ESR proposal

- Use the same thesis proposal of last year

Determination of the polarization fractions in the fully leptonic WZ scattering using machine learning techniques with the ATLAS detector

Fellow	Host	PhD	Start	Duration	Deliverables
ESR 3	*TUD (PH)*	*Y*	*10*	*36*	*D2.1, D2.3, D2.7*
Fully-leptonic WZ scattering measurement with the ATLAS detector (WP1, WP2)					
Objectives: After the preparation of a software analysis framework dedicated to processing the ATLAS Run3 data and simulation, the measurement of the production cross section of the WZ and WZjj processes will be performed, and used as preliminary step to familiarise with the WBS final state of interest. During a secondment at Krakow the student will learn about the phenomenology of Monte Carlo sample generation for WBS, and polarisation studies which will result in the responsibility for official sample production for this analysis. A secondment at ENW will follow, where the ESR will familiarise with novel ML techniques used in industry for computer vision. These methods will be employed in the WBS search, to characterise at best the final state (e.g. the missing information carried away by the neutrino in the W boson decay), to suppress the dominant backgrounds, and in particular to identify the polarisation of the vector bosons with deep learning techniques built from low-level variables. Special care will be devoted to the explainability of the ML, to allow for a proper theoretical interpretation of the measurement outcome (e.g. because of the ambiguous definition of the polarisation of vector bosons at matrix element level). The project will terminate publishing the results, and actively participating in the overall combination of the single analyses results.					
Expected Results: Measurement of the WZ and WZjj differential cross sections and gauge boson polarisation fractions, measurement of WZ WBS, with the entire dataset collected by ATLAS at the LHC Run3.					
Planned secondment(s): Academic: (1) IFJ PAN, Anna Kaczmarska, month 15-17, preparation of MC samples for WZ final states and polarisation studies, Non-academic (2) EWN, Giovanni Anceschi, month 18-20, ML application to computer vision.					

- Main objectives:
  - Use the Run-3 data to study the fully leptonic WZ VBS
    - ML techniques can be applied to recover the missing neutrino information from the W decay, identify the different boson polarizations, in addition to the use signal/background discrimination
    - Developments on MC simulation for polarizations
    - Unfolded distributions of polarization sensitive variable and interpretations

- Secondments as last time (Not fixed yet):
  - Academic: Krakow to work on MC generation
  - Non-academic: Energy Way