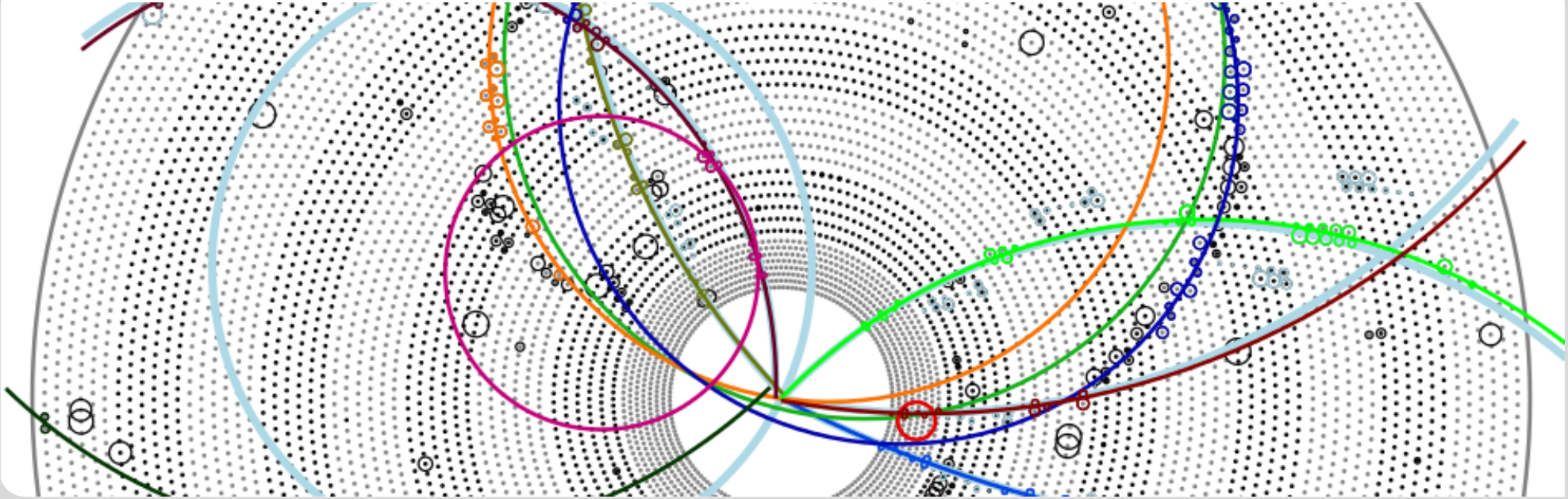
Karlsruher Institut für Technologie

MC-Matching based on χ^2.

Weekly Tracking Meeting.

Nils Braun | 13.01.2017

IEKP - KIT



First of all...

Happy New Year!

New MC-Matcher

- Current matcher is based on hit-information - which is perfectly well for tracking studies, but may not be the information we want to "deliver" in the end.
- An additional matching based on the extracted tracking parameters may (?!) be better suited for the analysis people
- New matcher uses the fitted tracks (`Belle2::Track`), which is our final result.

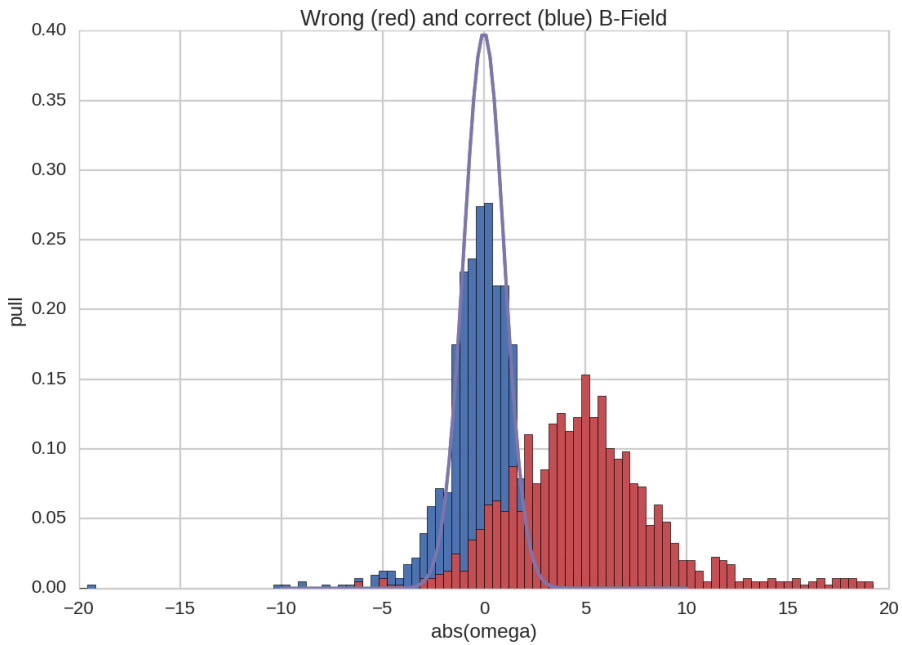
How does it work?

- I extracted a base class for the matcher, on which the hit-based and the parameter-based matcher are built on.
- Basic functionality taken from hit-based matcher (+ some generalization): extract a “confusion matrix” relating all MC and PR tracks (entries depend on implementation) and use it to classify as “fakes”, “clones”, etc.
- implementation for the parameter-based matcher:
  - Get the `TrackFitResult` for each PR track and extract a 5d-state (if fit failed, classify as “background”).
  - Extract the 5d-state also from the MC Reco Tracks.
  - Calculate the entry in the matrix with

$$\chi^2 = (s_{\mathrm{MC}} - s_{\mathrm{PR}})^T C^{-1} (s_{\mathrm{MC}} - s_{\mathrm{PR}})$$

    (precisely use ‘$1/\chi^2$)
- After that, the same rules apply as for the hit-based matcher (best match is called “found”, rest is clone. If $1/\chi^2$ is below a certain value, do not make the relation ...).

Two Things I have spotted

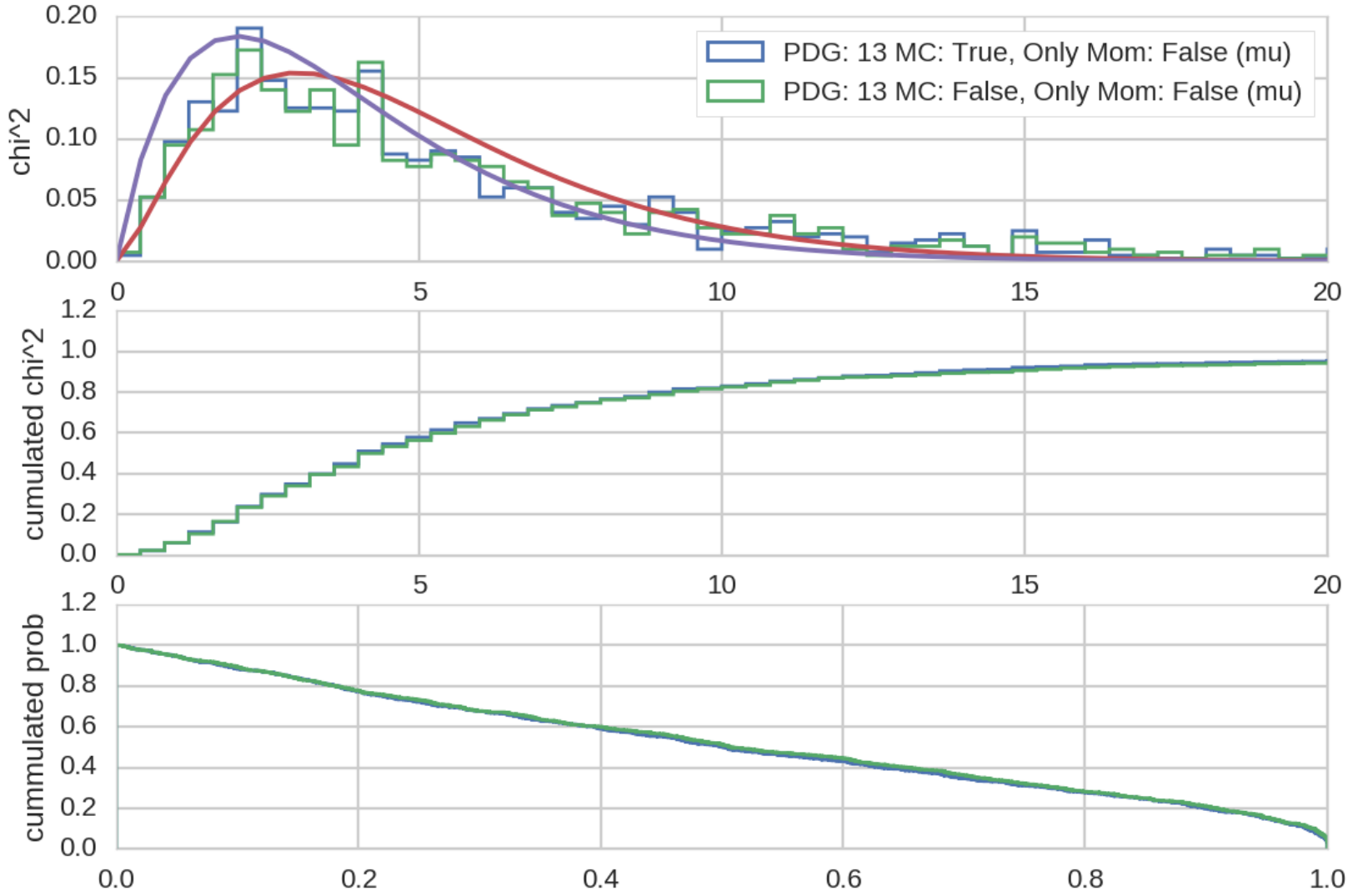


- The magnetic field was hardcoded to 1.5 in some validation scripts, which was not in aggreement with the 1.484 in the 3d magnetic field map (see BII-1939). This destroyed out pulls.
- This was not seen in the validation page, because we accidentally used the tracking seeds instead of the fitted information for the pulls... (see PR-184).

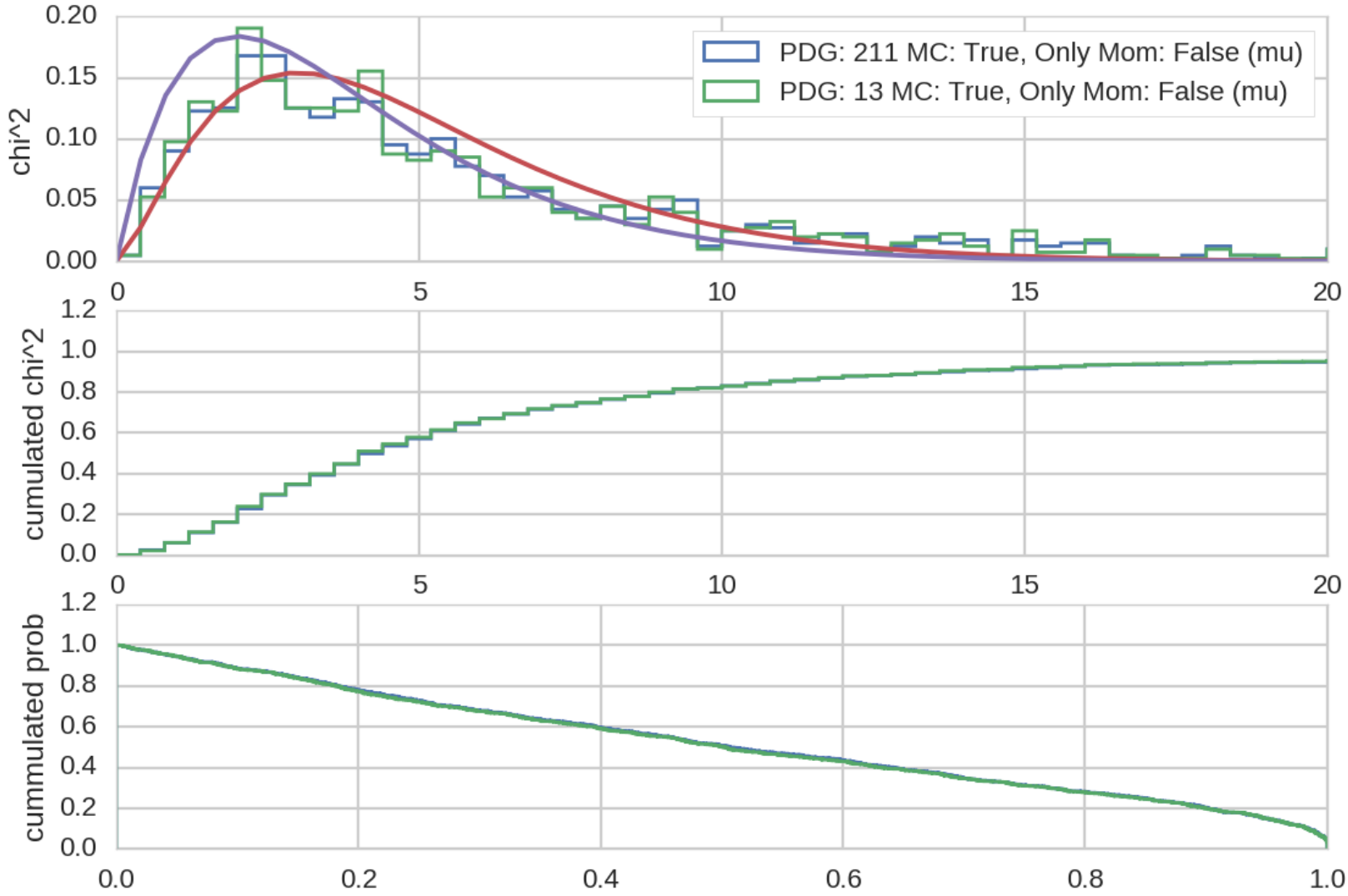
Results and Problems

- Problem: One has to define a maximal χ^2 value, below which a relation is called “matched”.
- We will look into a very “simple” example, to get some feeling.
- In the following plots you will always see:
  - 1000 single ‘μ between 0.1 and 4 GeV momentum.
  - No cut applied to the maximal χ^2 (so there are no ghosts).
  - Mostly all of the tracks could be fitted (so there are no background tracks).
  - Only a very small amount of events do not have exactly one found track (so more or less no clones).
  - The state is calculated using all 5, or only $\phi_0, \omega, \tan\lambda$ (no vertex information).

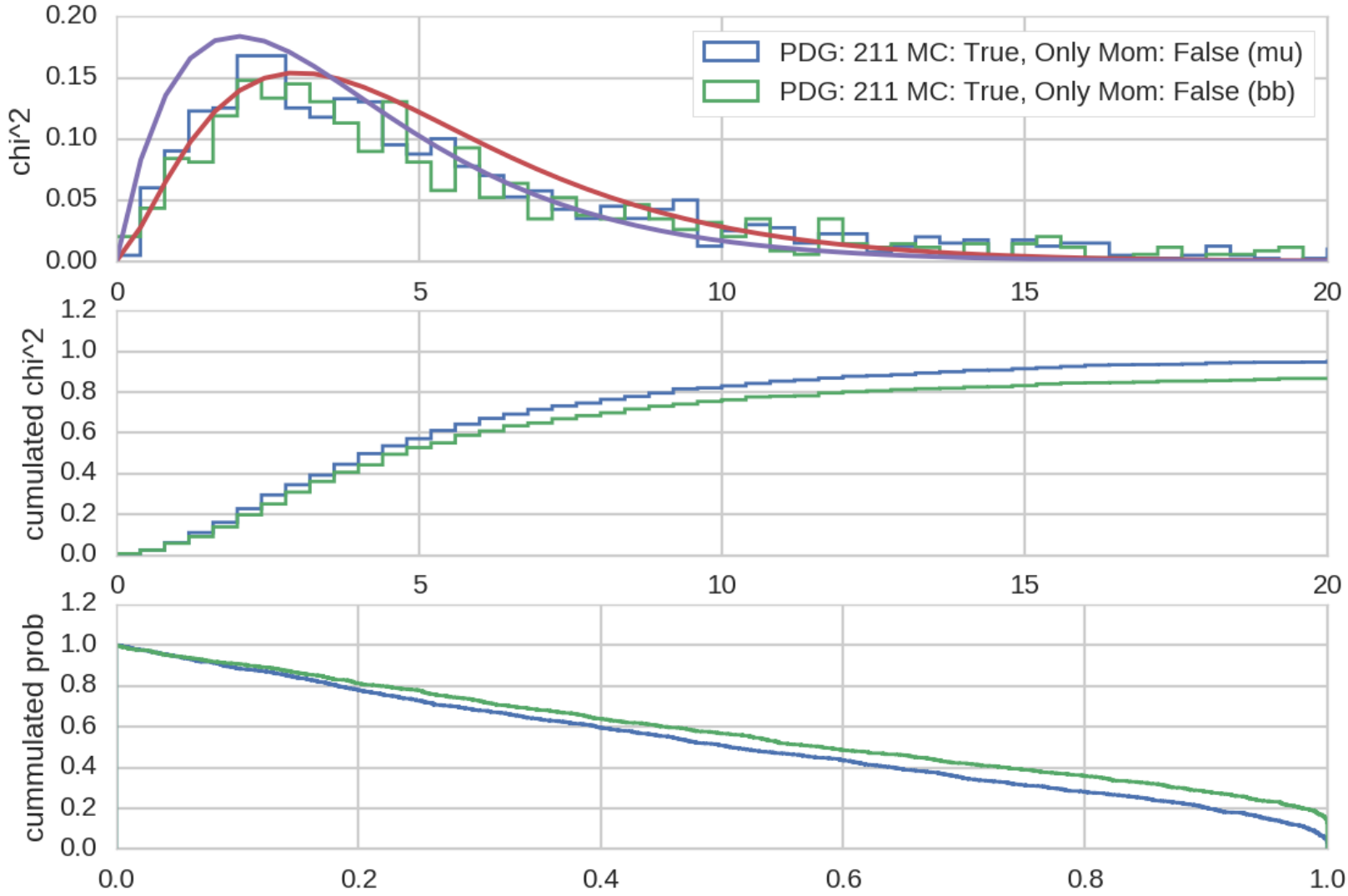
Results


PDG: 13 MC: True, Only Mom: False (mu)
PDG: 13 MC: False, Only Mom: False (mu)
chi^2
cumulated chi^2
cummulated prob

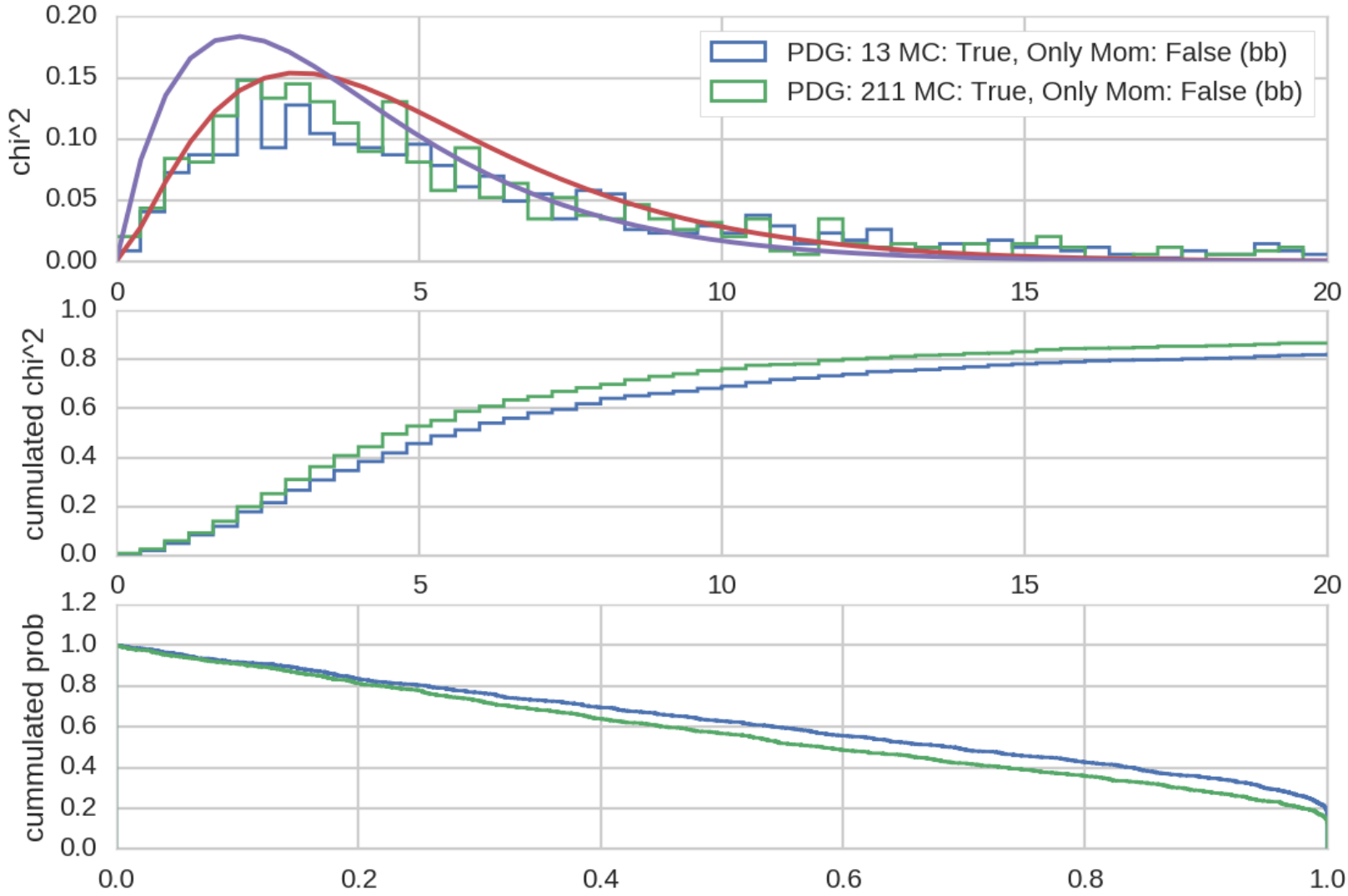
Results


PDG: 211 MC: True, Only Mom: False (mu)
PDG: 13 MC: True, Only Mom: False (mu)
chi^2
cumulated chi^2
cummulated prob

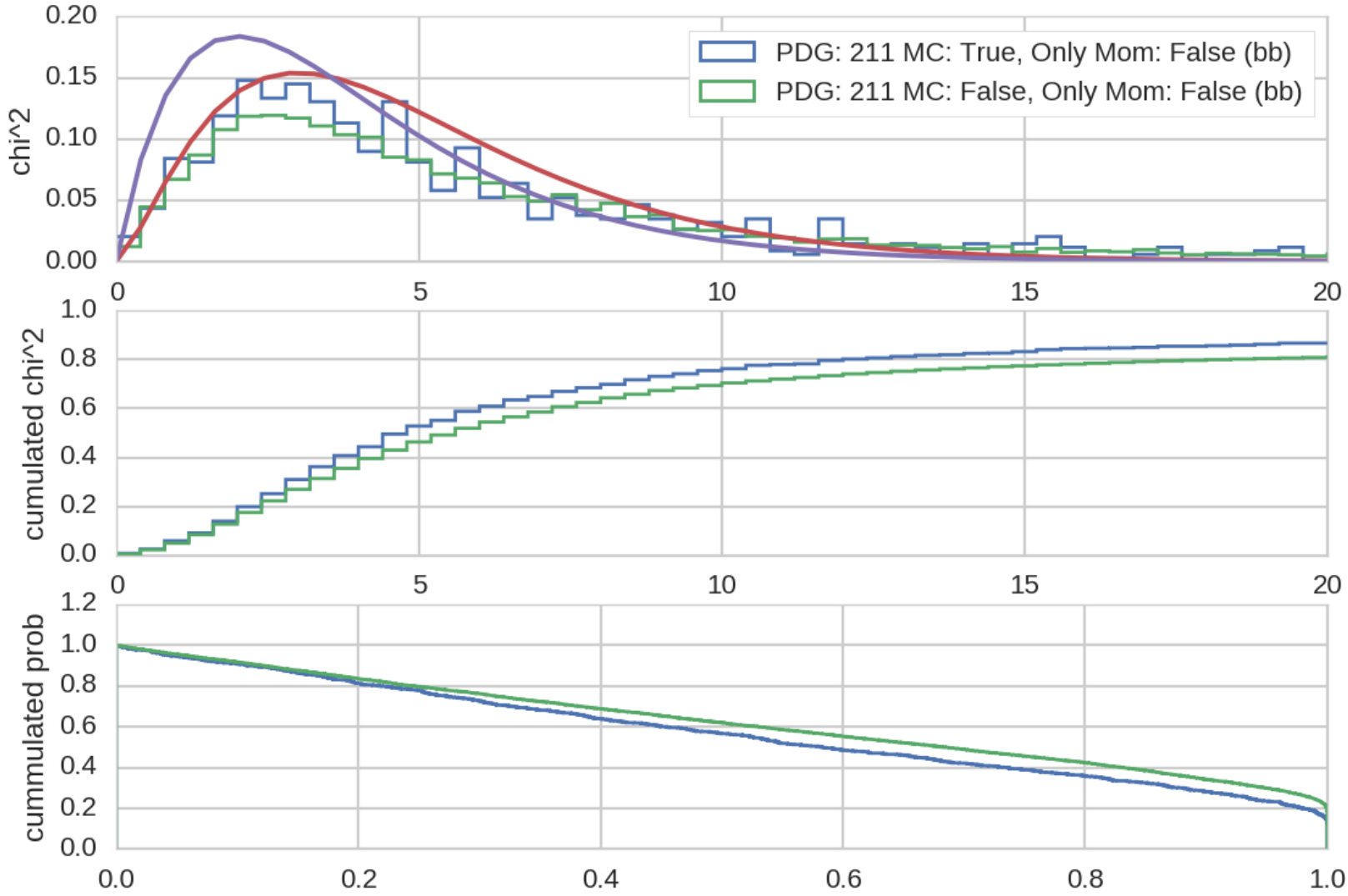
Results


PDG: 211 MC: True, Only Mom: False (mu)
PDG: 211 MC: True, Only Mom: False (bb)
chi^2
cumulated chi^2
cummulated prob

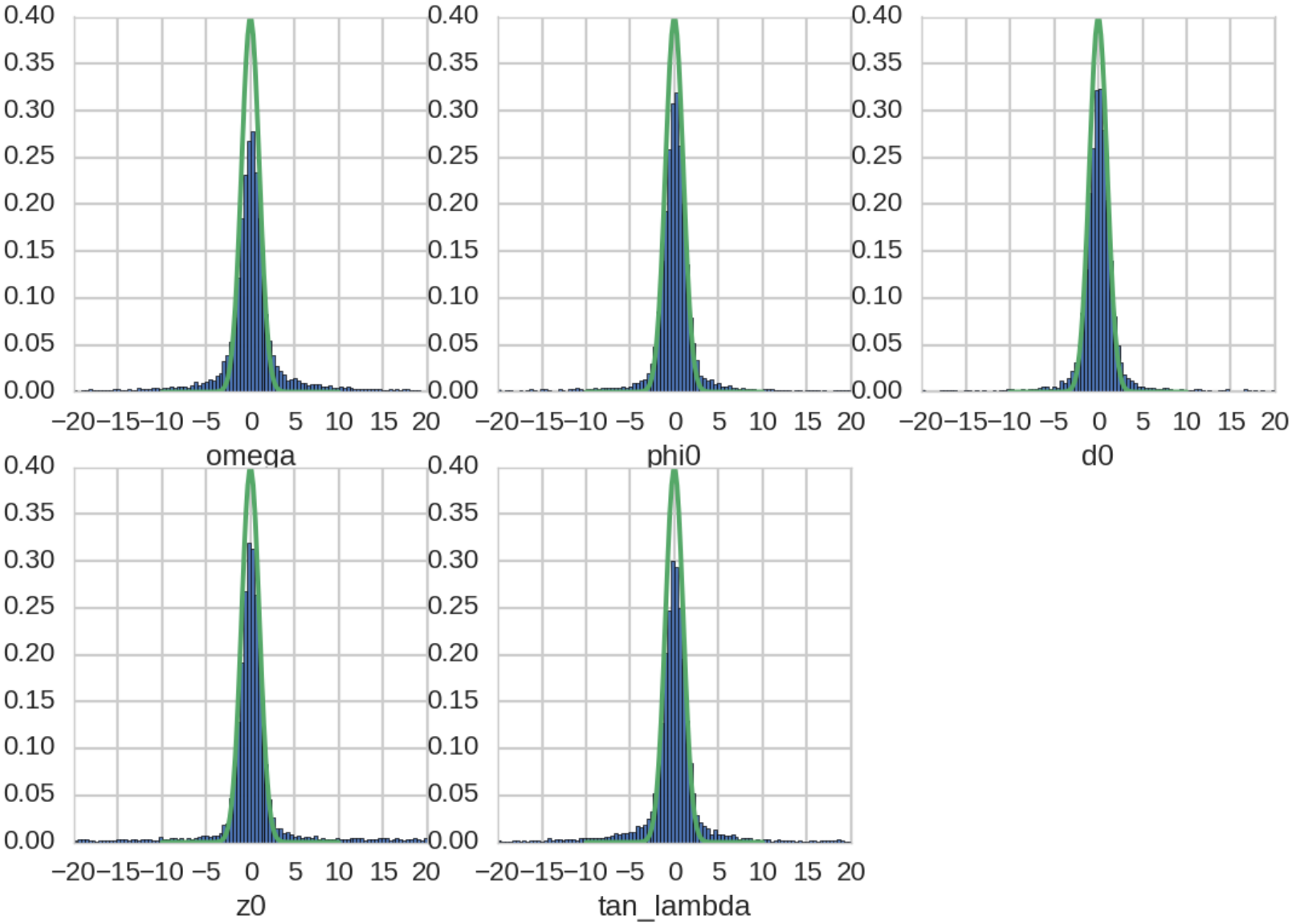
Results


PDG: 13 MC: True, Only Mom: False (bb)
PDG: 211 MC: True, Only Mom: False (bb)
chi^2
cumulated chi^2
cummulated prob

Results


PDG: 211 MC: True, Only Mom: False (bb)
PDG: 211 MC: False, Only Mom: False (bb)
chi^2
cumulated chi^2
cummulated prob

Pulls


0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−20 −15 −10 −5 0 5 10 15 20
omega
phi0
d0
z0
tan_lambda

Pulls

Ratios	Above 10 σ	Above 5 σ
ω	0.119949	0.119949
ϕ_0	0.085042	0.085042
d_0	0.066722	0.066722
z_0	0.133444	0.133444
$\tan\lambda$	0.064837	0.064837