

Update 13.6.2022

Model Updates

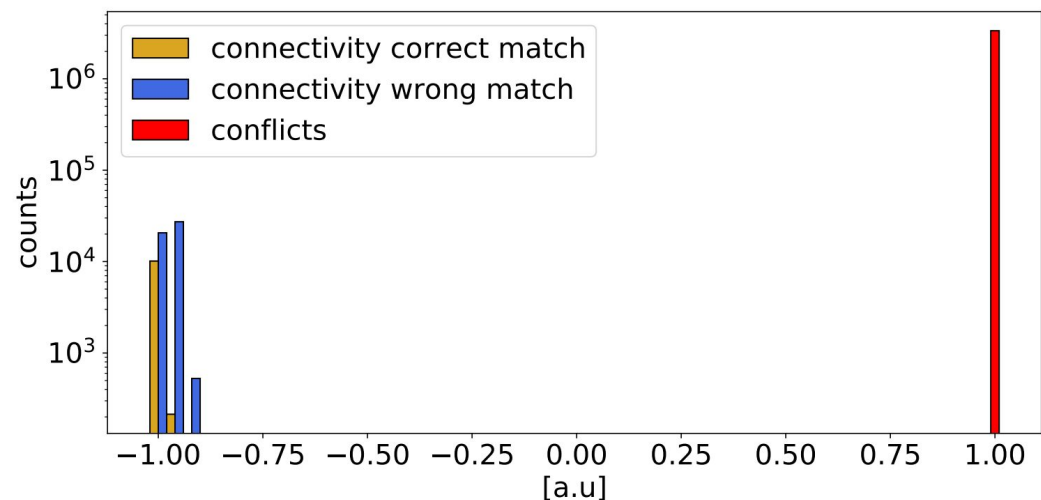
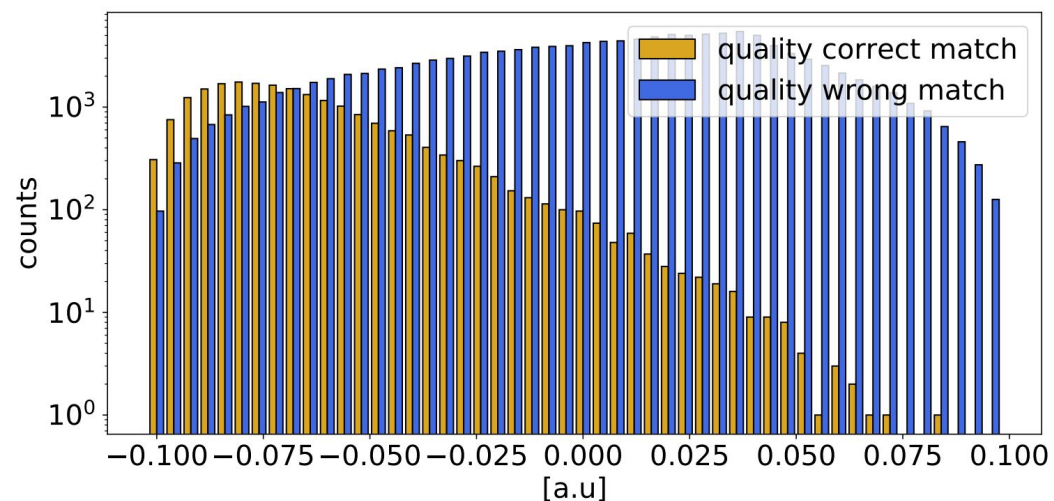
Initial solution guess

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Hamburg, 13.6.2022

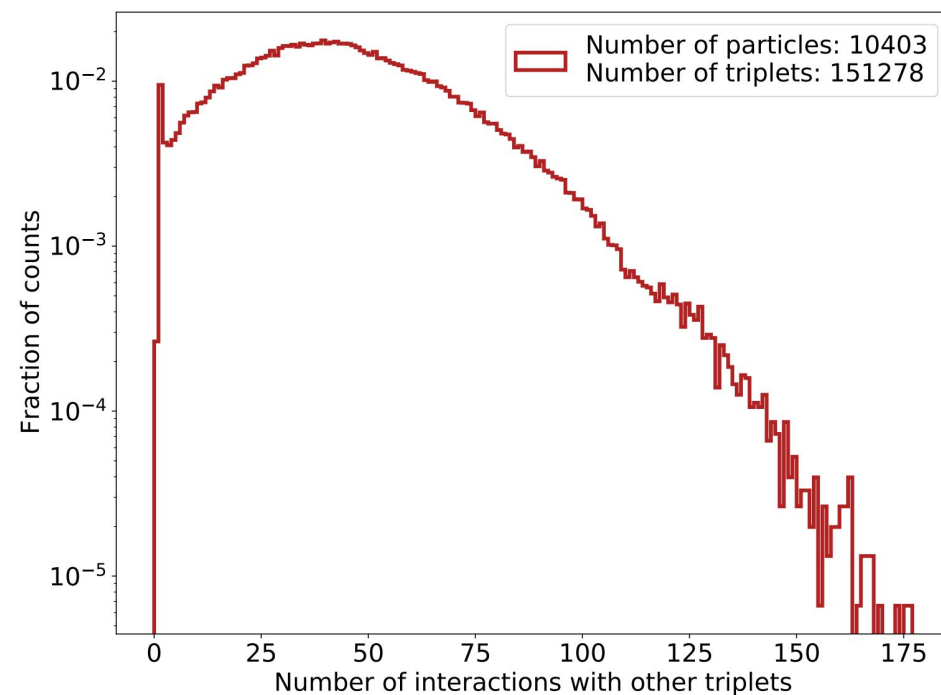
Data Composition

Representative example



Computational time ~ 5 min, not parallelized

```
63 ---
64 Statistics:
65
66 Number of particles hitting at leas one detector layer: 10403
67
68 Number of doublets found: 723693
69 Number of tracks approximately possible to reconstruct at doublet level: 10397
70
71 Number of triplets found: 151278
72 Number of tracks approximately possible to reconstruct at triplet level: 10374
73
```



Configurations

Preselection configurations + observed QUBO results

Configuration	a_i	b_{ij} match	b_{ij} conflict	comment (SubQUBO size of 7)
1	0	-1	1	<ul style="list-style-type: none">- stable convergence to a result \sim ground state energy- nearly no dependency on track density / triplet list size- moderate efficiency and fake rate
2	0	$f(\text{angles}) \rightarrow [-1, a]$ $a < 0$	1	<ul style="list-style-type: none">- efficiency drops for significantly for higher track density and fake rate rises a lot- used for CTD- better efficiency and fake rate for lower ξ than Configuration 1
3	$f(\text{angles}) \rightarrow [b, c]$ $-1 < b < c < 1$	$f(\text{angles}) \rightarrow [-1, a]$ $a < 0$	1	<ul style="list-style-type: none">- stable results- high efficiency and low fake rate- best choice of a, b, c somewhat unclear- used for ACAT (- agreed on not using z-scores for a_i

Fixed Initialisation + bit flip tabu search

Energy vs. iteration on initial tabu ON/OFF

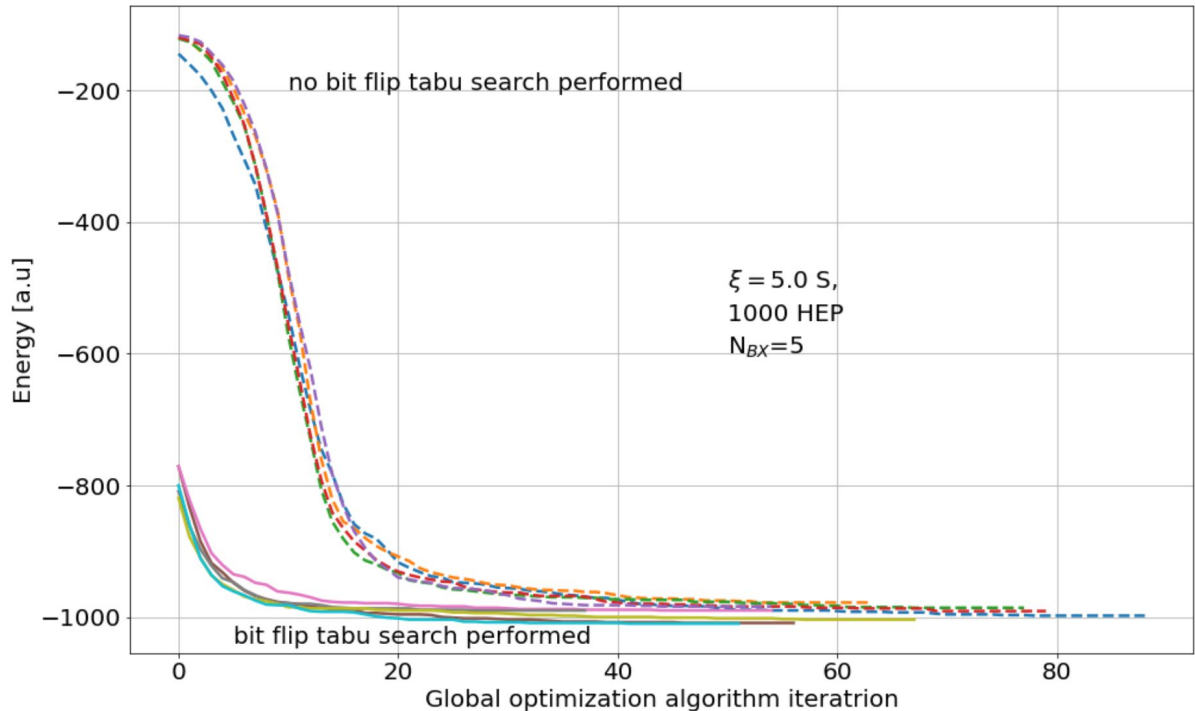
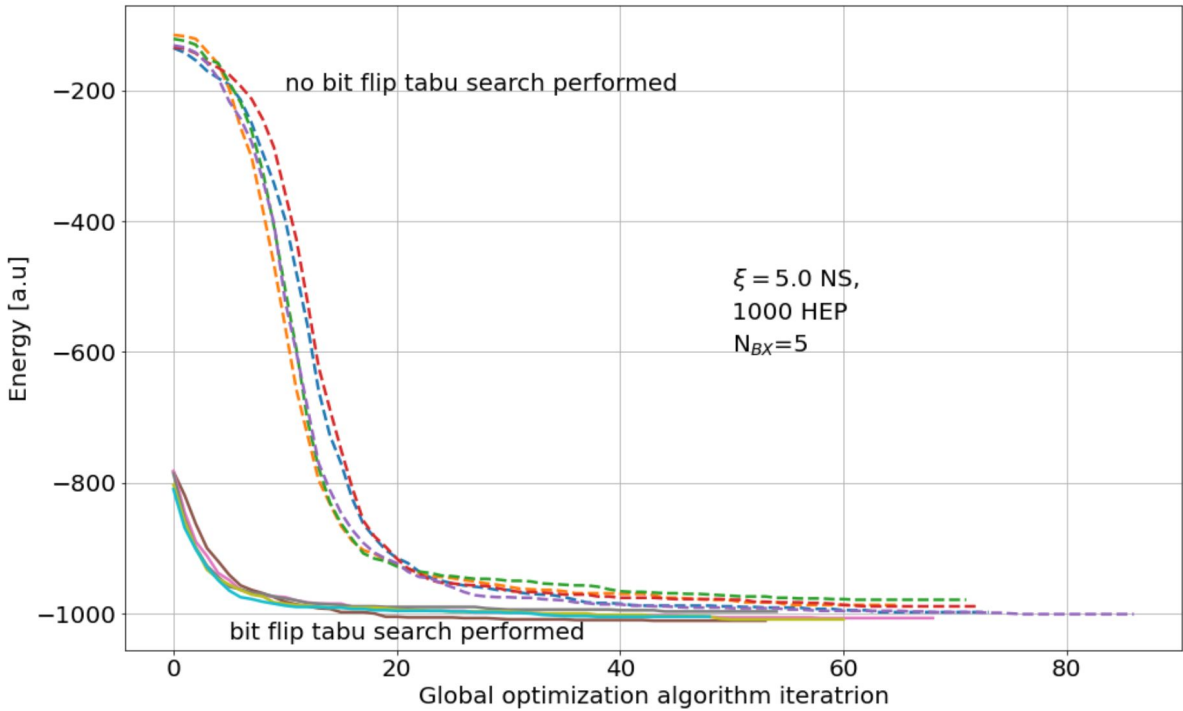
- 1) Initialising binary solution vector for the triplet list as $[1, 1, 1, 1, \dots, 1]$
 - 2) Order triplets by impact from highest to lowest
 - 3) Check if bit flip would decrease energy level $\rightarrow [1, 1, 0, 1, \dots, 0, 1, 0, \dots]$
- Better results with every preselection configuration than just choosing a random solution at start
 - Energy value converges faster
 - Question need to be answered:
 - Why does it work?
 - Navigating into stable local minimum?

Applying initial bit flip search on 1000 particles

Energy vs. iteration on initial bit-flip-search ON/OFF

Results on triplet level:
~ 74% precision and recall without initial bit flip search
~ 78% if initial bit flip search applied
~ 1% loss due to scattering

Configuration	a_i	b_{ij} match	b_{ij} conflict
1	0	-1	1



Impact of initial bit flip search on 10403 particles (whole BX!)

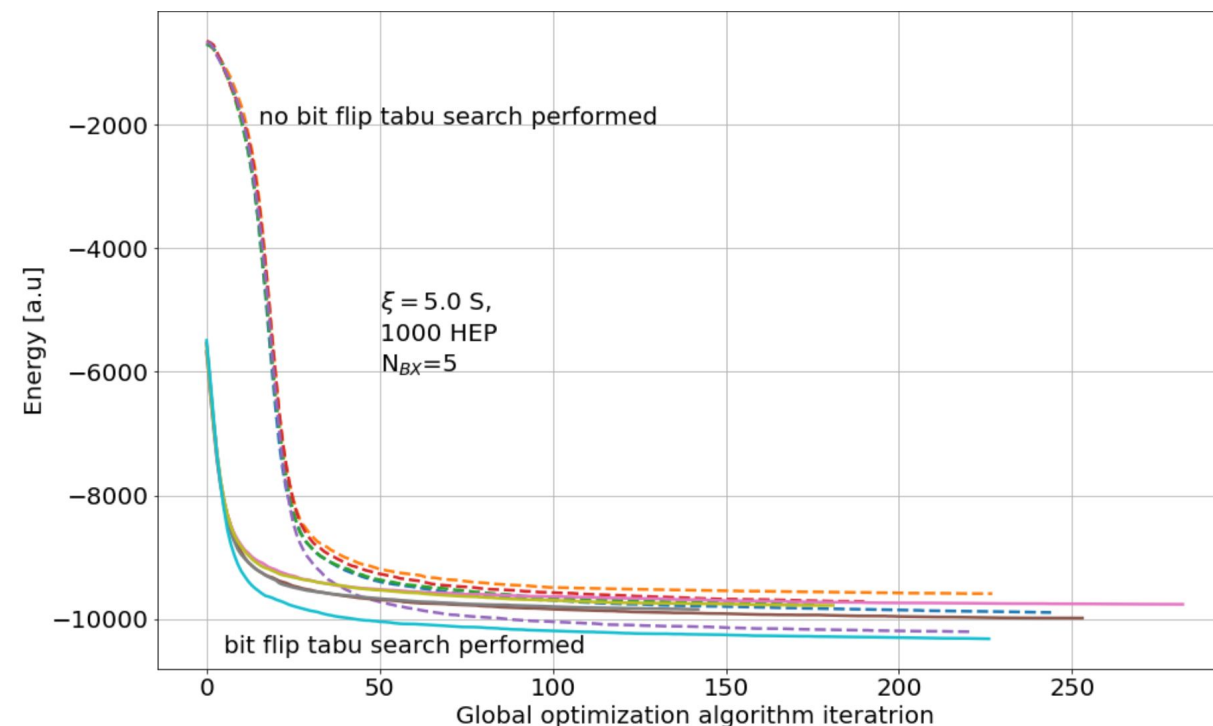
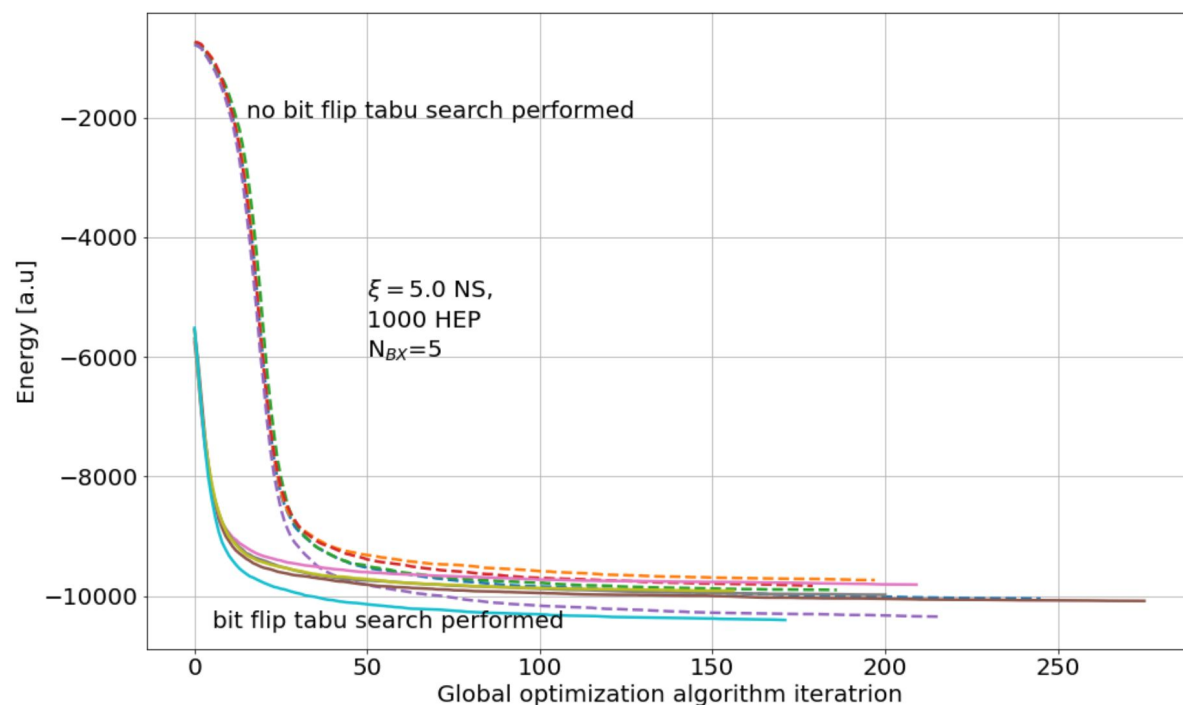
Energy vs. iteration on initial tabu ON/OFF

Results on triplet level:

~ 67% precision and recall without initial bit flip search

~ 70% if initial bit flip search applied

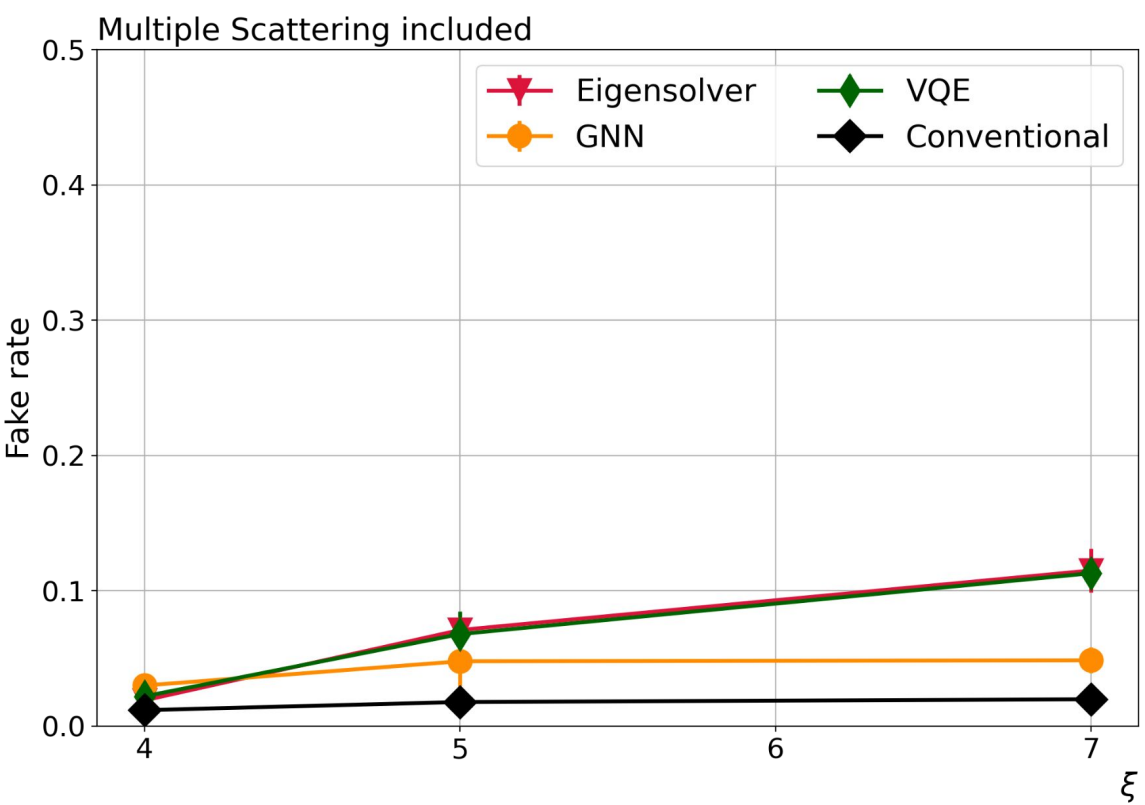
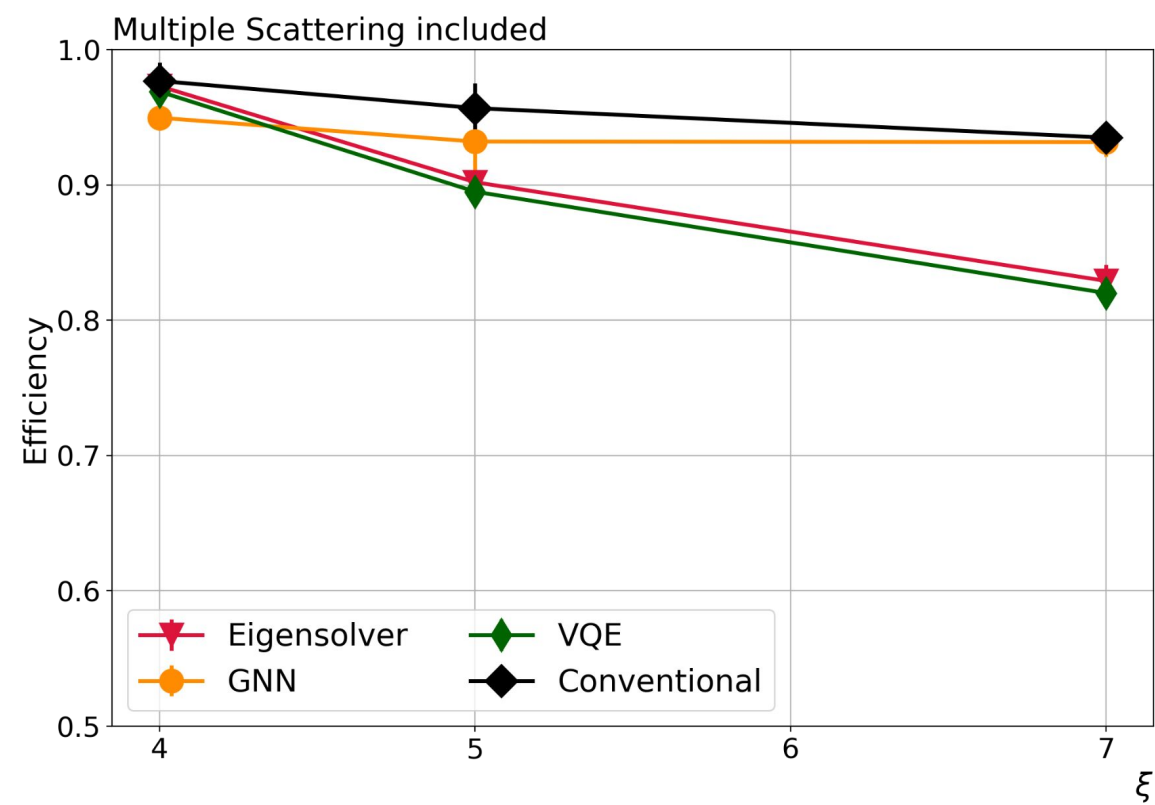
Configuration	a_i	b_{ij} match	b_{ij} conflict
1	0	-1	1



Results for CTD 2022

Configuration 2 + fixed initialising + bit flip

Configuration	a_i	b_{ij} match	b_{ij} conflict
2	0	$f(\text{angles}) \rightarrow [-1, a]$ $a < 0$	2



Results for 500 particles

Configuration 3 + fixed initialising + bit flip

Ambiguity solving on triplet
level not optimized yet

Configuration	a_i	b_{ij} match	b_{ij} conflict
3	$f(\text{angles}) \rightarrow [b, c]$ $-1 < b < c < 1$	$f(\text{angles}) \rightarrow [-1, a]$ $a < 0$	1

