# Weekly report

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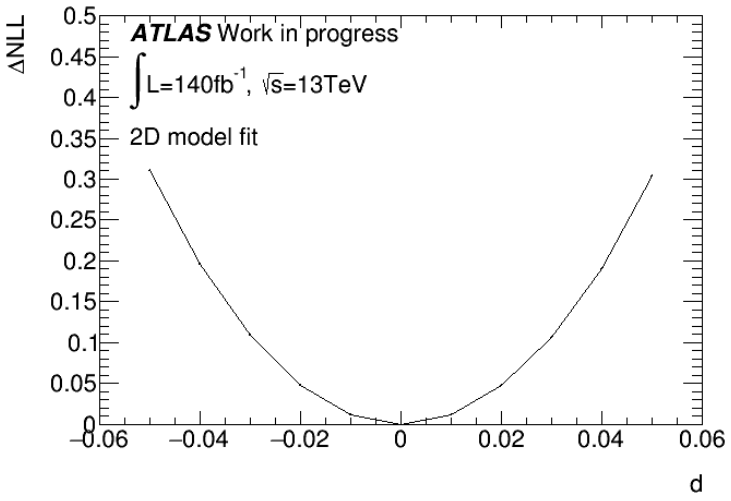
# VBF Higgs CP

Comparison of different fit methods

- Likelihood function: $\ln(\mathcal{L}(\mu, \boldsymbol{\theta}|x_i)) = \sum_{i=1}^{N} \ln(\, f(x_i|\mu, \boldsymbol{\theta})\,)$.
- Traditionally, we fix NP and get the best-fit POI by maximum likelihood fit.

  Binning = independently measure POI several times, so $\mathcal{L} = \prod_{i=1}^{N_{bins}} \mathcal{L}$, and $\sigma(\mu) = \frac{1}{\sum \frac{n_i}{\sigma_i}}$.
- In this test, the POI $\tilde{d}$ isn't $\mu/\boldsymbol{\theta}$. It's a part of dataset $\{x_i\}$. Theoretically binning has no relation to the better performance.



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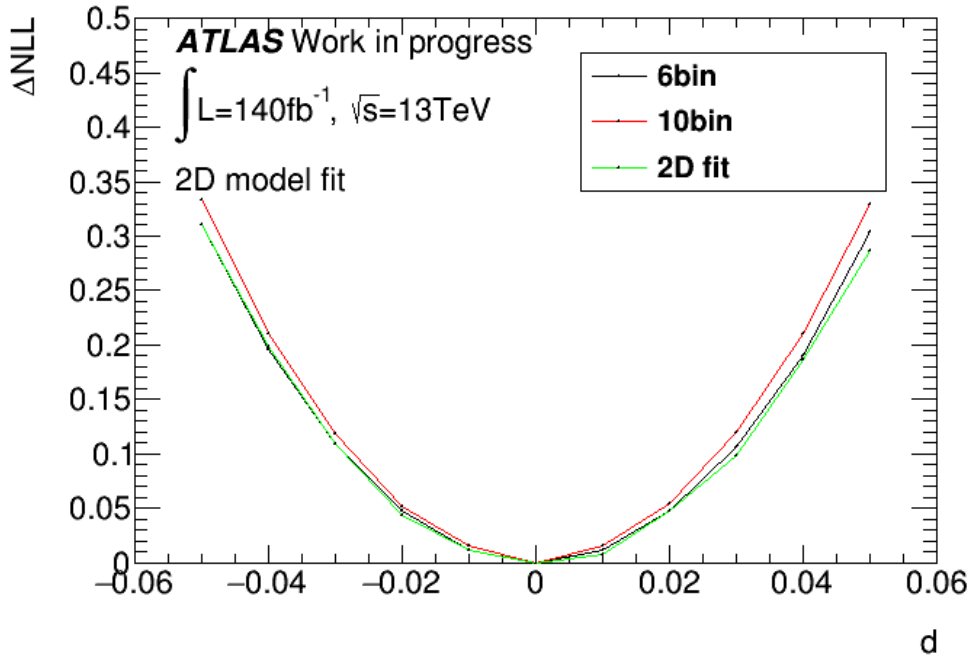


Float the signal strength, and fit in 1D/2D model.
Comparing with 6bin 1D fit, neither 10 bins nor 2D shows significant improvement.

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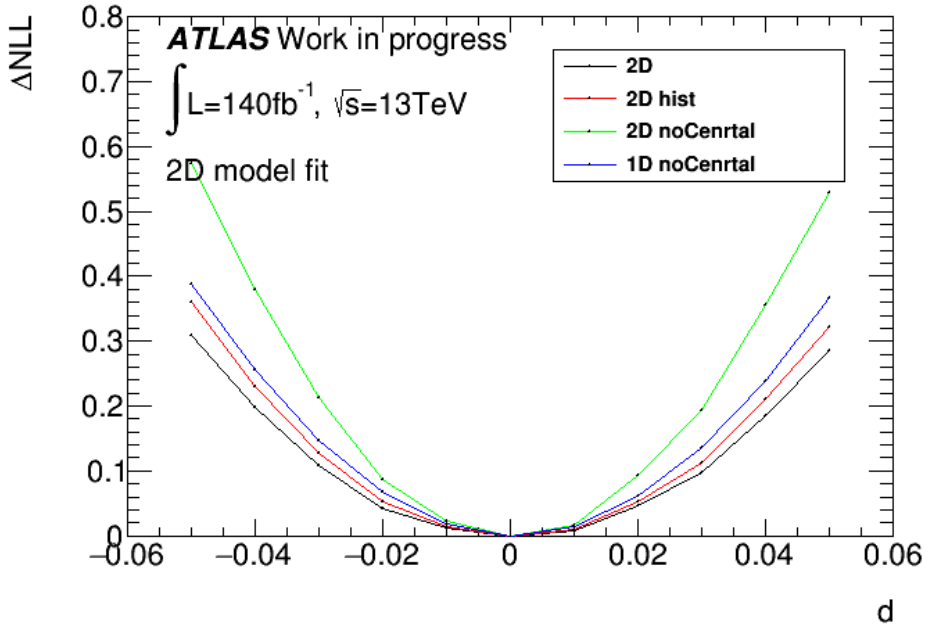


2D: functional 2D model

2D hist: HistPdf in OO

2D noCentral: exclude [-3, 3] OO region when extracting NLL.

1D noCentral: fit 1D OO in $m_{\gamma\gamma} \in$ [120, 130] GeV, exclude OO in [-3, 3].

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Brief summary

- Removing central OO region can reject many background events, so it can provide improvement.
- Binfit method needs optimization in binning. (Huirun may do this).

- Internal note: start to write. https://gitlab.cern.ch/atlas-physics-office/HIGG/ANA-HIGG-2020-08/ANA-HIGG-2020-08-INT1