K+ decays



Source: CMS Collaboration



Observable properties



Bmass – B+ mass



Balpha – Angle between B+ meson displacement(SV –PV distance) and its 3d momentum



Bchi2cl – Chi square probability of the secondary decay vertex



dls - Decay length normalized by its uncertainity



Btrk1Pt – Track's tranverse momentum





Btrk1Eta – track's pseudorapidty



Correlation between variables

		Correlation Matrix - Background													1 00
0.18	- 1.00	Btrk1Pt -	1.00	-0.08	-0.01	-0.00	0.05	-0.06	0.03	-0.01	-0.01	0.02		ľ	
0.00	- 0.75	Trk1DCAz -	-0.08	1.00	0.03	-0.13	-0.03	0.01	-0.01	0.01	-0.04	0.00		- 0).75
0.01	- 0.50	rk1DCAxy -	-0.01	0.03	1.00	0.01	-0.00	-0.06	-0.02	-0.00	-0.02	0.02		- 0	0.50
0.01		dls -	-0.00	-0.13	0.01	1.00	0.14	-0.08	0.08	0.02	0.06	-0.10		- ().25
0.02	- 0.25	Balpha -	0.05	-0.03	-0.00	0.14	1.00	-0.19	0.04	-0.02	0.01	-0.08		- (0.00
0.02	- 0.00	dls2D -	-0.06	0.01	-0.06	-0.08	-0.19	1.00	-0.02	0.06	0.00	0.05			
0.09	0.25	Bchi2cl -	0.03	-0.01	-0.02	0.08	0.04	-0.02	1.00	-0.03	0.00	-0.01			-0.25
).00		Btrk1Eta -	-0.01	0.01	-0.00	0.02	-0.02	0.06	-0.03	1.00	0.03	-0.01			-0.50
0.00	0.50	Bmass -	-0.01	-0.04	-0.02	0.06	0.01	0.00	0.00	0.03	1.00	-0.01			-0.75
0.00	0.75	Bpt -	0.02	0.00	0.02	-0.10	-0.08	0.05	-0.01	-0.01	-0.01	1.00			_1 00
1.00	1 00		<1Pt -	CAz -	- Axy	dls -	- pha	s2D -	- ii2cl	LEta -	ass -	Bpt -		_	-1.00
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Future goals

- Employ the studied variables to train ML algorithms
- Algorithms that may be tried: BDT, NN(pyTorch), or others found to be useful!
- Repeat the procedure to the more challenging low pT region

