



2022 5-8月研究生考核报告

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Outline



- **Ongoing studies:**

- ATLAS:

- VBF Higgs CP study in $H \rightarrow \gamma\gamma$ channel and the combination with $H \rightarrow \tau\tau$ channel.
 - ATLAS LAr EM shower shape study.

- CEPC

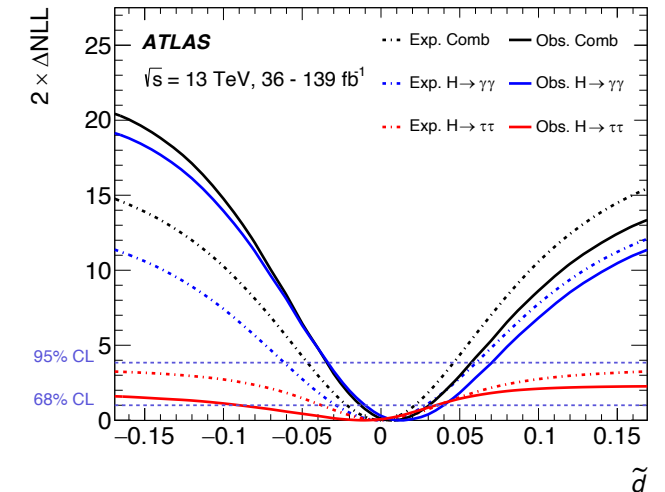
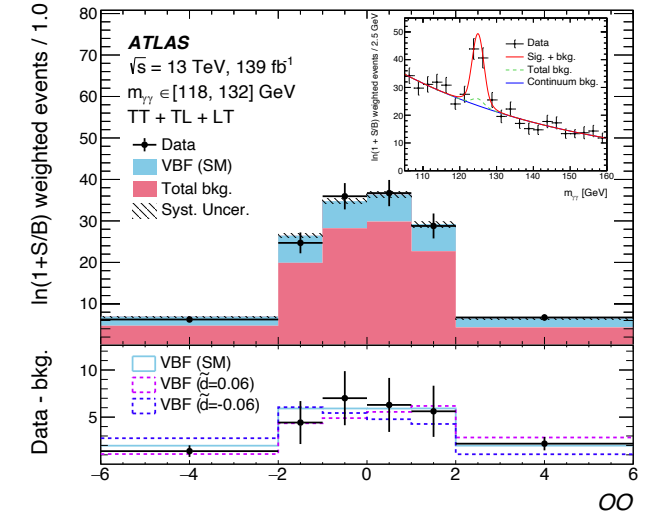
- CEPC crystal ECAL reconstruction software.

VBF Higgs CP study



- The CP property of the Higgs to electroweak boson coupling in VBF $H \rightarrow \gamma\gamma$ channel:
 - Finished the final sign-off in ATLAS. Paper draft has been submitted to [arxiv](#) and PRL. Waiting for the replies from journal.
 - Results are shown in [Higgs10](#), [ICHEP](#) and [高能物理大会](#).
 - Trying to catch an opportunity to report this study this year.

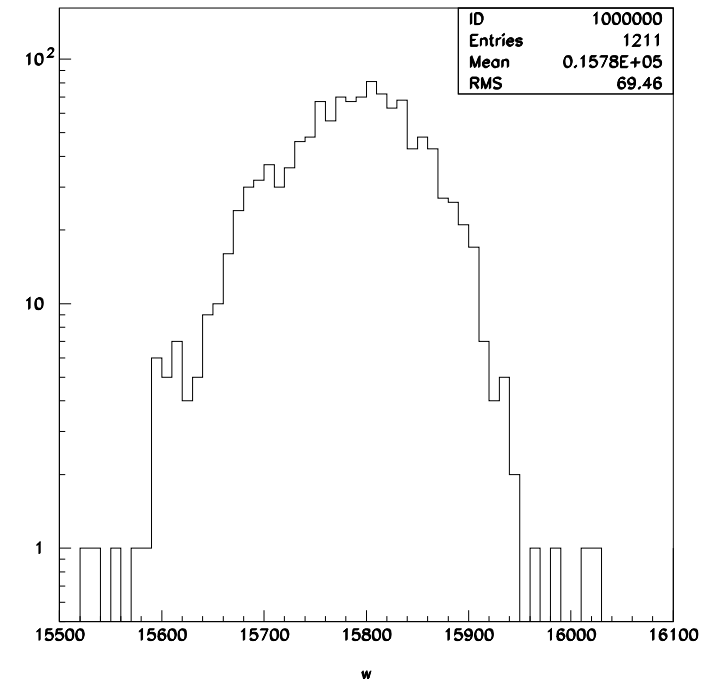
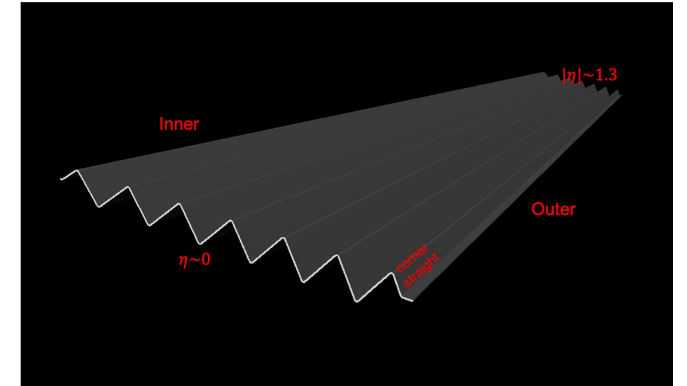
	68% (exp.)	95% (exp.)	68% (obs.)	95% (obs.)
\tilde{d} (inter. only)	$[-0.027, 0.027]$	$[-0.055, 0.055]$	$[-0.011, 0.036]$	$[-0.032, 0.059]$
\tilde{d} (inter.+quad.)	$[-0.028, 0.028]$	$[-0.061, 0.060]$	$[-0.010, 0.040]$	$[-0.034, 0.071]$
\tilde{d} from $H \rightarrow \tau\tau$	$[-0.038, 0.036]$	–	$[-0.090, 0.035]$	–
Combined \tilde{d}	$[-0.022, 0.021]$	$[-0.046, 0.045]$	$[-0.012, 0.030]$	$[-0.034, 0.057]$
$c_{H\tilde{W}}$ (inter. only)	$[-0.48, 0.48]$	$[-0.94, 0.94]$	$[-0.16, 0.64]$	$[-0.53, 1.02]$
$c_{H\tilde{W}}$ (inter.+quad.)	$[-0.48, 0.48]$	$[-0.95, 0.95]$	$[-0.15, 0.67]$	$[-0.55, 1.07]$



ATLAS LAr calorimeter shower shape study



- **Motivation: find out the reason of EM shower shape disagreement between data and MC.**
 - Possible: **detector geometry**, simulation, cross-talk, pile-up, etc.
 - Check the absorber in simulation:
 - Sandwich structure steel-glue-lead-glue-steel.
 - Total weight: 44.6 kg. Lead plate weight: 34.6 kg.
 - Contact CERN people for the records from ~ 20 years ago:
 - Lead plate absorber: weight $36.13 \text{ kg} \pm 70\text{g}$. \rightarrow 4% difference.
 - Implement this 4% difference in simulation:
 - Scale the lead density to 104%.
 - $E=65.536 \text{ GeV}$, $|\eta| \in [0.2, 0.25]$, 1000 events.
 - Check the shower shape variables: Reta, Rphi, weta1, weta2.

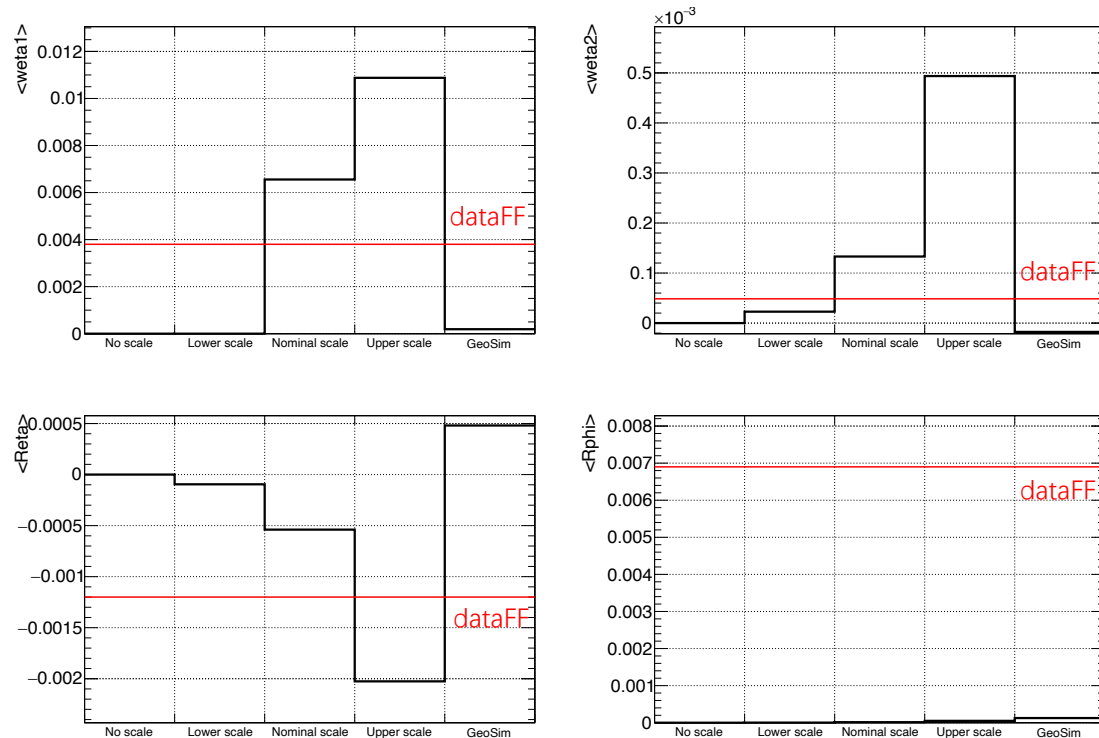


ATLAS LAr calorimeter shower shape study



- **Shower shape variables' mean value:**

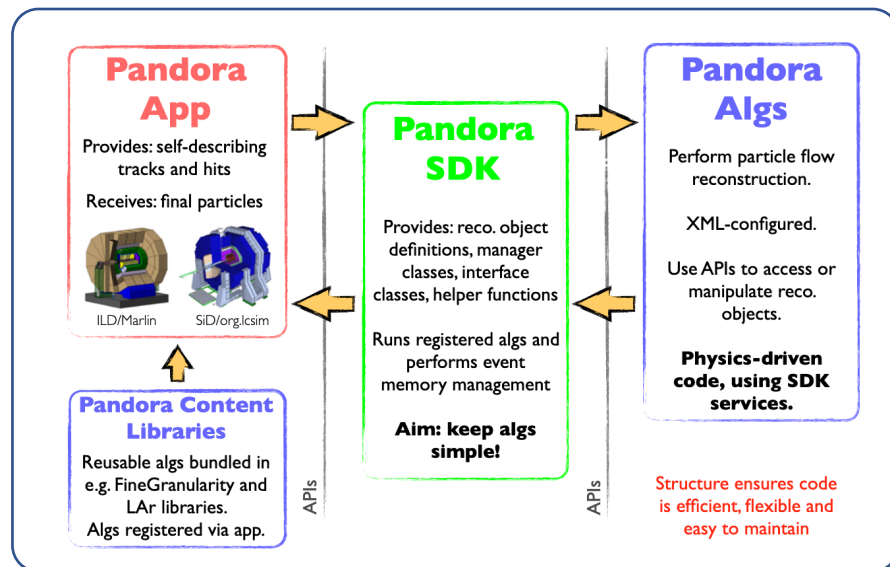
- A very obvious conclusion: this 4% lead density difference can not be the main reason for shower shape disagreement.
- Results are discussed in [ATLAS EGamma meeting](#). We are discussing with experts.



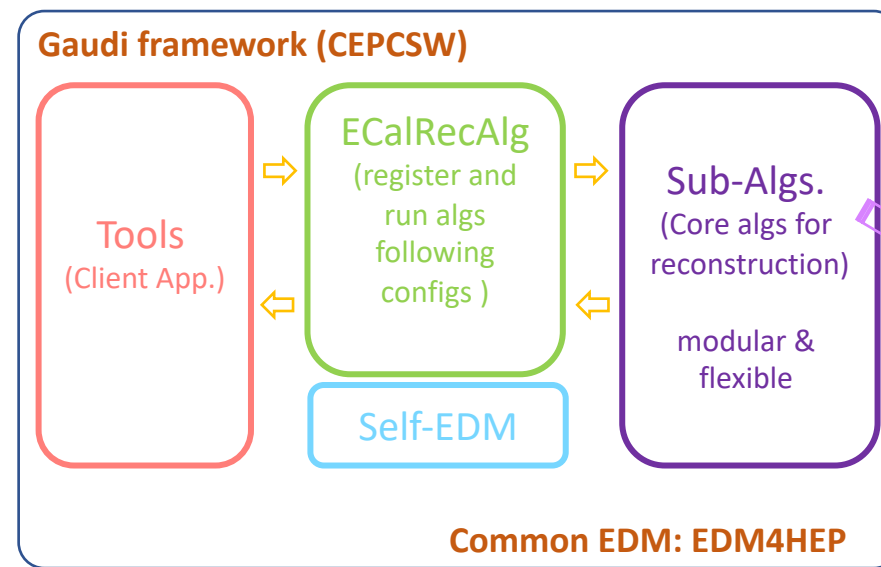
CEPC crystal ECAL reconstruction

- **Design the skeleton of the software:**

- Following the idea of PandoraSDK: flexible, reusable and modular.
- Re-write the data model to match the EDM4HEP.
- Update the algorithms to fit the Key4HEP.



J.S.Marshall, CHEF 2013



Not mature yet

Reconstruction flow:

- CoreForming: LocalMaxFinding, HoughClustering.
- 1D: EnergySplitting
- 2D: Matching in 2 adjacent layers.
- 3D: Clustering with cores.
- Track matching
- Re-clustering
-

Summary and plan



• Plans for the next months:

- ATLAS VBF Higgs CP study has been finished. Waiting for the final publication.
- Complete the CEPC software before the CEPC workshop and have a released version.
- 2 papers based on previous work in internal review:
 - *The expected measured precision of the branching ratio of the Higgs decaying to the di-photon at the CEPC.* Target CPC.
 - *Reconstruction algorithm for the CEPC crystal ECAL.* Target NIM A.
- Start to write the dissertation.