

ISU HEP group weekly Report

2020/07/01

Shuaiyan

$D^0 \rightarrow K^- \pi^+ e^+ e^-$ Reconstruction: generic UDS MC background

UDS bkg sources in region
 $1.80 < mD^0 < 1.93 \text{ GeV}$

Type	Fraction %
correct FSP: all	30.1
correct FSP: $e^+ e^- \pi$ with π fake K	30.1
correct FSP: K, π with at least one π fake e	13.0
correct FSP: e, π with π fake e and K (three π in total)	5.7

K source (for correct FSP K and π)	fraction %
virtual photon from ee	56.1
$K^{*0}, K^{*\pm}$	17.5, 17.5
Bkg with correct FSP: K, π	46.3

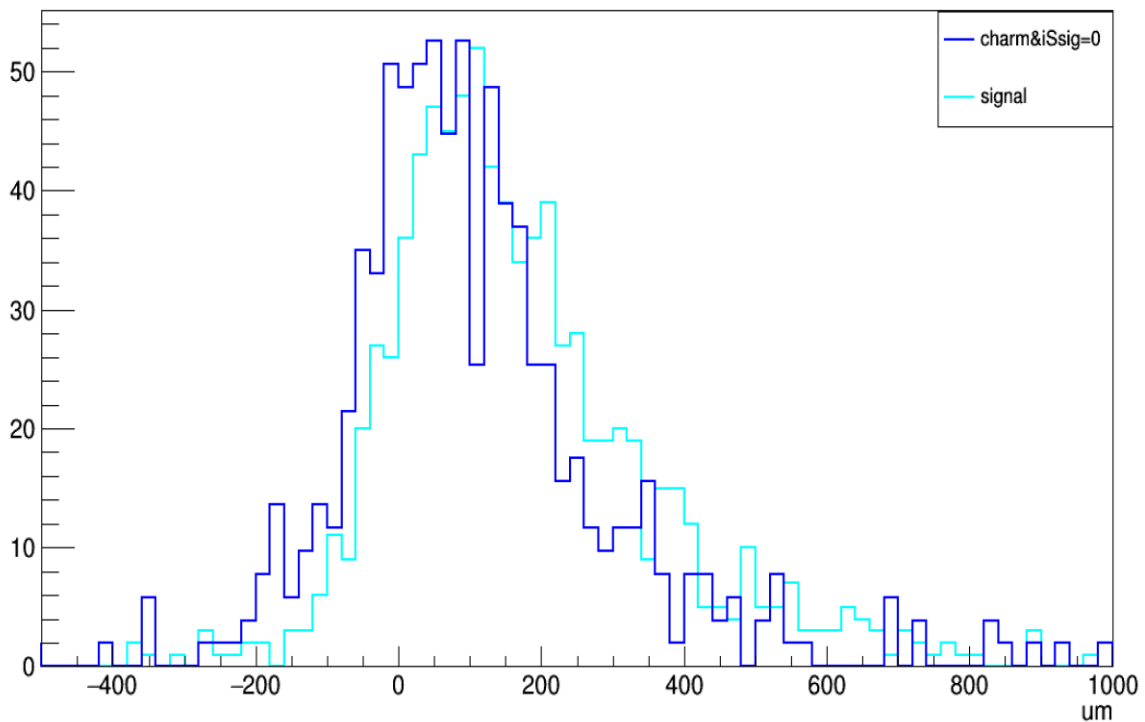
e source (for correct FSP ee)	fraction %
γ	57.9
π^0	20.8
η	16.9
ω	3.4
ρ^0	1.1

fraction = No. of electron with matched mother/
 total No. of electrons (2 x No. of bkg)

π source (for correct FSP K, π and correct FSP: π, π fake K)	fraction %
ρ^0, ρ^\pm	16.0, 25.3
virtual photon from ee	28.4
ω	9.3
$K^{*0}, K^{*\pm}$	3.7, 3.7
Bkg with correct FSP: K, π	46.3
Bkg with correct FSP: π, π fake K	35.8

$D^0 \rightarrow K^- \pi^+ e^+ e^-$ Reconstruction: Flight Distance

Flight Distance 2D



Flight distance $l = d \cdot \hat{p}$

Proper time

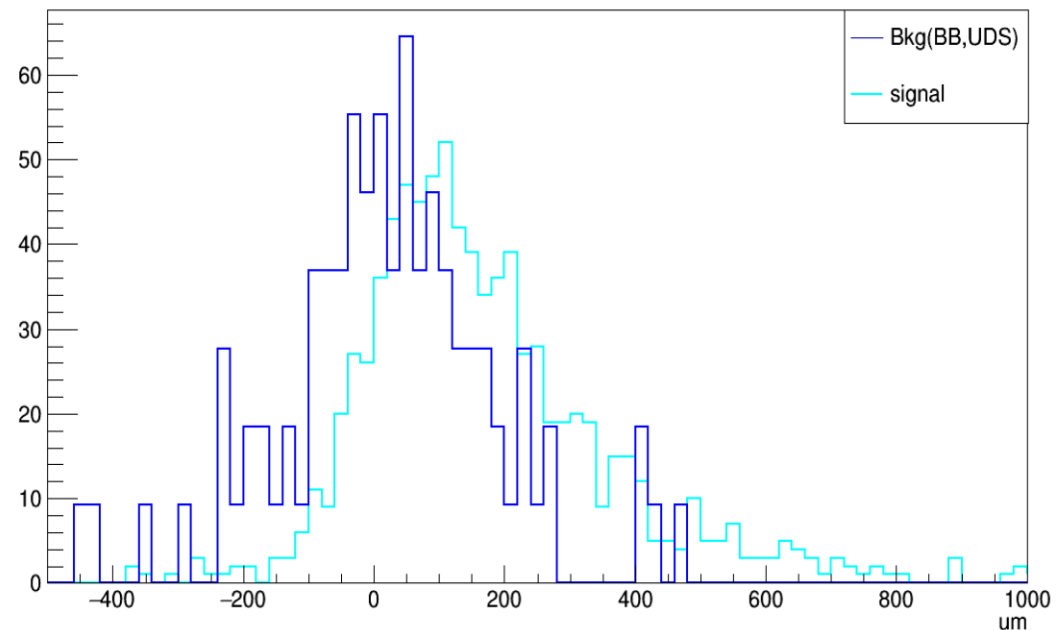
$$t = m(K^- \pi^+ e^+ e^-)l/cp$$

D^0 lifetime

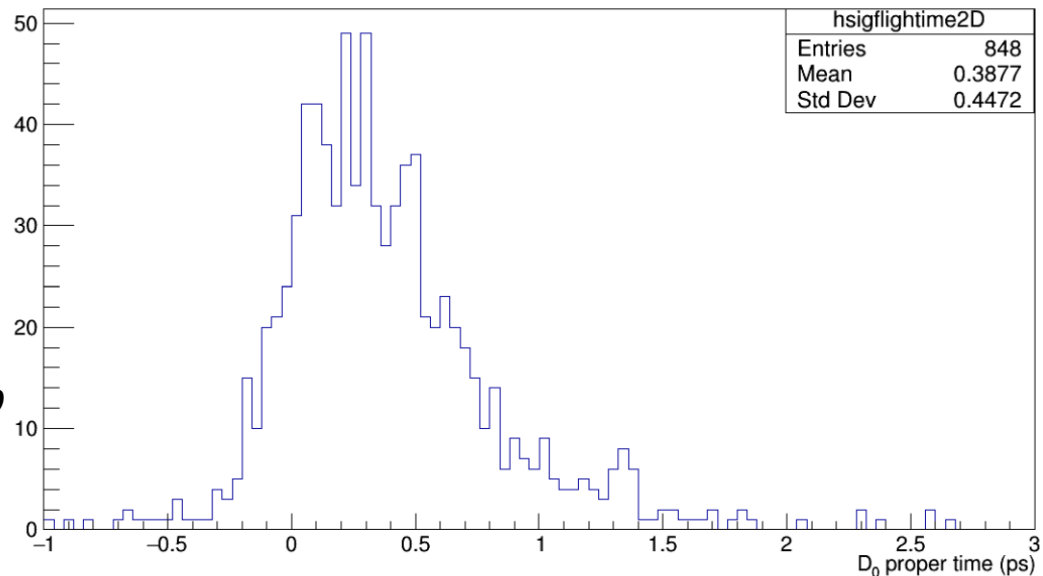
$$\tau_{PDG} \sim 0.4 \text{ ps}$$

Scaled to same entries

Flight Distance 2D

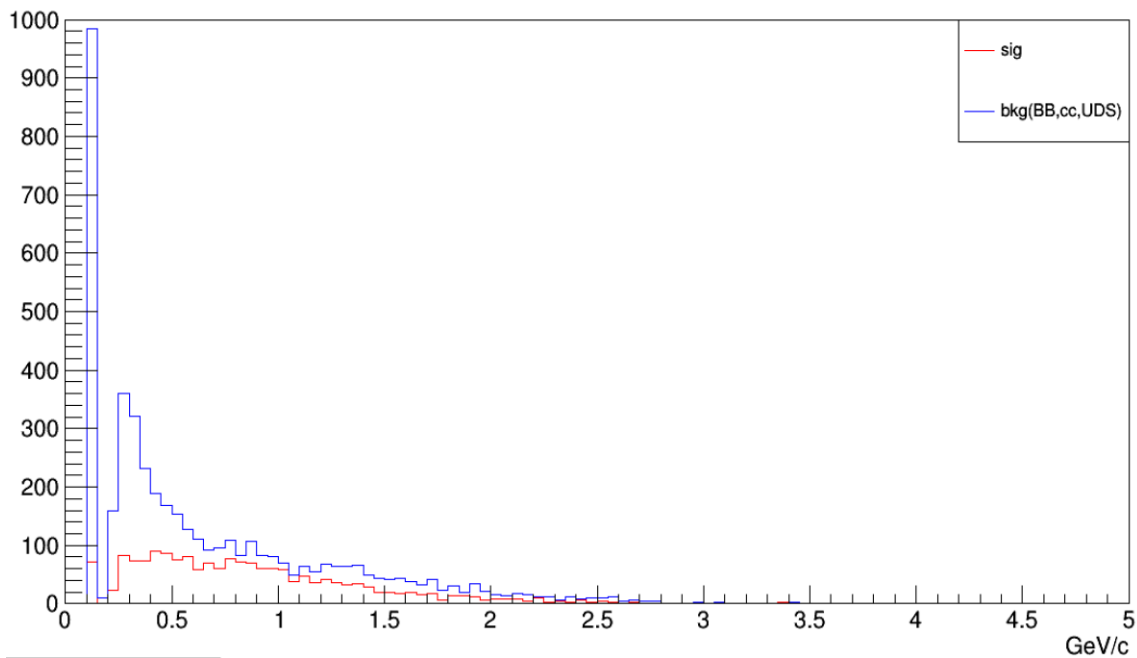


D^0 Proper time (truth matched signal MC)

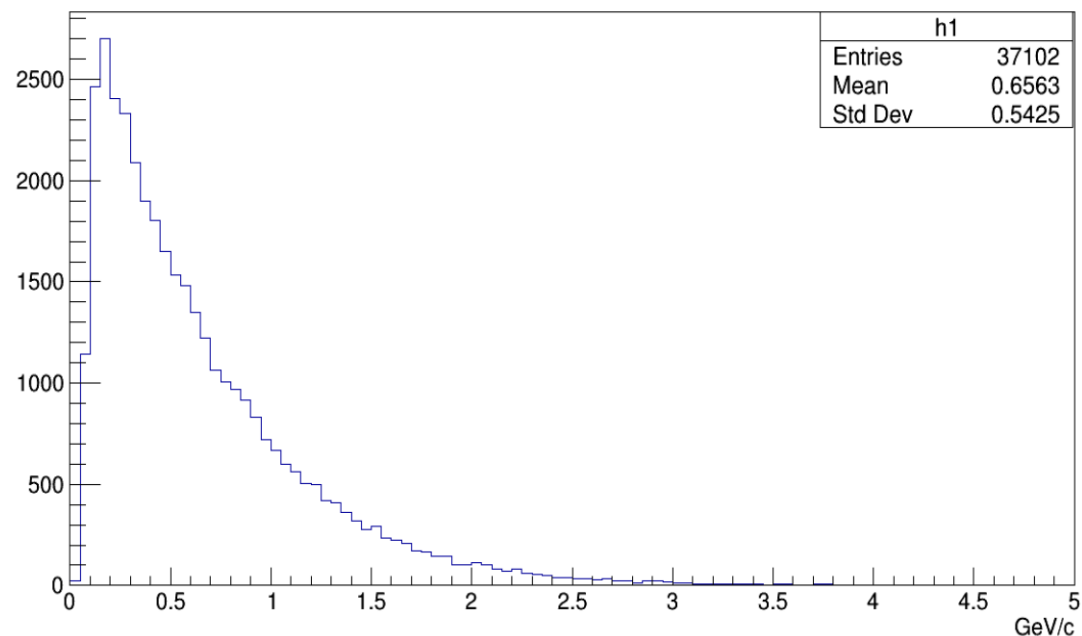


$D^0 \rightarrow K^- \pi^+ e^+ e^-$ Reconstruction: Signal MC

Electron momentum from truth matched after current cuts (in backup) with veto $M(ee) > 0.12 \text{ GeV}/c^2$



Electron momentum from generated signal D^0



Signal efficiency: truth matched D^0 in $1.85 < mD^0 < 1.88 \text{ GeV}$
/ total generated signal $\sim 3.4\%$

Basf2 TopoAna module

- A module for studying the topology of the samples
- Offline module based on basf2 framework
- Planned for release-05
- Experiment: Belle , Belle II, BESIII
- Input: gen info

```
Number of particles      : 25
PDG codes of particles  : 433,
                        -321, 223, 211, -413, 431, 111, 211, -211, 111, -411,
                        111, 321, 113, 22, 22, 22, 22, 321, -211, -211,
                        22, 22, 211, -211
Mother indices of particles : -1,
                              -1, -1, -1, 0, 0, 2, 2, 2, 4,
                              4, 5, 5, 6, 6, 9, 9, 10, 10, 10,
                              11, 11, 13, 13
```

- Features: Find/Rank:
 - product/decay chain of specific particles
 - Root particle decay chain/inclusive decay
 - Signal identification
- Project pepo: <https://stash.desy.de/users/zhouxy/repos/topoana/browse>

Production branch of electron

rowNo	production branch of e^+	iProdBrP	nCase	nCCase
1	$\pi^0 \rightarrow e^+ e^- \gamma^F$	4	2270	2270
2	$D^0 \rightarrow e^+ \nu_e K^-$	0	1050	3320
3	$D^+ \rightarrow e^+ \nu_e \bar{K}^0$	3	730	4050
4	$D^0 \rightarrow e^+ \nu_e K^{*-}$	1	652	4702
5	$D^+ \rightarrow e^+ \nu_e \bar{K}^*$	6	333	5035
rest	others (80 in total)	—	2541	7576

Gen info from Belle generic MC exp65

Back up: $D^0 \rightarrow K^- \pi^+ e^+ e^-$ Reconstruction

Belle generic MC: $\sim 771 \text{ fb}^{-1}$, ($\sim 692 \text{ fb}^{-1}$ $\Upsilon(4S)$ resonance)

Type: charm, uds, charged, mixed

Signal MC: total 20K $D^0 \rightarrow K^- \pi^+ e^+ e^-$, 10K for C.C.

Current cuts:

on each track: $p > 0.1 \text{ GeV}/c$, $|d_0| < 2 \text{ cm}$, $|z_0| < 5 \text{ cm}$

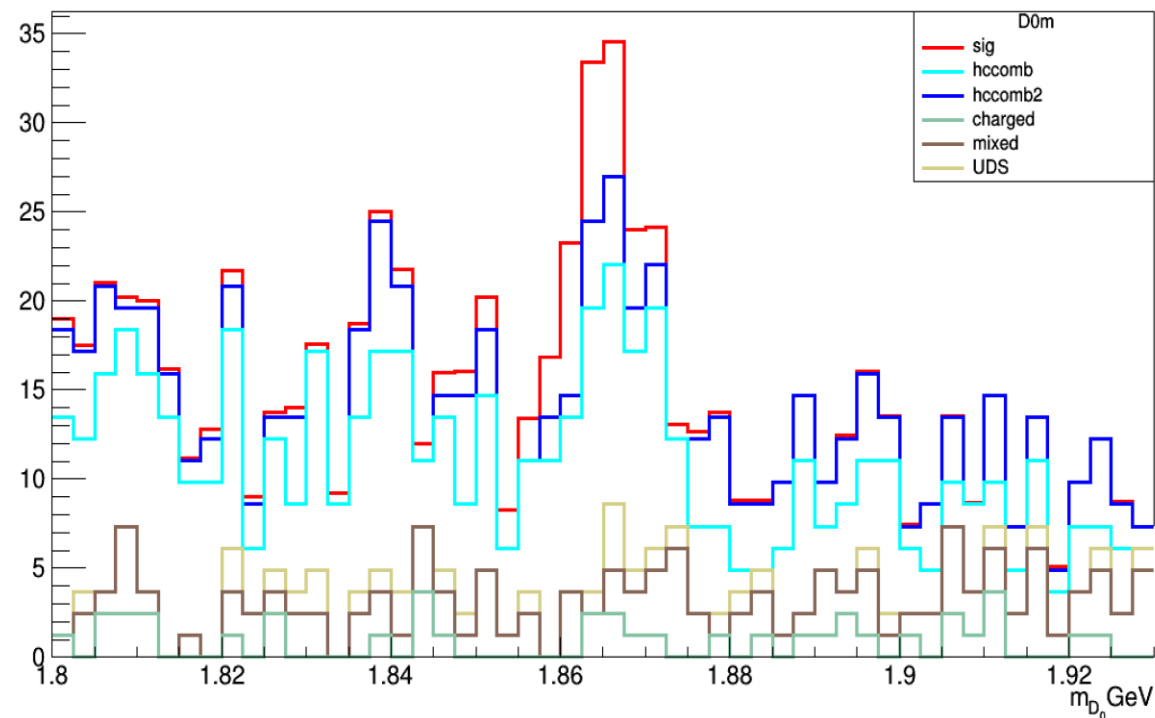
Vertex fit χ^2 prob ≥ 0.004 , $p^*(D^*) > 2.6 \text{ GeV}/c$

eID > 0.9

Kaon selection: KID > 0.3 , eID < 0.1

Pion selection: KID < 0.3 , eID < 0.1

m_{D^0} , $M(ee) > 0.12 \text{ GeV}/c^2$, $p(e) > 0.4 \text{ GeV}/c$



hccomb: charm bkg with all correct chosen FSP

hccomb2: charm bkg, at least one FSP is misidentified

Belle Generic MC

	stream 0				stream 1		
exp	charged/mixed	charm	uds		charged/mixed	charm	uds
7	3158539	8301094	13344899		3158539	8301093	13344895
9	2243082	5351450	8603092		2243082	5351449	8603093
11	4194377	11378093	18292014		4194376	11378094	18292012
13	5833568	15474913	24878299		5833569	15474913	24878301
15	6913772	18322889	29457105		6913774	18322888	29457105
17	5029273	13107770	21072977		5029272	13107769	21072977
19	13419896	36681420	58971781		13419895	36681419	58971779
21	2351610	5609655	9018475		2351610	5609656	9018476
23	3447814	10055733	16166293		3447814	10055733	16166295
25	13889176	35299639	56750156		13889175	35299637	56750154
27	13818245	37851617	60853111		13818246	37851618	60853108
31	9278486	25200819	40514730		9278484	25200814	40514730
33	9473597	25989763	41783285		9473591	25989760	41783284
35	9194075	24501819	39391173		9194074	24501816	39391168
37	33181995	87161659	140128564		33181989	87161644	140128571
39	23083585	62893043	101112316		23083584	62893045	101112320
41	31243163	81750432	131429212		31243172	81750420	131429206
43	29763451	81751768	131431414		29763451	81751787	131431417
45	6972626	19614162	31533444		6972624	19614159	31533451
47	20015809	52168966	83871449		20015819	52168970	83871437
49	14535659	42048751	67601209		14535654	42048746	67601210
51	21130003	56604652	91002498		21130008	56604661	91002496
53	0	26080481	41929328		0	26080479	41929327
55	38841213	102575844	164909962		38841224	102575873	164909985
61	18624949	57352188	92204287		18624953	57352185	92204284
63	17528959	48566294	78079436		17528965	48566288	78079432
65	20259429	65418613	105172696		20259430	65418597	105172697
67	0	49509625	79596025		0	49509626	79596020
69	0	71587985	115091121		0	71587980	115091125
71	0	58394093	93879498		0	58394099	93879507
Total	377426351	1236605230	1988069849		377426374	1236605218	1988069862
Lum	692.5	951.2	951.2		692.5	951.2	951.2
	generic MC stream 0	charged/mixed	charm		uds		
	total /Lum	377426351/692.5	1236605230/951.2		1988069849/951.2		
	runned/Lum	377426351/692.6	1003284005/771.7		1612962140/771.7		