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Search for exited B_{SJ} states via B_{SJ} -> $B_s^{(*)}$pi0 Decays

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Introduction

QCD predicts existence of 4 P-wave states of Bs- B's1, B*s0, Bs1 and B*s2. 2 states Bs1 and B*s2 have been observed by CDF and D0[2,3]. Two states still haven't been observed. In this project, I reconstruct different decay modes of B*s0 -> Bspi0 decay to look for peaks near the B*s0 threshold using spectroscopy.

B^*_{s0} meson		
Relativistic quark model	[13]	5804
Relativistic quark model	[14]	5833
Relativistic quark model	[15]	5830
Relativized quark model	[16]	5805
Bardeen, Eichten, Hill	[17]	5718(35)
Q.-F. Lü *et al.*	[18]	5756
LQCD: $q\bar{q} + BK$	[12]	5713(11)(19)
LQCD: $q\bar{q}$	[19]	5752(16)(5)(25)
Covariant (U)ChPT	[20]	5726(28)
NLO UHMChPT	[21]	5696(20)(30)
LO UChPT	[22, 23]	5725(39)
LO χ-SU(3)	[24]	5643
HQET + ChPT	[25]	5706.6(1.2)

TABLE I. Mass, in MeV, of the B^*_{s0} meson predicted by different theoretical approaches.

Methods

To study the decays, we start by colliding two protons in a lab and collect as much data as possible about the daughter particles. Form that data, we reconstruct back the decays we want to study. In this project, we use two decay modes of Bs to reconstruct the decay and then combine the Bs candidates with pi0 particles.

The two decay modes used to reconstruct Bs candidates are Bs -> KKpi0 and Bs-> J/psi phi.

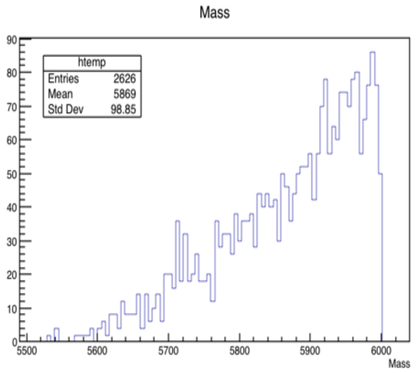
Results

In figure 11, a small peak can be seen around the threshold for B*s0. This data is then fitted to a model that includes a Cheby Chev polynomial background superimposed with a Gaussian peak. Figure 12 shows the raw data along with the model fit.

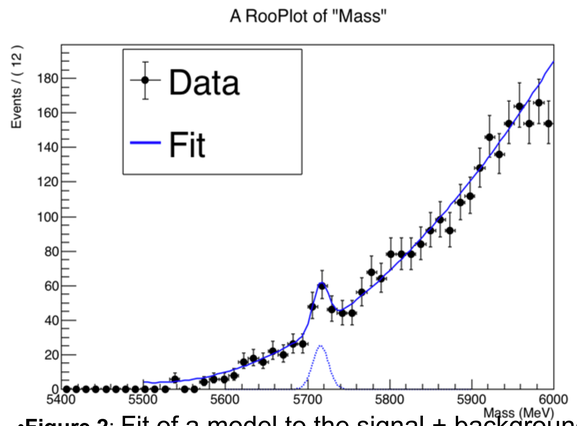
The parameters for the fit of the Gaussian signal are -

Mean – 5.716e+3 +- 3
Sigma – 9.637 +- 2.731
Maximum Likelihood - -957.534

The mean is close to the threshold we expect for the exited Bs state.

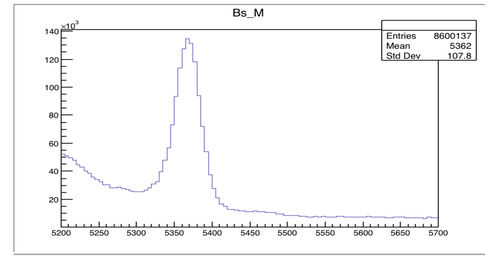


•**Figure 1**: Final mass spectrum for the whole system



•**Figure 2**: Fit of a model to the signal + background

Results



•**Figure 3**: Mass of Bs mesons for Bs2Dspi0 decay after applying the cuts and removing background

Conclusions

As can be seen from the plots and the fit, there is a small peak near the threshold. The next step would be to fit the same signal to just the polynomial model and using the likelihoods from both the fits, find the significance of the signal, and also determine if it's a real signal or a statistical fluctuation.

References

[1] Threshold effects in P-wave bottom-strange mesons August 3, 2018
[2] arXiv:0710.4199, Observation of Orbitally Excited B_s Mesons
[3] arXiv:0711.0319, Observation and properties of the orbitally excited B_{s2}* Meson

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