

# Topology Analysis <sup>\*†‡§</sup>

(v2.12.3)

August 16, 2023

---

<sup>\*</sup>Xingyu Zhou, Liaoning Normal University, zhouxy@lnnu.edu.cn

<sup>†</sup>This package is implemented referring to a program called TOPO, which is first developed by Prof. Shuxian Du from Zhengzhou University and later extended and maintained by Prof. Gang Li from Institute of High Energy Physics, Chinese Academy of Sciences. The TOPO program has been widely used by colleagues in BESIII collaboration. Several years ago, when I was a Ph.D. student working on the BESIII experiment, I learned the idea of topology analysis and a lot of programming techniques from the TOPO program. So, I really appreciate the original works of Prof. Du and Prof. Li 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 2017, when I just started my post-doctoral research at Beihang University, my co-supervisor Prof. Chengping Shen reminded me that it could be a useful tool for the Belle II experiment as well. So, I revised and extended it, making it more well-rounded and suitable for the Belle II experiment. Now, it also applies to many other similar high energy physics experiments. Here, I would like to thank Prof. Du and Prof. Li for their original works, and Prof. Shen for his suggestion, guidance, support, and encouragement.

<sup>‡</sup>Besides, I would like to thank all of the people who have helped me in the development of the program. I am particularly grateful to Prof. Xingtao Huang for his comments on the principles and styles of the program, to Remco de Boer for his suggestions on the tex output and the use of GitHub, and to Xi Chen for his discussions on the core algorithms. I am especially indebted to Prof. Xiqing Hao, Longke Li, Xiaoping Qin, Ilya Komarov, Yubo Li, Guanda Gong, Suxian Li, Junhao Yin, Prof. Xiaolong Wang, Yeqi Chen, Hannah Wakeling, Hongrong Qi, Hui Li, Ning Cao, Sanjeeda Bharati Das, Kazuki Kojima, Tingting Han, Fang Yan, Lin Wang, Meiru An, and Noreen Rauls for their advice in extending and perfecting the program. Also, I thank Xi'an Xiong, Runqiu Ma, Wencheng Yan, Sen Jia, Lu Cao, Dong Liu, Hongpeng Wang, Jiawei Zhang, Jiajun Liu, Maoqiang Jing, Yi Zhang, Wei Shan, and Yadi Wang for their efforts in helping me test the program.

<sup>§</sup>The paper on the tool has been published by *Computer Physics Communications*. You can find this paper and the preprint corresponding to it in the links [Comput. Phys. Commun. 258 \(2021\) 107540](#) and [arXiv:2001.04016](#), respectively. If the tool really helps your researches, we would appreciate it very much if you could cite the paper in your publications.

## List of Tables

1	Decay trees and their respective initial-final states. . . . .	3
---	--	---

Table 1: Decay trees and their respective initial-final states.

rowNo	decay tree (decay initial-final states)	iDcyTr	nEtr	nCEtr
1	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\rho^+\rho^-K^+K^-\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	78	7	7
2	$e^+e^- \rightarrow \pi^0\pi^+\pi^+\pi^-\rho^-\omega K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	246	6	13
3	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\rho^0\pi^+\pi^-K^+K^-, \rho^0 \rightarrow \pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	97	5	18
4	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-\rho^-K^+K^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-$ )	203	5	23
5	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^I$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	352	5	28
6	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\rho^0\pi^+\pi^-K^+K^-\gamma^I, \rho^0 \rightarrow \pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	469	5	33
7	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^-\rho^+\omega K^+K^-\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	484	5	38
8	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\rho^-K^+K^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	1080	5	43
9	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^I$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	1166	5	48
10	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-\rho^+\rho^-K^+K^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	1325	5	53
11	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	144	4	57
12	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^-\rho^+\omega K^+K^-, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	145	4	61
13	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\omega K^+K^-\gamma^I, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	155	4	65
14	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-\rho^+\omega K^+K^-, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	212	4	69
15	$e^+e^- \rightarrow \pi^-\rho^+K^*\bar{K}^*K^-K^{*+}\gamma^I\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, K^* \rightarrow \pi^-K^+, \bar{K}^* \rightarrow \pi^+K^-, K^{*+} \rightarrow \pi^+K^0, K^0 \rightarrow K_L^0$ ( $e^+e^- \dashrightarrow \pi^0K_L^0\pi^+\pi^+\pi^-\pi^-K^+K^-K^-\gamma^I\gamma^I$ )	233	4	73
16	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-\pi^-\omega\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^-\gamma^I$ )	417	4	77
17	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	518	4	81

rowNo	decay tree (decay initial-final states)	iDcyTr	nEtr	nCEtr
18	$e^+e^- \rightarrow \pi^+\pi^-\rho^+\rho^-K^+K^-, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	827	4	85
19	$e^+e^- \rightarrow \pi^0\pi^+\pi^+\rho^-\rho^-K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	1007	4	89
20	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-K^+K^-p\bar{p}$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^-K^+K^-p\bar{p}$ )	1278	4	93
21	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^-\pi^-\rho^+\rho^+K^+K^-, \rho^+ \rightarrow \pi^0\pi^+, \rho^+ \rightarrow \pi^0\pi^+$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	91	3	96
22	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\rho^-K^+K^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	45	3	99
23	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-\rho^+K^+K^{*-}, \rho^+ \rightarrow \pi^0\pi^+, K^{*-} \rightarrow \pi^0K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	112	3	102
24	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-K^+K^-\gamma^I, \rho^0 \rightarrow \pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	131	3	105
25	$e^+e^- \rightarrow \pi^+\pi^-\rho^+\rho^-K^+K^-\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	160	3	108
26	$e^+e^- \rightarrow \pi^0\rho^0\pi^-\rho^+K^+K^-\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	305	3	111
27	$e^+e^- \rightarrow \pi^0\pi^+\pi^-K^+K^+K^-K^{*-}, K^{*-} \rightarrow \pi^0K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^-\pi^-K^+K^+K^-K^-$ )	366	3	114
28	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\rho^+\rho^-\omega, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-$ )	372	3	117
29	$e^+e^- \rightarrow \rho^0\pi^+\pi^+\pi^-\rho^-K^+K^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-$ )	445	3	120
30	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\rho^+K^*K^-\gamma^I\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, K^* \rightarrow \pi^-K^+$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I$ )	447	3	123
31	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\rho^-K^-K^{*+}\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^- \rightarrow \pi^0\pi^-, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	631	3	126
32	$e^+e^- \rightarrow \pi^0\pi^-\rho^+K^-p\bar{\Lambda}, \rho^+ \rightarrow \pi^0\pi^+, \bar{\Lambda} \rightarrow \pi^0\bar{n}$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^-p\bar{p}$ )	672	3	129
33	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^-\omega\bar{K}^*K^+\gamma^I, \omega \rightarrow \pi^0\pi^+\pi^-, \bar{K}^* \rightarrow \pi^+K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	766	3	132
34	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\rho^0\pi^+\pi^-\omega, \rho^0 \rightarrow \pi^+\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-$ )	839	3	135
35	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\omega K^+K^{*-}, \omega \rightarrow \pi^0\pi^+\pi^-, K^{*-} \rightarrow \pi^0K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	894	3	138

rowNo	decay tree (decay initial-final states)	iDcyTr	nEtr	nCEtr
36	$e^+e^- \rightarrow \pi^0\pi^-\pi^-\rho^+\rho^+\omega K^+K^-, \rho^+ \rightarrow \pi^0\pi^+, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-$ )	1086	3	141
37	$e^+e^- \rightarrow \pi^0\pi^+\pi^+\pi^-\pi^-\omega K^+K^-\gamma^I, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	1232	3	144
38	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^-\rho^+K^-K^{*+}\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	1273	3	147
39	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\pi^+\pi^-K^+K^-\gamma^I\gamma^I, \rho^0 \rightarrow \pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I$ )	1415	3	150
40	$e^+e^- \rightarrow \pi^0\pi^+\pi^+\pi^-\rho^-\omega\gamma^I, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	1491	3	153
41	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-\rho^+\rho^-K^+K^-\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	1494	3	156
42	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^-\rho^+K^+K^-\gamma^I, \rho^+ \rightarrow \pi^0\pi^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-K^+K^-\gamma^I$ )	1508	3	159
43	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-\pi^-\rho^+K^+K^-\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	1581	3	162
44	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\rho^0\pi^+\rho^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-$ )	1690	3	165
45	$e^+e^- \rightarrow \rho^+\rho^-K^+K^-K^-K^{*+}, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-, K^{*+} \rightarrow \pi^+K^0, K^0 \rightarrow K_S^0, K_S^0 \rightarrow \pi^+\pi^-\gamma^F$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-K^-\gamma^F$ )	1924	3	168
46	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\rho^-\omega K^+K^-, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ )	2022	3	171
47	$e^+e^- \rightarrow \pi^+\pi^-\rho^+\rho^-K^+K^-\gamma^I\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I$ )	2081	3	174
48	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\omega K^+K^-\gamma^I, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	2340	3	177
49	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\rho^-K^+K^+K^-K^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-K^+K^+K^-K^-$ )	2366	3	180
50	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I, \rho^0 \rightarrow \pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I$ )	2541	3	183
51	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\rho^0\pi^+\pi^-\omega K^+K^-, \rho^0 \rightarrow \pi^+\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	2601	3	186
52	$e^+e^- \rightarrow \pi^0\pi^0\pi^-\rho^+K^-K^{*+}\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-K^+K^-\gamma^I$ )	2788	3	189
53	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^-\bar{K}^*K^+K^+K^-, \bar{K}^* \rightarrow \pi^+K^-$ ( $e^+e^- \rightarrow \pi^0\pi^+\pi^+\pi^-\pi^-K^+K^+K^-K^-$ )	2980	3	192

rowNo	decay tree (decay initial-final states)	iDcyTr	nEtr	nCEtr
54	$e^+e^- \rightarrow \rho^-\eta\bar{K}^*K^+\phi, \rho^- \rightarrow \pi^0\pi^-, \eta \rightarrow \pi^0\pi^+\pi^-, \bar{K}^* \rightarrow \pi^+K^-, \phi \rightarrow K^+K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-K^+K^+K^-K^-$ )	3010	3	195
55	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-K^+K^-\gamma^I$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-K^+K^-\gamma^I$ )	3165	3	198
56	$e^+e^- \rightarrow \pi^0\pi^0\pi^-\rho^+\rho^-\omega\bar{K}^*K^+\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-, \bar{K}^* \rightarrow \pi^+K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	3322	3	201
57	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\rho^0\pi^+\pi^-\pi^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-\gamma^F$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^-\gamma^F$ )	19	2	203
58	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\rho^0\pi^+\pi^-\omega\gamma^I, \rho^0 \rightarrow \pi^+\pi^-\gamma^F, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\gamma^I\gamma^F$ )	25	2	205
59	$e^+e^- \rightarrow \pi^0\pi^0\rho^-\bar{K}^*K^+K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-, \bar{K}^* \rightarrow \pi^0\bar{K}^0, \bar{K}^0 \rightarrow K_L^0, K_L^0 \rightarrow \pi^0\pi^0\pi^0$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^0\pi^0\pi^-\pi^-K^+K^+K^-\gamma^I$ )	28	2	207
60	$e^+e^- \rightarrow \pi^0\pi^0\pi^-\rho^+\rho^+K^*K^-\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^+ \rightarrow \pi^0\pi^+, K^* \rightarrow \pi^-K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	35	2	209
61	$e^+e^- \rightarrow \pi^0\rho^0\pi^-\rho^+K^-K^{*+}, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	38	2	211
62	$e^+e^- \rightarrow \pi^0\pi^0\pi^-\rho^+\omega K^+K^-, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ )	0	2	213
63	$e^+e^- \rightarrow \pi^+\pi^+\pi^-\rho^-\omega K^*K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-, K^* \rightarrow \pi^-K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	2	2	215
64	$e^+e^- \rightarrow \pi^0\rho^0\pi^+\pi^-\rho^-\gamma^I\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-\gamma^I\gamma^I$ )	82	2	217
65	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\rho^+K^+K^-\phi, \rho^+ \rightarrow \pi^0\pi^+, \phi \rightarrow K^+K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^+K^-K^-$ )	83	2	219
66	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\rho^-\rho^-K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	87	2	221
67	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\omega K^*K^-\gamma^I, \omega \rightarrow \pi^0\pi^+\pi^-, K^* \rightarrow \pi^-K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	6	2	223
68	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\rho^-K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-\gamma^F$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^F$ )	95	2	225
69	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\rho^-K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	13	2	227
70	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\omega\omega\gamma^I\gamma^I, \omega \rightarrow \pi^0\pi^+\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\gamma^I\gamma^I$ )	98	2	229
71	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\pi^+\pi^-K^*\bar{K}^*, \rho^0 \rightarrow \pi^+\pi^-, K^* \rightarrow \pi^-K^+, \bar{K}^* \rightarrow \pi^+K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-$ )	111	2	231

rowNo	decay tree (decay initial-final states)	iDcyTr	nEtr	nCEtr
72	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\pi^+\pi^-K^-K^{*+}, \rho^0 \rightarrow \pi^+\pi^-, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ )	116	2	233
73	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-\omega K^+K^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	130	2	235
74	$e^+e^- \rightarrow \pi^0\pi^+\pi^+\pi^-\rho^-K^+K^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	133	2	237
75	$e^+e^- \rightarrow \pi^0\pi^+\pi^+\rho^-\omega K^+K^-, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	171	2	239
76	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\pi^+\pi^-K^+K^-, \rho^0 \rightarrow \pi^+\pi^-\gamma^F$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^F$ )	180	2	241
77	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\rho^-\bar{K}^*K^+, \rho^- \rightarrow \pi^0\pi^-, \bar{K}^* \rightarrow \pi^+K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ )	187	2	243
78	$e^+e^- \rightarrow \pi^-\rho^+\omega K^+K^-\gamma^I\gamma^I\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I\gamma^I$ )	216	2	245
79	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^-K^{*+}\gamma^I, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	229	2	247
80	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\rho^-K^+K^-\gamma^I\gamma^I, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-K^+K^-\gamma^I\gamma^I$ )	253	2	249
81	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\pi^-\rho^+\omega\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	307	2	251
82	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^-\rho^+K^+K^{*-}, \rho^+ \rightarrow \pi^0\pi^+, K^{*-} \rightarrow \pi^0K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-$ )	309	2	253
83	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-K^*\bar{K}^*K^-K^{*+}, K^* \rightarrow \pi^-K^+, \bar{K}^* \rightarrow \pi^+K^-, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-K^-$ )	320	2	255
84	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\rho^+K^*K^-\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, K^* \rightarrow \pi^-K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	339	2	257
85	$e^+e^- \rightarrow \pi^0\pi^+\rho^-K^+K^+K^-K^-\gamma^I\gamma^I, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-K^+K^+K^-K^-\gamma^I\gamma^I$ )	364	2	259
86	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\rho^+\rho^-K^0K^-\gamma^I\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-, K^0 \rightarrow K_L^0$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0K_L^0\pi^+\pi^-\pi^-K^-\gamma^I\gamma^I$ )	377	2	261
87	$e^+e^- \rightarrow \pi^+\pi^-\rho^+\rho^-K^-K^{*+}\gamma^I, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-, K^{*+} \rightarrow \pi^0K^+$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I$ )	379	2	263
88	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^-K^+K^-\bar{n}p$ ( $e^+e^- \rightarrow \pi^0\pi^+\pi^-\pi^-K^+K^-\bar{n}p$ )	383	2	265
89	$e^+e^- \rightarrow \rho^0\pi^-\rho^+K^+K^{*-}\gamma^I\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+, K^{*-} \rightarrow \pi^0K^-$ ( $e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I$ )	394	2	267

rowNo	decay tree (decay initial-final states)	iDcyTr	nEtr	nCEtr
90	$e^+e^- \rightarrow \pi^0\pi^0\rho^0\rho^0\omega K^+K^-\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+K^-\gamma^I$ )	399	2	269
91	$e^+e^- \rightarrow \pi^0\pi^+\pi^-\bar{K}^0 K^* K^+ K^- \phi \gamma^I, \bar{K}^0 \rightarrow K_L^0, K^* \rightarrow \pi^- K^+ \gamma^F, \phi \rightarrow K^+ K^-$ ( $e^+e^- \dashrightarrow \pi^0 K_L^0 \pi^+\pi^-\pi^-K^+K^+K^+K^-K^-\gamma^I\gamma^F$ )	401	2	271
92	$e^+e^- \rightarrow \pi^+\pi^-\rho^- K^+ K^- \bar{n}p, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^+\pi^-\pi^-K^+K^- \bar{n}p$ )	409	2	273
93	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^-\eta K^+ K^-, \eta \rightarrow \pi^0\pi^+\pi^-\gamma^F$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^F$ )	413	2	275
94	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\rho^-, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-$ )	421	2	277
95	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^-\rho^+\rho^-\omega, \rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-$ )	428	2	279
96	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\rho^-\omega K^- K^{*+}, \rho^- \rightarrow \pi^0\pi^-, \omega \rightarrow \pi^0\pi^+\pi^-, K^{*+} \rightarrow \pi^0 K^+$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-$ )	433	2	281
97	$e^+e^- \rightarrow \rho^0\pi^+\pi^-\pi^-\rho^+\omega\gamma^I\gamma^I, \rho^0 \rightarrow \pi^+\pi^-, \rho^+ \rightarrow \pi^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\pi^-\gamma^I\gamma^I$ )	437	2	283
98	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^-\rho^- K^+ K^- \gamma^I\gamma^I\gamma^I, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-K^+K^-\gamma^I\gamma^I\gamma^I$ )	462	2	285
99	$e^+e^- \rightarrow \pi^0\pi^0\pi^0\pi^+ K^* K^+ K^- K^- \phi \gamma^I\gamma^I, K^* \rightarrow \pi^- K^+, \phi \rightarrow K^+ K^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^-K^+K^+K^+K^-K^-K^-\gamma^I\gamma^I$ )	463	2	287
100	$e^+e^- \rightarrow \pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\rho^-\gamma^I, \rho^- \rightarrow \pi^0\pi^-$ ( $e^+e^- \dashrightarrow \pi^0\pi^0\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-\gamma^I$ )	474	2	289
rest	$e^+e^- \rightarrow \text{others (3956 in total)}$ ( $e^+e^- \dashrightarrow \text{corresponding to others}$ )	—	4164	4453