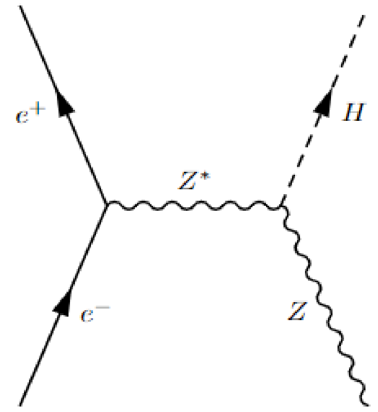
Introduction

Basic theory: 6-dimension EFT $\mathcal{L}_{eff} = \mathcal{L}_{SM}^{(4)} + \frac{1}{\Lambda^2}\sum \alpha_K \mathcal{O}_K$,

$m_Z = m_Z^{SM}(1+\delta Z), G_F = G_F^{SM}(1+\delta G_F), \alpha_{em} = \alpha_{em}^{SM}(1+\delta A)$



- In CEPC $e^+e^- \to HZ(\to l^+l^-)$ process:

$$\mathcal{L}_{\text{eff}} \supset c_{ZZ}^{(1)} HZ_\mu Z^\mu + c_{ZZ}^{(2)} H Z_{\mu\nu} Z^{\mu\nu} + c_{Z\tilde{Z}} H Z_{\mu\nu} \tilde{Z}^{\mu\nu} + c_{AZ} H Z_{\mu\nu} A^{\mu\nu} + c_{A\tilde{Z}} H Z_{\mu\nu} \tilde{A}^{\mu\nu}$$
$$+ HZ_\mu \bar{\ell}\gamma^\mu (c_V + c_A\gamma_5)\ell + Z_\mu \bar{\ell}\gamma^\mu (g_V - g_A\gamma_5)\ell - g_{\text{em}} Q_\ell A_\mu \bar{\ell}\gamma^\mu \ell,$$

- Differential cross section could be written as:

$$\frac{d\sigma}{d\cos\theta_1\, d\cos\theta_2 d\phi} = \frac{1}{m_H^2} \mathcal{N}_\sigma(q^2)\, \mathcal{J}(q^2, \theta_1, \theta_2, \phi),$$

$$\begin{aligned}\mathcal{J}(q^2,\theta_1,\theta_2,\phi) = {} & J_1(1+\cos^2\theta_1\cos^2\theta_2 + \cos^2\theta_1 + \cos^2\theta_2) \\ & + J_2 \sin^2\theta_1 \sin^2\theta_2 + J_3\cos\theta_1\cos\theta_2 \\ & + (J_4 \sin\theta_1\sin\theta_2 + J_5\sin 2\theta_1 \sin 2\theta_2)\sin\phi \\ & + (J_6 \sin\theta_1\sin\theta_2 + J_7\sin 2\theta_1 \sin 2\theta_2)\cos\phi \\ & + J_8 \sin^2\theta_1\ \sin^2\theta_2\ \sin 2\phi + J_9 \sin^2\theta_1\ \sin^2\theta_2\ \cos 2\phi.\end{aligned}$$

- $J_i(c_{H,A,Z}, g_{A,V})$ contains the couplings in EFT.
- 6 of 9 J_i are independent, within them J_4, J_5, J_8 are CP-odd.
- Parameterize σ into CP-even and CP-odd term:

$$\frac{d\sigma}{dcos\theta_1 dcos\theta_2 d\phi} = N\ \times (J_{CP-even}(\theta_1,\theta_2,\phi) + p \times J_{CP-odd}(\theta_1,\theta_2,\phi))$$

where p is an additional global CP-mixing parameter.

Analysis strategy

Basic setting in theory:

- fix some perturbation parameters to 10^{-3}: $\delta G_F = -\alpha_{4l} + 2\alpha_{\Phi l}^{(3)},\ \alpha_{\Phi l}^{V},\ \alpha_{\Phi l}^{A}, \alpha_{A\tilde{Z}},\ \alpha_{Z\tilde{Z}}$.
- Others are all 0.
- In J_i CP-odd and CP-even contribution are totally de-coupled.

Optimal variable:

- With parameterized differential cross section

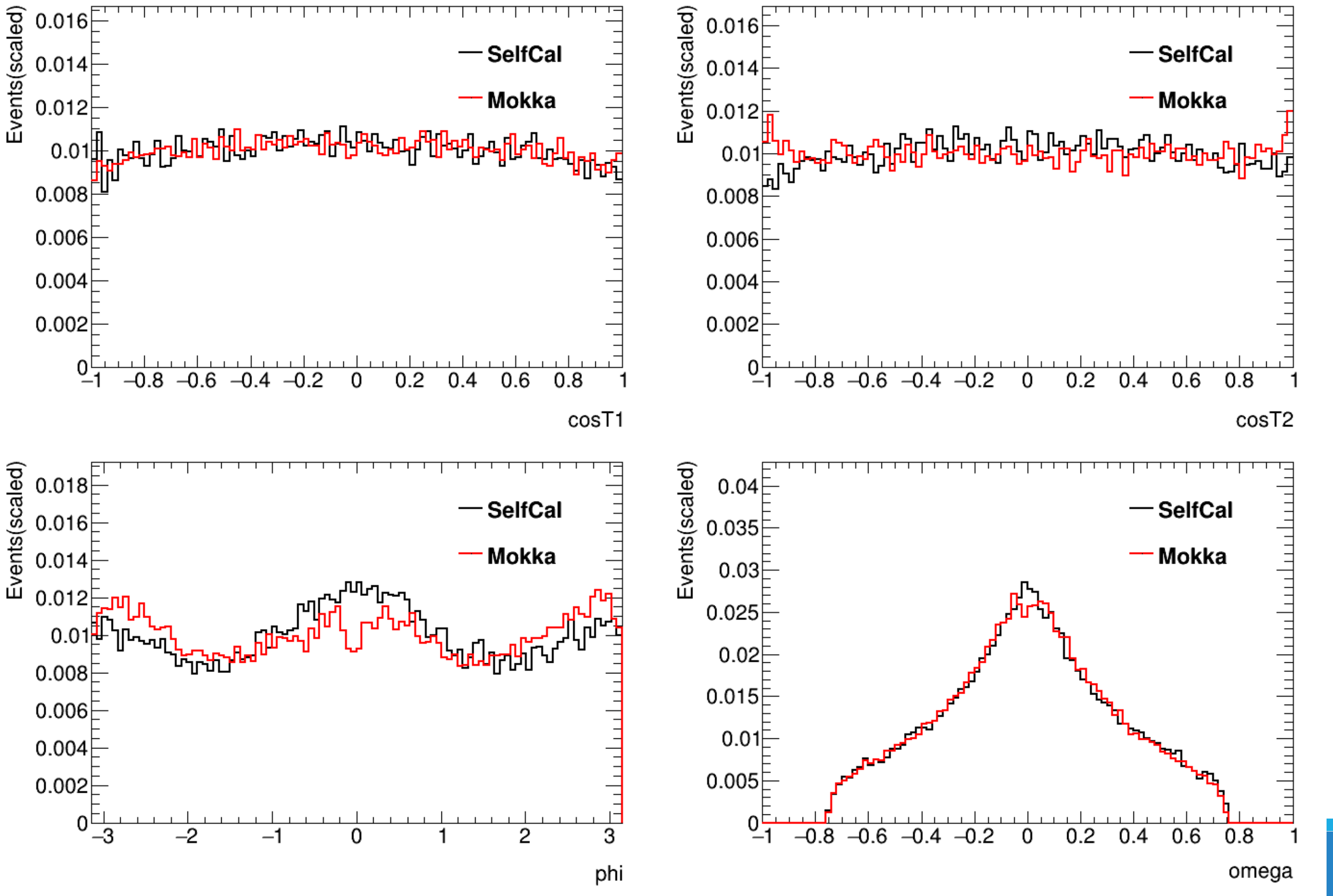
$$\frac{d\sigma}{dcos\theta_1 dcos\theta_2 d\phi} = N \times (J_{CP-even}(\theta_1, \theta_2, \phi) + p \times J_{CP-odd}(\theta_1, \theta_2, \phi)),$$

  define: $\omega = \frac{J_{CP-odd}(\theta_1,\theta_2,\phi)}{J_{CP-even}(\theta_1,\theta_2,\phi)}$ as Optimal variable.
- ω combines the information from θ_1, θ_2, ϕ, is supposed to be more sensitive.

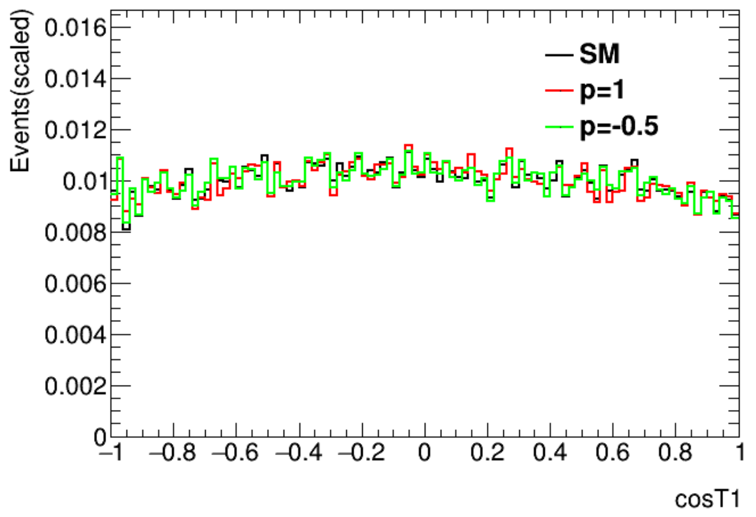
Validation of theory calculation

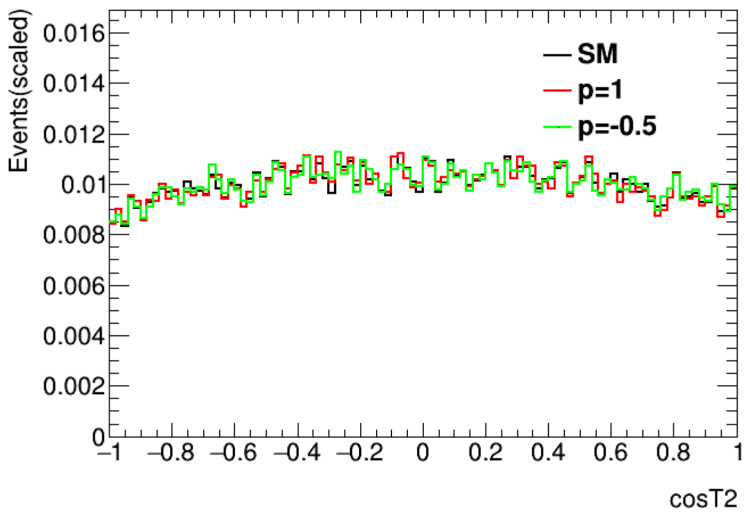
Compare the performance of angles:

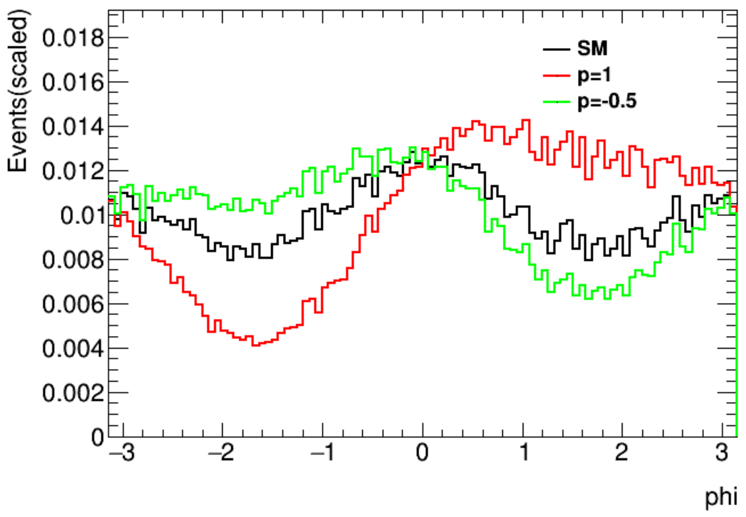
- Events generated by Wizhard1.95+MokkaC, $ee \to ZH \to \mu\mu\gamma\gamma$ process
- Shape generated from differential cross section formula.

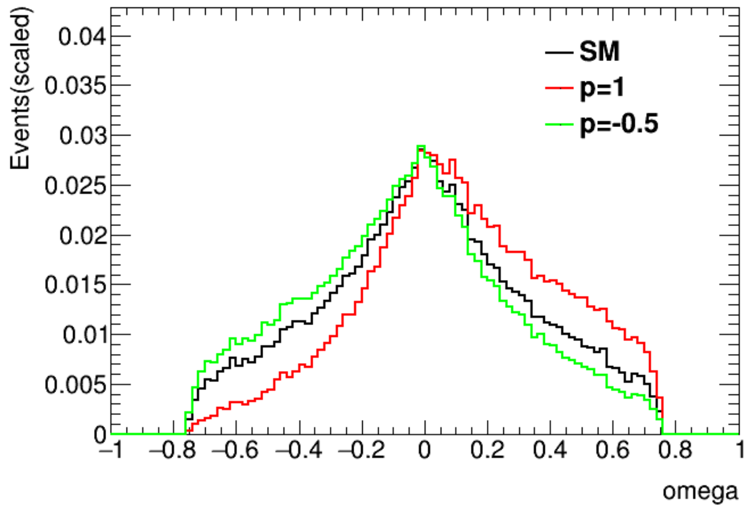


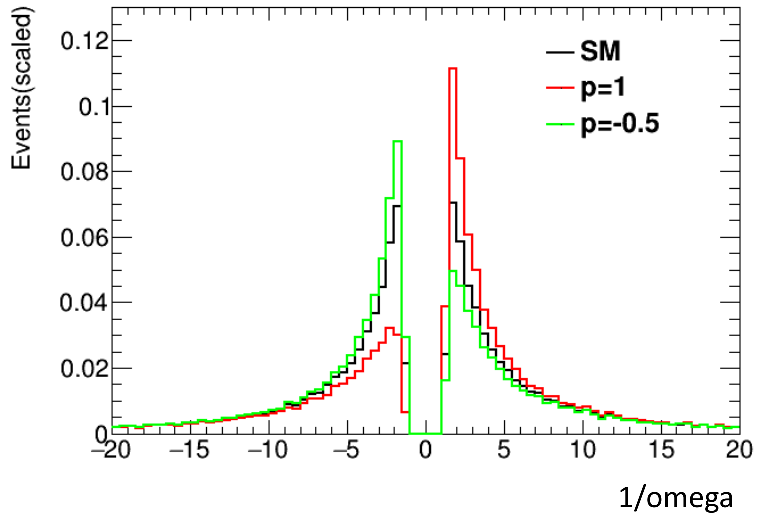
Performance in SM vs BSM











Separation power(SM vs. p=1):

$cos\theta_1$: 3.78×10^{-4}

$cos\theta_2$: 2.38×10^{-4}

ϕ: 4.89×10^{-2}

ω: 5.75×10^{-2}

$1/\omega$: 6.62×10^{-2}