LCFIPlus Performance Tests with preliminary new samples

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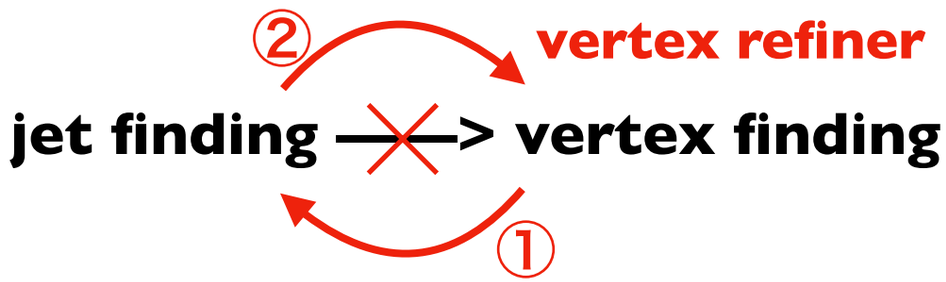
on behalf of LCFIPlus developers

ILD Software meeting
22nd Nov. 2017

What's LCFIPlus?

It's Jet flavour identification tools!

- **Originated from LCFIVertex**



- Assign vertices to jets if necessary
- Find single track vertices ("pseudo-vtx")
- Force two vertices

- **Implemented in iLCSoft, but not necessarily.**
- **Now it is becoming the standard in LC physics.**
- **Developpers :**
  T. Tanabe, T. Suehara, M. Kurata, J. F. Strube

RY has just joined.

1 D. Bailey, et al., The LCFIVertex package: vertexing, flavour tagging and vertex charge reconstruction with an ILC vertex detector, Nucl.Instrum.Meth. A610 (2009) 573–589.

Urgent matter of LCFIPlus

- **iLCSoft has been intensively developed for coming MC mass-production (MP).**
- **Jet clustering part in LCPFPlus can be user option, while vertex finding part is common for most process and thus it is to be performed in the MP.**
- **It means the performance, especially of vertex finding part, must be checked before the MP.**

LCFIPlus performance tests

How ?

Comparing with the previous results that is already published.

NIM A 808 (2016) 109 - 116

Test samples:

- **bb~(~35k), cc~(~40k), qq~ (q= u,d,s) (~40k)**
- **√s=91.2GeV,**
- **W/O ISR,**
- **ILD_l4_v02 and ILD_s4_v02 (from DD4hep)**
- **ilcsoft v01-19-04**
- **produced by Akiya in August 2017 (https://ild.ngt.ndu.ac.jp/elog/dbd-prod/76)**

Issues with these samples :

- **Known problem with detector geometry (v01-19-04)**
- **No RecoMCTruthLink collection (bugs in Marlin).**
- **Temporarily MarlinTrkTracksMCTruthLink collection used.**

(For a particle associated more than 2 tracks, the first track entry is always used.)

- **This can affect our results to some extent.**

Vertex finding results (Reference)

Categorize tracks by their origins using MC info

Reference(Table2)

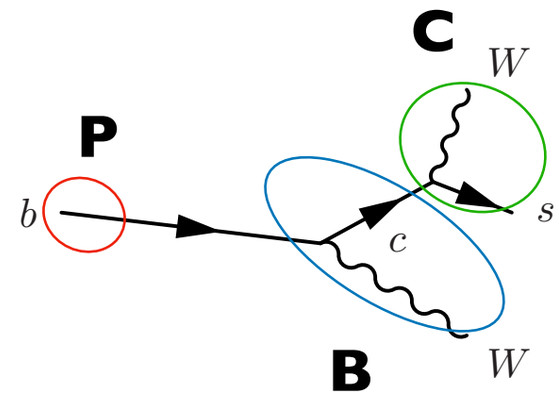
Track origin	Primary
Total number of tracks	496897
Tracks in secondary vertices	0.6%
... from the same decay chain	—
... from the same parent particle	—

Track origin	Bottom
Total number of tracks	258299
Tracks in secondary vertices	57.5%
... from the same decay chain	56.6%
... from the same parent particle	32.2%

Track origin	Charm
Total number of tracks	247352
Tracks in secondary vertices	64.3%
... from the same decay chain	63.4%
... from the same parent particle	38.9%

Track origin	Others
Total number of tracks	56432
Tracks in secondary vertices	2.5%
... from the same decay chain	1.9%
... from the same parent particle	1.2%

(bb~ sample used)



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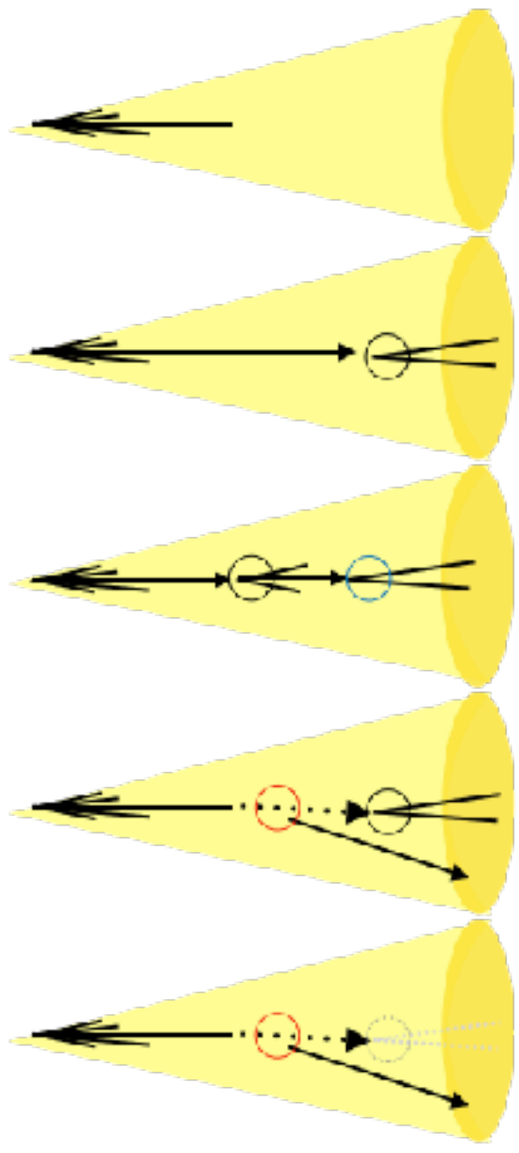
This test

	l4	s4
Primary		
Total number of tracks	329521	319965
Tracks in secondary vertices	0.9%	0.8%
Bottom		
Total number of tracks	182606	181268
Tracks in secondary vertices	59.3%	59.3%
... from the same decay chain	57.5%	57.7%
... from the same parent particle	33.9%	34.3%
Charm		
Total number of tracks	167334	166693
Tracks in secondary vertices	64.8%	65.3%
... from the same decay chain	63.6%	64.2%
... from the same parent particle	38.9%	39.6%
Others		
Total number of tracks	36508	34930
Tracks in secondary vertices	6.6%	6.0%
... from the same decay chain	5.9%	5.5%
... from the same parent particle	1.6%	1.6%

Vertex refiner results

Definition of categories

	(#vtx, #pseudo-vtx)	jet structure
1	(0,0)	q-jet like
2	(1,0)	c-jet like
3	(2,0)	b-jet like
4	(1,1)	b-jet like
5	(0,1)	unexpected



Vertex refiner results

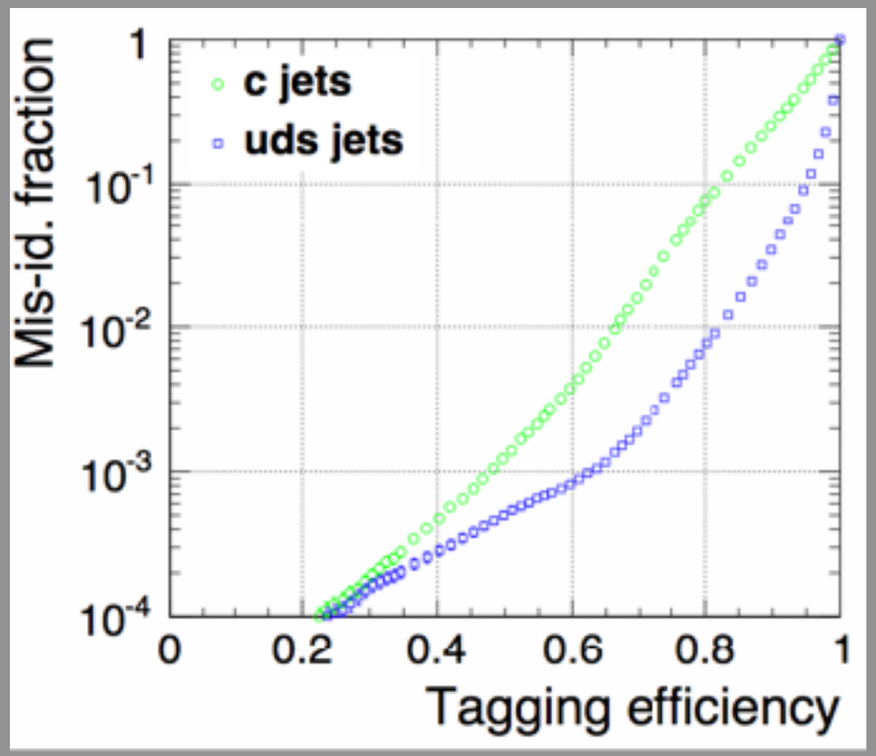
This test

Reference(table3)

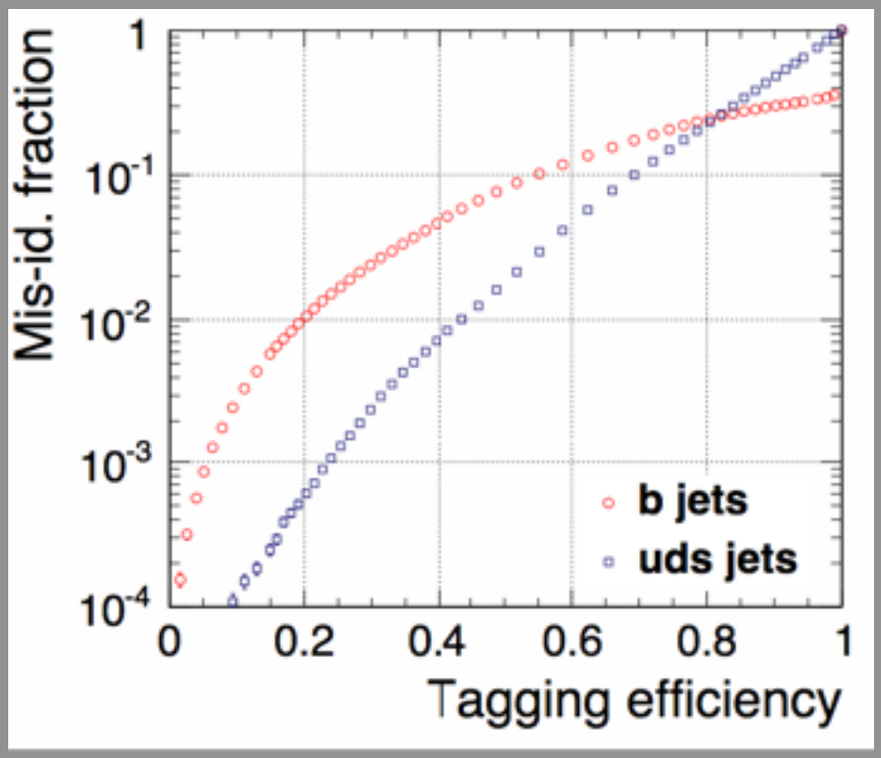
	(#vtx, #pseudo-vtx)	b jet	**l4**	**s4**
bb~	(0,0)	21.3%	**20.3 %**	**20.1 %**
	(0,1)	1.61%	**1.68 %**	**1.74 %**
	(1,0)	39.7%	**37.9 %**	**38.0 %**
	(1,1)	13.5%	**18.6 %**	**18.6 %**
	(2,0)	23.8%	**21.5 %**	**21.4 %**
	(#vtx, #pseudo-vtx)	c jet		
cc~	(0,0)	59.3%	**59.1 %**	**58.8 %**
	(0,1)	0.17%	**0.19 %**	**0.18 %**
	(1,0)	39.8%	**39.9 %**	**40.2 %**
	(1,1)	0.54%	**0.72 %**	**0.69 %**
	(2,0)	0.19%	**0.11 %**	**0.12 %**
	(#vtx, #pseudo-vtx)	uds jet		
qq~	(0,0)	98.1%	**99.0 %**	**99.0 %**
	(0,1)	0.01%	**0.02 %**	**0.01 %**
	(1,0)	1.80%	**0.93 %**	**0.97 %**
	(1,1)	0.02%	**0.03 %**	**0.03 %**
	(2,0)	0.04%	**0.03 %**	**0.02 %**

flavour tagging results (Reference)

reference (Fig.1)

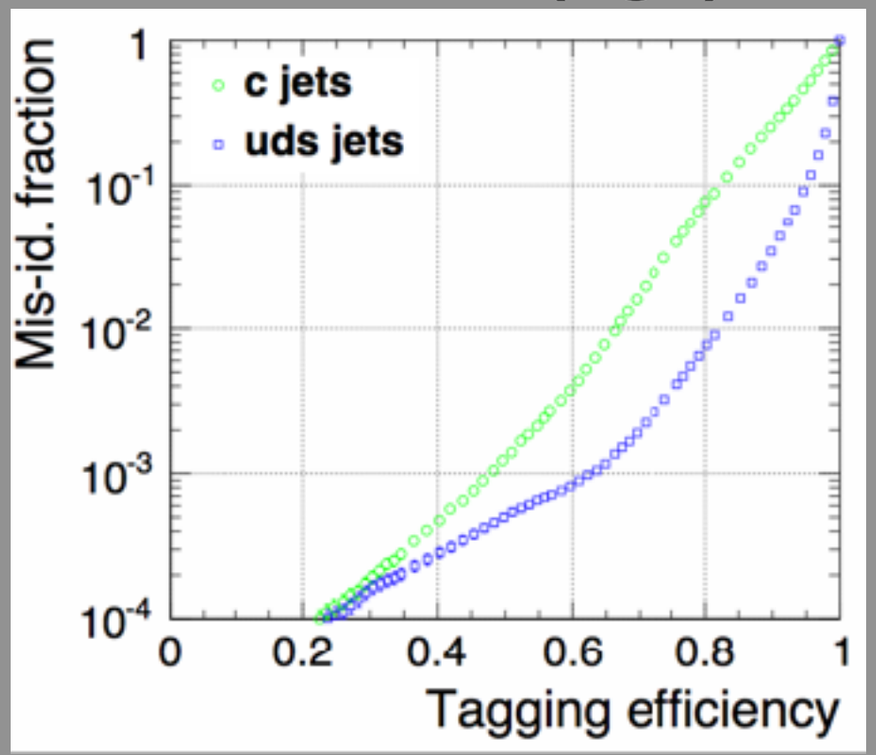


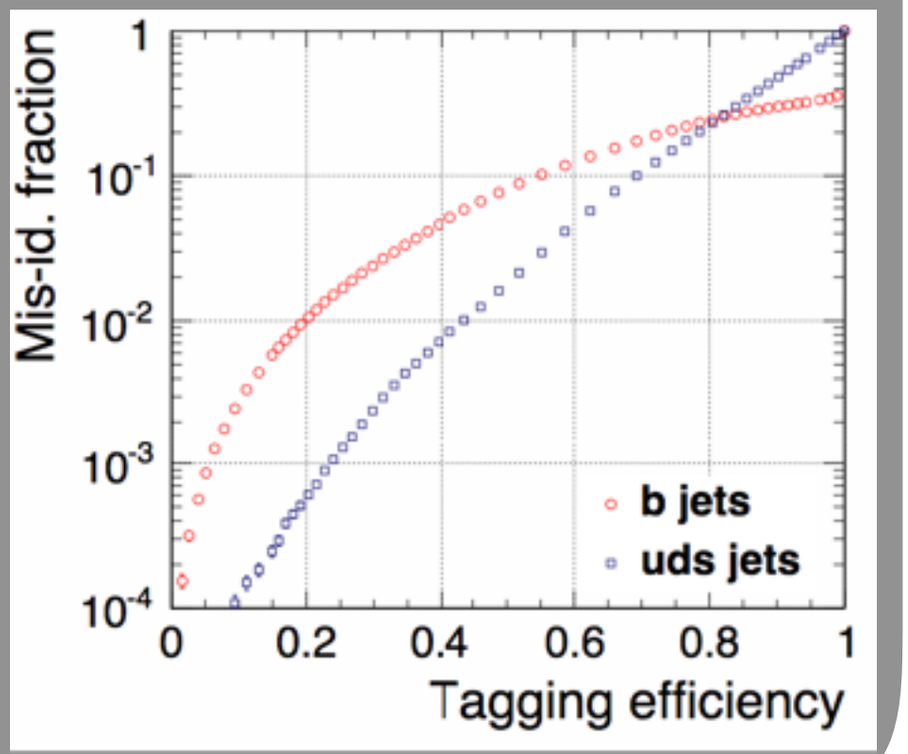
b-tagging performance (Mis-id probability)



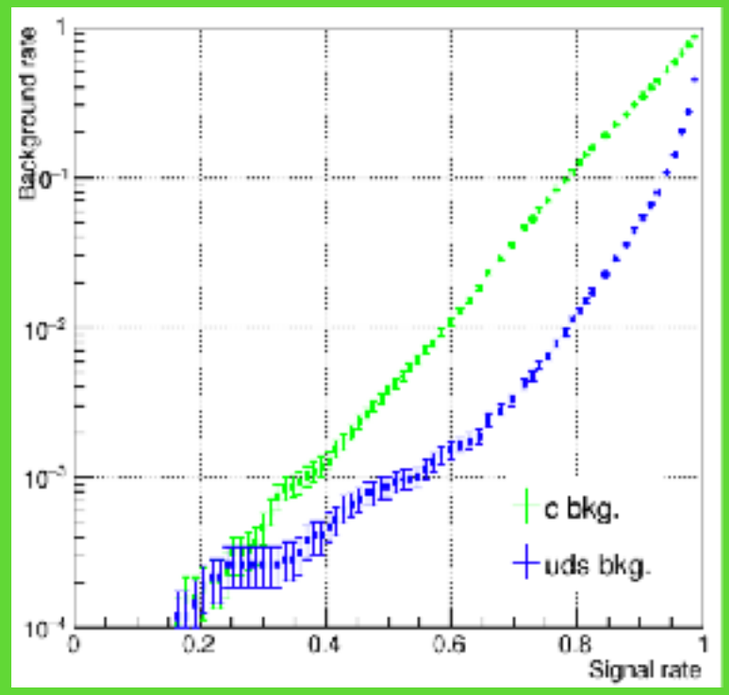
c-tagging performance (Mis-id probability)

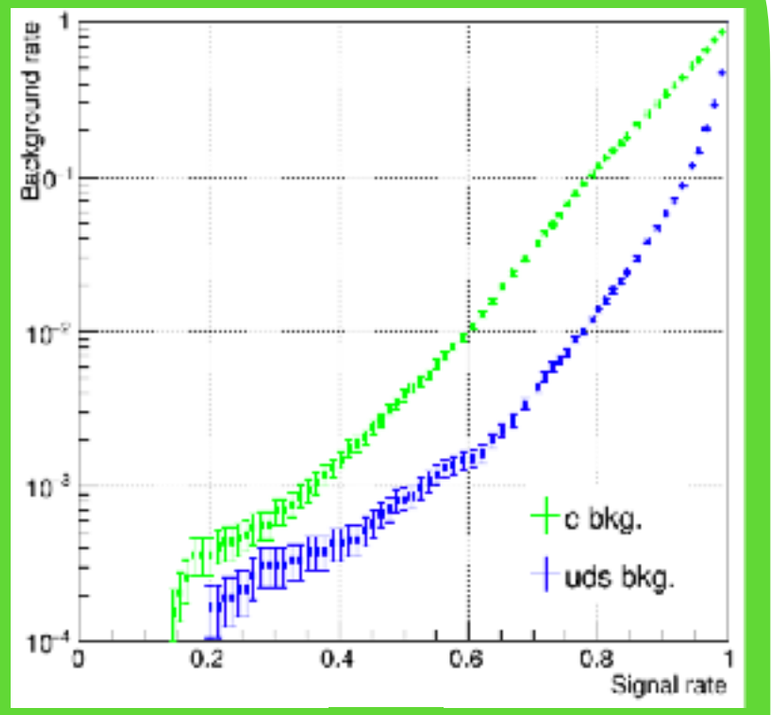
reference (Fig.1)



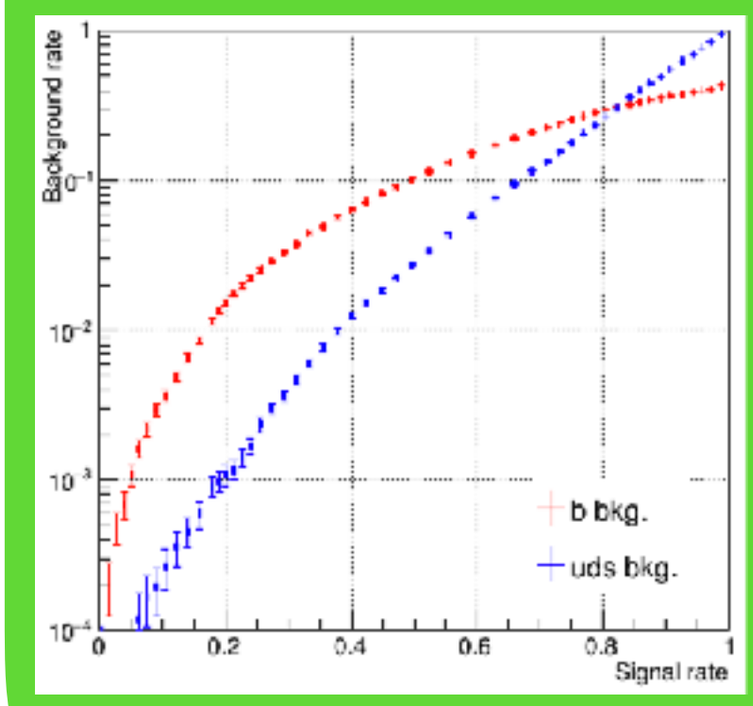


This test

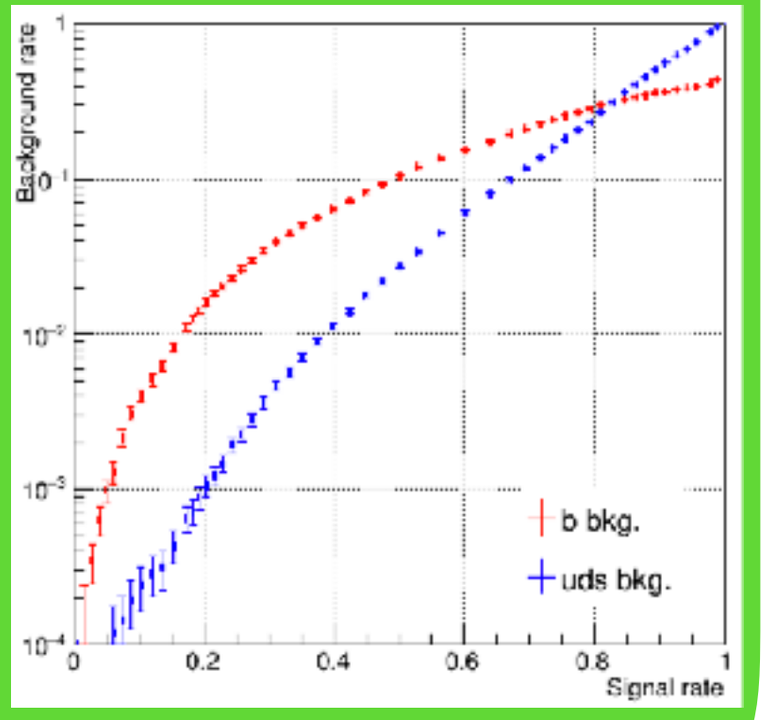




l4



s4



Conclusion

- **We checked LCFIPlus performances with preliminary new samples (ilcsoft v01-19-04).**

- **The results shows NO big disaster.**
  Some differences are still under investigation.

- **We are ready to test LCFIPlus with next samples produced with ilcsoft v01-19-05.**