

Nathan Grieser - Chung-Yao Chao Fellowship Application

Nate Grieser

Chinese Academy of Sciences, IHEP, LHCb Experiment

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- 2 Previous Physics Analysis
- 3 Current Research
- 4 Previous Hardware and Software Work

Curriculum Vitae - Research Overview

Education:

- B.S. Physics and Astronomy (2013)
 - Ohio Northern University (USA)
- PhD. Experimental High Energy Physics (2020)
 - University of Oklahoma (USA)
- Post-Doc Positions (October 2020-)
 - Chinese Academy of Sciences - IHEP
 - Supervisors: Jianchun Wang and Yiming Li

Research Projects:

- **Hardware Projects**
 - HALT/HASS experiment design for pixel detectors.
- **Combined performance projects:**
 - Calibration of light jet flavour tagging using the negative tag method.
- **Physics analysis projects:**
 - Heavy resonance search in the $WW \rightarrow \ell\nu\ell\nu$ final state.
 - $h \rightarrow WW$ cross section measurement.
 - Diboson heavy resonance combination.

Publications

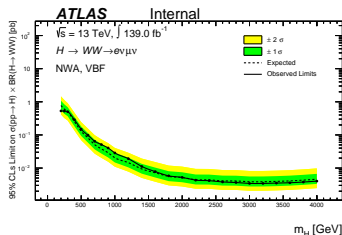
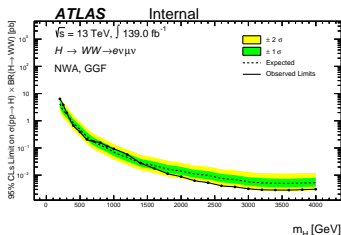
- Measurements of gluon fusion and vector-boson-fusion production of the Higgs boson in $H \rightarrow WW^* \rightarrow e\nu\mu\nu$ decays using pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector
- Observation of vector-boson-fusion production of Higgs bosons in the $H \rightarrow WW^* \rightarrow e\nu\mu\nu$ decay channel in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

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$R \rightarrow WW \rightarrow l\nu l\nu$ - Overview

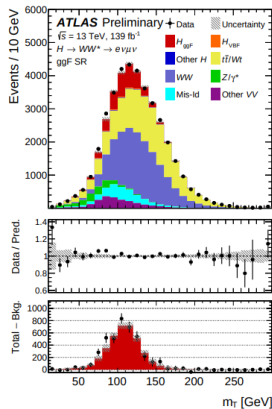
- BSM search for heavy scalar/vector bosons decaying to WW with the $l\nu l\nu$ final state.
- Multiple signal interpretations:
 - Scalars: Narrow Width Approximation (NWA), Georgi-Machacek (GM), Radion (ϕ)
 - Neutral vector bosons: Heavy Vector Triplet (HVT Z')
 - Spin-2: RS Graviton (G^*)



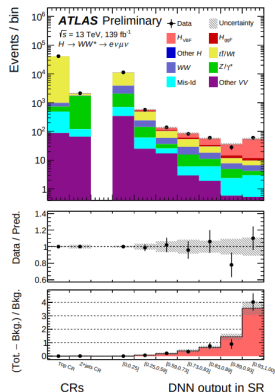
- Contributions:** Analysis Contact, Primary analyzer (Full analysis chain)

$h \rightarrow WW \rightarrow \ell\nu\ell\nu$ - Overview

- Standard model measurement of Higgs cross section and coupling to W bosons.
- Multiple signal channels:
 - gluon-gluon fusion (ggF): 0/1 jet, ≥ 2 jets
 - Vector boson fusion (VBF): ≥ 2 jets
- Contributions: Monte-Carlo generation, sample validation, theoretical uncertainty calculation



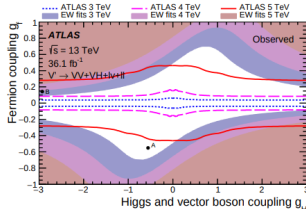
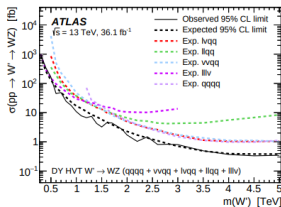
Gluon-Gluon Fusion
Signal Region



Vector Boson Fusion
Regions

Heavy Resonance Combination - Overview

- Statistical combination of resonance searches with diboson, leptonic, and quarkonic final states
- Multiple signal interpretations:
 - Scalars: Radion (ϕ)
 - Neutral vector bosons: Heavy Vector Triplet (HVT W/Z')
 - Spin-2: RS Graviton (G^*)



- Contributions: $WW \rightarrow l\nu l\nu$ Contact, Statistical workspace building

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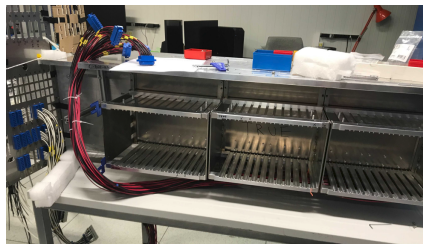
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LHCb Upgrade - Upstream Tracker Installation

- Primary detector work is the installation and commissioning of the Upstream Tracker (UT) **Responsibilities:**
 - Assist in the installation and validation of PEPI (Peripheral Electronics) volumes.
 - Design and validation of cable routing and High Voltage (HV) installation procedure for surface test and underground installation.

Additional tasks:

- Assembly of PC boards to be utilized in the PEPI assembly.
- Validation and assembly of cooling racks and manifolds.

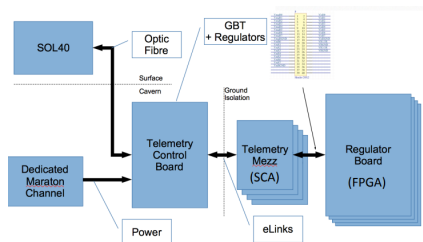


LHCb Upgrade - Upstream Tracker DAQ + DCS

- Additional work on the UT is involved in the data control, safety, and acquisition framework. **Responsibilities:**
 - Develop DAQ and DCS controls for surface test and commissioning.
 - Implement tests for validation of detector assembly, PC board productions, and cable routing.

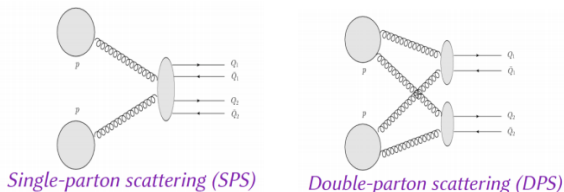
Additional tasks:

- Develop LV and HV controls for power supplies
- Coordinate DSS (Detector Safety System) needs for the UT with the LHCb safety teams.



BD Meson Associated Production

- Long-term goal is to search for doubly heavy tetraquark T_{bc} .
- Intermediate goal: study associated production of BD meson pairs.
 - To be done by measuring $\sigma_{\text{eff}} (= \frac{\sigma_B \times \sigma_D}{\sigma_{\text{DPS}}})$



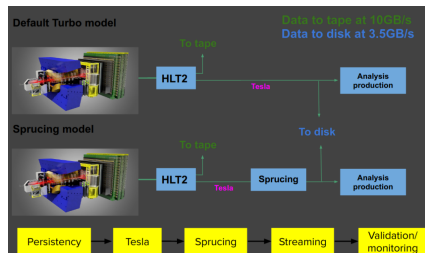
- $B^+ + (D_0/D^+/D_s^+)$ decays theoretically show high available production statistics even in run 1+2 dataset.
- Selection is being optimized already with goals of performing a 2-dimensional mass fit of B and D mesons.
 - Process includes preparation of data processing framework for upcoming LHC run 3.
- **Additional:** Assist in supervision of PhD student (Quan Zuo)

LHCb Upgrade - Real Time Analysis

- Serving as *B&Q* RTA/DPA liaison for the LHC Run-3 preparation.
Responsibilities:
 - Communicate RTA/DPA needs from the *B&Q* physics analysis group with the RTA/DPA preparatory groups.
 - Develop and validate HLT2 and Sprucing (Slimmed + Pruned) lines for the *B&Q* physics analysis group.

Additional involvement beyond role responsibilities:

- Migrate run 1+2 'functor' classes to the run 3 format. (LoKi \rightarrow ThOr)
- Migrate run 1+2 analysis production to the run 3 format.



Discussion

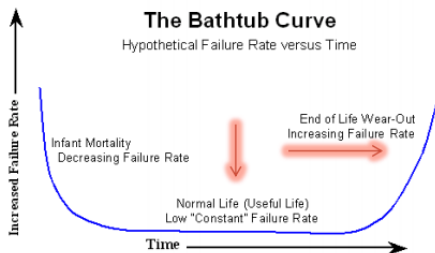
BACKUP

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HALT/HASS - Overview

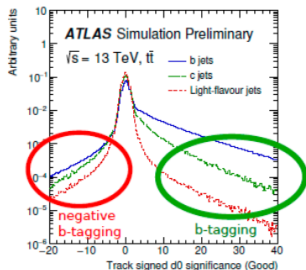
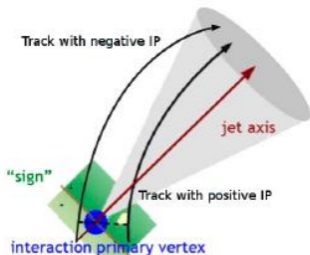
- HALT (Highly Accelerated Lifetime Testing) probes devices for weaknesses related to LHC conditions.
- Use of thermal cycling and vibration tests allows the discovery of device weaknesses prior to lengthy installation process - **Allows for fixes/improvements early!**



- **Contributions:** Design of pneumatic control for vibration table, Thermal cycling optimization

Negative Tag Method Light Jet Calibration - Overview

- **Goal:** calibrate the mistag rate of light (u , d , s) flavour jets as b -jets.
- Employs a flipped version of common b -tagging algorithms (MV2c10 specifically) to obtain a more uniformly distributed jet flavour sample.



- **Contributions:** Software Release Migration, Light jet scale factors and uncertainties calculations for AntiKt02TrackJets