# Stronger together to search for new heavy resonances in ATLAS

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Heavy resonance in BSM

- The new heavy resonance search is one of the most important tasks in the ATLAS program to explore BSM.

- Analysis combining different final states is powerful way to improve sensitivity to the heavy resonances.

- Results of combination of $\ell\nu$, $\ell\ell$, VH and VV with a part of ATLAS Run2 dataset taken in 2015/2016 (36 fb^{-1}) were published in 2018.

- Combination analysis with full Run2 dataset (139 fb^{-1}) is ongoing, including more different final states.
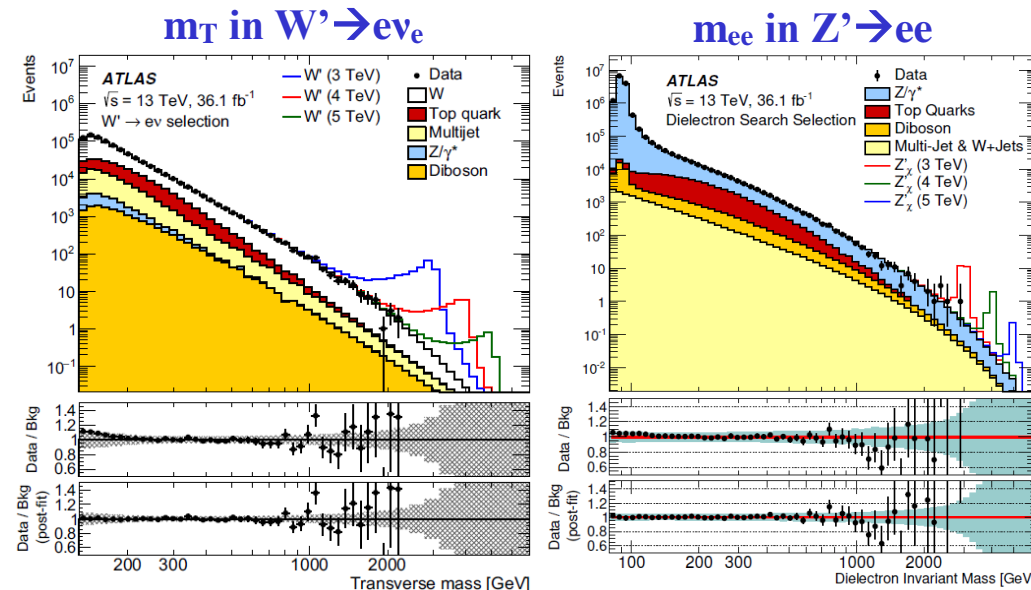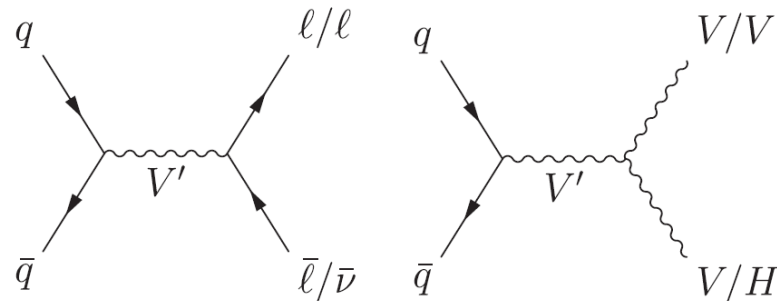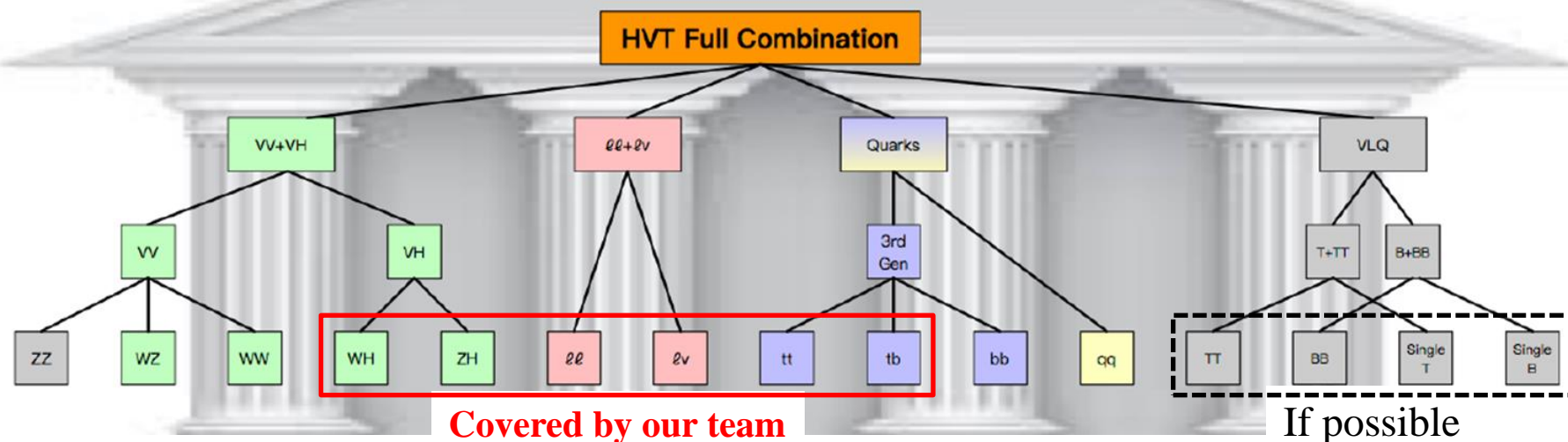
Our project

Goal | Exploration of heavy resonances with full ATLAS Run2 dataset, combining most of different final states.

- Extensive study of previous combination analysis with 36 fb^{-1}.

- Inclusion of the 3rd generation is important to evaluate effect of flavor anomaly observed in Babar, Belle and LHCb (Eur. Phys. J. C (2017) 77, 895)

This project was approved in TYL-FJPPL 2019 (HEP12) and was applied to TYL-FJPPL 2020 for extension of the project.


Covered by our team   If possible

Our project team

Final states	Institute	Person
$\ell\ell$	LAPP	T. Berger-Hryn'ova
$\ell\nu$	KEK	Y. Takubo, K. Nagano
VH	LPNHE	R. Camacho Toro
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- Effort to recruit a ph-D student will be made in French and Japanese institutes.

- The student can participate in the exciting research for BSM search and can learn analysis skills under supervision of analysis experts in different institutes.

Activity in 2019 (1)

- Analysis results in $\ell\ell$ and $\ell\nu$ final states with full Run2 dataset were published, and their templates were provided for the combination ([Phys. Lett. B 796 (2019) 68], [Phys. Rev. D 100 (2019) 052013]).

- Both $\ell\ell$ and $\ell\nu$ analyses produced plots of sensitivity to parameters in HVT model that show better sensitivity than earlier combination with 36 fb^{-1} [Phys. Rev. D 98, 052008 (2018)].
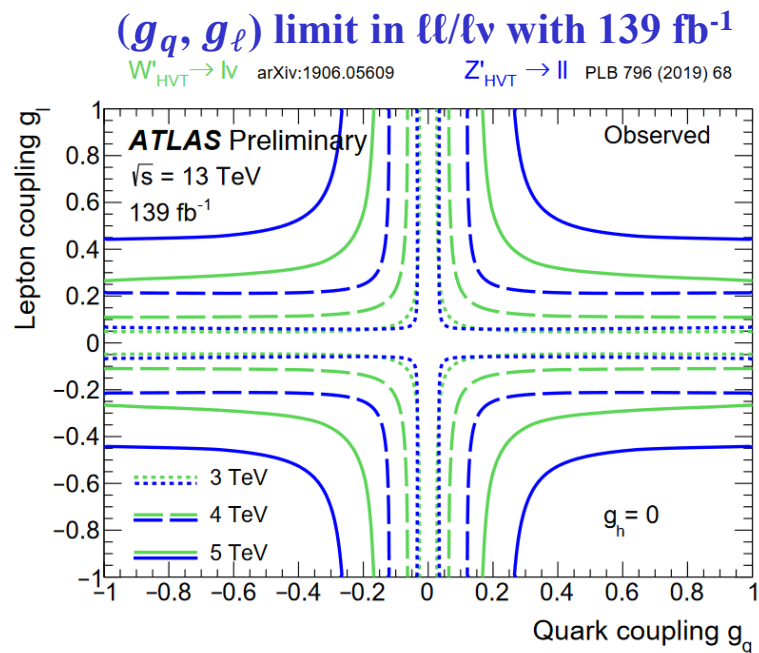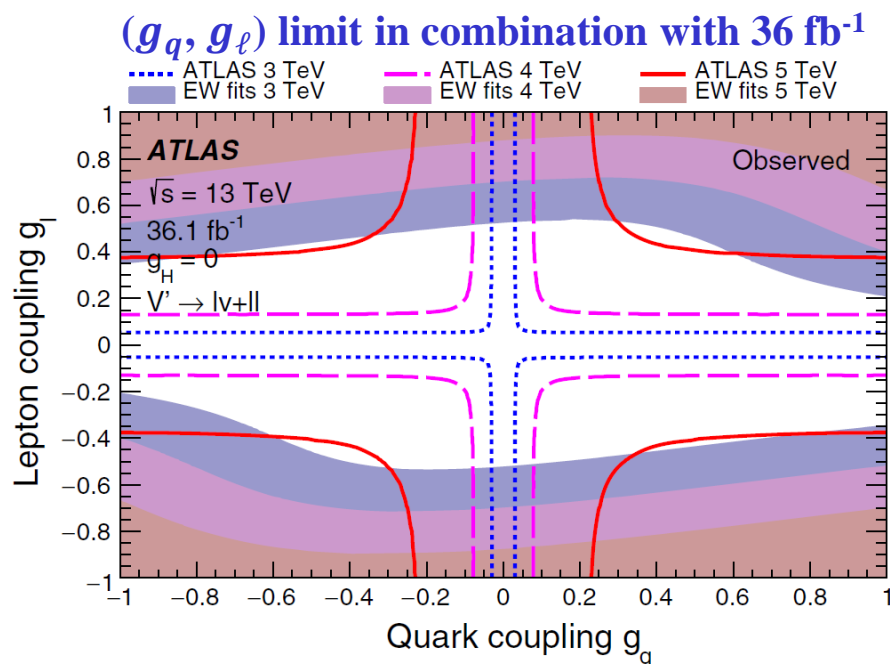
Activity in 2019 (2)

- Orthogonality between different final states was studied, and it turned out that $t\bar{t}$ and $t\bar{b}$ final states need additional cut to remove the overlap.

- The signal region was unblinded in VH(qqbb) and and $t\bar{t}$ (full hadronic) final states.

- Koji became the analysis contact in the combination analysis.

- Tetiana became Hot Spot contact with theorists and one of the editors for the combination paper.

Approval in TYL-FJPPL2019 tightened our collaboration and it resulted in big progress in our analayses.

Plan for 2020

- $\ell\ell/\ell\nu$ combination based on currently published results is ongoing, aiming to make it public.

- Investigation of $\ell\ell/\ell\nu$ channel in VBF (Vector Boson Fusion) process which may be interesting at low couplings to quarks.

VBF process in $\ell\ell/\ell\nu$

- Finalizing analysis for VH(qqbb) and $t\bar{t}$ (full hadronic) final states for publication.

- Unblinding for $t\bar{t}$ (ℓ+jet) final state.

- The common benchmark coupling planes used for the limit in the paper will be decided, discussing with theorists and CMS group.
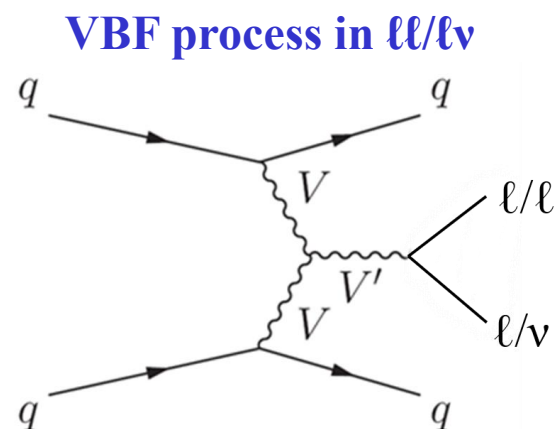
2020 is an important period to materialize this combination with studies on orthogonality, interpretation, new signal models, etc..

We aim the first combination results with full Run2 dataset in 2021!