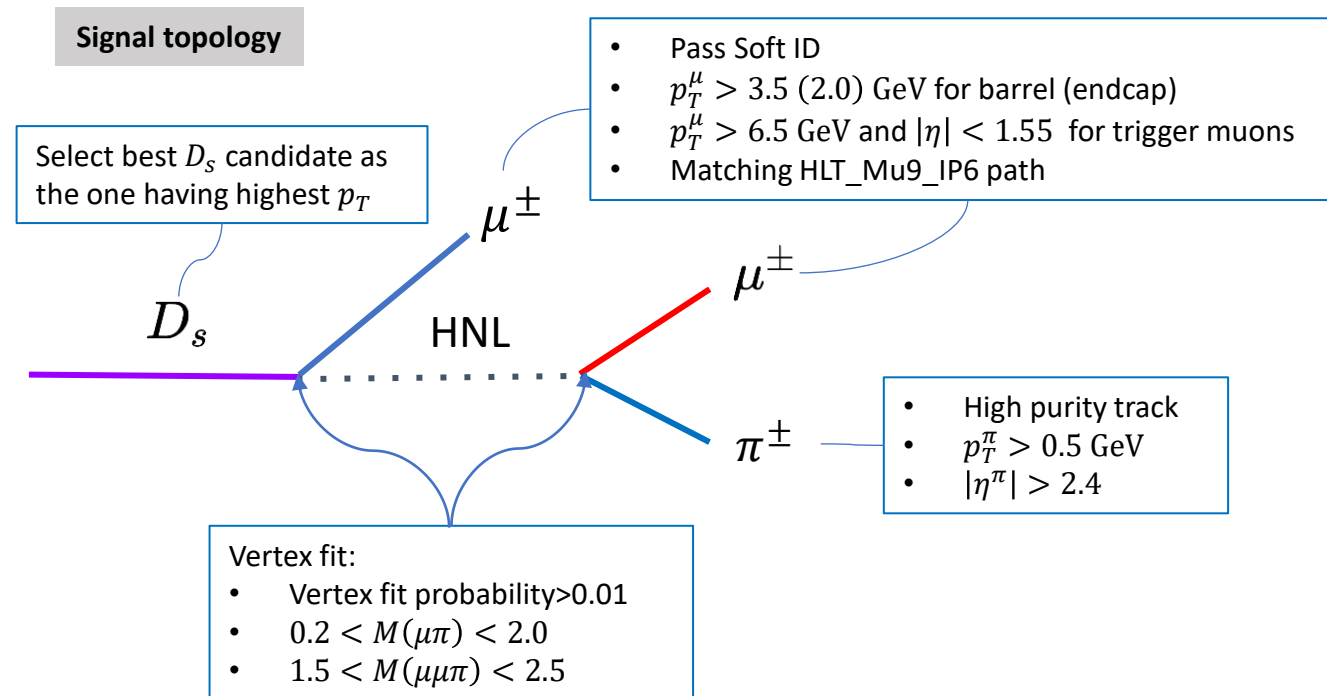# Signal topology

- Heavy Neutral Lepton (HNL) vertex is expected to be well detached from the PV (and also from the Ds vertex)
- Both Ds and HNL vertex are fitted
- In the next slide I compare the displacement at gen-level witht the one extracted from the kinematic vertex fit for MC signal events
- The MC contains Ds coming from Bs decay. The Ds then decays into HNL and a muon as shown below

Signal topology

Select best D_s candidate as the one having highest p_T

- Pass Soft ID
- $p_T^\mu > 3.5$ (2.0) GeV for barrel (endcap)
- $p_T^\mu > 6.5$ GeV and $|\eta| < 1.55$ for trigger muons
- Matching HLT_Mu9_IP6 path

$\mu^\pm$

D_s

HNL

$\mu^\pm$

$\pi^\pm$

- High purity track
- $p_T^\pi > 0.5$ GeV
- $|\eta^\pi| > 2.4$

Vertex fit:
- Vertex fit probability>0.01
- $0.2 < M(\mu\pi) < 2.0$
- $1.5 < M(\mu\mu\pi) < 2.5$

Running on 1k signal MC events in UL/non-UL conditions

HNL decay length from vertex fit [mm]

HNL decay length gen-level info [mm]

HNL decay length from vertex fit [mm]

HNL decay length gen-level info [mm]

non-UL sample

Row	*	Instance	*	fabs(C_Hn	*	C_Hnl_gen
	*		*	56.758156	*	57.126190
	*		*	166.19611	*	166.06161
	*		*	39.539978	*	40.300338
	*		*	34.549608	*	32.926780
9	*	0	*	87.814007	*	88.036125
10	*	0	*	5.4681075	*	5.1217408
11	*	0	*	90.913468	*	91.434318
12	*	0	*	15.655779	*	15.517757
16	*	0	*	281.94932	*	281.38665
22	*	0	*	140.62379	*	140.34623
23	*	0	*	62.231158	*	49.687313
26	*	0	*	48.875744	*	51.168872
27	*	0	*	150.77647	*	151.0793
28	*	1	*	22.723946	*	25.032003
30	*	0	*	97.552177	*	98.667602
31	*	0	*	33.503121	*	33.224697
32	*	0	*	63.462581	*	64.572036
36	*	0	*	106.27912	*	104.77968
37	*	0	*	6.7294031	*	6.9818115
38	*	0	*	30.583883	*	31.827323
41	*	0	*	10.824251	*	10.491328
43	*	0	*	239.65513	*	240.27409
46	*	0	*	181.41534	*	171.21597
48	*	0	*	86.492868	*	86.683944
51	*	0	*	96.068114	*	95.166992

Type <CR> to continue or q to quit ==> q

UL sample

Row	*	Instance	*	fabs(C_Hn	*	C_Hnl_gen
	*		*	1.3905680	*	254.76753
	*		*	1.5295827	*	549.47460
	*		*	54.886713	*	55.932972
	*		*	0.1076757	*	61.515487
9	*	0	*	0.3280419	*	125.29300
11	*	0	*	0.4515755	*	141.64856
14	*	0	*	9.8923602	*	9.7262563
15	*	0	*	6.4565205	*	8.1965885
17	*	0	*	1.0270661	*	78.777282
18	*	0	*	0.4114031	*	237.18754
19	*	0	*	4.6176053	*	4.7535972
20	*	0	*	1.1375626	*	96.607948
22	*	0	*	0.2094578	*	313.54922
24	*	1	*	0.6242917	*	126.54401
26	*	0	*	0.5682945	*	1312.6757
28	*	2	*	0.4707098	*	50.018562
29	*	0	*	0.0642621	*	216.70831
33	*	0	*	0.0068172	*	83.596344
34	*	0	*	11.830121	*	11.958951
35	*	0	*	29.560523	*	28.936555
38	*	0	*	31.316008	*	31.412382
39	*	3	*	1.1536625	*	56.887538
41	*	0	*	0.1086163	*	73.443992
42	*	1	*	0.6402760	*	214.51088
43	*	0	*	3.6098527	*	3.3791348

Type <CR> to continue or q to quit ==> q

Global tag: 106X_upgrade2018_realistic_v16_L1v1
CMSSW rel: 10_6_30

non-UL

(Fitted decay lenght) – (gen decay length) [mm]

htemp	
Entries	68
Mean	−0.09695
Std Dev	2.793

UL

(Fitted decay length) – (gen decay length) [mm]

htemp	
Entries	110
Mean	−130.5
Std Dev	177.6