

# Introduction

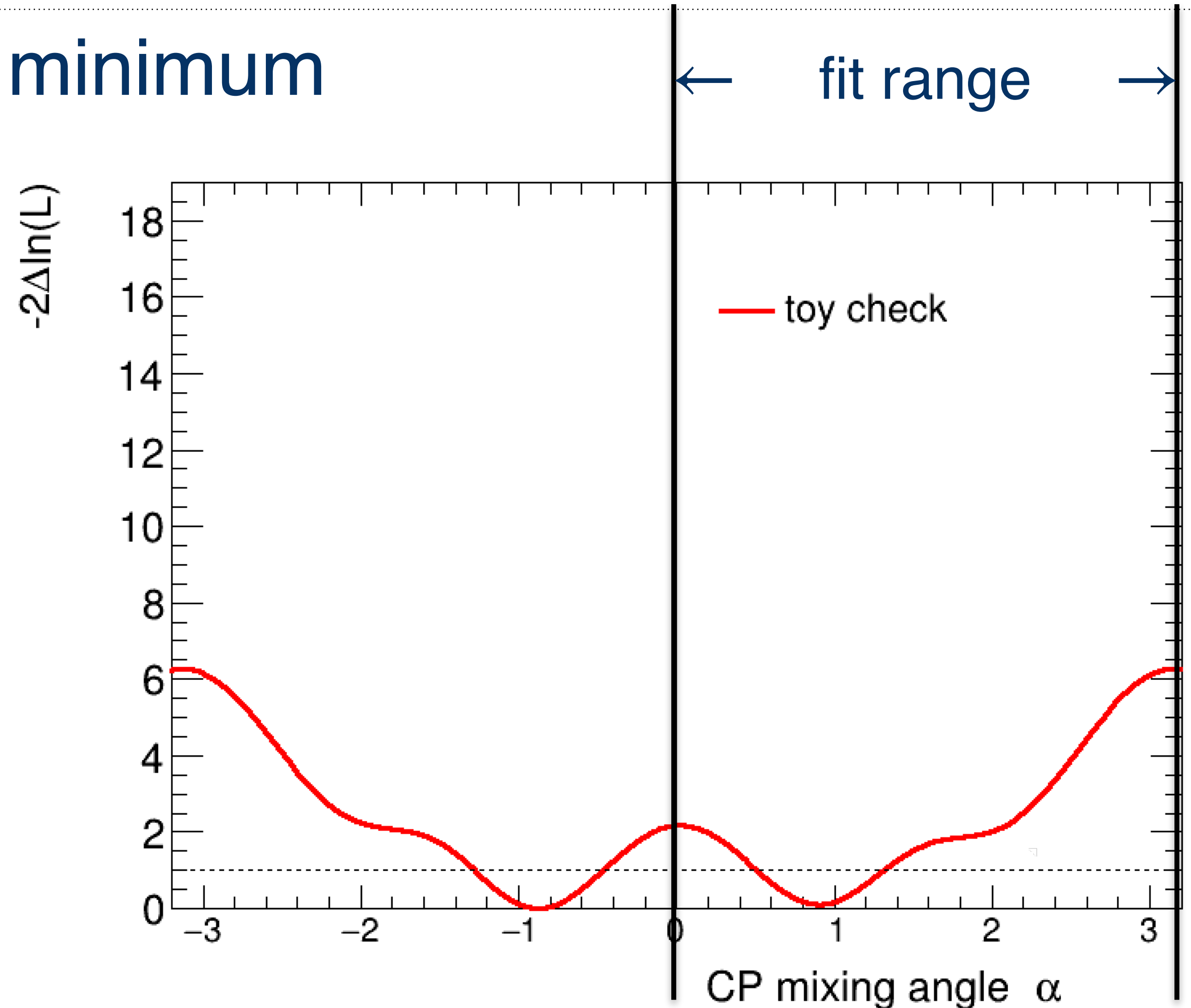
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- We are researching on the CP mixing angle  $\alpha$  using ttH gamgam channel by running toys
- However, We found an issue since toy mean do not corresponds to expected input value and investigated it
  - found differences between the -2NLL minimum and the toy Minuit minimum
- Poi:  $\alpha$
- NPs:
  - $\kappa_t$ , we fix it in the fit for simplicity
  - From Data-driven method:  $\text{nbkg}_*$ ,  $p1_*$
  - Constrained systematic uncertainty:  $\text{ATLAS}_*$ ,  $\text{TheorySig}_*$
  - ggF and  $H \rightarrow \gamma\gamma$  constrained by the Higgs boson coupling combination:  $C_g$ ,  $C_\gamma$
- Dataset named “newDataset”, generated with:
  - $\alpha=1.5$
  - $K_t=1.007$ , which is the best-fit value if we profile data to  $\alpha=1.5$
  - Other NPs randomized around the values which are best-fit values if we profile data to  $\alpha=1.5$

# Likelihood scan

To manually find the NLL minimum

- NLL scan performed with alpha from  $-\pi$  to  $\pi$
- From the NLL scan, there is a well-defined NLL minimum around  $\alpha=0.9$ , if alpha is constrained in  $(0, \pi)$



# RooFit issue

ROOT version: 6.28/00

RooFitExtensions are needed to run the fit

- Input file and a root macro reproducing the issue included in tarball
- Minuit2, migrad used
- All systematic uncertainty included
- Alpha initial value = 1.5, range = [0, pi]
- Fitted to 0 under both fit strategy

```
Info in <Minuit2>: Minuit2Minimizer::Hesse Using max-calls 90000
Info in <Minuit2>: Minuit2Minimizer::Hesse Hesse is valid - matrix is accurate
*****
fixing systematics: 0
fit strategy: 1
alpha initial value: 1.5
Fitted alpha value: 7.72952e-07
```

```
Info in <Minuit2>: Minuit2Minimizer::Hesse Using max-calls 90000
Info in <Minuit2>: Minuit2Minimizer::Hesse Hesse is valid - matrix is accurate
*****
fixing systematics: 0
fit strategy: 2
alpha initial value: 1.5
Fitted alpha value: 7.72952e-07
```

# RooFit issue: continued

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- Changing alpha initial value to 2, the fit result is 0.90, which is correct under both fit strategy

```
Info in <Minuit2>: Minuit2Minimizer::Hesse Using max-calls 90000
Info in <Minuit2>: Minuit2Minimizer::Hesse Hesse is valid - matrix is accurate
*****
fixing systematics: 0
fit strategy: 1
alpha initial value: 2
Fitted alpha value: 0.904682
```

```
Info in <Minuit2>: Minuit2Minimizer::Hesse Using max-calls 90000
Info in <Minuit2>: Minuit2Minimizer::Hesse Hesse is valid - matrix is accurate
*****
fixing systematics: 0
fit strategy: 2
alpha initial value: 2
Fitted alpha value: 0.904682
```