

Update on AfkQED

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The Evaluation of the Leading
Hadronic Contribution to the Muon
 $g - 2$: MITP topical workshop

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Overview

- Collaborating on AfkQED since March, I often got big help by Fedor
- Progress for STRONG2020:
 - ❑ Obtained code in FORTRAN from V. Druzhinin
 - ❑ Ran standalone version in C++ prepared by Fedor
 - ❑ Fedor submitted current histograms, I'm about to submit LO results too
- Will focus more on this from now on, especially to meet summer deadlines

AfkQED: overview

```
0. e+e- -> mu+mu- gamma
1. e+e- -> pi+pi- gamma
2. e+e- -> pi+pi-pi+pi- gamma
3. e+e- -> pi+pi-pi0 pi0 gamma
4. e+e- -> pi+pi-pi0 gamma
5. e+e- -> K+ K- gamma
6. e+e- -> KS KL gamma
7. e+e- -> Ks K-+ pi+- gamma
8. e+e- -> K+ K- pi0 gamma
9. e+e- -> p+ p- gamma
10. e+e- -> eta pi+ pi- gamma
11. e+e- -> pi0 phi(K+K-) gamma
12. e+e- -> eta phi(K+K-) gamma
13. e+e- -> pi+pi-pi+pi-pi+pi- gamma
14. e+e- -> pi+pi-pi+pi-pi0 pi0 gamma
15. e+e- -> pi+pi-pi0 pi0 pi0 pi0 gamma
16. e+e- -> K+K- pi+pi- gamma
17. e+e- -> K+K- 2pi0 gamma
18. e+e- -> KS KS pi+pi- gamma
19. e+e- -> KS KS 2pi0 gamma
20. e+e- -> KS KL pi+pi- gamma
21. e+e- -> KS KL 2pi0 gamma
22. e+e- -> K+K-K+K- gamma
23. e+e- -> K+K-KSKS gamma
24. e+e- -> K+K-KSKL gamma
25. e+e- -> e+e- pi+pi- gamma
```

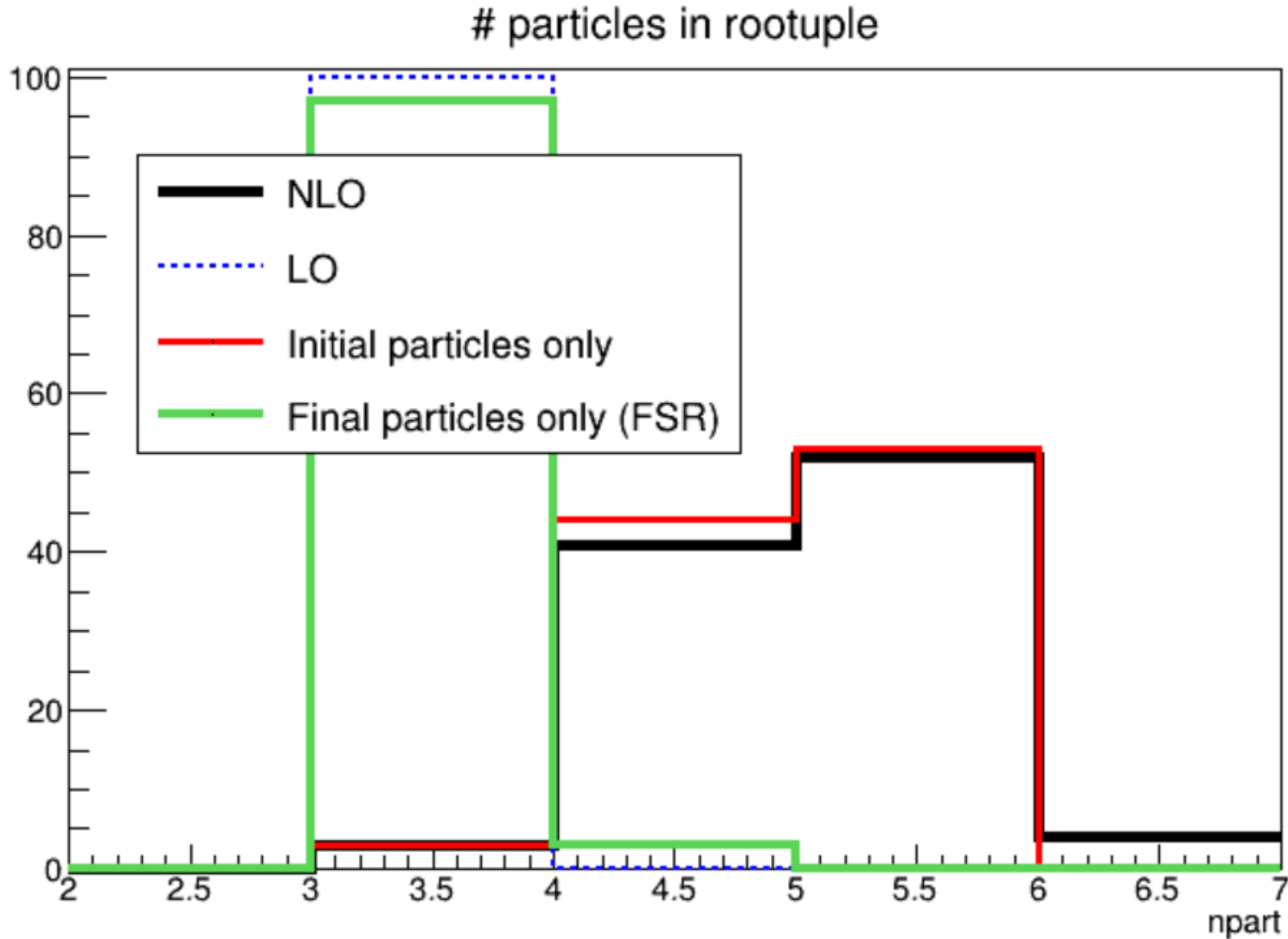


- $\mu\mu\gamma$: based on Born cross section formulae from A.B.Arbutov et al. hep-ph/9702262. ISR, FSR and interference between them; VP both hadronic and leptonic
- $\pi\pi\gamma$: based on approach developed by H.Czyz and J.H.Kuhn in Eur. Phys. J. C18(2001), 497. Original EVA program modified to implement into BaBar software
- Cannot work in CMD scenario, cannot simulate Bhabha scattering; AfkQED might not be good for KLOE I scenario (Large Angle) because of collinear approximation of additional photons

AfkQED generation modes

- Initial two collinear ISR «structures»: re-summed photons using D functions – see Fedor’s presentation. Can be switched off.
- Then 1 photon process is generated in boosted system
- FSR photons generated by PHOTOS. Can be switched off.
- VP: can be «None», «Leptonic only», «Leptons+rho+omega+phi»

AfkQED «extraPhotonMode»



Mode = 0: LO, FSR and jets collinear to initial particles are OFF

Mode = 1: only collinear structures

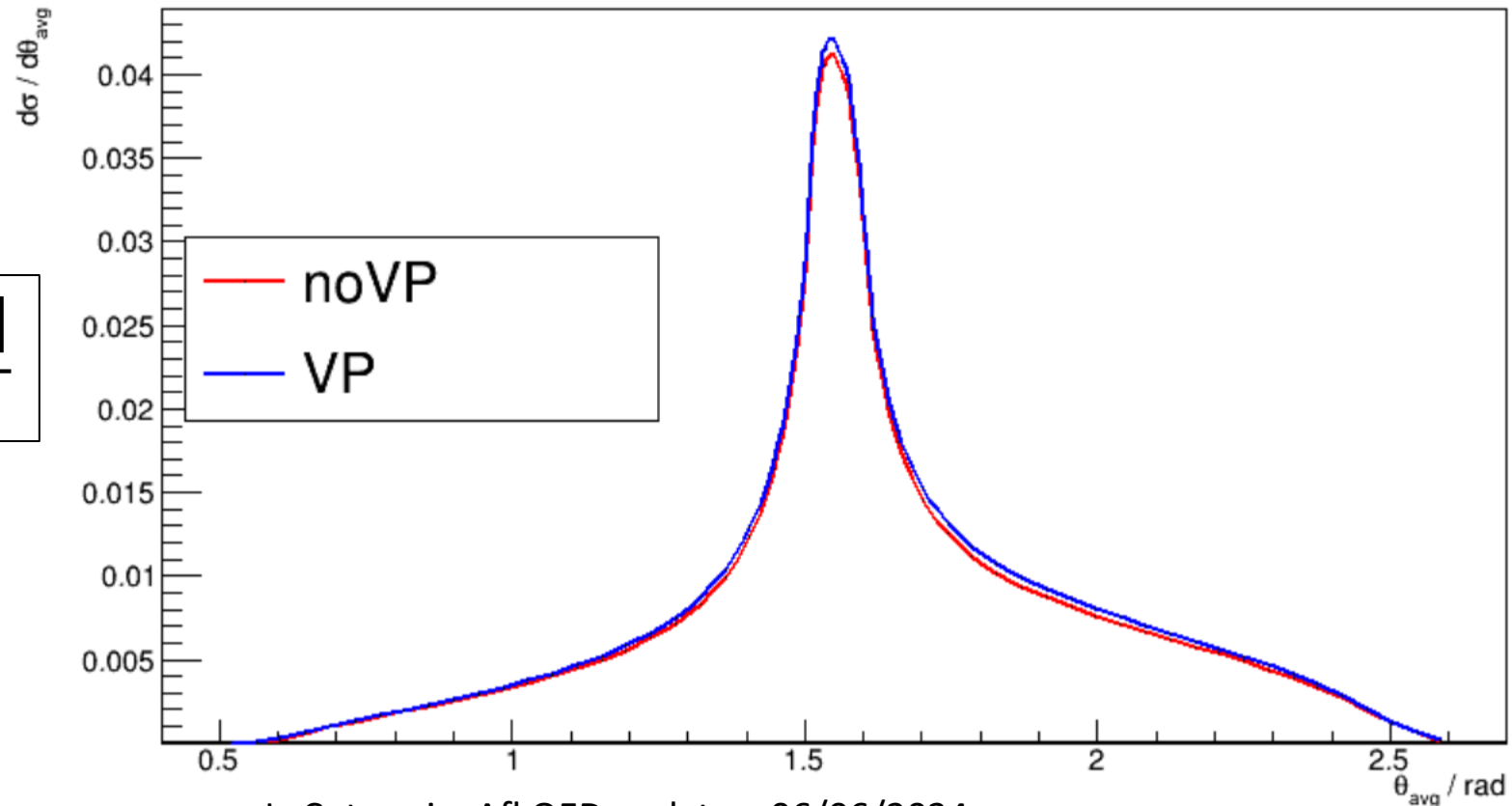
Mode = 2: only FSR

Mode = 3: NLO, everything switched ON

STRONG2020 plots

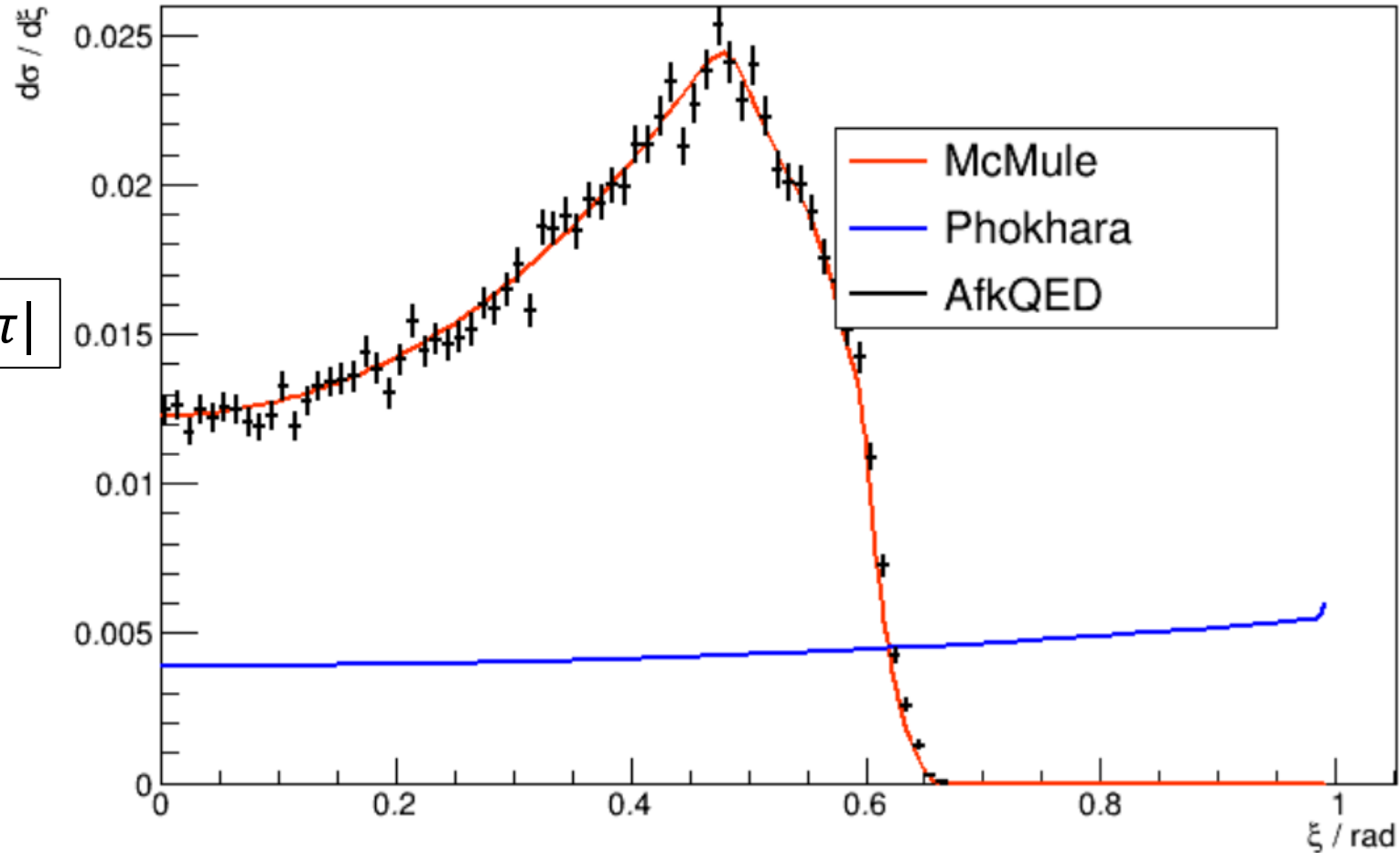
- For each scenario/final state: 500 submissions, 1e6 events each.
NLO with/without VP are pushed. Example: BaBar, mumu channel

$$\theta_{avg} = \frac{|\theta^- - \theta^+ + \pi|}{2}$$



LO to be added to Gitlab (soon)

- Low stats example: BaBar scenario LO, p_ip_i channel



$$\xi = |\theta^+ + \theta^- - \pi|$$

Disclaimer 1: I just compared with what present last night on the website
Disclaimer 2: error bars are shown here only for AfkQED

Summary and future steps

- I will upload LO for all scenarios: statistics for NLO was $5e8$, I'll upload LO with limited statistics ($1e6$) and launch many batch submissions to improve soon
- Will contribute with Fedor to paragraph on Overleaf
- On the side, I'm also planning to produce additional comparisons with Phokhara, for which in contact with Pau – I'm setting up code machinery