Work progress

Haoyu Sang

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Outline

- Summary of selection and further analysis;
- Consist of background;
- Cut number of total charged track;
- Analysis of data;

Change selection channel

- Before:
  - $\tau \to e\nu_e\nu_\tau$ / μ;
  - $\tau \to K^*\nu_\tau$;
  - $K^* \to \pi K_s$;
- Now:
  - $\tau \to e\nu_e\nu_\tau$ / μ;
  - $\tau \to \pi K_s\nu_\tau$;
- Contain all possibilities of which decays $\pi K_s\nu_\tau$ and get more events what we want;

Summary of cut selection

- Dynamic analysis:
  - nGood charged tracks = 2;
  - epratio for electron > 0.8;
  - muon counter;
  - invariant mass of ks is between 0.488 and 0.508GeV;
  - invariant mass of π^0 is between 0.115 and 0.15GeV;
- MVA analysis (8 varibles):
  - E(tot) in EMC;
  - number of neutral clusters;
  - Pt(tot);
  - magnitude of thrust;
  - P(ks);
  - P(π+ks) and m(π+ks);
  - θ(ks , π);

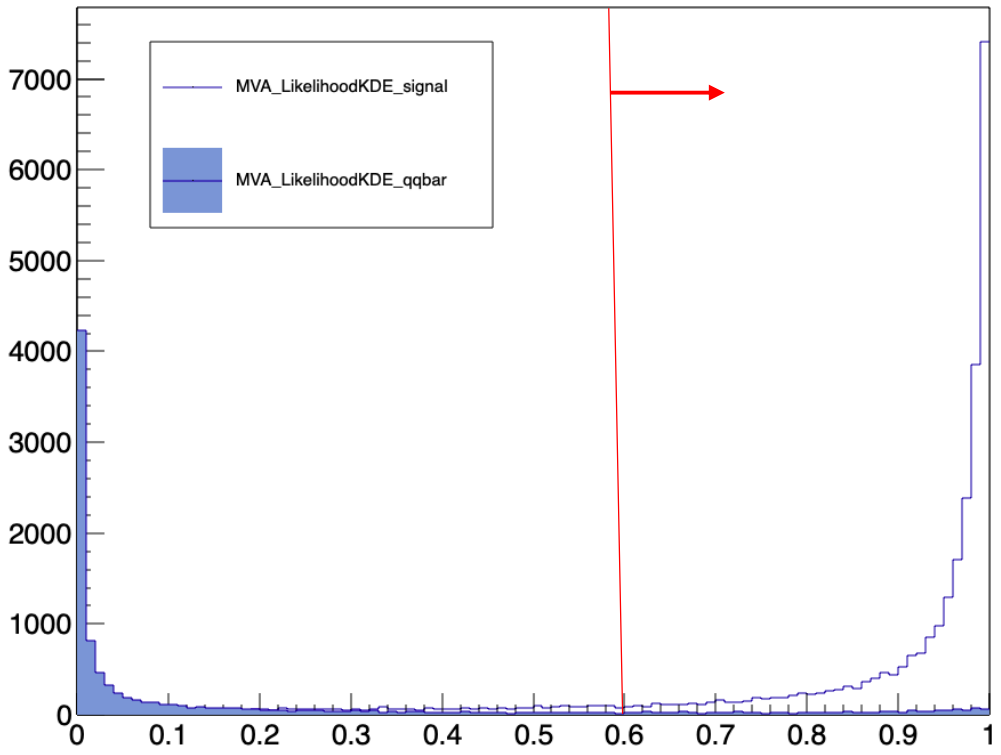
No k*

	signal tau-		
total events	2*10^5		
step 1	59.12%		
step 2	47.66%		
step 3	29.61%		
step 4	27.91%		
total select efficiency	27.91%	$0\pi^0$	95.53%
		$1\pi^0$	3.89%
		$2\pi^0$	0.49%
		$>2\pi^0$	0.086%

Efficiency selection of different backgrounds except cutting k*

		bhabha	dimu	hadrons	DD	ditau	ISR	qqbar	digamma	gammaXYZ	dielectron
signal τ^-	selected number	224	25	745	16457	5734	2922	36030	7	136	184
	total number	2.1*10^8	10^7	5*10^5	4*10^6	9.2*10^6	1.1*10^6	2.7*10^7	3.3*10^7	4.8*10^4	1.1*10^7
	new efficiency	1.1*10^-6	2.5*10^-6	1.5*10^-3	4.1*10^-3	6.2*10^-4	2.7*10^-3	1.3*10^-3	2.1*10^-7	2.8*10^-3	1.7*10^-5

MVA analysis



MVA analysis

- 1σ for signal, cut 0.6:

	number event selected (LikelihoodKDE)	select efficiency
		LikelihoodKDE
signal	46800	23.40%
qqbar	4005	1.48*10^-4
ISR	383	3.48*10^-4
ditau	2369	2.58*10^-4
DD	1901	4.75*10^-4

Consist of qqbar

- π/μ:
  - $\bar{u}\pi^-\pi^-\pi^+\pi^+(\geq 0K_L)(\geq 0\gamma)$
- K/μ:
  - $\bar{u}\pi^-\pi^-\pi^+K^+(\geq 0K_L)(\geq 0\gamma)$

final states	iTopology	nEvt	nTot
$\bar{u}\pi^-\pi^-\pi^+\pi^+\gamma\gamma\gamma\gamma$	83	9	9
$\bar{u}\pi^-\pi^-K_L\pi^+\pi^+$	42	8	17
$\bar{u}\pi^-\pi^-\pi^+K^+$	89	7	24
$\pi^-\pi^-\bar{s}\pi^+\gamma\gamma K^+$	290	7	31
$\bar{u}\bar{u}\pi^-\pi^-K_Lg\pi^+\pi^+$	116	6	37
$\pi^-\pi^-\bar{s}\pi^+K^+$	177	6	43
$\bar{u}\pi^-\pi^-\pi^+\gamma\gamma K^+$	13	6	49
$\bar{u}\pi^-\pi^-K_L\pi^+\pi^+\gamma\gamma$	37	5	54
$\pi^-\pi^-\bar{s}\pi^+K^+$	293	5	59
$\bar{u}\pi^-\pi^-K_L\pi^+\pi^+$	16	4	63
$\bar{u}\pi^-\pi^-K_Lug\pi^+\pi^+\gamma\gamma$	54	4	67
$\bar{u}\pi^-\pi^-ug\pi^+K^+$	77	4	71
$\bar{u}\bar{u}\pi^-\pi^-\bar{n}g\pi^+\pi^+n$	84	3	74
$\pi^-\pi^-\bar{s}K_L\pi^+\pi^+$	67	3	77
$\bar{u}\pi^-\pi^-\pi^+\pi^+\gamma\gamma$	110	3	80
$\pi^-\pi^-\bar{s}K_L\pi^+\pi^+\gamma\gamma$	61	3	83
$\bar{u}\pi^-\pi^-\pi^+\pi^+\gamma\gamma\gamma\gamma$	133	3	86
$\pi^-\pi^-\bar{s}\pi^+\gamma\gamma K^+$	135	3	89
$e^+e^-e^+e^-\pi^-\pi^-K_Lg\pi^+\pi^+$	168	3	92
$\pi^-\pi^-\bar{s}K_L\pi^+\pi^+\gamma\gamma$	78	3	95
$e^+e^-e^+e^-\pi^-\pi^-K_Lgg\pi^+\pi^+\gamma\gamma\gamma\gamma$	79	3	98
$e^+e^-\pi^-\pi^-K_L\pi^+\pi^+$	62	3	101
$\pi^-\pi^-\bar{s}\bar{s}K_Lg\pi^+\pi^+$	446	3	104

Consist of ditau

- signal:
  - $e^+\pi^-\pi^+\pi^-\bar{\nu_\tau}\nu_e\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
  - $\mu^+\pi^-\pi^+\pi^-\bar{\nu_\tau}\nu_e\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
- π/μ:
  - $\pi^-\pi^-\pi^+\pi^+\bar{\nu_\tau}\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
  - $\pi^-\mu^-\pi^+\pi^-\overline{\nu_\mu}\bar{\nu_\tau}\nu_\tau(\geq 0K_L)(\geq 0\gamma)$

final states	iTopology	nEvt	nTot
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_e\nu_\tau\pi^+$	2	86	86
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_e\nu_\tau\pi^+$	9	58	144
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+\gamma\gamma$	0	48	192
$\mu^+\bar{\nu}_\tau\pi^-\pi^-\nu_\mu\nu_\tau\pi^+$	1	44	236
$\mu^+\bar{\nu}_\tau\pi^-\pi^-\nu_\mu\nu_\tau\pi^+$	14	36	272
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_e\nu_\tau\pi^+\gamma\gamma$	11	21	293
$\mu^+\bar{\nu}_\tau\pi^-\pi^-\nu_\mu\nu_\tau\pi^+\gamma\gamma$	19	14	307
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+\gamma\gamma$	21	10	317
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_e\nu_\tau\pi^+\gamma\gamma$	20	9	326
$\bar{\nu}_\mu\bar{\nu}_\tau\pi^-\mu^-\nu_\tau\pi^+\pi^+$	3	9	335
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_e\nu_\tau\pi^+$	29	8	343
$e^+\bar{\nu}_\tau\pi^-e^-\nu_\tau\pi^+\gamma\gamma\gamma$	5	7	350
$\mu^+\bar{\nu}_\tau\pi^-\pi^-K_L\nu_\mu\nu_\tau\pi^+$	22	6	356
$\bar{\nu}_e\bar{\nu}_\tau\pi^-e^-\nu_\tau\pi^+\pi^+$	7	6	362
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+\gamma\gamma$	61	6	368
$\mu^+\bar{\nu}_\tau\pi^-\pi^-\nu_\mu\nu_\tau\pi^+$	24	5	373
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_eK_L\nu_\tau\pi^+$	26	5	378
$e^+\bar{\nu}_\tau\pi^-\pi^-\nu_e\nu_\tau\pi^+\gamma$	28	5	383
$\mu^+\bar{\nu}_\tau\pi^-\nu_\mu\nu_\tau\gamma\gamma\gamma\gamma$	4	5	388
$\bar{\nu}_\mu\bar{\nu}_\tau\pi^-\mu^-\nu_\tau\pi^+\pi^+$	34	5	393
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+$	16	5	398
$\mu^+\bar{\nu}_\tau\pi^-\pi^-\nu_\mu\nu_\tau\pi^+\gamma\gamma$	40	4	402
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+\gamma\gamma$	48	4	406
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+\gamma\gamma$	10	4	410
$\bar{\nu}_\tau\pi^-\pi^-\nu_\tau\pi^+\pi^+$	27	3	413

Consist of DD

- signal:
  - $e^+\pi^-\pi^+\pi^-\bar{\nu}_\tau\nu_e\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
  - $\mu^+\pi^-\pi^+\pi^-\bar{\nu}_\tau\nu_e\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
- π/μ:
  - $\pi^-\pi^-\pi^+\pi^+\bar{\nu}_\tau\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
  - $\pi^-\mu^-\pi^+\pi^-\overline{\nu_\mu}\bar{\nu}_\tau\nu_\tau(\geq 0K_L)(\geq 0\gamma)$
- >4 charged track
  - $e^+\pi^-\pi^+\pi^-\pi^-\nu_e K^+$c

final states	iTopology	nEvt	nTot
$e^+\bar{\nu}_\mu\pi^-\nu_e\mu^-K_L\pi^+c$	41	22	22
$e^+\pi^-\pi^-\nu_e K_L\pi^+\gamma\gamma c$	141	20	42
$e^+\pi^-\pi^-\pi^-\nu_e\pi^+K^+c$	85	17	59
$e^+\bar{\nu}_\mu\pi^-\nu_e\mu^-K_L\pi^+\gamma\gamma c$	19	15	74
$e^+\bar{\nu}_\mu\pi^-\nu_e\mu^-K_L\pi^+\gamma\gamma c$	6	15	89
$\mu^+\bar{\nu}_\mu\pi^-\mu^-K_L\nu_\mu\pi^+\gamma\gamma c$	105	14	103
$e^+\bar{\nu}_\mu\pi^-\nu_e\mu^-K_L\pi^+\gamma\gamma c$	84	14	117
$\mu^+\bar{\nu}_\mu\pi^-\mu^-K_L\nu_\mu\pi^+c$	10	13	130
$\mu^+\bar{\nu}_\mu\pi^-\mu^-K_L\nu_\mu\pi^+\gamma\gamma c$	97	13	143
$\mu^+\pi^-\pi^-K_L\nu_\mu\pi^+\gamma\gamma c$	121	11	154
$\mu^+\pi^-\pi^-K_L\nu_\mu\pi^+\gamma\gamma\gamma\gamma c$	53	10	164
$e^+\pi^-\pi^-\nu_e K_L\pi^+\gamma\gamma\gamma\gamma c$	178	10	174
$\mu^+\bar{\nu}_\mu\pi^-\mu^-K_L\nu_\mu\pi^+\gamma\gamma c$	27	8	182
$e^+\pi^-\pi^-\nu_e K_L\pi^+\gamma\gamma\gamma\gamma c$	87	7	189
$\mu^+\bar{\nu}_\mu\pi^-\mu^-K_L\nu_\mu\pi^+\gamma\gamma c$	11	7	196
$e^+\bar{\nu}_\mu\pi^-\pi^-\nu_e\mu^-\pi^+\pi^+\gamma\gamma c$	176	7	203
$e^+\bar{\nu}_\mu\pi^-K^-\nu_e\mu^-\pi^+\pi^+\gamma\gamma c$	15	7	210
$\mu^+\pi^-\pi^-K_L\nu_\mu\pi^+\gamma\gamma c$	126	6	216
$e^+\pi^-\pi^-\nu_e K_L\pi^+\gamma\gamma\gamma\gamma c$	37	6	222
$e^+\pi^-\pi^-\pi^-\nu_e K_L\pi^+\pi^+\gamma\gamma c$	25	5	227
$\mu^+\pi^-\pi^-K_L\nu_\mu\pi^+\gamma\gamma c$	116	5	232

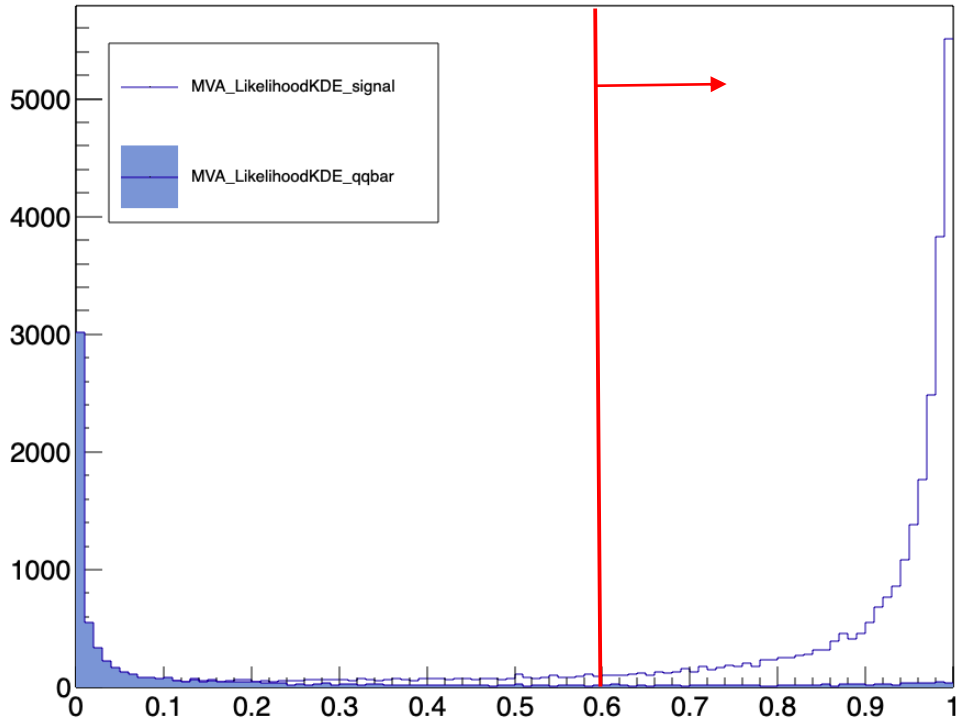
Cut total charged track = 4

	signal tau-		
total events	2*10^5		
step 1	48.06%		
step 2	45.60%		
step 3	28.35%		
step 4	26.75%		
total select efficiency	26.75%	$0\pi^0$	95.56%
		$1\pi^0$	3.86%
		$2\pi^0$	0.49%
		$>2\pi^0$	0.088%

Cut total charged track = 4

		DD	ditau	ISR	qqbar
signal τ^-	selected number	11041	5286	2042	24806
	total number	4*10^6	9.2*10^6	1.1*10^6	2.7*10^7
	efficiency	2.8*10^-3	5.7*10^-4	1.9*10^-3	9.2*10^-4

MVA analysis



MVA analysis

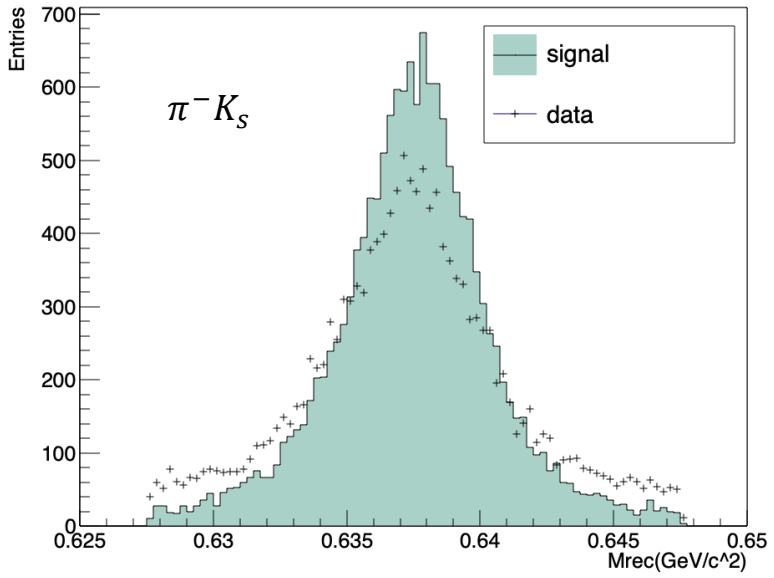
- 1σ for signal, cut 0.6:

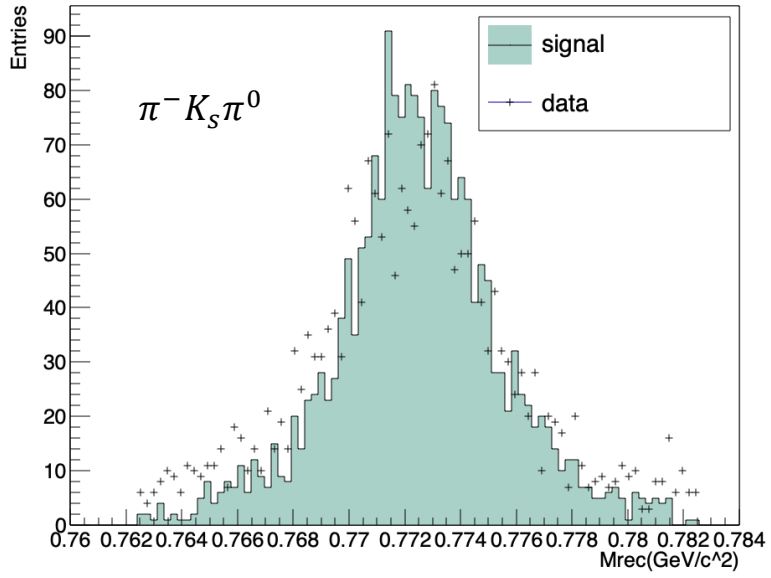
	number event selected (LikelihoodKDE)	select efficiency
		LikelihoodKDE
signal	44989	22.49%
qqbar	2697	9.99*10^-5
ISR	260	2.36*10^-4
ditau	2232	2.43*10^-4
DD	1212	3.03*10^-4

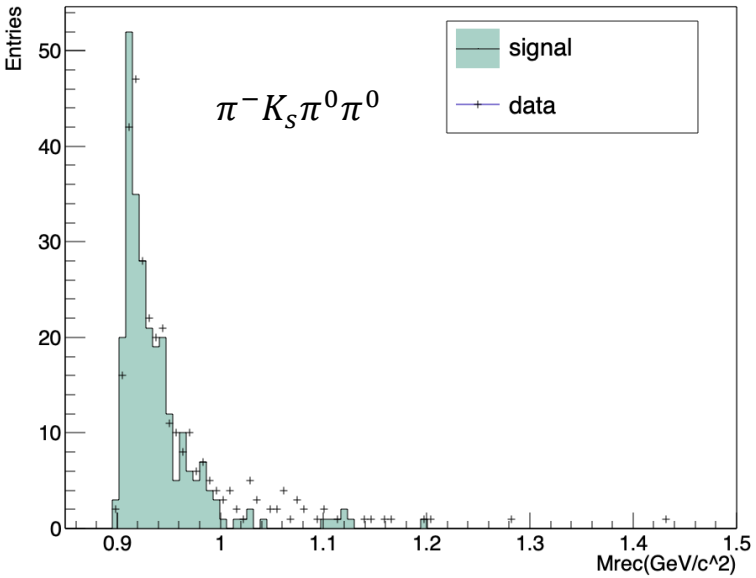
Run data

			data for τ^-	MVA analysis
total number	1.77*10^9	select number	23198	4560

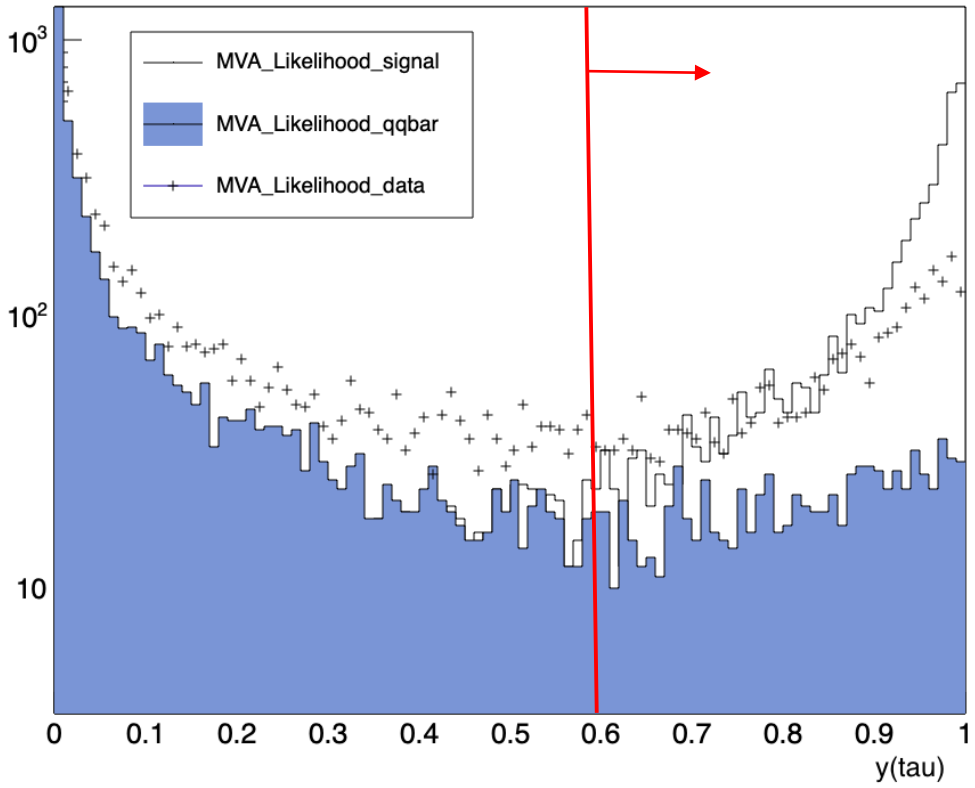
Total invariant mass in signal side







MVA analysis



Run data

total number	1.95*10^9	τ^-	preliminary select	
			MVA select	
		τ^+	preliminary select	
			MVA select	

Next step

- Analysis the different number of τ^- and τ^+ in data;
- Give a decay-rate asymmetry;

BACK UP

Thrust definition

thrust T is defined by

$$T \equiv \max_{\vec{n}} \frac{\sum_i |\vec{n} \cdot \vec{p}_i|}{\sum_i |\vec{p}_i|}, \tag{2.1}$$

where $\vec{p}_i$ runs over the 3-momenta of the final state particles, and $\vec{n}$ is a 3-vector with unit norm. It is conventional to introduce the variable $\tau \equiv 1 - T$, which we will use extensively later. The limit $\tau \to 0$ corresponds to the final-state configuration of two back-to-back jets, and the limit $\tau \to 1/2$ corresponds to a nearly isotropic event.