

Topology Analysis ^{*}

(v1.5)

Xingyu Zhou [†]
Beihang University

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^{*}This package is implemented with reference to a program called TOPO, which is developed by Prof. Shuxian Du from Zhengzhou University in China and has been widely used by people in BESIII collaboration. Several years ago, when I was a PhD student working on BESIII experiment, I learned the idea of topology analysis and a lot of programming techniques from the TOPO program. So, I really appreciate Prof. Du's original work very much. To meet my own needs and to practice developing analysis tools with C++, ROOT and LaTeX, I wrote the package from scratch. At that time, the package functioned well but was relatively simple. At the end of last year (2017), my co-supervisor, Prof. Chengping Shen reminded me that it could be a useful tool for Belle II experiment as well. So, I revised and extended it, making it more well-rounded and suitable for Belle II experiment. Here, I would like to thank Prof. Du for his original work, Prof. Shen for his suggestion and encouragement, and Wencheng Yan, Sen Jia, Yubo Li, Suxian Li, Longke Li, Guanda Gong, Junhao Yin, Xiaoping Qin, Xiqing Hao, HongPeng Wang, JiaWei Zhang for their efforts in helping me test the program.

[†]Email: zhouxy@buaa.edu.cn

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index	event tree (event initial-final states)	iEvtTr	iEvtIFSts	nEvts	nCmltEvts
12	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \rho^- K^+ J/\psi, \bar{B}^0 \rightarrow D^+ D_s^{*-}, \rho^- \rightarrow \pi^0 \pi^-, J/\psi \rightarrow e^+e^-,$ $D^+ \rightarrow \pi^0 \pi^+ K_S, D_s^{*-} \rightarrow D_s^- \gamma, K_S \rightarrow \pi^0 \pi^0, D_s^- \rightarrow \tau^- \bar{\nu}_\tau, \tau^- \rightarrow \mu^- \bar{\nu}_\mu \nu_\tau$ $(e^+e^- \rightarrow e^+e^- \mu^- \bar{\nu}_\mu \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- K^+ \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	11	11	1	12
13	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \pi^+ \pi^- K^0 D^0 \bar{D}^0, \bar{B}^0 \rightarrow \pi^0 \pi^+ \rho^- \rho^- D^+, K^0 \rightarrow K_L, \rho^- \rightarrow \pi^0 \pi^-,$ $\rho^- \rightarrow \pi^0 \pi^-, D^+ \rightarrow \mu^+ \nu_\mu \bar{K}^0, K_L \rightarrow \pi^0 \pi^0 \pi^0, \bar{K}^0 \rightarrow K_L$ $(e^+e^- \rightarrow \mu^+ \nu_\mu K_L \pi^+ \pi^+ \pi^- \pi^- \pi^- D^0 \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	12	12	1	13
14	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \pi^+ \eta \bar{D}^{*-}, \bar{B}^0 \rightarrow K^0 K^{*-} D^{*+}, \eta \rightarrow \pi^0 \pi^0 \pi^0, \bar{D}^{*-} \rightarrow \pi^0 D^-,$ $K^0 \rightarrow K_S, K^{*-} \rightarrow \pi^0 K^-, D^{*+} \rightarrow \pi^+ D^0, D^- \rightarrow \mu^- \bar{\nu}_\mu K^0, K_S \rightarrow \pi^+ \pi^-, K^0 \rightarrow K_L$ $(e^+e^- \rightarrow \mu^- \bar{\nu}_\mu K_L \pi^+ \pi^+ \pi^- \pi^- K^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	13	13	1	14
15	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \rho^+ D^-, \bar{B}^0 \rightarrow \pi^- K^+ K^- D^{*+}, \rho^+ \rightarrow \pi^0 \pi^+, D^- \rightarrow K_S a_1^-,$ $D^{*+} \rightarrow \pi^+ D^0, K_S \rightarrow \pi^0 \pi^0, a_1^- \rightarrow \pi^0 \rho^-, \rho^- \rightarrow \pi^0 \pi^-$ $(e^+e^- \rightarrow \pi^+ \pi^+ \pi^- \pi^- K^+ K^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	14	14	1	15
16	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \pi^0 \pi^0 \pi^+ \eta \bar{D}^{*-}, \bar{B}^0 \rightarrow e^- \bar{\nu}_e D^{*+}, \eta \rightarrow \pi^0 \pi^0 \pi^0, \bar{D}^{*-} \rightarrow \pi^0 D^-,$ $D^{*+} \rightarrow \pi^0 D^+, D^- \rightarrow \pi^+ \pi^- \pi^- \pi^- K^+, D^+ \rightarrow \mu^+ \nu_\mu \bar{K}^*, \bar{K}^* \rightarrow \pi^+ K^-$ $(e^+e^- \rightarrow e^- \bar{\nu}_e \mu^+ \nu_\mu \pi^+ \pi^+ \pi^- \pi^- \pi^- K^+ K^- \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	15	15	1	16
17	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow e^+ \nu_e \bar{D}^{*-}, \bar{B}^0 \rightarrow \pi^0 \pi^+ K^{*-} D^0 \bar{D}^{*0}, \bar{D}^{*-} \rightarrow \pi^- \bar{D}^0, K^{*-} \rightarrow \pi^- \bar{K}^0,$ $\bar{D}^{*0} \rightarrow \pi^0 \bar{D}^0, \bar{K}^0 \rightarrow K_S, K_S \rightarrow \pi^+ \pi^-$ $(e^+e^- \rightarrow e^+ \nu_e \pi^+ \pi^+ \pi^- \pi^- \pi^- D^0 \bar{D}^0 \bar{D}^0 \gamma \gamma \gamma \gamma)$	16	16	1	17
18	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow K^* D^- D^{*+}, \bar{B}^0 \rightarrow \pi^0 \eta \bar{K}^0 K^- D_s^+, K^* \rightarrow \pi^0 K^0, D^- \rightarrow \pi^- \pi^- K^+,$ $D^{*+} \rightarrow \pi^+ D^0, \eta \rightarrow \gamma \gamma, \bar{K}^0 \rightarrow K_L, D_s^+ \rightarrow \mu^+ \nu_\mu \phi, K^0 \rightarrow K_S, \phi \rightarrow K^+ K^-,$ $K_S \rightarrow \pi^0 \pi^0$ $(e^+e^- \rightarrow \mu^+ \nu_\mu K_L \pi^+ \pi^- \pi^- K^+ K^+ K^- K^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	17	17	1	18
19	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \bar{D}^{*-} D_s^{*+}, \bar{B}^0 \rightarrow e^- \bar{\nu}_e D^{*+}, \bar{D}^{*-} \rightarrow \pi^- \bar{D}^0, D_s^{*+} \rightarrow D_s^+ \gamma,$ $D^{*+} \rightarrow \pi^+ D^0, D_s^+ \rightarrow \rho^+ \eta, \rho^+ \rightarrow \pi^0 \pi^+, \eta \rightarrow \pi^0 \pi^0 \pi^0$ $(e^+e^- \rightarrow e^- \bar{\nu}_e \pi^+ \pi^+ \pi^- D^0 \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	18	18	1	19
20	$e^+e^- \rightarrow \Upsilon(4S), \Upsilon(4S) \rightarrow B^0\bar{B}^0, B^0 \rightarrow \mu^+ \nu_\mu D_2^{*-}, \bar{B}^0 \rightarrow \pi^0 \pi^+ \pi^+ \pi^- \rho^- \bar{D}^{*0}, D_2^{*-} \rightarrow \pi^- \bar{D}^{*0}, \rho^- \rightarrow \pi^0 \pi^-,$ $\bar{D}^{*0} \rightarrow \pi^0 \bar{D}^0, \bar{D}^{*0} \rightarrow \pi^0 \bar{D}^0$ $(e^+e^- \rightarrow \mu^+ \nu_\mu \pi^+ \pi^+ \pi^- \pi^- \pi^- \bar{D}^0 \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma)$	19	19	1	20

Table 2: Event initial-final states.

index	event initial-final states	iEvtIFSts	nEvs	nCmltEvs
1	$e^+e^- \rightarrow e^- \bar{\nu}_e \pi^+ \pi^+ \pi^+ \pi^- \pi^- K^+ K^- D^0 \bar{D}^0 \gamma \gamma \gamma \gamma$	0	1	1
2	$e^+e^- \rightarrow e^+ e^- \pi^+ \pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^- D^0 \gamma \gamma \gamma$	1	1	2
3	$e^+e^- \rightarrow e^+ \nu_e K_L K_L \pi^+ \pi^+ \pi^- \pi^- \pi^- K^+ D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	2	1	3
4	$e^+e^- \rightarrow e^+ e^- \pi^+ \pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^- D^0 \bar{D}^0 \gamma \gamma$	3	1	4
5	$e^+e^- \rightarrow e^+ \nu_e \pi^+ \pi^+ \pi^- \pi^- \pi^- K^+ K^- \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	4	1	5
6	$e^+e^- \rightarrow e^+ e^- \nu_e \nu_e \pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^- K^- \bar{D}^0 \gamma \gamma \gamma \gamma$	5	1	6
7	$e^+e^- \rightarrow \pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- K^+ K^- \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	6	1	7
8	$e^+e^- \rightarrow e^+ \nu_e \nu_\tau \bar{\nu}_\tau \pi^+ \pi^+ \pi^- \pi^- \pi^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	7	1	8
9	$e^+e^- \rightarrow \mu^- \bar{\nu}_\mu \pi^+ \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	8	1	9
10	$e^+e^- \rightarrow \mu^+ \nu_\mu K_L \pi^+ \pi^+ \pi^- \pi^- \pi^- \pi^- \pi^- K^+ K^+ K^- \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	9	1	10
11	$e^+e^- \rightarrow \mu^+ \mu^+ \nu_\mu \nu_\mu K_L K_L \pi^+ \pi^- \pi^- K^- \bar{D}^0 \gamma \gamma$	10	1	11
12	$e^+e^- \rightarrow e^+ e^- \mu^- \bar{\nu}_\mu \nu_\tau \bar{\nu}_\tau \pi^+ \pi^- K^+ \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	11	1	12
13	$e^+e^- \rightarrow \mu^+ \nu_\mu K_L \pi^+ \pi^+ \pi^- \pi^- \pi^- D^0 \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	12	1	13
14	$e^+e^- \rightarrow \mu^- \bar{\nu}_\mu K_L \pi^+ \pi^+ \pi^+ \pi^- K^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	13	1	14
15	$e^+e^- \rightarrow \pi^+ \pi^+ \pi^- \pi^- K^+ K^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	14	1	15
16	$e^+e^- \rightarrow e^- \bar{\nu}_e \mu^+ \nu_\mu \pi^+ \pi^+ \pi^- \pi^- \pi^- K^+ K^- \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	15	1	16
17	$e^+e^- \rightarrow e^+ \nu_e \pi^+ \pi^+ \pi^- \pi^- \pi^- D^0 \bar{D}^0 \gamma \gamma \gamma \gamma$	16	1	17
18	$e^+e^- \rightarrow \mu^+ \nu_\mu K_L \pi^+ \pi^- \pi^- K^+ K^+ K^- K^- D^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	17	1	18
19	$e^+e^- \rightarrow e^- \bar{\nu}_e \pi^+ \pi^+ \pi^- D^0 \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	18	1	19
20	$e^+e^- \rightarrow \mu^+ \nu_\mu \pi^+ \pi^+ \pi^- \pi^- \pi^- \bar{D}^0 \bar{D}^0 \gamma \gamma \gamma \gamma \gamma \gamma \gamma \gamma$	19	1	20