Introduction

sPHENIX Heavy Flavor Topical Group Meeting, May 17, 2021

Hideki Okawa (Fudan)

Jin Huang (BNL)

General Information

- Further studies on MDC1 samples highly welcome! → More details by Cameron
  - Thanks to all the nice studies done so far: Zhaozhong Shi (MIT), Ming Liu (LANL), Han-sheng Li (Purdue), Sourav Tarafdar (Vanderbilt), Sebastian Tapia Araya (ISU), Dan Lis (Vertexing)
- Full list of topics: https://wiki.bnl.gov/sPHENIX/index.php/Heavy_Flavor_Topical_Group#Study_plans
- Recent HFTG status reports:
  - 112th sPHENIX Fortnightly Meeting (May 14, 2021): https://indico.bnl.gov/event/11851/
  - Hugo Pereira da Costa at APS GHP (Apr. 13-16, 2021): https://indico.jlab.org/event/412
  - 10th sPHENIX Collaboration Meeting (Jan. 21-22, 2021): https://indico.bnl.gov/event/10568
  - BUP (sPH-TRG-2020-001): https://indico.bnl.gov/event/9301/
- Upcoming conference/workshop talks
  - SQM-2021 (May 17-22): https://indico.cern.ch/event/985652/ (Yasser Morales for plenary)
  - AUM2021 (June 8-11): https://indico.bnl.gov/event/11322/ (Ejiro Umaka for plenary, Cameron Dean for HF)
  - ISMD 2021 (July 12-16): https://indico.cern.ch/e/ismd202112 abs due June 15
  - PANIC 2021 (Aug. 30-Sep 3, 2021): https://indico.lip.pt/event/592/16

MatterMost

- **Lots of discussions are ongoing on Mattermost!** Please join the topics you are interested in. We can also create a new group if your topic is not there yet.
  - MDC1: https://chat.sdcc.bnl.gov/sphenix/channels/hf-mdc1
  - Λ_c: https://chat.sdcc.bnl.gov/sphenix/channels/hf-lc
  - HF jet track counting tagger: https://chat.sdcc.bnl.gov/sphenix/channels/hf-jet-tc-tagger
  - HF triggering (legacy): https://chat.sdcc.bnl.gov/sphenix/channels/hf-track-trigger
  - D^0 program in pp: https://chat.sdcc.bnl.gov/sphenix/channels/hf-d0
  - Bs: https://chat.sdcc.bnl.gov/sphenix/channels/hf-bs
  - D-D correlation: https://chat.sdcc.bnl.gov/sphenix/channels/hf-d0d0
  - KFParticle: https://chat.sdcc.bnl.gov/sphenix/channels/kfparticle
  - (related) Tracking QA: https://chat.sdcc.bnl.gov/sphenix/channels/tracking-qa
  - (related) Tracking software: https://chat.sdcc.bnl.gov/sphenix/channels/tracking-software

MDC1 for HF

- First attempt to exercise the full Day-1 analysis chain: simulation (full detector), reconstruction (ACTS, KFParticle) & analysis.
- **First MDC1 HF note (sPH-HF-2021-001)**: https://indico.bnl.gov/event/11336/
  - Documenting KFParticle & preliminary MDC1 plots. → & presented at APS GHP
  - **Another MDC1 note planned for finalized plots & full list of contributions.**

[Samples]

- 50M events generated for ccbar (0.2/pb; 4-day data) & bbbar (30/pb; 6 times the first 3 year plan) signals.
- **50M Minbias events are currently under request** (pending for some version updates in the framework).
  - We may also request high qhat samples later.
- We will use the same setup for jet samples for b-tag studies in post-MDC1.

Plans for Final MDC1 Note

1. Channels to cover: what we already have in the first note (& Λ_c)
2. Plots to present: truth-isolated invariant mass distributions, acceptance efficiency & spectrum with full background.
3. Updates in the software: Fixes in the ACTS vertexing (necessary for D^0 results). Try the truth resonance tagging Cameron has recently introduced.
4. Need to check the statistics for MB → If high mass background is correlated with high qhat, we will request another 50M for high qhat samples.

- b-jets studies are beyond the scope of MDC1 studies, but will be considered for the next production this year.

Today's Agenda

20:00 → 20:05	**Introduction** **Speakers**: Hideki Okawa (Fudan University) , Dr Jin Huang (Brookhaven National Lab)	5m
20:05 → 20:25	**Development on HF tools** **Speaker**: Cameron Dean (LANL)	20m
20:25 → 20:45	**D0 update** **Speaker**: Han-Sheng Li (Purdue University)	20m
20:45 → 21:05	**D_s & D^+ checks with truth parent filtering** **Speaker**: Zhaozhong Shi (MIT)	20m

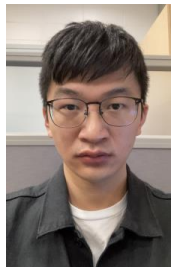
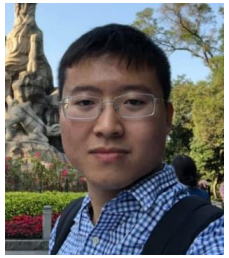
Backup

Current Contributors in MDC1 Studies

- HF production manager & KFParticle: Cameron Dean (LANL)
- [Pre-MDC1] Pythia8 HF tune: Sanghoon Lim, Woohyeong Park (Pusan), Long Ma (Fudan)
- Prompt/non-prompt D^0 & $D^{\pm}$: Sebastian Tapia (Iowa State), Han-Sheng Li (Purdue), Cameron Dean (LANL)
- Prompt, non-promt D_s, D^+: Zhaozhong Shi (MIT)
- $B_s \rightarrow J/\psi\phi$ & Λ_c: Sourav Tarafdar (Vanderbilt)
- Please join us if you are interested!

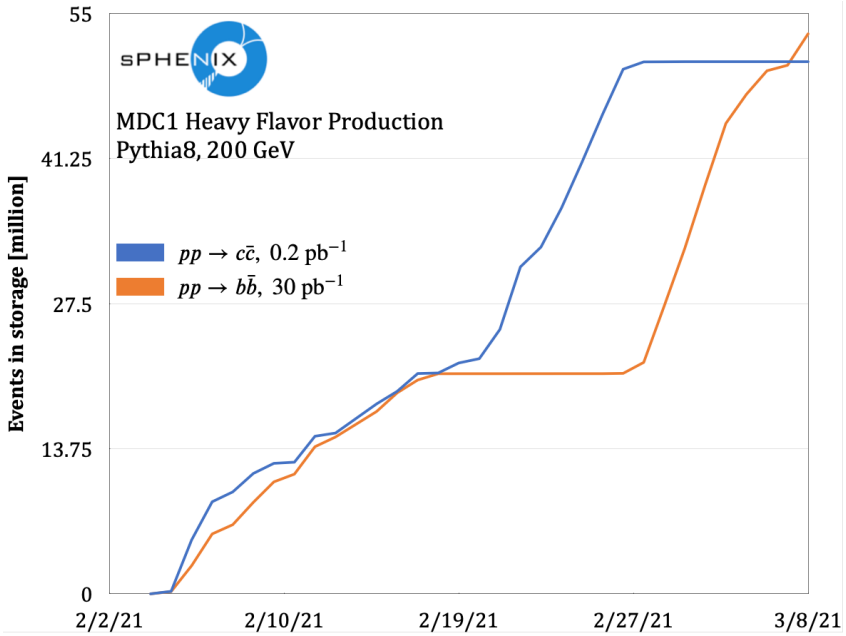


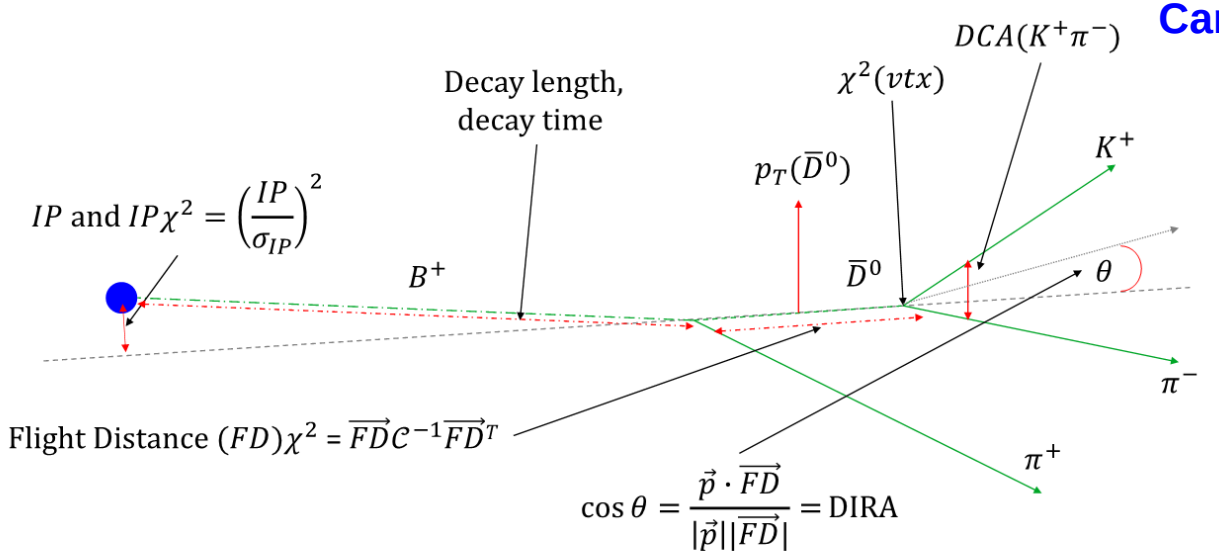



(sPH-HF-2021-001) https://indico.bnl.gov/event/11336/

HF Production Manager & KFParticle



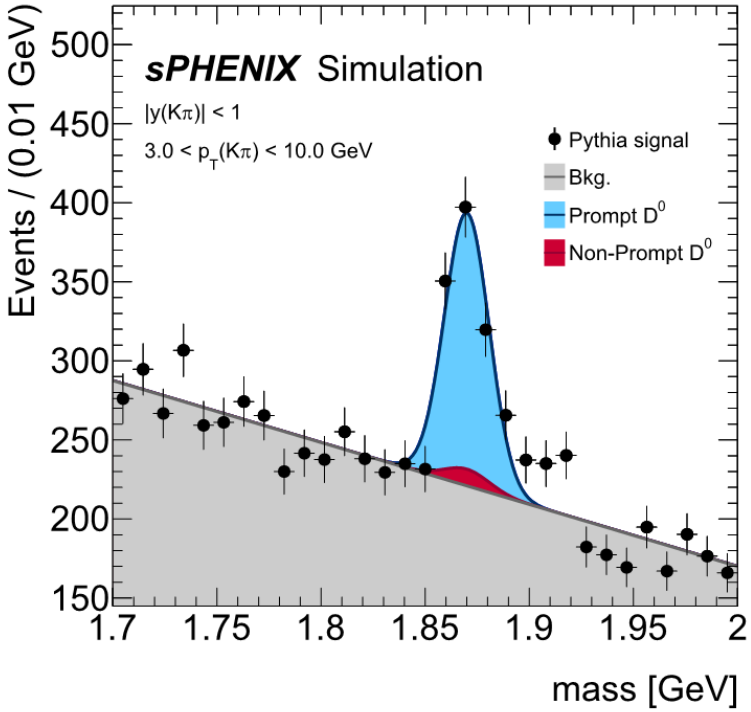


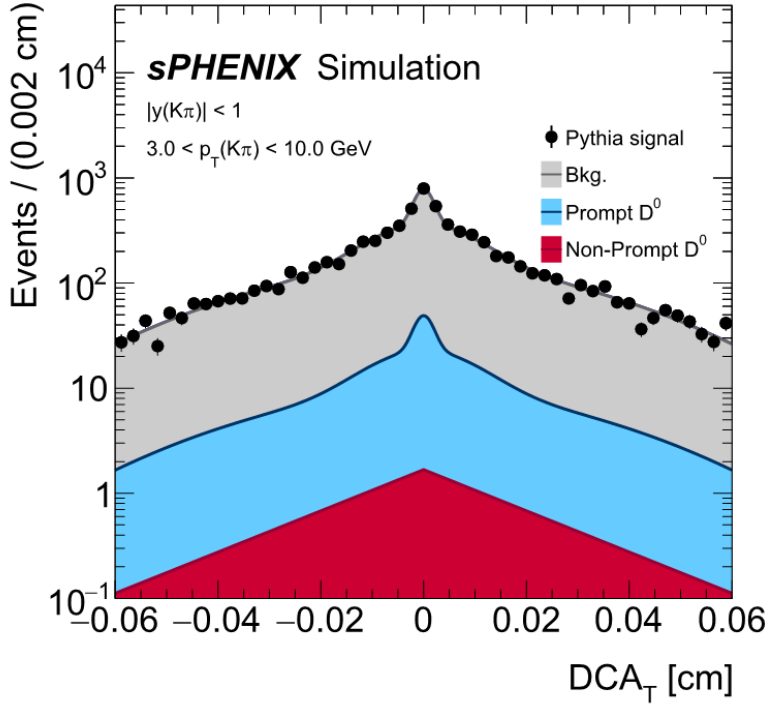
Cameron Dean (LANL)

- Cameron has been the HF production manager.
- Sample information & KFParticle are documented in sPH-HF-2021-001.
- Cameron will present the details of software status & updates in the next talk.

Prompt & Non-prompt $D^0 \rightarrow K\pi$

Sebastian Tapia Araya
(Iowa State)



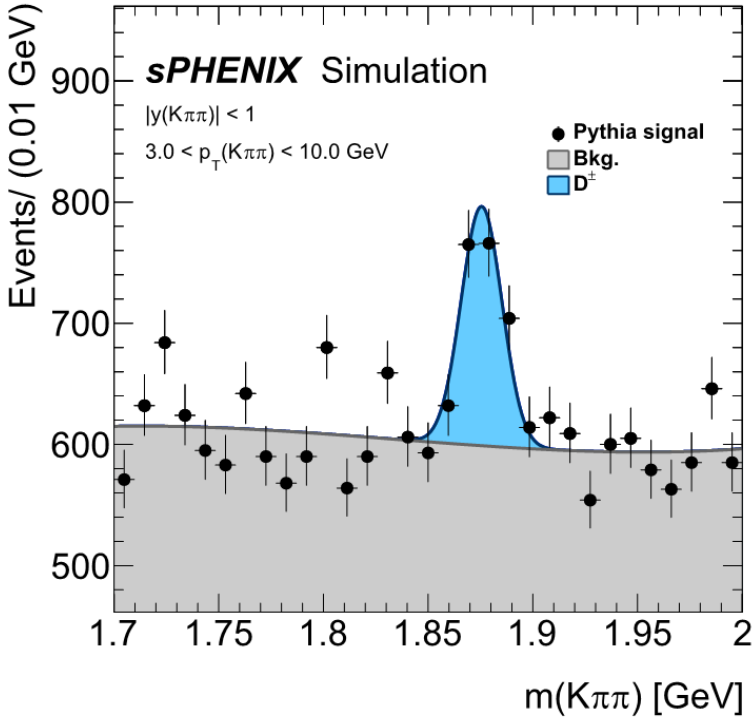


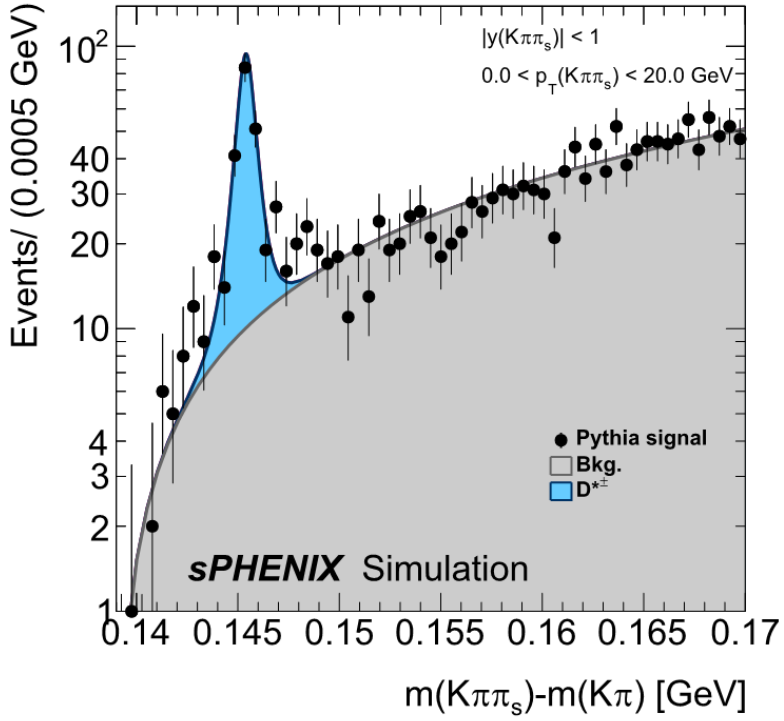
- **Using ccbar & bbbar signal samples.**
- KFParticle with loose selections: track $p_T > 0.5$ GeV, track and vertex $\chi^2/ndf < 4$, the distance between two daughter tracks < 0.03 mm, and the opening angle < 90°.
- Prompt D^0 DCA is fitted with triple Gaussian, non-prompt with two-sided exponential.

(sPH-HF-2021-001) https://indico.bnl.gov/event/11336/

$D^+ \rightarrow K^-\pi^+\pi^+$ & $D^{*+} \rightarrow D^0\pi^+ \rightarrow K^-\pi^+\pi^+$

Sebastian Tapia Araya
(Iowa State)

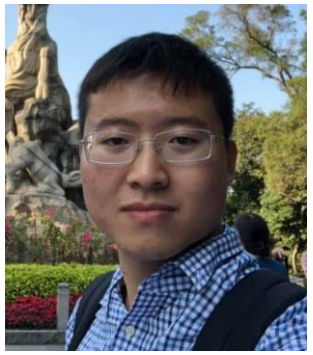


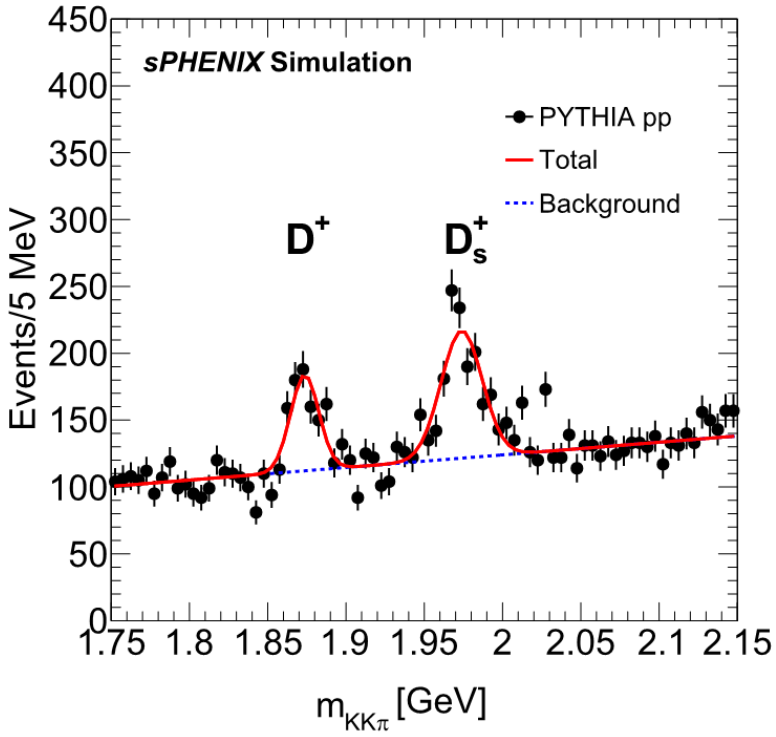


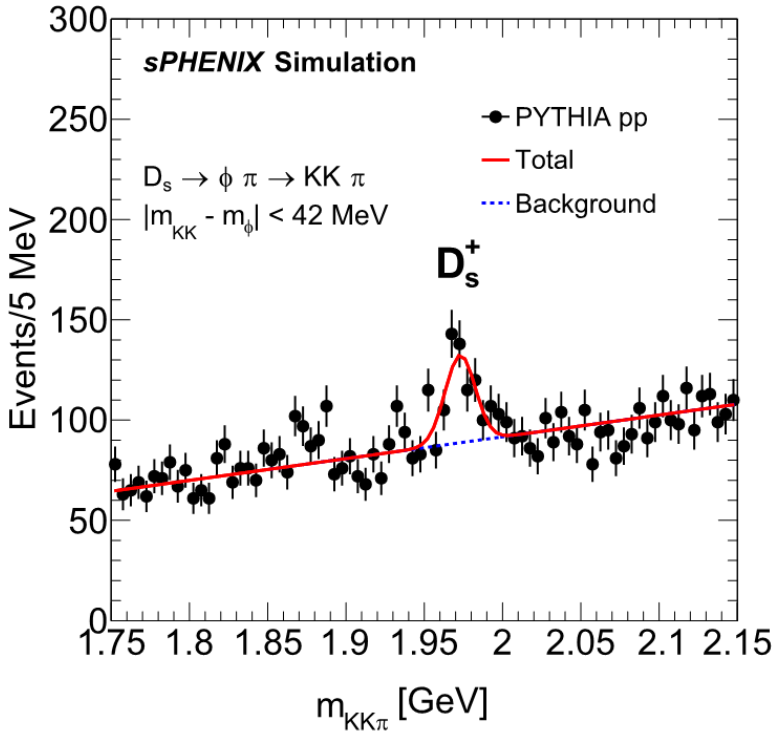
- **Using ccbar & bbbar signals.** The same selection as previous slide used in KFParticle.
- (Left) D+ reconstruction w/ 3 tracks.
- (Right) Difference b/w mass of fully reconstructed D^{*+} and D^0

Prompt $D^+_{(s)} \rightarrow K^+K^-\pi^+$ & $D^+_s \rightarrow \phi\pi^+ \rightarrow K^+K^-\pi^+$

Zhaozhong Shi (MIT)



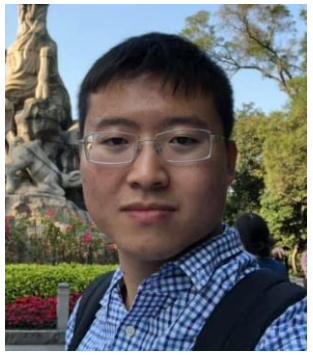


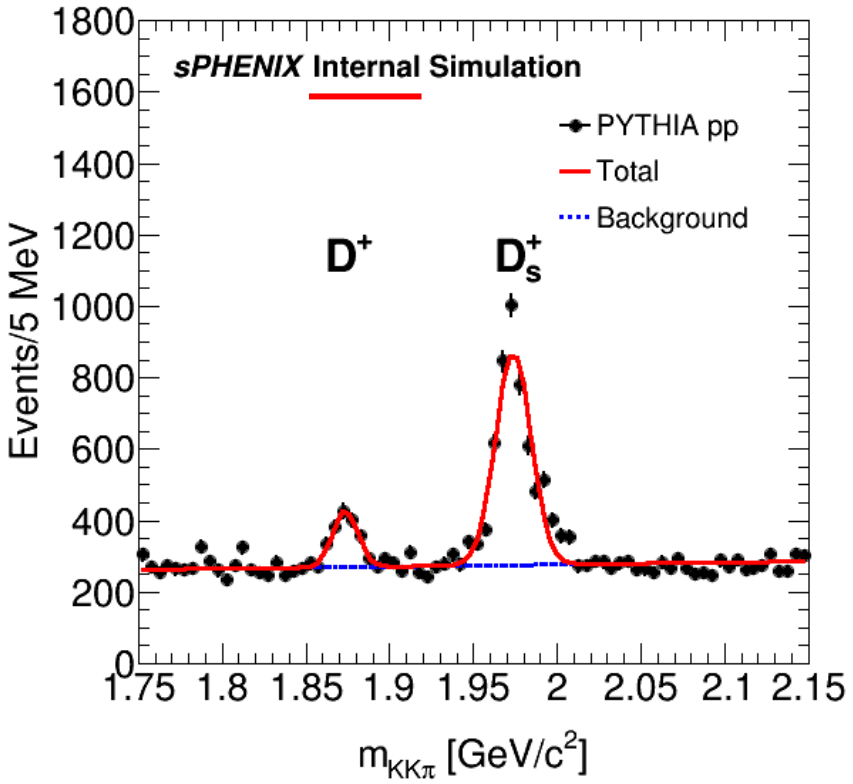


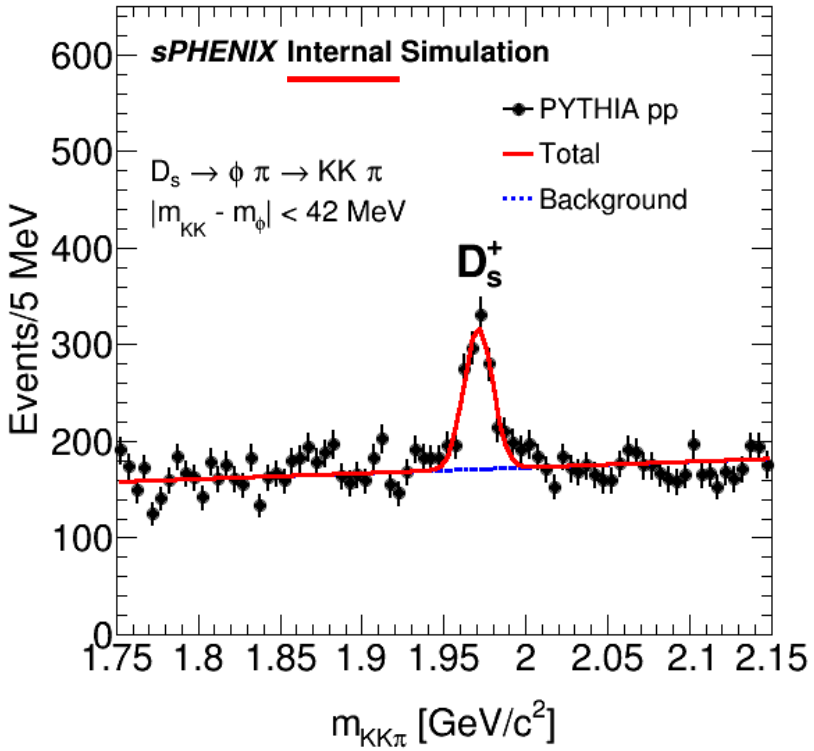
- **ccbar signals used.** Considered 3 tracks in KFParticle w/ loose selections: track $p_T > 1$ GeV, track and vertex χ^2/ndf < 40, the minimum distance between two daughter tracks < 0.1 mm, and the open angle < 90◦
- BG suppressed by requiring reco track PID to match the truth PID as well as a few more truth-level selections (please refer the note).

Non-prompt $D^+_{(s)} \rightarrow K^+K^-\pi^+$ & $D^+_s \rightarrow \phi\pi^+ \rightarrow K^+K^-\pi^+$

Zhaozhong Shi (MIT)

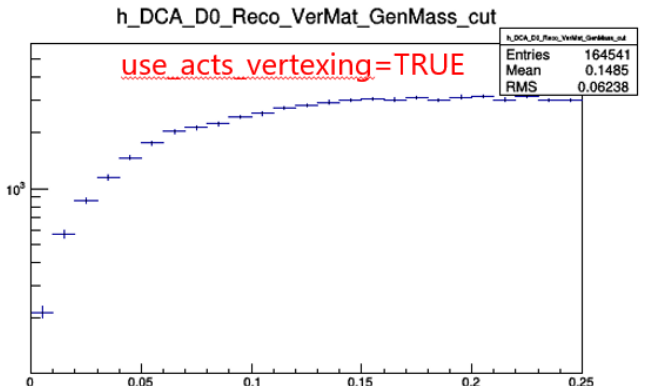


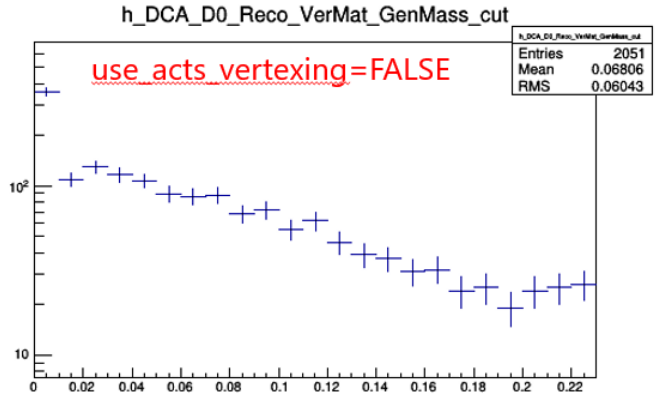




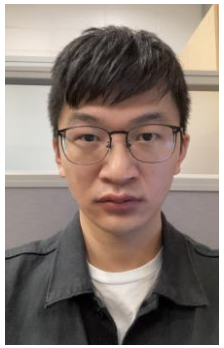
- Similar exercise done for bbbar signals. Further studies ongoing.
- Not included in the first MDC1 note. Will be considered for the next note.

Other Ongoing Studies



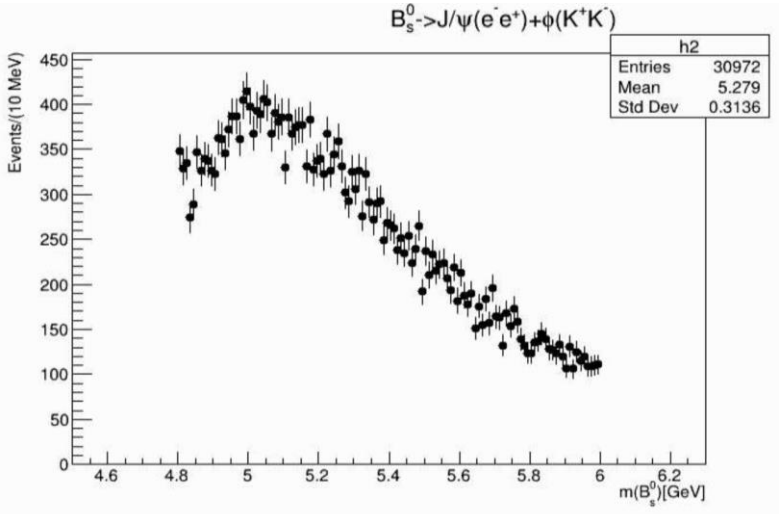


Han-Sheng Li (Purdue)



Sourav Tarafdar (Vanderbilt)

Correlated BG for
$B_s \rightarrow J/\psi\ \phi \rightarrow (l^+l^-)(K^+K^-)$



- Vertex information needs to be fixed in ACTS (also confirmed by Sebastian)

Wishlist for Future Production (2021,2022)

From Camelia's talk at GM (Mar. 19)

	A	B	C	D
22	**TG**	**PYTHIA 2022 needs-- WITH PU**		**Embedding?**
23	HF	**ccbar**	50M	yes
24		**bbar**	50M	
25		**charm jet signal**	1M	
26		**bottom jet signal**	1M	
27		**D0(kpi)**	1M	
28		**D+(Kpipi)**	1M	
29		**Lc(piKp)**	1M	
30		**Psi(1s,2s)->mumu**	2M	
31		**B->DX**	5M	
32		**B->JpsiX**	3M	
33				
34		**directPhoton, MSEL=10**		
35	cQCD	qhat>0	100M	
36	Jets	ptTruth_photon [10,30] GeV	1M	yes
37		ptTruth_photon [10,30] GeV	1M	
38				
39		**MB QCD, MSEL=1**		
40	cQCD, HF	qhat>0	1B	→ Likely to be ~300M each
41		qhat>5GeV	1B	
42		no filtering	1M	
43	Jets, HF	ptTruth_jet [10,20]GeV	5M	yes
44		ptTruth_jet [20,40]GeV	5M	
45		ptTruth_jet>40GeV	1M	
46				
47	HF, Onia	Single track	6M	

- Discussions started at our last TG meeting & Cameron presented the plan at the simulation meeting: https://indico.bnl.gov/event/10504
- Further discussions ongoing with the computing team & will be reported at the S&C review: https://indico.bnl.gov/event/11083
- **Pythia jet samples for pp will be produced this year.**
  - **Inclusive: 10M**
  - **c-jets: 1M**
  - **b-jets: 1M**
- Pileup & embedding will be considered for the production in 2022.
- We can use the MB samples to validate our BG fastsim.