Precision bounds on composite Higgs models at the FCC-ee

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Composite Higgs models (CHM)

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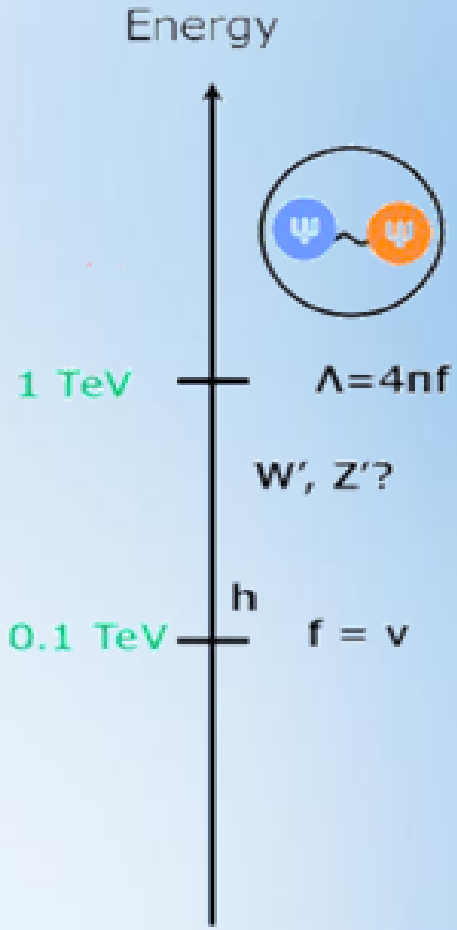

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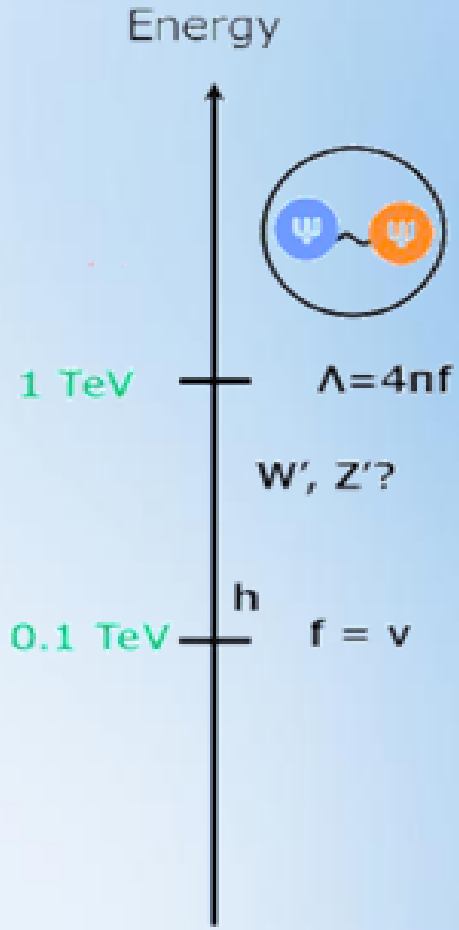

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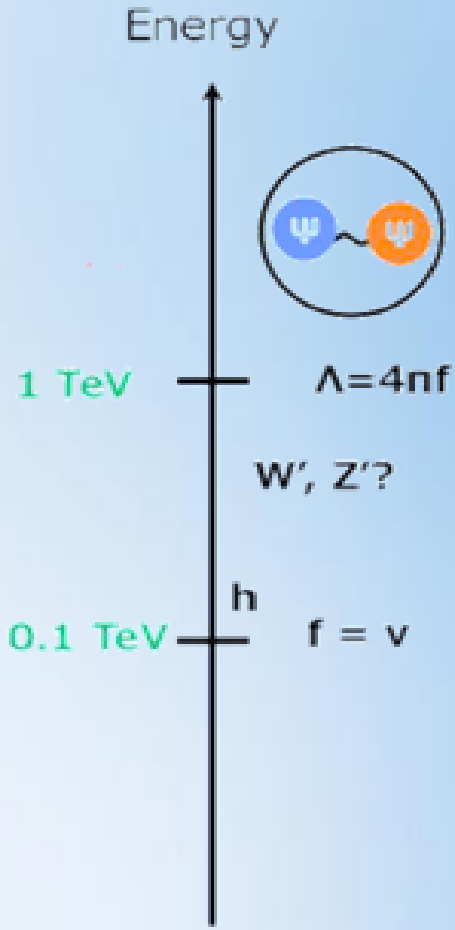
- The CHM provides an interesting phenomenology that could be tested at future colliders.



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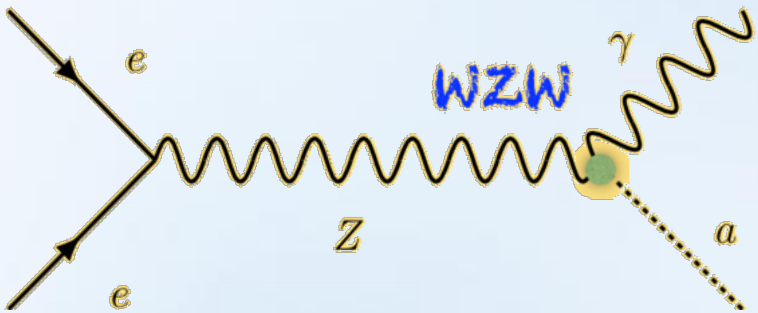

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$\longrightarrow$ The Electroweak precision tests (EWPTs) could shed some light in the nature of the new particles either composite models or elementary models (Work done).

INTERNSHIP M2

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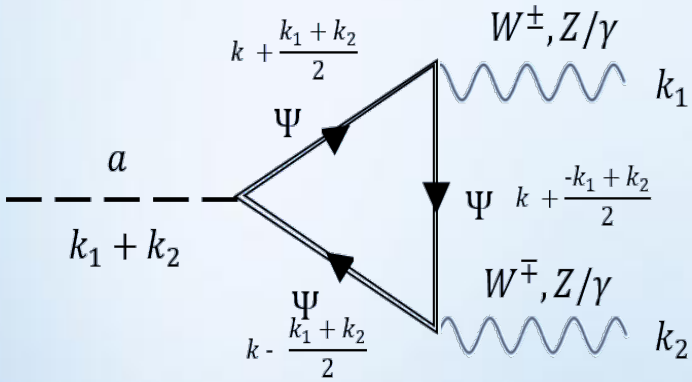

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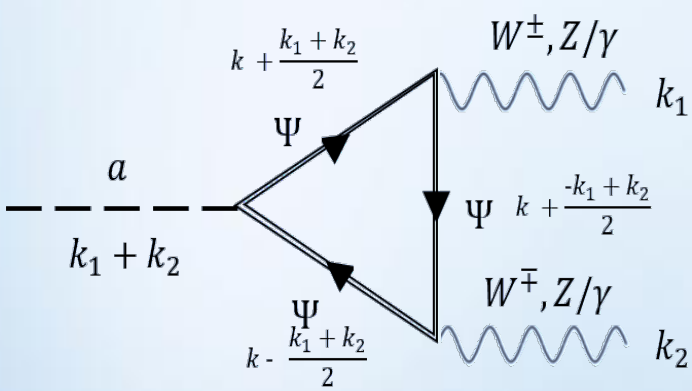
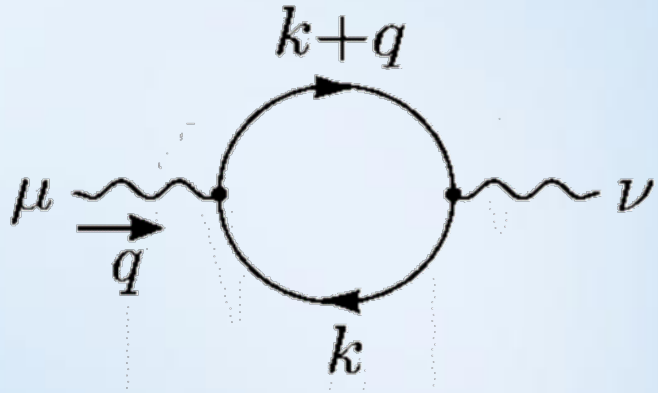
1. Extension of the SM by adding a complex scalar field (cxSM).
2. Connect the new particles with the electroweak (EWK) sector by analyzing the decays with the Partial Widths (PWs).
3. Looking for signs of new physics in the EWPTs (oblique parameters) in the cxSM for the FCC-ee.





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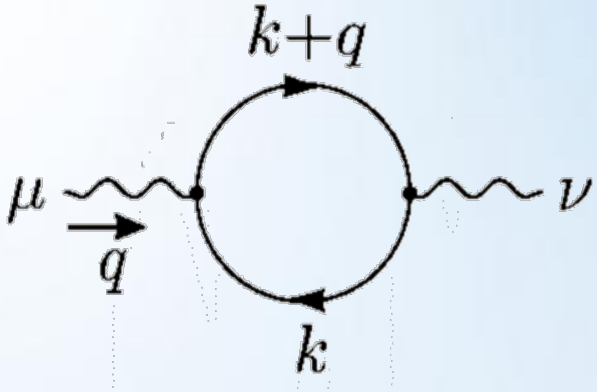
The Oblique Parameters

$\longrightarrow$ The quantum fluctuations due to new physics (NP) can be determine by computing the so called oblique parameters S and T.



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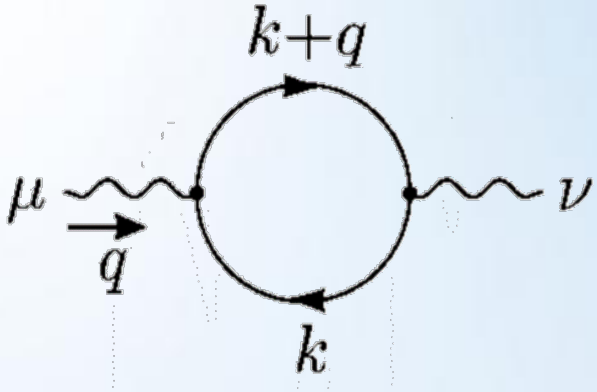

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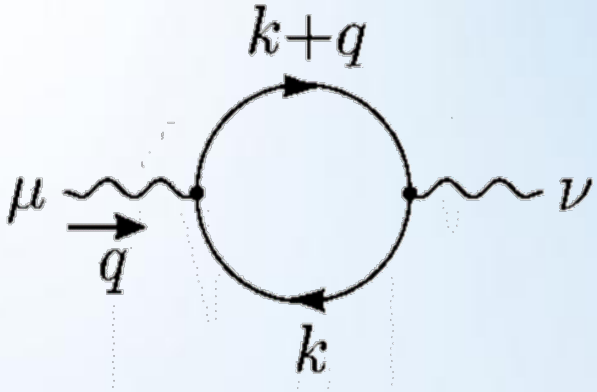

$\longrightarrow$ Taking into account VLF only, the contribution is zero,

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$\longrightarrow$ The cxSM provides two mixed states that can contribute to S and T.

The Oblique Parameters

$\longrightarrow$ The VLF does not contribute to the oblique parameters but the mixed states do, therefore,

$$\Delta T_{\rm el} = -\frac{3}{8\pi \cos^2\theta_W}(1-\cos^2\phi)\log\frac{m_{H_2}}{m_{H_1}},$$

$$\Delta S_{\rm el} = \frac{1}{6\pi}(1-\cos^2\phi)\log\frac{m_{H_2}}{m_{H_1}}.$$

where ϕ is the mixing angle, $m_{H_1} = 125$ GeV and $m_{H_2} \gg m_{H_1}$.

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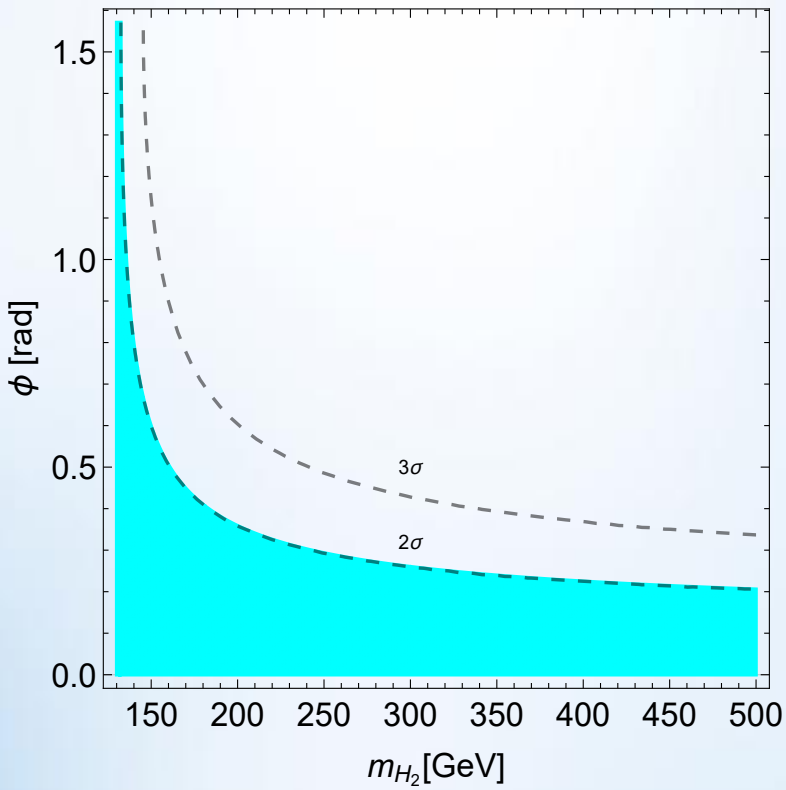
$\longrightarrow$ If we consider the scalars as a composite state, we have,

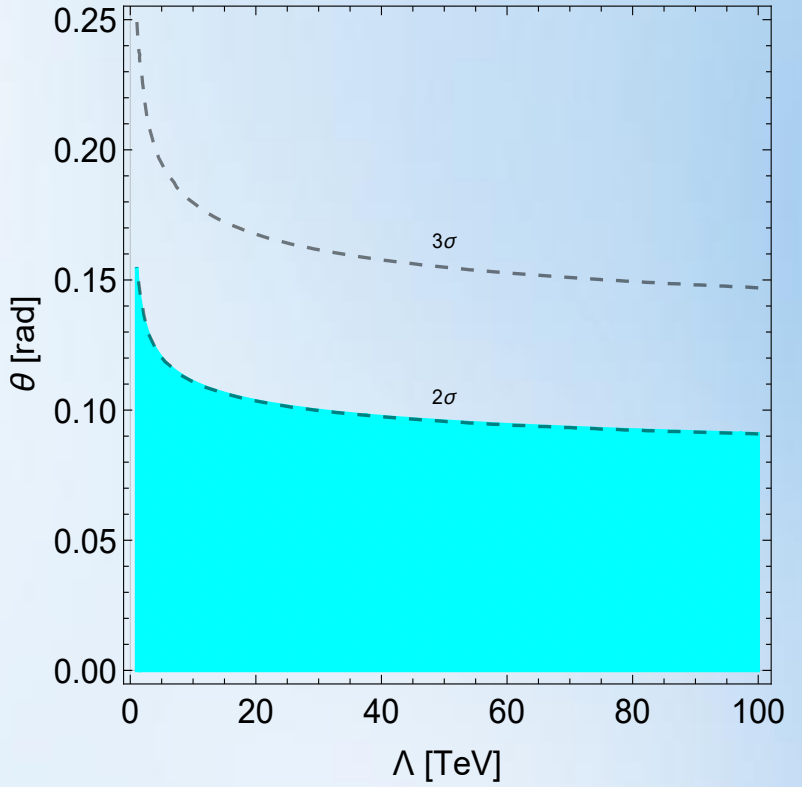
$$\Delta T_{\rm co} = -\frac{3}{8\pi \cos^2\theta_W}(1-\cos^2\theta)\log\frac{\Lambda}{m_h},$$
$$\Delta S_{\rm co} = \frac{1}{6\pi}(1-\cos^2\theta)\log\frac{\Lambda}{m_h} + 2\sin^2\theta.$$

where θ is the compositeness angle, Λ the energy cut-off and $m_h = 125$GeV.

The 2D likelihood

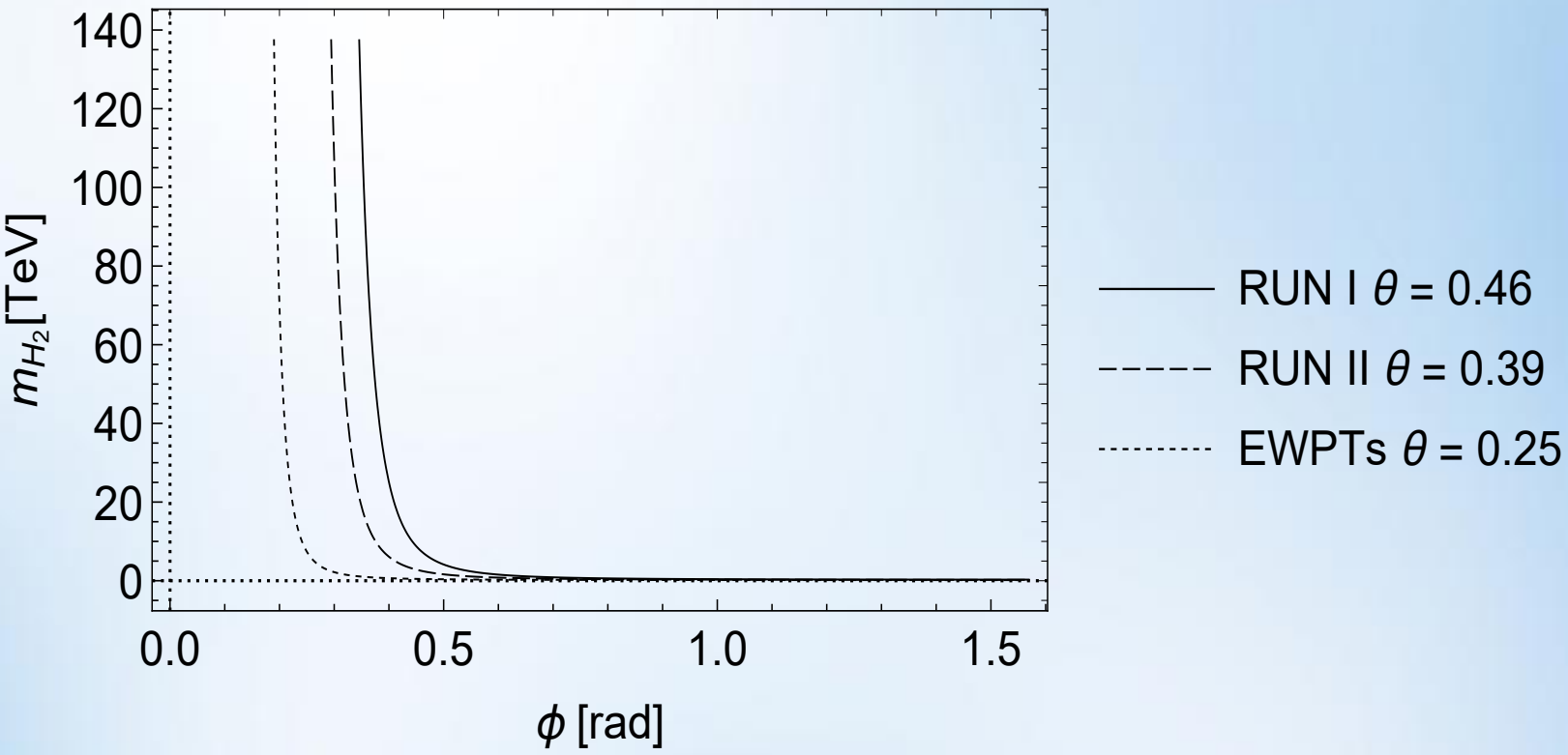


(a) Elementary model



(b) Composite model

The mass and mixing angle for H_2



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- The different scenarios proposed are able to provide partial widths that depend on the hypercharge values.
- The oblique parameters could shed some light on the nature of the pseudo-scalar for the elementary or composite models.
- The greater the mass of the second mixed state, the less is the mixing between the new complex field particles and the SM-Higgs boson.