

Topology Analysis ^{*†‡§}

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[†]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.

[‡]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.

[§]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.

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Table 1: Decay trees and their respective final states.

rowNo	decay tree	decay final state	iDcyTr	nEtr	nCcEtr	nAllEtr	nCEtr
1	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}a_1^0\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_1^0 \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	90	71	57	128	128
2	$e^+e^- \rightarrow \bar{\Delta}^-\Delta^{++}b_1^-\gamma^f, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, \Delta^{++} \rightarrow \pi^+p, b_1^- \rightarrow \pi^-\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	21	35	92	127	255
3	$e^+e^- \rightarrow p\bar{\Delta}^{--}b_1^+\gamma^f, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	45	73	42	115	370
4	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}b_1^0\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	4	112	—	112	482
5	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}h_1(1170)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, h_1(1170) \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	73	54	49	103	585
6	$e^+e^- \rightarrow \bar{\Delta}^-\Delta^{++}b_1^-, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, \Delta^{++} \rightarrow \pi^+p, b_1^- \rightarrow \pi^-\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	145	51	45	96	681
7	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}b_1^0, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	149	79	—	79	760
8	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}a_1^0, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_1^0 \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	38	39	38	77	837
9	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}h_1(1170)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, h_1(1170) \rightarrow \pi^0\rho^0, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	313	66	—	66	903
10	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}h_1(1170), \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, h_1(1170) \rightarrow \pi^+\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	230	37	25	62	965
11	$e^+e^- \rightarrow p\bar{\Delta}^{--}a_1^+\gamma^f, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	695	31	25	56	1021
12	$e^+e^- \rightarrow \bar{p}\Delta^{++}b_1^-, \Delta^{++} \rightarrow \pi^+p, b_1^- \rightarrow \pi^-\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	403	22	33	55	1076
13	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^{--}a_1^+\gamma^f, \Delta^+ \rightarrow \pi^0p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	128	30	24	54	1130
14	$e^+e^- \rightarrow n\bar{p}b_1^+\gamma^f, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	132	25	24	49	1179
15	$e^+e^- \rightarrow \Delta^0\bar{\Delta}^{--}b_1^+\gamma^f, \Delta^0 \rightarrow \pi^-p, \bar{\Delta}^{--} \rightarrow \pi^0\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	70	19	21	40	1219
16	$e^+e^- \rightarrow \pi^+p\bar{p}b_1^-\gamma^f, b_1^- \rightarrow \pi^-\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	121	16	22	38	1257
17	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^-\bar{K}^0K^+, \bar{K}^0 \rightarrow K_S^0, K_S^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-\pi^-K^+p\bar{p}\gamma^f$	622	13	24	37	1294
18	$e^+e^- \rightarrow \bar{\Delta}^-\Delta^{++}a_1^-, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, \Delta^{++} \rightarrow \pi^+p, a_1^- \rightarrow \rho^0\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	742	12	25	37	1331
19	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \rho^0\pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	125	36	—	36	1367
20	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^0K^+K^-$	$\pi^0\pi^+\pi^-\pi^-K^+K^-p\bar{p}\gamma^f$	176	34	—	34	1401
21	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285), \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^0K^+K^-$	$\pi^0\pi^+\pi^-\pi^-K^+K^-p\bar{p}$	203	34	—	34	1435

rowNo	decay tree	decay final state	iDcyTr	nEtr	nCcEtr	nAllEtr	nCEtr
22	$e^+e^- \rightarrow n\bar{p}a_1^+\gamma^f, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-n\bar{p}\gamma^f$	612	20	13	33	1468
23	$e^+e^- \rightarrow p\bar{p}a_1^0\gamma^f, a_1^0 \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^-p\bar{p}\gamma^f$	158	18	12	30	1498
24	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}h_1(1170), \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, h_1(1170) \rightarrow \pi^0\rho^0, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	223	30	—	30	1528
25	$e^+e^- \rightarrow K^+\bar{p}\Lambda\gamma^f, \Lambda \rightarrow \pi^-p$	$\pi^-K^+p\bar{p}\gamma^f$	659	14	14	28	1556
26	$e^+e^- \rightarrow p\bar{p}h_1(1170)\gamma^f, h_1(1170) \rightarrow \pi^+\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^+\pi^-p\bar{p}\gamma^f$	59	12	15	27	1583
27	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285), \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \rho^0\pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}$	106	27	—	27	1610
28	$e^+e^- \rightarrow \pi^0\Delta^{++}\bar{\Delta}^{--}\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}$	$\pi^0\pi^+\pi^-p\bar{p}\gamma^f$	923	27	—	27	1637
29	$e^+e^- \rightarrow K^+\bar{p}\Lambda b_1^0\gamma^f, \Lambda \rightarrow \pi^-p, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	11	10	16	26	1663
30	$e^+e^- \rightarrow \Lambda\bar{\Sigma}^{*-}b_1^+\gamma^f, \Lambda \rightarrow \pi^-p, \bar{\Sigma}^{*-} \rightarrow \pi^-\bar{\Lambda}, b_1^+ \rightarrow \pi^+\omega, \bar{\Lambda} \rightarrow \pi^+\bar{p}, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	400	11	13	24	1687
31	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0'\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow K^+K^-$	$\pi^+\pi^-K^+K^-p\bar{p}\gamma^f$	84	22	—	22	1709
32	$e^+e^- \rightarrow K^+\bar{p}\Lambda b_1^0, \Lambda \rightarrow \pi^-p, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}$	137	9	13	22	1731
33	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0', \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow K^+K^-$	$\pi^+\pi^-K^+K^-p\bar{p}$	526	22	—	22	1753
34	$e^+e^- \rightarrow p\bar{\Delta}^{--}a_1^+, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}$	629	15	7	22	1775
35	$e^+e^- \rightarrow \Delta^0\bar{\Delta}^-b_1^+, \Delta^0 \rightarrow \pi^-p, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	142	14	7	21	1796
36	$e^+e^- \rightarrow \bar{\Delta}^0pb_1^-\gamma^f, \bar{\Delta}^0 \rightarrow \pi^+\bar{p}, b_1^- \rightarrow \pi^-\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	93	13	7	20	1816
37	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^-b_1^0\gamma^f, \Delta^+ \rightarrow \pi^0p, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^0\pi^0\pi^+\pi^-p\bar{p}\gamma^f$	819	20	—	20	1836
38	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^0\pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	26	15	4	19	1855
39	$e^+e^- \rightarrow \pi^-\Delta^{++}\bar{\Delta}^{--}b_1^+, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}$	327	8	11	19	1874
40	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^{--}b_1^+\gamma^f, \Delta^+ \rightarrow \pi^+n, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	433	10	9	19	1893
41	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^{--}a_1^+\gamma^f, \Delta^+ \rightarrow \pi^0p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_1^+ \rightarrow \rho^0\pi^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	536	14	5	19	1912
42	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285), \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^-\bar{K}^0K^+, \bar{K}^0 \rightarrow K_S^0, K_S^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-\pi^-K^+p\bar{p}$	920	7	12	19	1931
43	$e^+e^- \rightarrow \Delta^0\bar{\Delta}^-a_1^+\gamma^f, \Delta^0 \rightarrow \pi^-p, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	1222	10	9	19	1950
44	$e^+e^- \rightarrow \pi^-\Delta^{++}\bar{\Delta}^{--}b_1^+\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	83	12	6	18	1968
45	$e^+e^- \rightarrow \pi^-p\bar{p}a_1^+\gamma^f, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	343	9	9	18	1986

rowNo	decay tree	decay final state	iDcyTr	nEtr	nCcEtr	nAllEtr	nCEtr
46	$e^+e^- \rightarrow \pi^0\pi^+\pi^-K^+K^-\gamma^I$	$\pi^0\pi^+\pi^-K^+K^-\gamma^I$	1388	18	—	18	2004
47	$e^+e^- \rightarrow \bar{p}\Delta^{++}a_1^-\gamma^f, \Delta^{++} \rightarrow \pi^+p, a_1^- \rightarrow \pi^0\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^0\pi^+\pi^-p\bar{p}\gamma^f$	61	7	10	17	2021
48	$e^+e^- \rightarrow n\bar{p}b_1^+, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-n\bar{p}$	213	9	8	17	2038
49	$e^+e^- \rightarrow \Delta^-\bar{\Delta}^0b_1^+\gamma^f, \Delta^- \rightarrow \pi^-n, \bar{\Delta}^0 \rightarrow \pi^+\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	379	7	10	17	2055
50	$e^+e^- \rightarrow \pi^+p\bar{p}b_1^-, b_1^- \rightarrow \pi^-\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	1201	9	8	17	2072
51	$e^+e^- \rightarrow p\bar{p}f_1(1285)\gamma^f, f_1(1285) \rightarrow \rho^0\pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	1227	17	—	17	2089
52	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0', \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow \rho^0\rho^0, \rho^0 \rightarrow \pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}$	33	16	—	16	2105
53	$e^+e^- \rightarrow K^+\bar{\Delta}^{--}\Sigma^{*+}\gamma^f, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, \Sigma^{*+} \rightarrow \pi^+\Lambda, \Lambda \rightarrow \pi^-p$	$\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	253	3	13	16	2121
54	$e^+e^- \rightarrow p\bar{p}b_1^+a_1^-\gamma^f, b_1^- \rightarrow \pi^-\omega, a_1^+ \rightarrow \rho^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	1013	8	8	16	2137
55	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^-a_0^+, a_0^+ \rightarrow \pi^+\eta, \eta \rightarrow \gamma\gamma$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma\gamma\gamma^f$	1116	7	9	16	2153
56	$e^+e^- \rightarrow \pi^0p\bar{\Delta}^{--}b_1^+\gamma^f, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	1701	11	5	16	2169
57	$e^+e^- \rightarrow p\bar{p}b_1^0\gamma^f, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	272	15	—	15	2184
58	$e^+e^- \rightarrow p\bar{p}a_1^0, a_1^0 \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^-\pi^-p\bar{p}$	530	7	8	15	2199
59	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^{--}b_1^+, \Delta^+ \rightarrow \pi^+n, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-n\bar{p}$	738	5	10	15	2214
60	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^-\bar{K}^0K^+, \bar{K}^0 \rightarrow K_L^0$	$K_L^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	289	4	10	14	2228
61	$e^+e^- \rightarrow \pi^+\Delta^-\bar{p}a_1^+, \Delta^- \rightarrow \pi^-n, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^+\pi^-\pi^-n\bar{p}$	813	7	7	14	2242
62	$e^+e^- \rightarrow K^+\bar{p}\Lambda a_1^0\gamma^f, \Lambda \rightarrow \pi^-p, a_1^0 \rightarrow \pi^+\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	978	4	10	14	2256
63	$e^+e^- \rightarrow \Sigma^{*-}\bar{\Lambda}b_1^+\gamma^f, \Sigma^{*-} \rightarrow \pi^-\Lambda, \bar{\Lambda} \rightarrow \pi^+\bar{p}, b_1^+ \rightarrow \pi^+\omega, \Lambda \rightarrow \pi^-p, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	0	6	7	13	2269
64	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0'\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow \rho^0\rho^0, \rho^0 \rightarrow \pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	25	13	—	13	2282
65	$e^+e^- \rightarrow p\bar{p}b_1^-a_1^+, b_1^- \rightarrow \pi^-\omega, a_1^+ \rightarrow \rho^0\pi^+, \omega \rightarrow \pi^0\pi^+\pi^-, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}$	99	8	5	13	2295
66	$e^+e^- \rightarrow \Lambda\bar{\Sigma}^{*-}b_1^+, \Lambda \rightarrow \pi^-p, \bar{\Sigma}^{*-} \rightarrow \pi^-\bar{\Lambda}, b_1^+ \rightarrow \pi^+\omega, \bar{\Lambda} \rightarrow \pi^+\bar{p}, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}$	225	7	6	13	2308
67	$e^+e^- \rightarrow K^+\bar{p}\Lambda b_1^0\gamma^f, \Lambda \rightarrow \pi^0n, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-K^+n\bar{p}\gamma^f$	236	5	8	13	2321
68	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0'\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	335	13	—	13	2334
69	$e^+e^- \rightarrow \pi^+\Delta^-\bar{p}b_1^+\gamma^f, \Delta^- \rightarrow \pi^-n, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	781	7	6	13	2347
70	$e^+e^- \rightarrow \eta\Delta^{++}\bar{\Delta}^{--}\gamma^f, \eta \rightarrow \pi^0\pi^+\pi^-, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	800	13	—	13	2360
71	$e^+e^- \rightarrow \pi^+n\bar{p}b_1^0\gamma^f, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	828	6	7	13	2373

rowNo	decay tree	decay final state	iDcyTr	nEtr	nCcEtr	nAllEtr	nCEtr
72	$e^+e^- \rightarrow \pi^+p\bar{\Delta}^{--}b_1^0, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	1423	5	8	13	2386
73	$e^+e^- \rightarrow p\bar{p}a_0^-b_1^+\gamma^f, a_0^- \rightarrow \pi^-\eta, b_1^+ \rightarrow \pi^+\omega, \eta \rightarrow \gamma\gamma, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma\gamma\gamma^f$	87	5	7	12	2398
74	$e^+e^- \rightarrow \pi^+n\bar{\Delta}^{--}b_1^+\gamma^f, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	259	8	4	12	2410
75	$e^+e^- \rightarrow K^+\bar{p}\Lambda a_1^0\gamma^f, \Lambda \rightarrow \pi^-p, a_1^0 \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	288	3	9	12	2422
76	$e^+e^- \rightarrow K^+\bar{p}\Lambda h_1(1170)\gamma^f, \Lambda \rightarrow \pi^-p, h_1(1170) \rightarrow \pi^+\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	747	6	6	12	2434
77	$e^+e^- \rightarrow \eta'\Delta^{++}\bar{\Delta}^{--}\gamma^f, \eta' \rightarrow \pi^+\pi^-\gamma^F, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^F\gamma^f$	840	12	—	12	2446
78	$e^+e^- \rightarrow K^+\bar{p}\Lambda h_1(1170)\gamma^f, \Lambda \rightarrow \pi^-p, h_1(1170) \rightarrow \pi^0\rho^0, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	964	5	7	12	2458
79	$e^+e^- \rightarrow K^+\bar{p}\Lambda h_1(1170)\gamma^f, \Lambda \rightarrow \pi^-p, h_1(1170) \rightarrow \pi^-\rho^+, \rho^+ \rightarrow \pi^0\pi^+$	$\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	996	2	10	12	2470
80	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^-a_0^+, a_0^+ \rightarrow \bar{K}^0K^+, \bar{K}^0 \rightarrow K_S^0, K_S^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-\pi^-K^+p\bar{p}\gamma^f$	2090	4	8	12	2482
81	$e^+e^- \rightarrow K^+\bar{p}\Sigma^{*+}b_1^-, \Sigma^{*+} \rightarrow \pi^+\Lambda, b_1^- \rightarrow \pi^-\omega, \Lambda \rightarrow \pi^-p, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+p\bar{p}$	18	6	5	11	2493
82	$e^+e^- \rightarrow \pi^0K^+\bar{p}\Lambda\gamma^f, \Lambda \rightarrow \pi^-p$	$\pi^0\pi^-\pi^+p\bar{p}\gamma^f$	331	4	7	11	2504
83	$e^+e^- \rightarrow p\bar{p}h_1(1170)\gamma^f, h_1(1170) \rightarrow \pi^0\rho^0, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^+\pi^-\pi^-\pi^+p\bar{p}\gamma^f$	410	11	—	11	2515
84	$e^+e^- \rightarrow K^+\bar{p}\Sigma^-b_1^+\gamma^f, \Sigma^- \rightarrow \pi^-n, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-K^+n\bar{p}\gamma^f$	453	5	6	11	2526
85	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^+a_0^-, a_0^- \rightarrow \pi^-\eta, \eta \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^+\pi^-\pi^-\pi^-p\bar{p}\gamma^f$	455	8	3	11	2537
86	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}a_0^0\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_0^0 \rightarrow K^+K^-$	$\pi^+\pi^-K^+K^-p\bar{p}\gamma^f$	460	11	—	11	2548
87	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}a_0^0\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_0^0 \rightarrow \pi^0\eta, \eta \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	560	11	—	11	2559
88	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0', \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow \pi^+\pi^-$	$\pi^+\pi^+\pi^-\pi^-p\bar{p}$	574	11	—	11	2570
89	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^{--}a_0^+\gamma^f, \Delta^+ \rightarrow \pi^0p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_0^+ \rightarrow \pi^+\eta, \eta \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	658	5	6	11	2581
90	$e^+e^- \rightarrow \bar{p}\Delta^{++}a_0^-\gamma^f, \Delta^{++} \rightarrow \pi^+p, a_0^- \rightarrow \pi^-\eta, \eta \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	734	6	5	11	2592
91	$e^+e^- \rightarrow \bar{\Delta}^-\Delta^{++}a_1^-, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, \Delta^{++} \rightarrow \pi^+p, a_1^- \rightarrow \pi^0\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^0\pi^0\pi^+\pi^-\pi^-p\bar{p}$	982	6	5	11	2603
92	$e^+e^- \rightarrow p\bar{p}f_1(1285)\gamma^f, f_1(1285) \rightarrow \pi^-\bar{K}^0K^+, \bar{K}^0 \rightarrow K_S^0, K_S^0 \rightarrow \pi^+\pi^-$	$\pi^+\pi^-\pi^-\pi^-K^+p\bar{p}\gamma^f$	1457	6	5	11	2614
93	$e^+e^- \rightarrow \Delta^0\bar{\Delta}^-a_1^+\gamma^f, \Delta^0 \rightarrow \pi^0n, \bar{\Delta}^- \rightarrow \pi^0\bar{p}, a_1^+ \rightarrow \rho^0\pi^+, \rho^0 \rightarrow \pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-n\bar{p}\gamma^f$	1938	3	8	11	2625
94	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_1(1285)\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_1(1285) \rightarrow \pi^+a_0^-, a_0^- \rightarrow \pi^-\eta, \eta \rightarrow \pi^0\pi^0\pi^0$	$\pi^0\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	2061	8	3	11	2636
95	$e^+e^- \rightarrow \pi^-\bar{p}\Delta^{++}b_1^0\gamma^f, \Delta^{++} \rightarrow \pi^+p, b_1^0 \rightarrow \pi^0\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	3065	8	3	11	2647
96	$e^+e^- \rightarrow K^+\bar{\Delta}^{--}\Lambda b_1^+, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, \Lambda \rightarrow \pi^-p, b_1^+ \rightarrow \pi^+\omega, \omega \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^+\pi^+\pi^-\pi^-\pi^-K^+p\bar{p}$	228	4	6	10	2657

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97	$e^+e^- \rightarrow \Delta^+\bar{\Delta}^{--}a_0^+, \Delta^+ \rightarrow \pi^0 p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, a_0^+ \rightarrow \pi^+\eta,$ $\eta \rightarrow \pi^0\pi^+\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}$	273	6	4	10	2667
98	$e^+e^- \rightarrow \Delta^{++}\bar{\Delta}^{--}f_0'\gamma^f, \Delta^{++} \rightarrow \pi^+p, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, f_0' \rightarrow \rho^+\rho^-,$ $\rho^+ \rightarrow \pi^0\pi^+, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^0\pi^+\pi^+\pi^-\pi^-p\bar{p}\gamma^f$	466	10	—	10	2677
99	$e^+e^- \rightarrow \pi^+K^+\bar{\Delta}^{--}\Lambda\gamma^f, \bar{\Delta}^{--} \rightarrow \pi^-\bar{p}, \Lambda \rightarrow \pi^-p$	$\pi^+\pi^-\pi^-K^+p\bar{p}\gamma^f$	477	3	7	10	2687
100	$e^+e^- \rightarrow K^+\bar{p}\Lambda h_1(1170), \Lambda \rightarrow \pi^-p, h_1(1170) \rightarrow \pi^+\rho^-, \rho^- \rightarrow \pi^0\pi^-$	$\pi^0\pi^+\pi^-\pi^-K^+p\bar{p}$	479	4	6	10	2697
rest	$e^+e^- \rightarrow \text{others (7548 in total)}$	corresponding to others	—	—	—	9976	12673