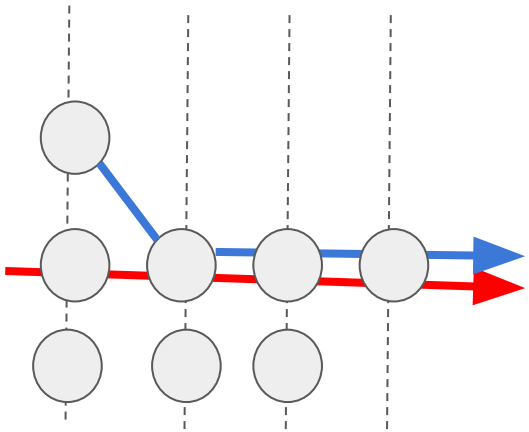
Quantum Computing meeting

update 10.10.2022

Trackfitting

- Idea: If two tracks overlap, choose the one with the better chi2
- Goal: lose small percentages in efficiency but reduce fake rate considerably
- Plots shown (Data only for 1BX!!):
  - Measure for overlapping tracks: Shared number of hits per xi
  - Efficiency before and after chi2 filtering
  - Fake rate before and after chi2 filtering
  - Additional measure: duplication rate

Efficiency: ¾ hits have to come from same particle



Problem: Two or more 4-hit xplets can be true for the same particle → increase the efficiency

Solution: count correctly reconstructed particles instead of correct hits (no multiple counting)

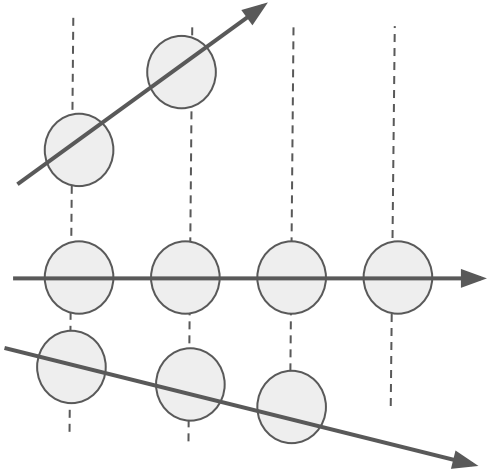
Fake rate is harder to define: If 100 are true, with 80 unique, & 30 false, is the fake rate then:
30/130 or 30/110?

Fake rate now (fake/all found) + duplication rate (20/80)

$$\text{Efficiency} = \frac{N_{\text{tracks}}^{\text{matched}}}{N_{\text{tracks}}^{\text{generated}}}$$

Generated tracks:
¾ definition: 2 tracks
4/4 definition: 1 track

simulation:

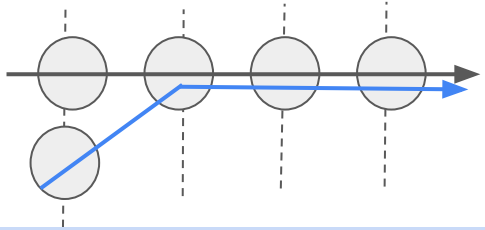


3 simulated particles:

- One leaves the detector after two hit (not “detectable” in 3/4 or 4/4 definition
- One leaves after 3 hits: detectable only with ¾ definition)
- One goes through all layers: detectable in all scenarios

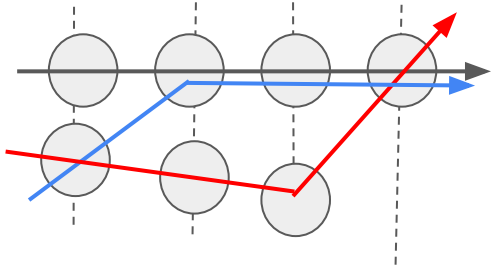
Matching 4/4 definition example:

Found: one true, one false: efficiency 100%: 1 true matched/1 generated tracks



Matching 3/4 definition example:

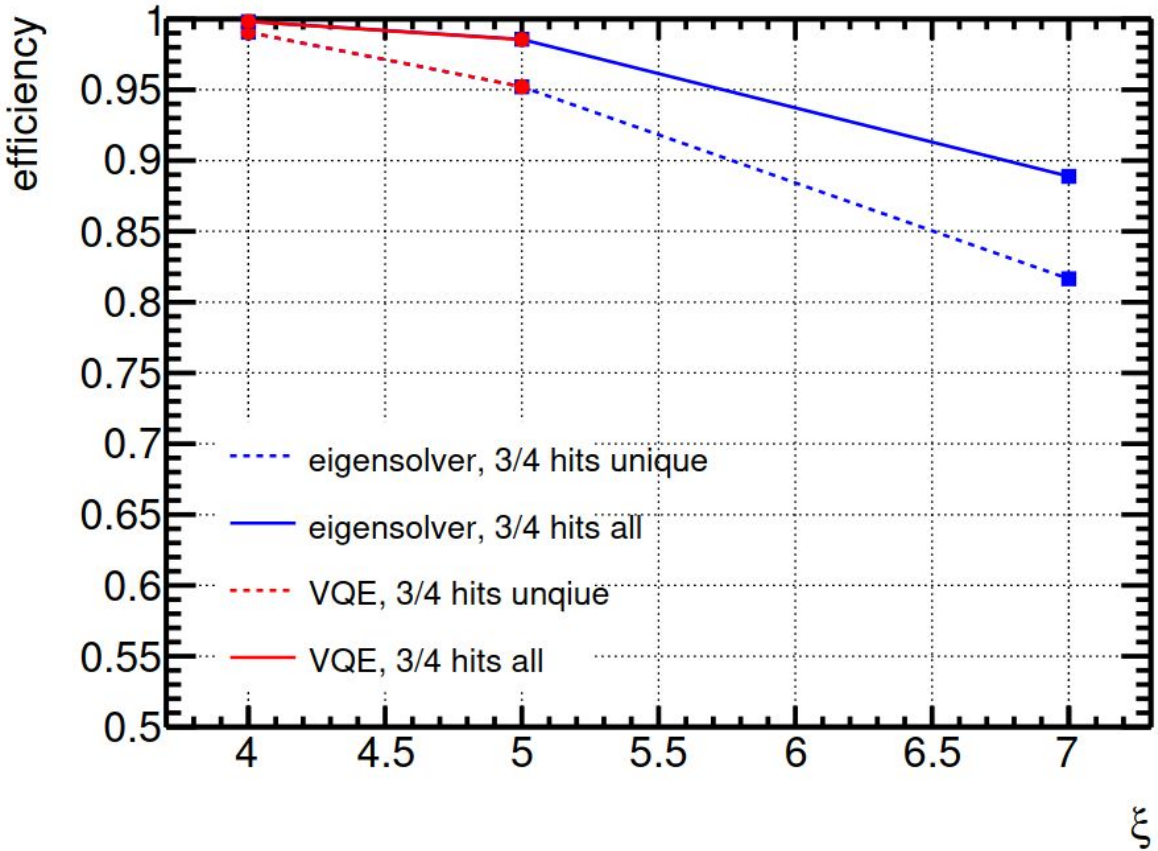
Found: 3 true, 0 false tracks,
BUT 2 true particle tracks (unique), 0 false tracks: efficiency 100%: 2 true matched/2 generated tracks



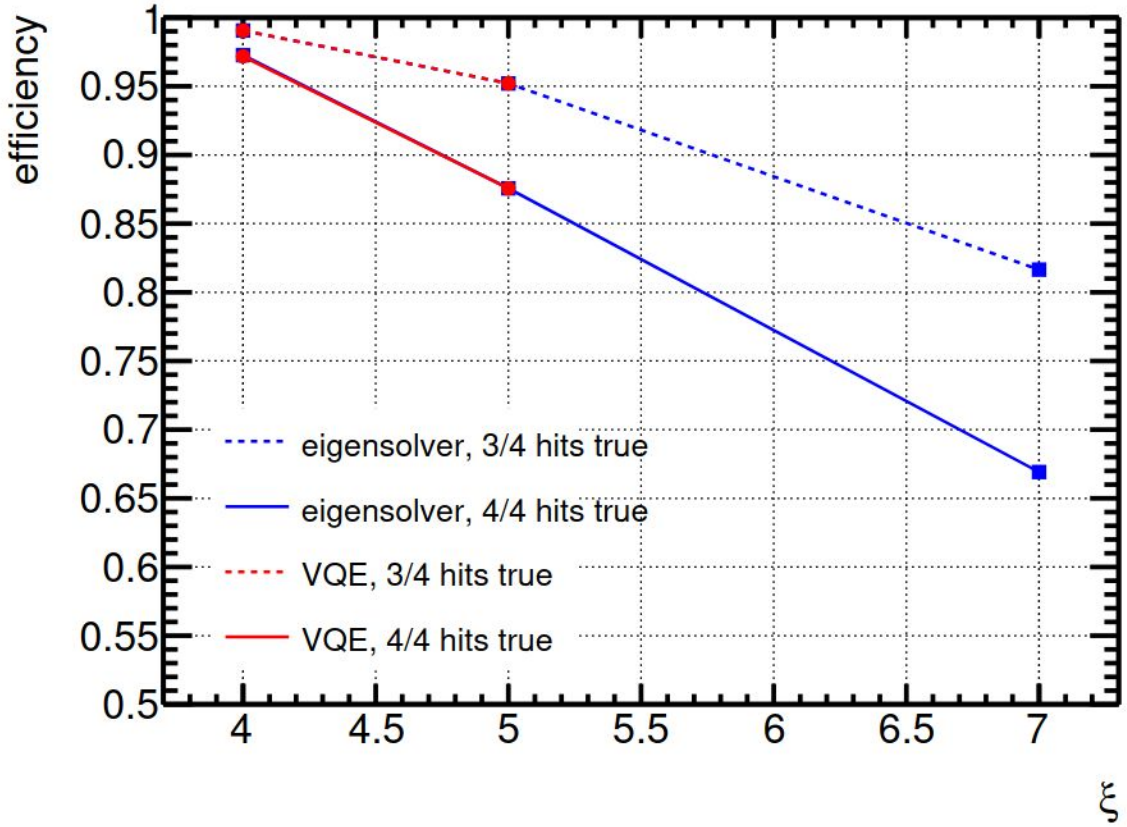
$$\text{Fake rate} = \frac{N_{\text{tracks}}^{\text{fake}}}{N_{\text{tracks}}^{\text{reconstructed}}}$$

4/4 definition:	Trivial, fake rate= (N [tracks != 4 same particle hits])/ (all matched tracks)
3/4 definition:	**Case1 (previous):** fake rate= (N [tracks != 3 same particle hits]) / (all matched tracks INCLUDING multiple true tracks) **Case2 (as discussed in the meeting):** fake rate= (N [tracks != 3 same particle hits]) / (all matched tracks EXCLUDING multiple true tracks)

Before fitting: Efficiency ¾ unique vs. all (multiple counting)



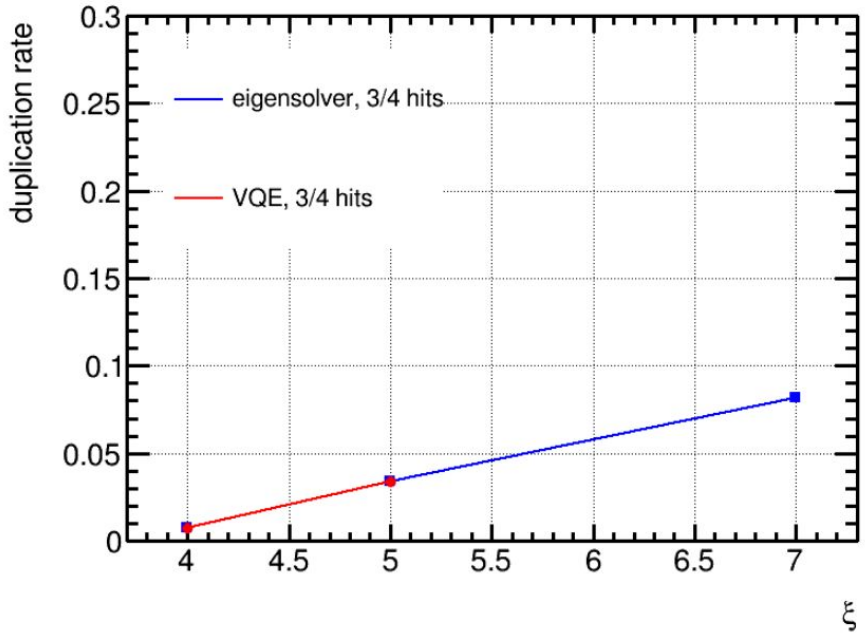
Efficiency before fitting: 4/4 vs unique 3/4



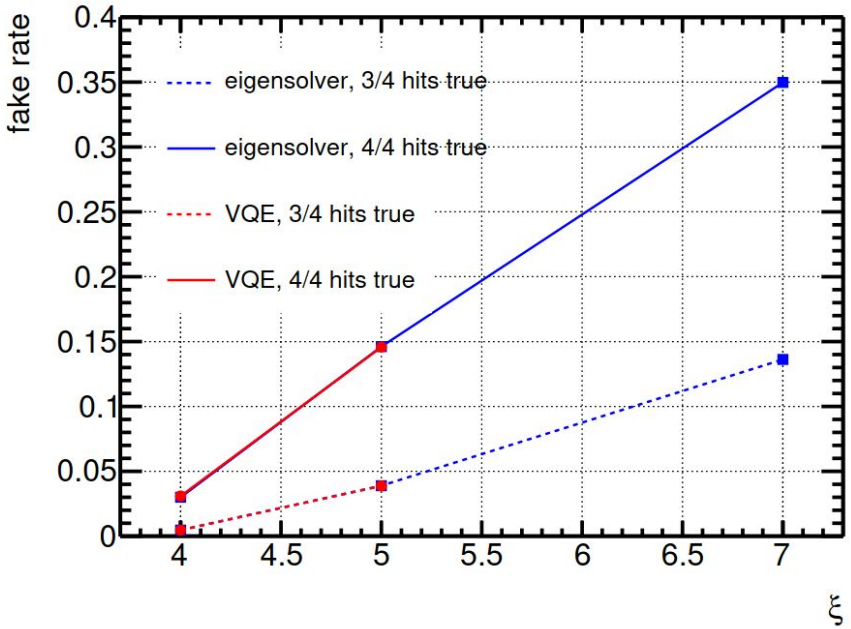
Duplication rate for ¾ definition

Duplication rate= unique true/ all true

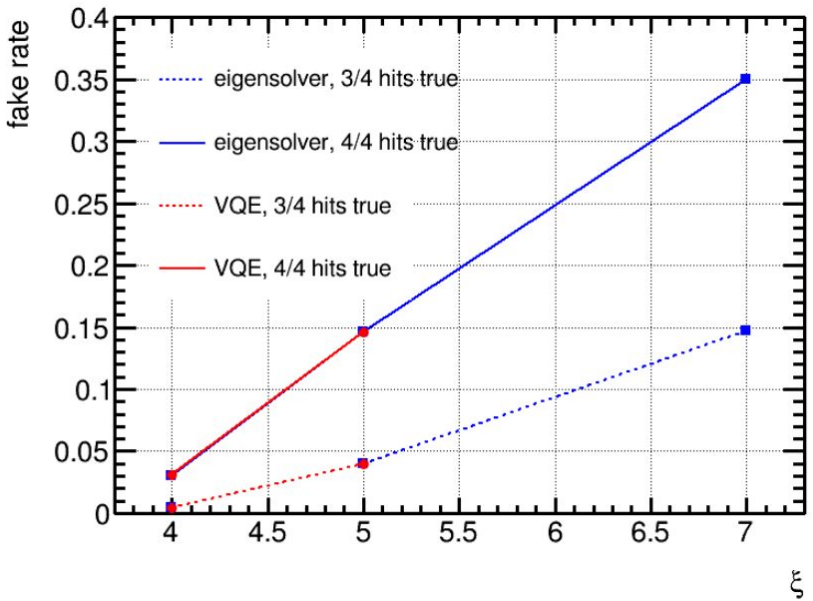
Unique: one particle can have only one true track



Before fitting: Fake rate - small increase in frate for case2

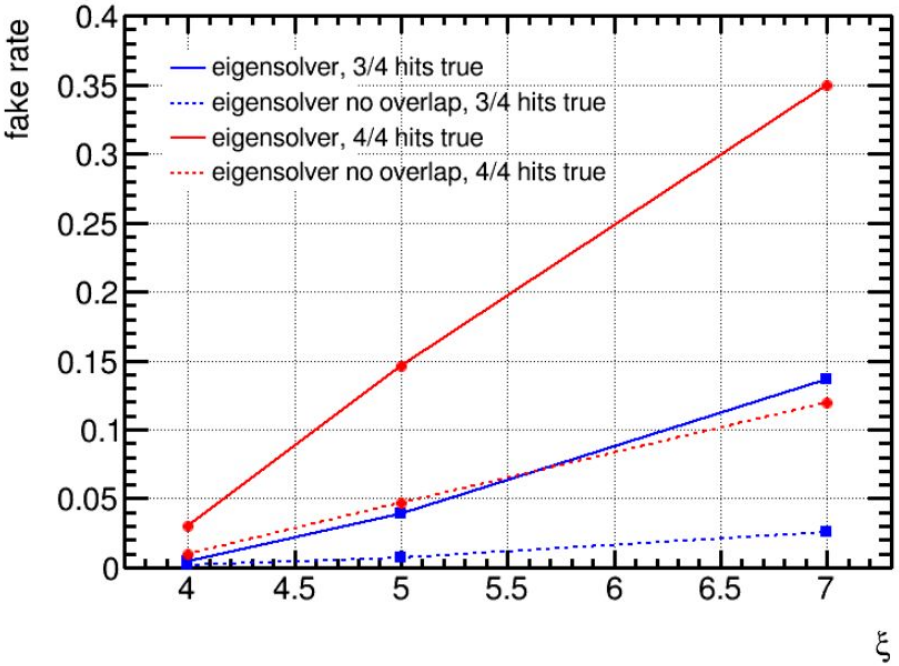


Case 1: including true duplicates



Case 2: excluding true duplicates

Fake rate: Chi2 filtering to reduce overlaps



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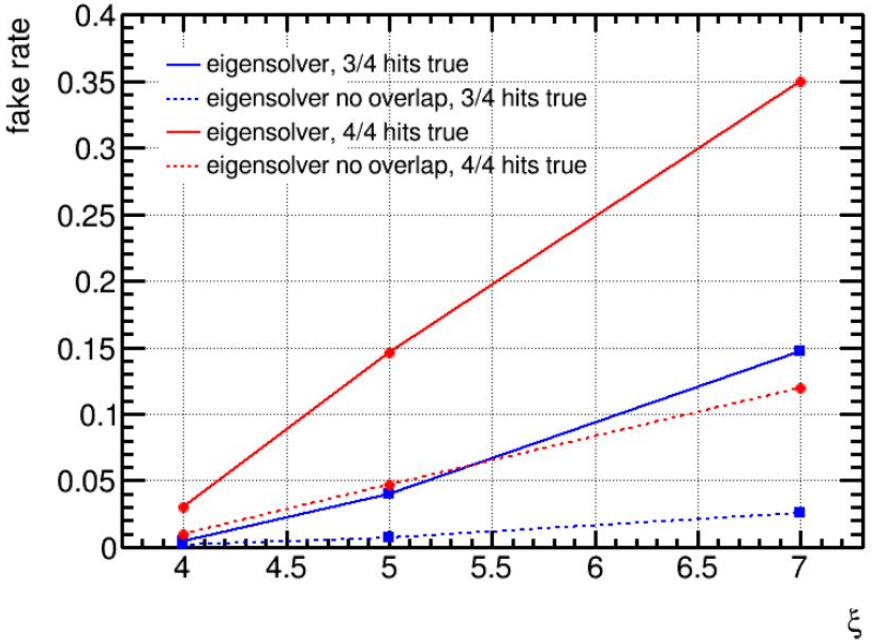

Case 2: excluding true duplicates

Efficiency: Chi2 filtering to reduce overlaps