Update on □□□large angle analysis and PHOHARA 5...

- "Island" studies
- □□ MC preFilter
- PHOKHARA 5

KLOE Phidec Meeting
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□□ filter studies:

□□ requests:

$$0.45 < |\vec{p}_{\square^+}| + |\vec{p}_{\square^-}| < 0.85\ \mathrm{GeV} \quad \text{.AND.}$$

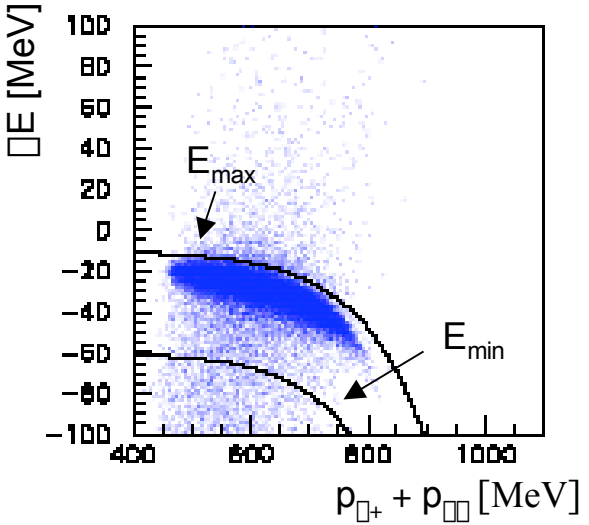
$$E_{min} < \square E < E_{max} \quad \text{.AND.}$$

Only tracks info

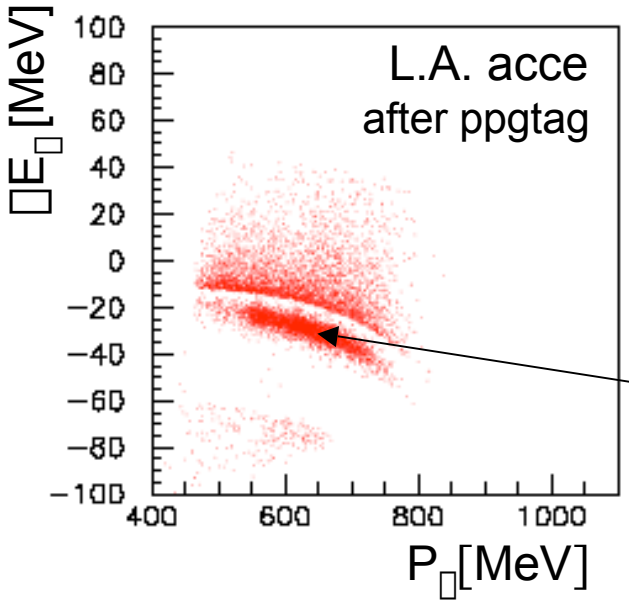
$$\sum_{cl_{neu}} E_{cl_{neu}} > 10\ MeV$$

Prompt photons according to t0_find module □ |□-1|<0.2

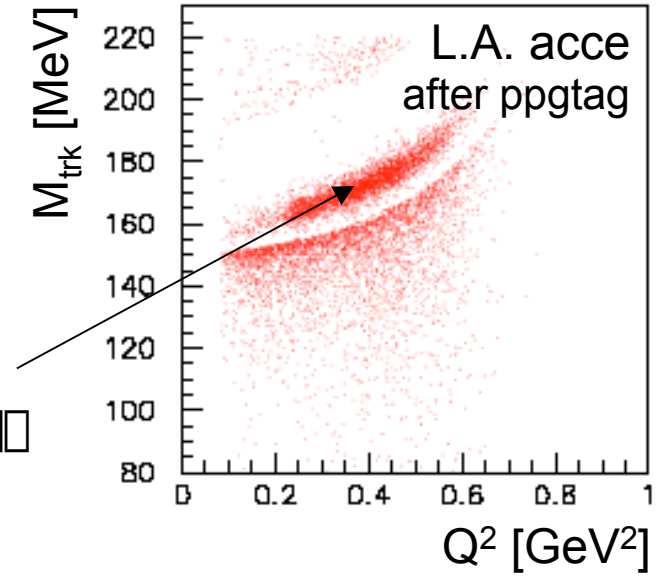
$$\square E = P_{tot}^{trk} \square \left(M_{\square} \square \sqrt{M_{\square^+}^2 + |\vec{p}_{\square^+}|} \square \sqrt{M_{\square^+}^2 + |\vec{p}_{\square^\square}|} \right)$$



The ppgtag selection used for 2001 □□□data is in anticoincidence to □□ selection:



The famous "island" remains in □□□ selection

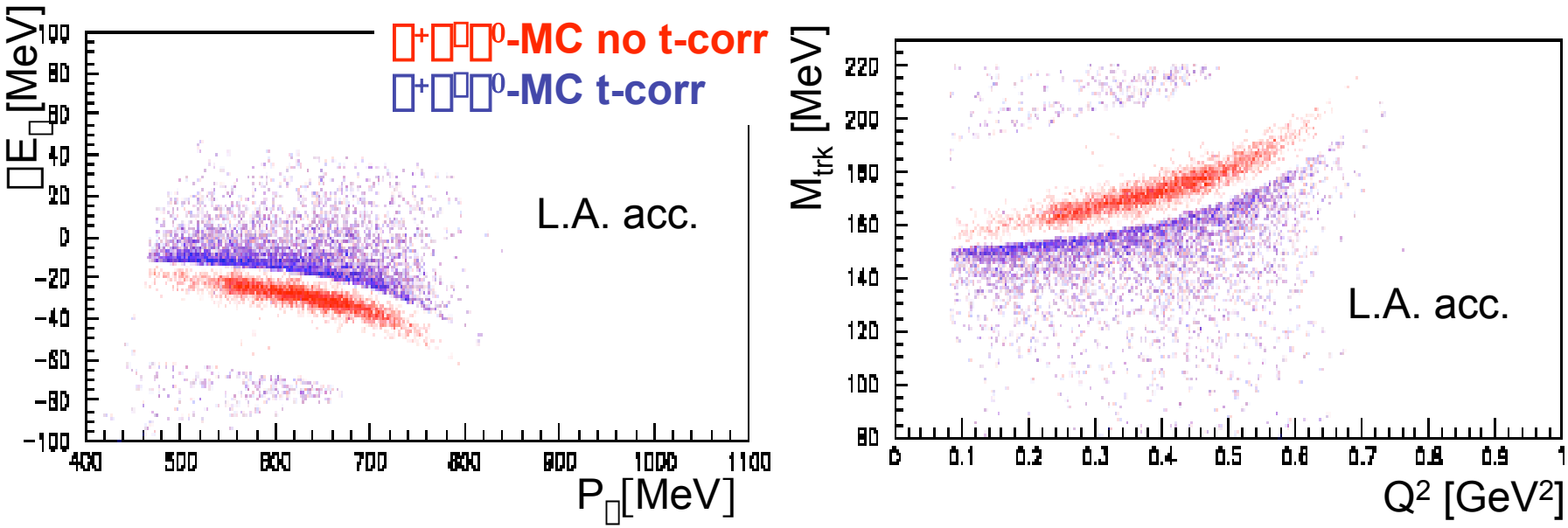


□□ filter studies:

Events in the island are events with $\sum_{cl_{neu}} E_{cl_{neu}}$<10 MeV

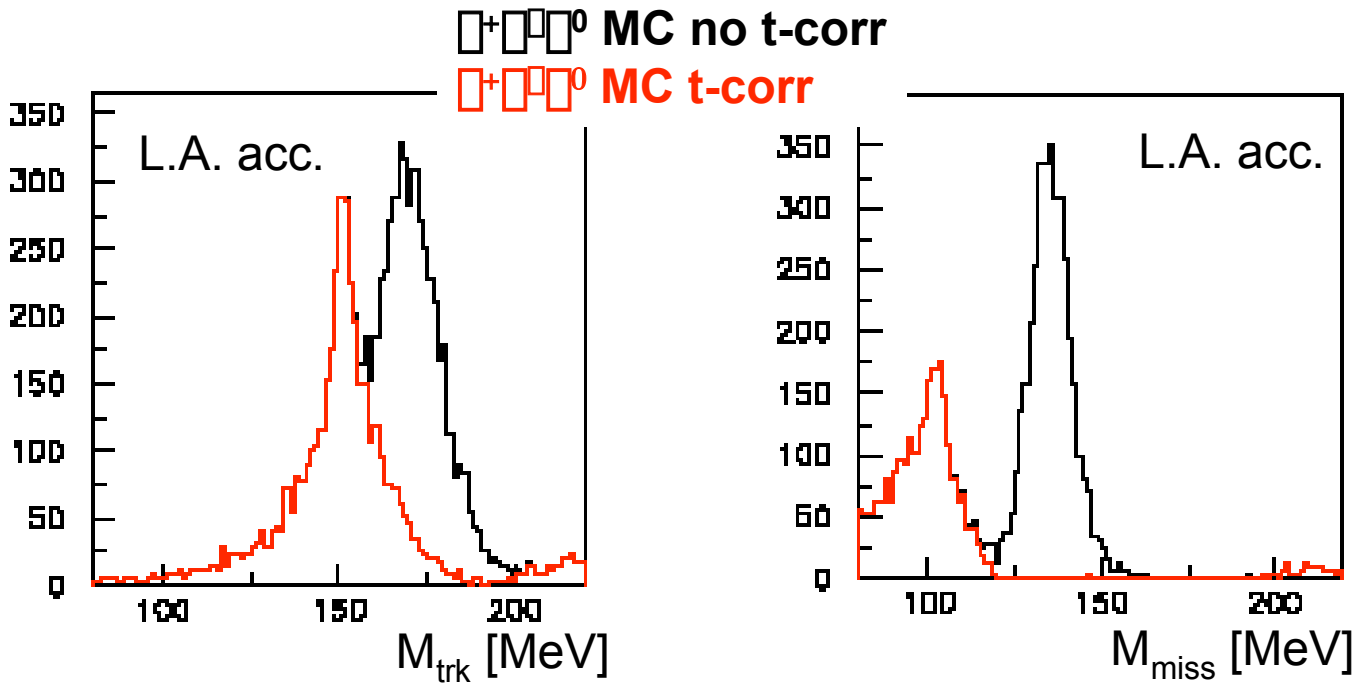
(however, at large angle is very unlikely that both the photons from the □^{0} are lost!)

Main reason:
The time of the photons is 'wrong' in ppfilt, and they are not recognized as prompt ones. For these events one can apply a correction on the time (rephasing t0 as done e.g. in the likelihood) and re-ask **.not.□□** with the 'new' t0 definition.



The island disappears ("Atlantis-effect")

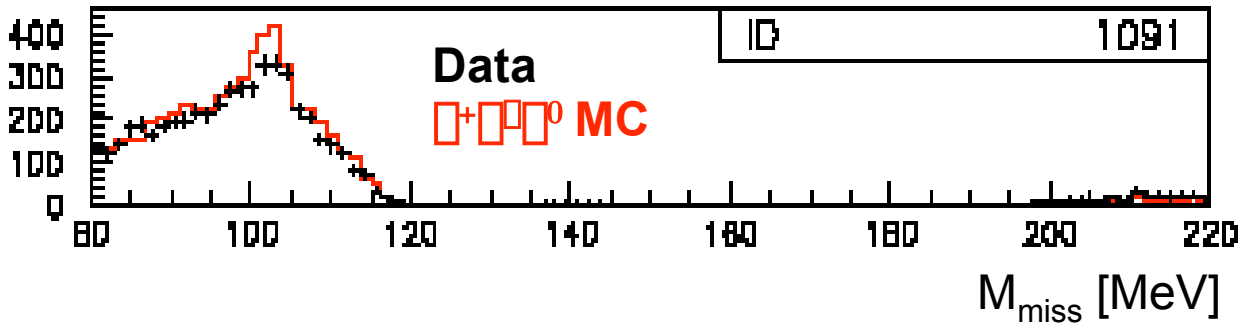
□□ filter studies:

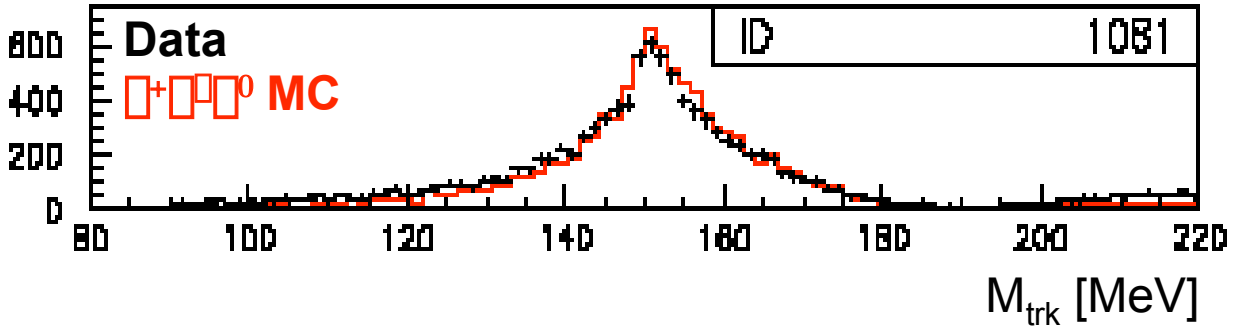


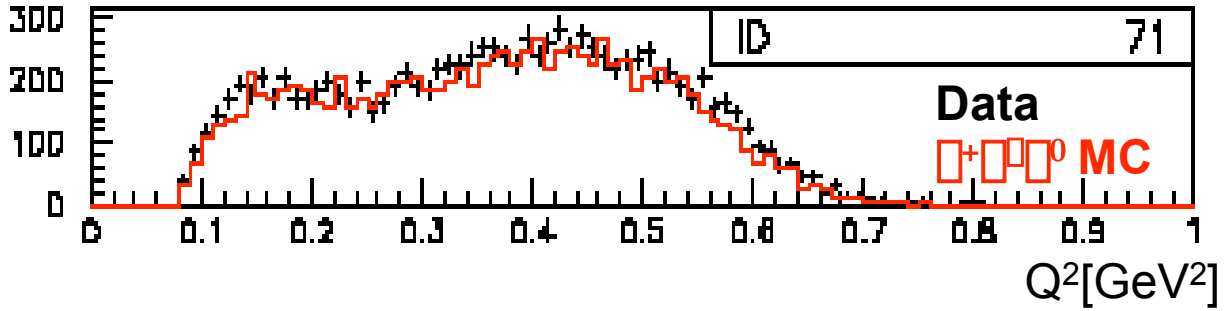
In the S.A. analysis to reject the residual □□□ contamination, we fitted the missing mass distribution data+MC and re-weighted the MC contribution according to the fit result. The fit normalization was mainly based on the larger peak (which is apparently very sensitive to changes in t0).

Can this have a sizeable effect in the background subtraction?

- Checks to be done in small angle acceptance region







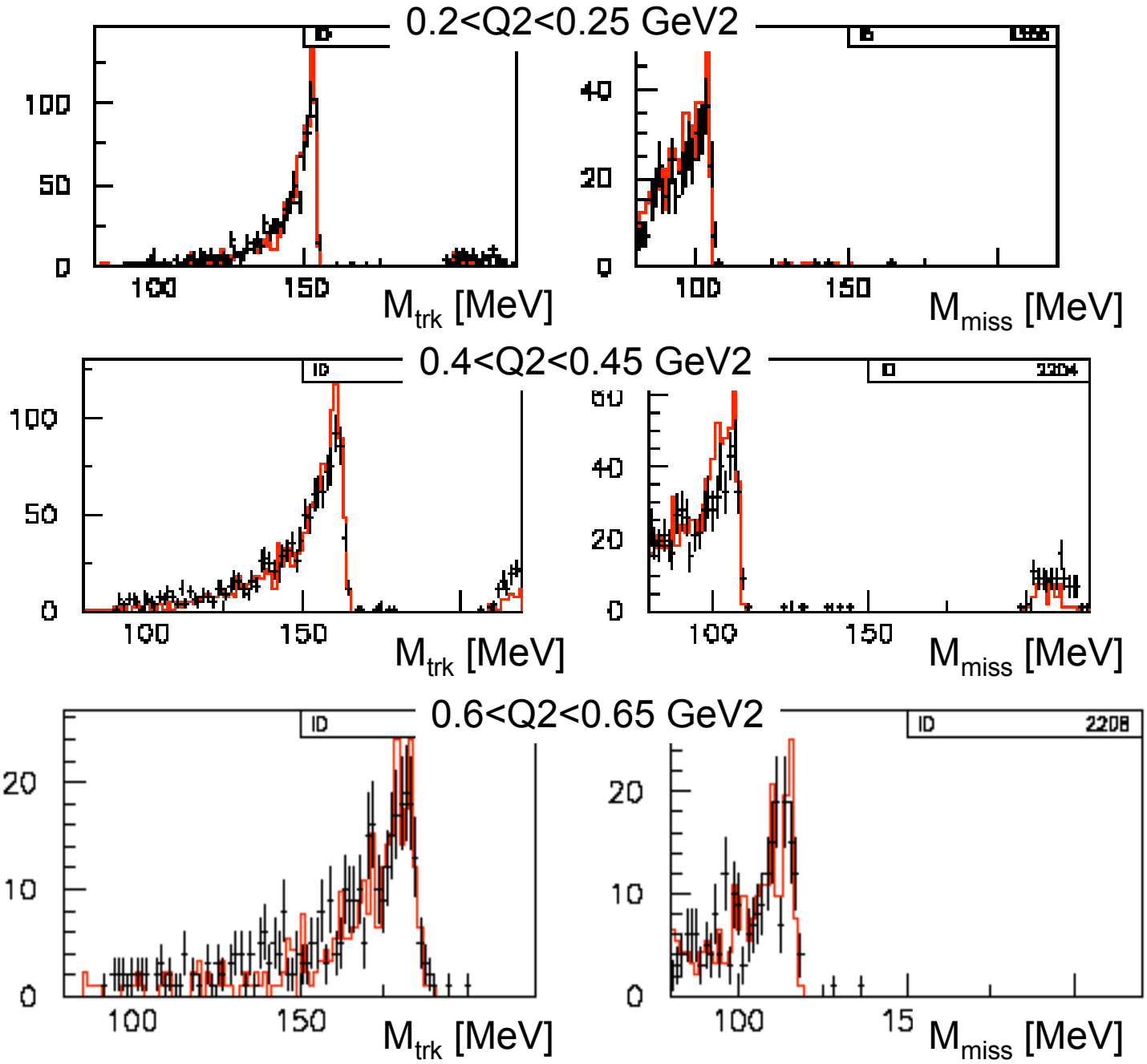
In order to check whether we see the same effect in data, we ask

$c^2_{ppp}<20$, to select ppp from our data sample (in L.A. acceptance)

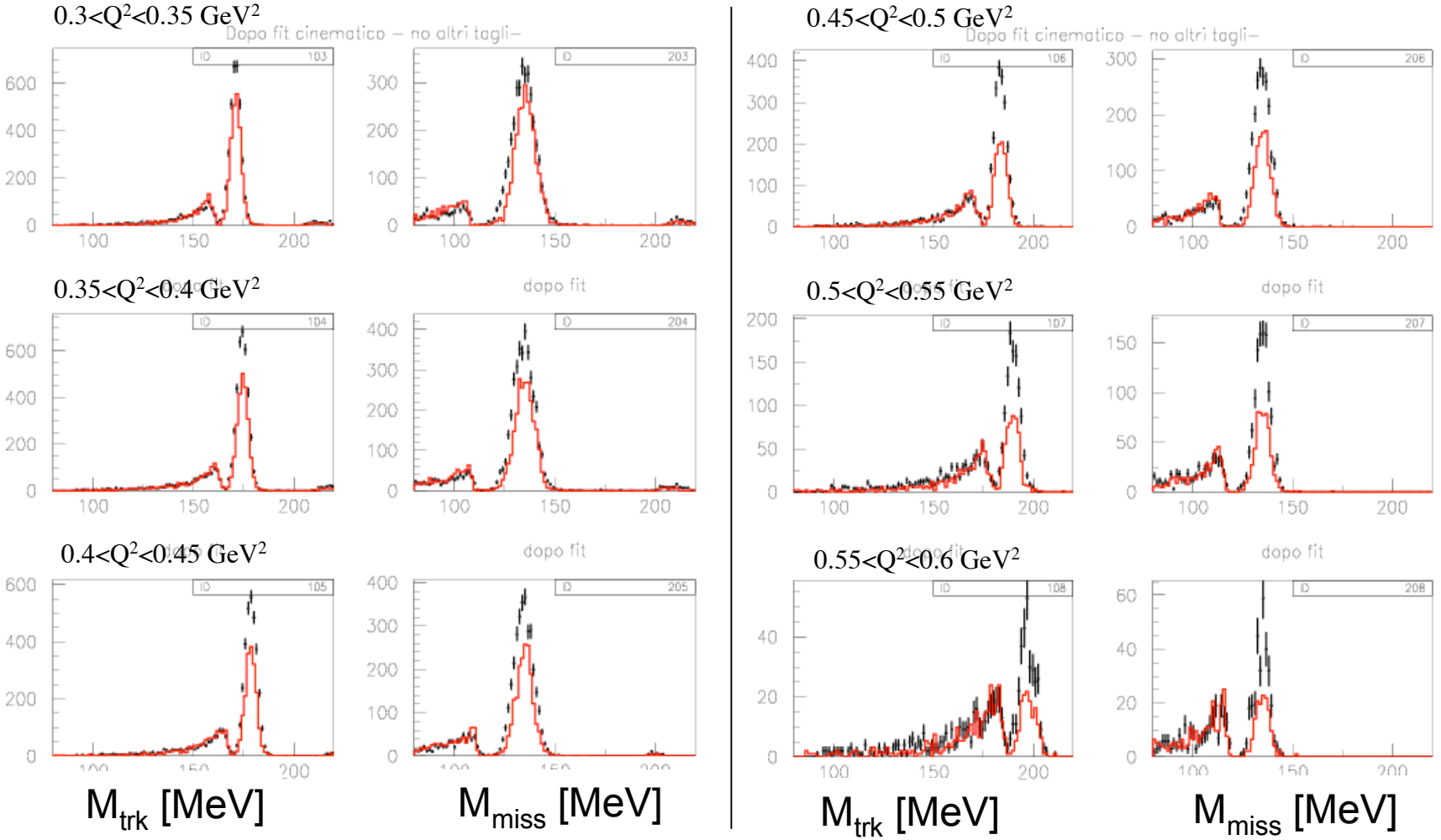
(no other cuts in these plots)

The ppp-MC reproduces well the data: important for the background subtraction

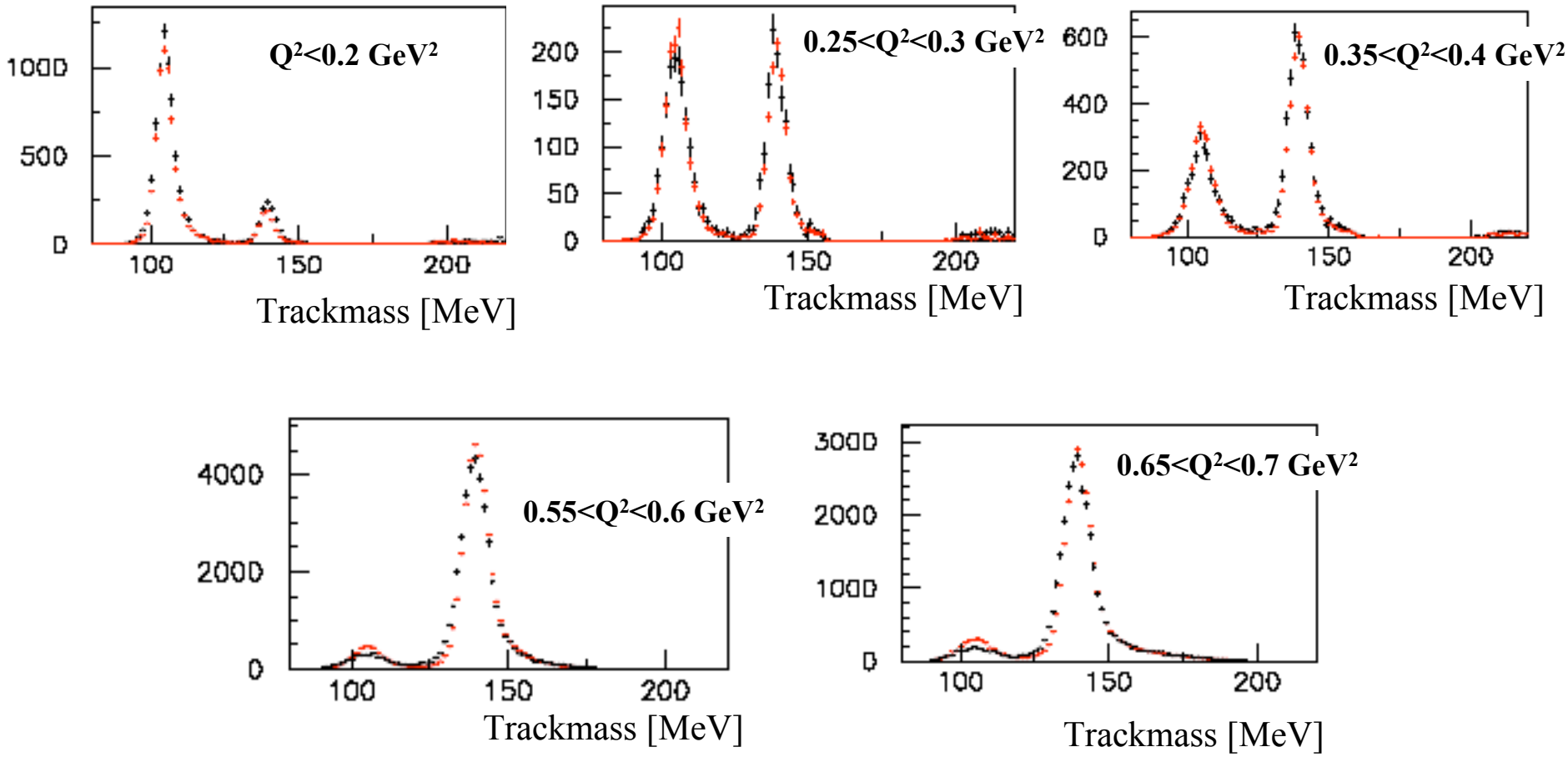
And that is true over the full Q^2 spectrum:



Comparison MC/Data without correcting t0:
(Q^2<50 to select 3π events)



Trackmass for MC and data in Q^2 bins:



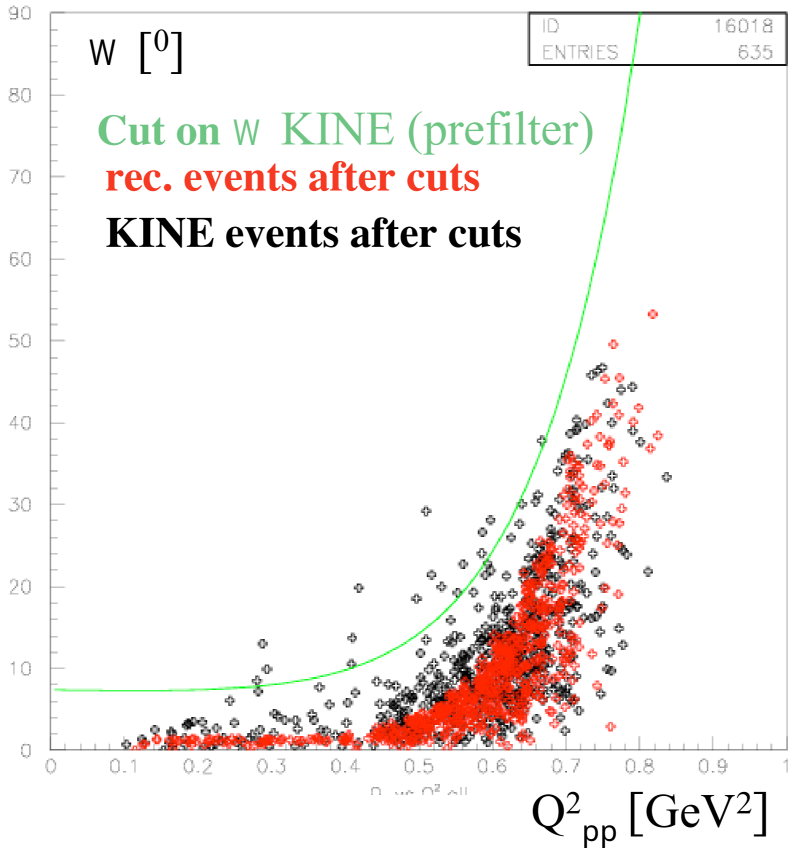
The reason of the bad agreement at high Q^2 in the muon peak is the cosmic veto from MC…
(for □□□signal MC is corrected for data cosmic veto)

Next steps:

- Use 2002 data!
- Studying the f0 contribution
  (new version of Phokhara)
- Studying the background □□, □ □ □□
- Efficiencies…
- Use increased filt_3p MC statistics

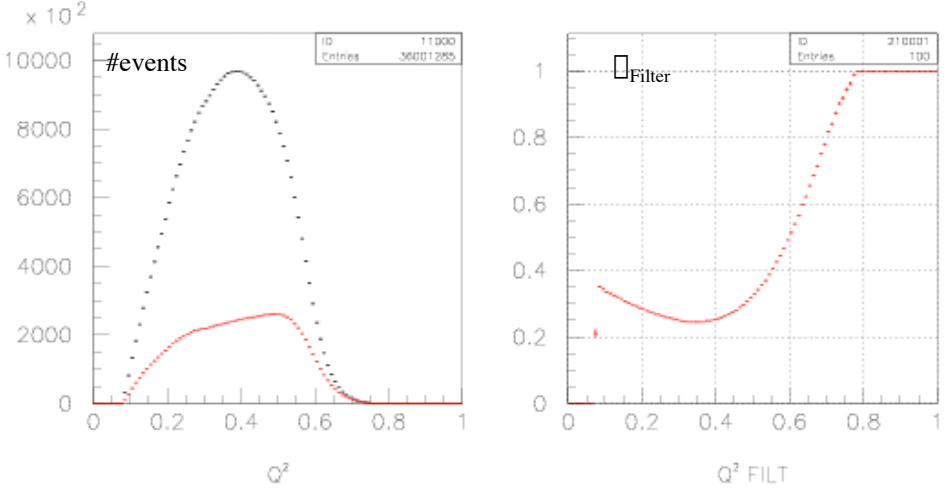
rp **prefilter (filt_3p):**

In order to produce vast amounts of rp MC needed for the precise evaluation of 3p background to the large angle ppg analysis, a prefilter based on the KINE angle W has been created, which cuts rp events on generator level which are not needed in the ppg analysis.

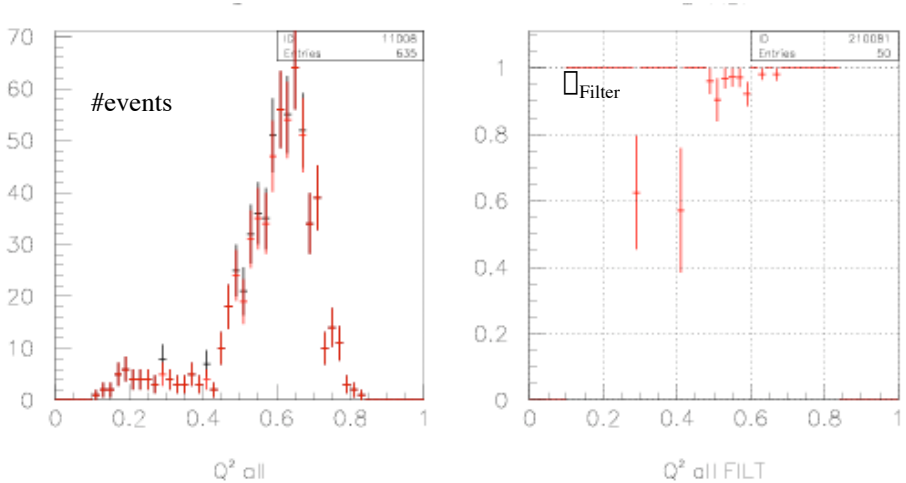


□□ prefilter (filt_3p):

Inclusive spectrum (all events)



After □□□Signal selection:



Few “signal” events are lost - eff. of the filter can be evaluated with the (unfiltered) phirp_3p production

PHOKHARA 5:

Channels included in Phokhara5:

- $e^+e^- \to \pi^+\pi^-\gamma$
- $e^+e^- \to \pi^+\pi^-\pi^0$ (also f_0 models added)
- $e^+e^- \to \pi^+\pi^-\pi^0\pi^0\gamma$
  $\to \pi^+\pi^-\pi^+\pi^-\gamma$
- $e^+e^- \to p\bar{p}\gamma$
  $\to n\bar{n}\gamma$
- $e^+e^- \to K^+K^-\gamma$
  $\to K^0\bar{K}^0\gamma$
- $e^+e^- \to \pi^+\pi^-\pi^0\gamma$

} new in Phokhara5

- I did the usual modifications (ntuple option, boost, eventcount, inputcard etc.), this standalone version can be found in /afs/kloe/group/phidec10/ppg/phokhara5/
- Parameters for 2 pion formfactor, f_0 models and 3 pion formfactor can be changed via input card
- It has been implemented in GEANFI (test).

PHOKHARA 5: $|F_\pi|^2$ Parametrization

Theoreticians now "officially" included GS-Parametrization
(in addition to KS) ⇒ see hep-ph/0409080 (Bruch, Kodjamirian, Kühn)

$$F_\pi(s) = \left[\sum_{n=0}^{3} c_n BW_n(s)\right]_{FIT} + \left[\sum_{n=4} c_n BW_n(s)\right]_{THEORY}$$

where in the n=0 term the ρ-ω mixing contribution is added via

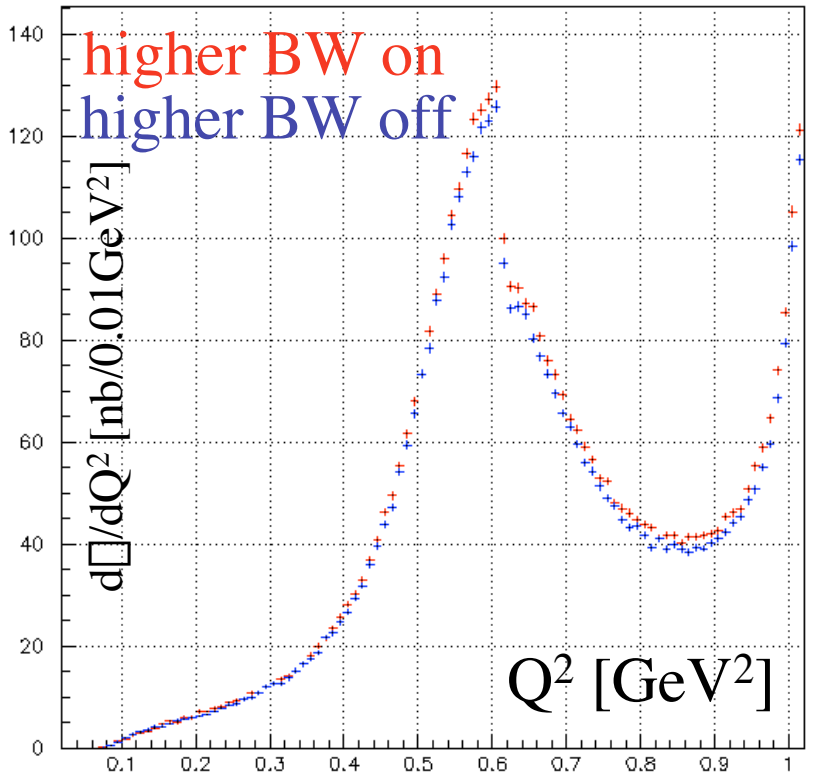
$$c_\omega BW_\omega(s) \Rightarrow \frac{c_\omega BW_\omega(s)}{1 + c_\omega}(1 + c_\omega BW_\omega)$$

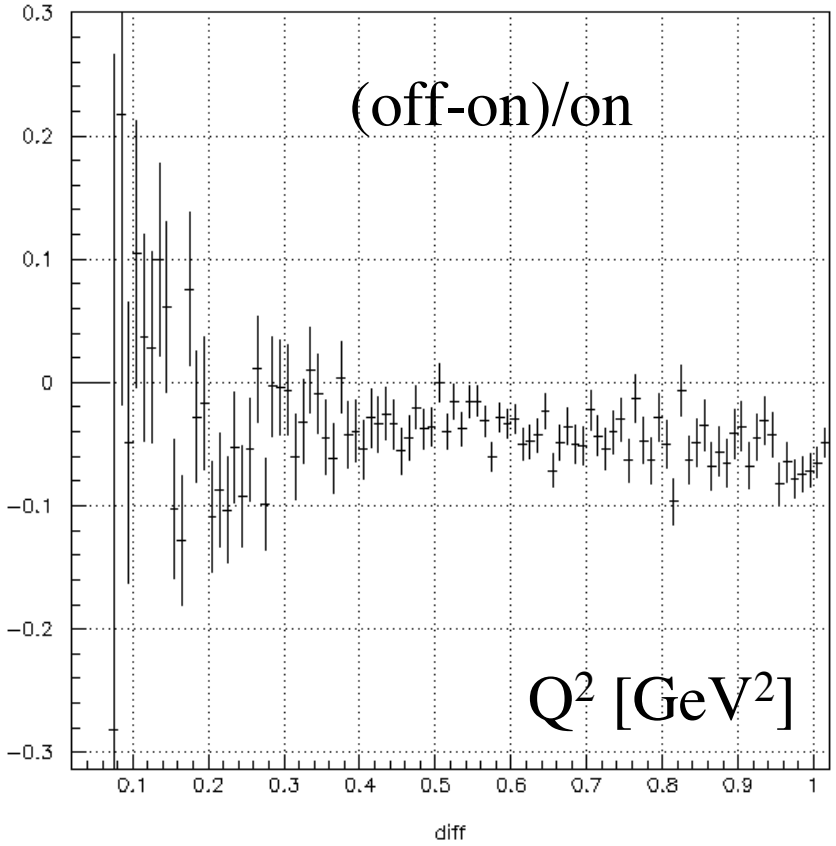
For GS-parametrization, the contribution from ρ,ρ',ρ'' are evaluated using a BW_{GS}. Theory part is evaluated only up to n=1000…

I have also added the possibility to put F_π=1 to obtain radiator H

PHOKHARA 5: $|F_\pi|^2$ Parametrization

Higher BW contr. have a non-negligible effect on the spectrum:





"If you have infinite sums, everything can happen" (H. Czyz)

PHOKHARA 5:

Input card main parameters:

```
============== Generation parameters ==============================
50000          ------------- number of generated events
10000          ------------- events to determine the maximum
"out.dat"      ------------- output file
0              ------------- printing(1), nonprinting(0) generated events
1              ------------- Born(0), NLO(1)*
.0001d0        ------------- soft photon cutoff
1          mu+mu-(0), pi+pi-(1), 2pi0pi+pi-(2), 2pi+2pi-(3), ppbar(4), nnbar(5),\
 K+K-(6), K0K0bar(7), pi+pi-pi0(8)
1              ------------- ISR only(0), ISR+FSR(1), ISR+INT+FSR(2)
1              ------------- IFSNLO: no(0), yes(1)
1              ------------- ivac : vacuum polarization switch: off (0), on (1)
1              ------------- tagged photons(0), untagged photons(1)
1              ------------- FF_pion: KS PionFormFactor(0),GS PionFormFactor(1), \
"pointlike"PionFormFactor(2)
2              ------------- for pi+pi- only: f0+f0(600): K+K- model(0), "no stru\
cture" model(1), no f0+f0(600)(2), f0 KLOE(3)
0              ------------- Flag: Ntupla yes (1), Ntupla no (0)
```

*Note: For charge asymmetry for muons/pions/f0…, born=0 should be used…in GEANFI, this is up to now hardcoded to 1 (nlo)

PHOKHARA 5:

Input card for 2pion channel:

```
-------------- 2 pion form factor ---------------------------------
0.77628d0          GeV ---------- rho0 mass
0.15053d0          GeV ---------- rho0 width
1.3806d0           GeV ---------- rho' mass
0.33981d0          GeV ---------- rho' width
1.7d0              GeV ---------- rho'' mass
0.24d0             GeV ---------- rho'' width
0.783d0            GeV ---------- omega mass
0.0084d0           GeV ---------- omega width
1.950d-3                ---------- |alpha| (omega BW contr.)
12.6                    ---------- arg(alpha) (omega BW contr.) for GS only!
-0.06300d0              ---------- beta (rho' BW contr.)
0.019655d0               ---------- gamma (rho'' BW contr.)
-0.028197d0             ---------- delta (rho''' BW contr.)
-0.0176316d0            ---------- eta (sum of higher order BW contr.)
```

- rho‘‘‘ mass and width fixed in the code
- originally no phase for alpha foreseen
- eta parameter acts only as a switch (if eta=0., do not take into account higher BWs)

PHOKHARA 5:

Input card for f_0 models:

```
-------------- f0 parameters ---------------------------------
1.00291061d0    GeV ---------- f0 mass
0.108171405d0   GeV ---------- f0 width
0.519709326d0   GeV ---------- f0(600) mass
0.319204396d0   GeV ---------- f0(600) width
0.0776526045d0      ---------- c_phi_gam
59.3919713647d0     ---------- c_phi_KK_f0_pi(model 0,1)
11.2156718914d0     ---------- c_phi_KK_f0_600_pi(model 0,1)
0.d0                ---------- phas_rho_f0(model 0,1)
98.4814123d0        ---------- phas_f0_f0600(model 0,1)
6.5d0               ---------- c_f0_KK_exp (model 3)
5.8d0               ---------- c_f0_pipi_exp (model 3)
```

Model 0: KaonLoop-model
Model 1: NoStructure-model
Model 2: no $f_0(980)$, no $f_0(600)$
Model 3: „KLOE“ model (Achasov kaon loop model without $f_0(600)$)

PHOKHARA 5: Input card for 3 pion channel

```
-------------- 3 pion parameters  ------------------------------
0.782405526d0          GeV ---------- omega mass
0.00868438102d0        GeV ---------- omega width
1.375d0                GeV ---------- omega(1420) mass
0.250d0                GeV ---------- omega(1420) width
1.63497109d0           GeV ---------- omega(1650) mass
0.245d0                GeV ---------- omega(1650) width
1.01924415d0           GeV ---------- phi mass
0.00414709391d0        GeV ---------- phi width
0.77609d0              GeV ---------- rho- mass
0.14446d0              GeV ---------- rho- width
0.77609d0              GeV ---------- rho+ mass
0.14446d0              GeV ---------- rho+ width
0.77609d0              GeV ---------- rho0 mass
0.14446d0              GeV ---------- rho0 width
1.465d0                GeV ---------- rho(1450)- mass
0.31d0                 GeV ---------- rho(1450)- width
1.465d0                GeV ---------- rho(1450)+ mass
0.31d0                 GeV ---------- rho(1450)+ width
1.465d0                GeV ---------- rho(1450)0 mass
0.31d0                 GeV ---------- rho(1450)0 width
1.7d0                  GeV ---------- rho(1700)- mass
0.235d0                GeV ---------- rho(1700)- width
1.7d0                  GeV ---------- rho(1700)+ mass
0.235d0                GeV ---------- rho(1700)+ width
1.7d0                  GeV ---------- rho(1700)0 mass
0.235d0                GeV ---------- rho(1700)0 width
18.4111211d0               ---------- aa_3pi
-0.870383579d0             ---------- bb_3pi
-0.532429515d0             ---------- dd_3pi
-0.710678272d0             ---------- ee_3pi
1.05007988d0               ---------- pow_3pi
-0.720147266d0             ---------- jj_3pi
-1.07149467d0              ---------- kk_3pi
```

for details see upcoming document of Czyz, Kühn, et al.

PHOKHARA 5 vs PHOKHARA 3:

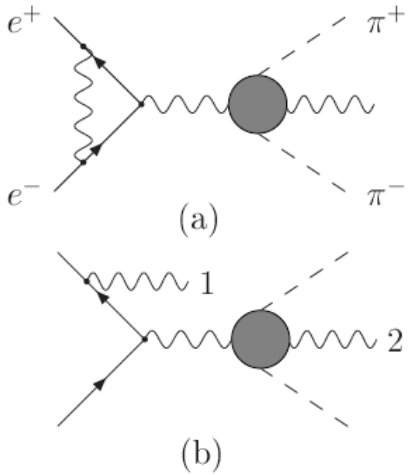
(Phok3 was the last version inserted in GEANFI)

a) "Theoretical" differences:

Initial state vertex corr. to FSR added in Phok 4

- Now also soft ISR+hard FSR is possible (before ISR photon 1 had to be hard)

- 2-3% to diff. cross section for incl. meas.,
- less than 1‰ for small angle cuts



b) "Experimental" differences:

- subroutine fgs within GS-parametrization is called with the s-dependent width (should be the constant width)
- dh/ds within GS-parametrization is "different" (and has been actually commented and replaced in phokhara 4)
- GS-subroutine is not always called where it should have been called (instead, KS is called)

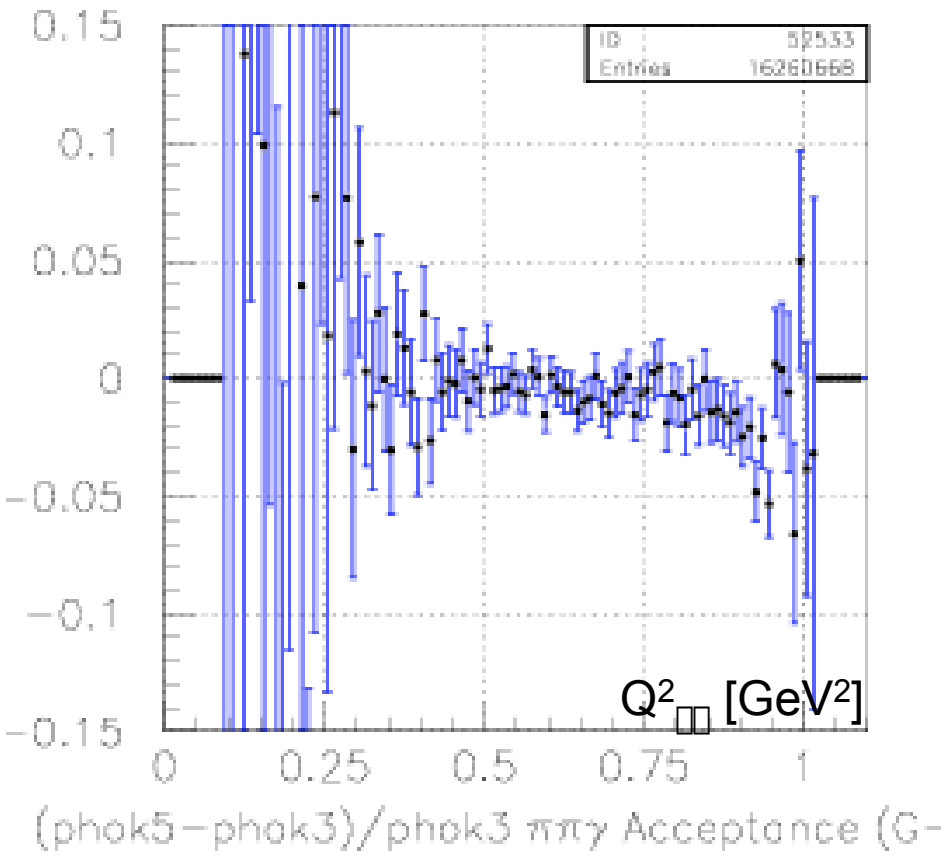
Only GS-parametrization is affected (KS has been used in the production)

…but GS has been used in the evaluation of the acceptance!!

PHOKHARA 5 vs PHOKHARA 3:

Effect of discrepancies in Phok3/Phok5 on acceptance:

(Experimental + Theoretical differences)

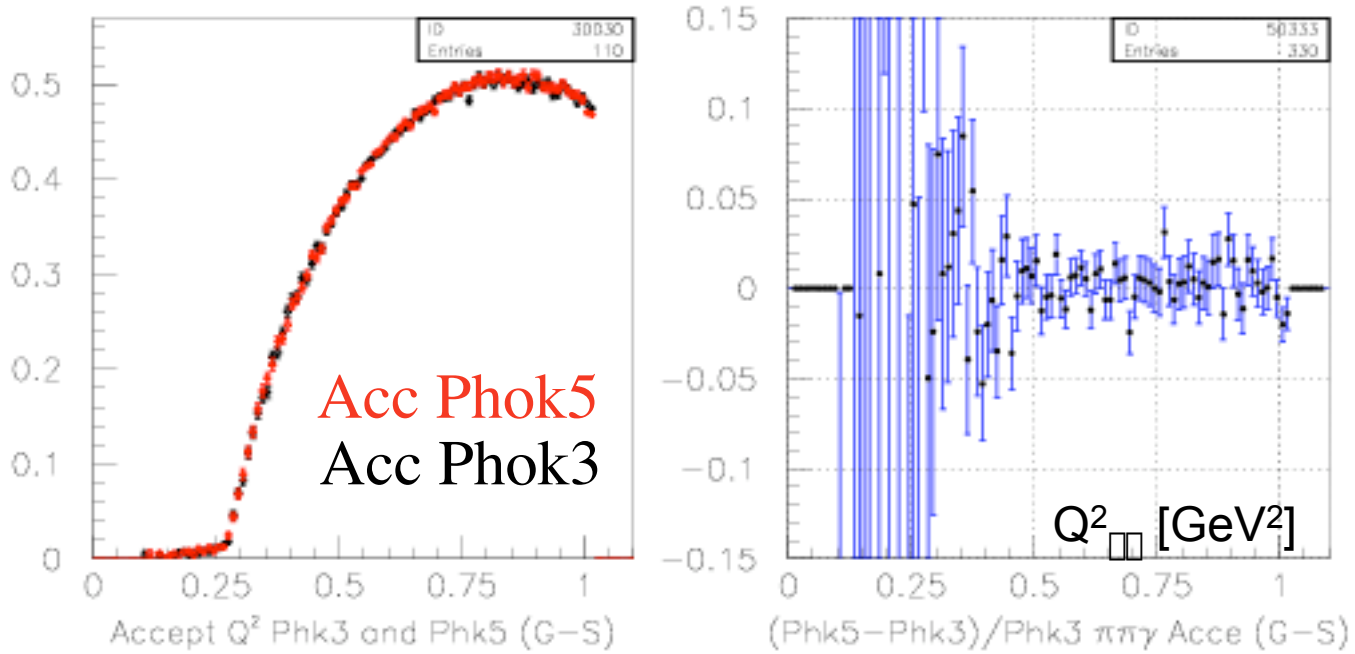


PHOKHARA 5 vs PHOKHARA 3:

Effect of discrepancies in Phok3/Phok5 on acceptance:

(Only theoretical differencies)

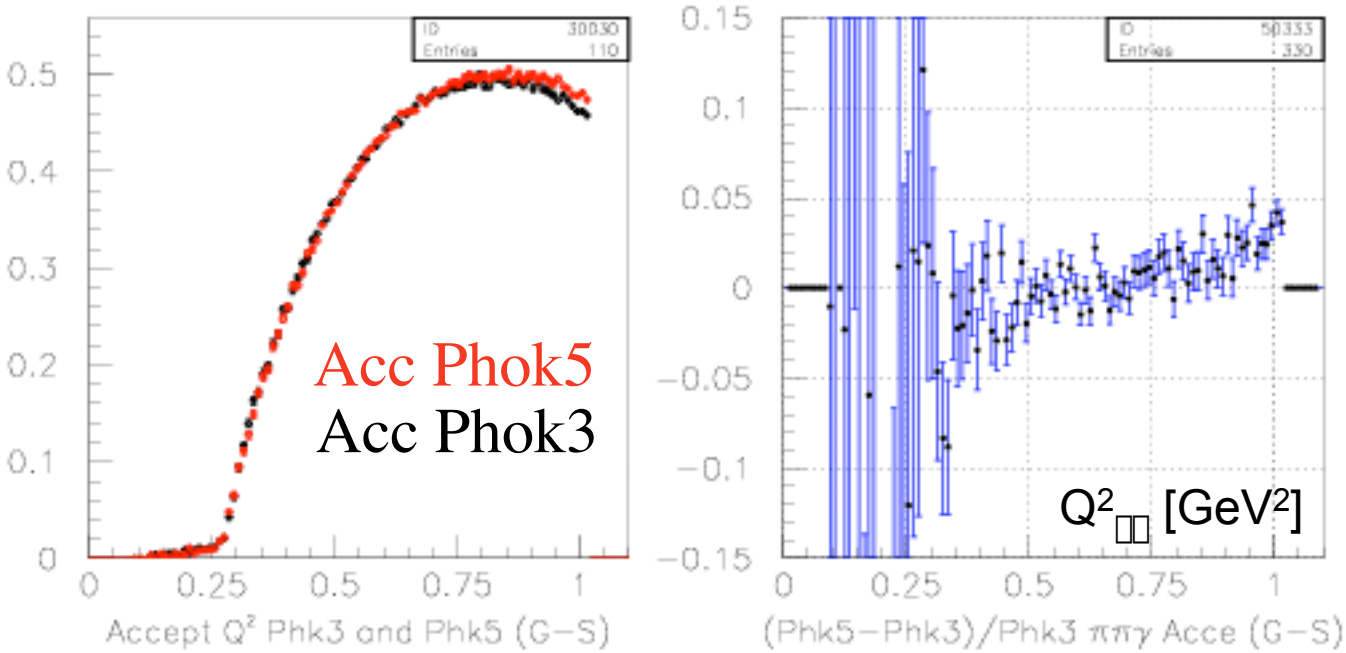
ISR+FSR, FSRNLO off



PHOKHARA 5 vs PHOKHARA 3:

Effect of discrepancies in Phok3/Phok5 on acceptance: (Only theoretical differencies)

ISR+FSR, FSRNLO on



However, what enters in the analysis is the acceptance as a function of $Q^2_{\square\square}$, not the one in $Q^2_{\square\square}$! The actual change will most likely influence only the bins at very high Q^2_{ppg} □ the checking of this however requires a Phokhara5□ generator, in which the photons carry a flag whether they come from ISR or FSR.

Conclusions:

- improved background understanding in large angle analysis
  □ □□ MC now reliable for □□□ analysis
- filter for □□ MC-production ready to use
- Phok5 available in GEANFI (ready to use!)
- Comparison Phok5 with Phok3…reveiled some bugs for GS in Phok3…

  To make a definitive statement on the acceptance change from Phok3 to Phok5, a version Phokhara5□ is needed!