Benedict Westhenry

bw13198@bristol.ac.uk

University of Bristol

Particle Physics – Flavour Physics at CERN

Project title

Precision measurement of the charge-parity-violation parameter gamma.

Science/research area

I'm a member of the LHCb collaboration at CERN. The LHCb experiment specialises in investigating the slight difference between matter and antimatter by studying a type of particle called the "beauty quark", or "the b quark".

My first project entails the precision measurement of the charge-parity-violation parameter gamma. If the measurement of gamma does not match up with the theoretical prediction it could point to new physics beyond the Standard Model of Particle Physics. During this study, machine and deep learning techniques will be investigated to determine the most effective method of reducing background.

My next project is to develop (and apply to LHCb data) a new three and four-body amplitude analysis and simulation. LHCb will have unprecedented event samples for amplitude analyses, with, in some channels, billions of very clean signal events. This provides new opportunities for precision measurements, but also an enormous theoretical and computational challenge. Amplitude analyses are notoriously complex and computationally intensive. In addition to the data analysis itself, we require several orders of magnitude more simulated data than we have collected, for Monte Carlo integration as well as for testing. Without new, powerful

About me

My linkedin profile: https://www.linkedin.com/in/benedict-westhenry-821509101/

I graduated from the University of Bristol with a 2:1 in joint honours Mathematics and Physics MSci in July 2017 before travelling to Texas to train and compete for West Texas A&M on a full athletics scholarship whilst studying towards an MBA. Unfortunately injury forced me to return home prematurely.

I located myself back in Bristol at the beginning of 2018 and worked ad hoc for a small Artificial Intelligence/Machine learning company called CLWB(now learn-tech.io) producing a machine learning and artificial intelligence course for the financial sector. During the Summer I undertook a placement within the Actuarial Change department at Lloyds Banking Group developing an automated analysis tool which was put forward for an internal innovation award. Alongside this I project managed a "Huddle board" app project. I began the Data Intensive CDT and PhD in Particle Physics at the University of Bristol in September 2018.

Outside of academia and work I am an avid athlete having run for Great Britain at Youth and Junior level. During my period of injury I have been coaching the University of Bristol endurance squad and was recently nominated for Student coach of the year.

software we will be unable to generate sufficient events, and to perform the complex parameter optimisation on the data (often with a large number of fit parameters) that will allow us to extract the exquisitely precise information hidden in those unprecedentedly large data samples.	

Data Intensive Research Skills and Interests:

Skills:
Languages: Python (&modules- pandas, numpy, matplotlib etc) , C++, C, Matlab, R, Maple.
Data visualisation: Tableau, ParaView, Matplotlib, ELK.
Databases: SQL.
Version control: Git.
Machine learning: scikit-learn.
Deep learning: TensorFlow, Keras.
Other: LaTeX.
Published papers: https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.121.256403

I've undertaken courses in machine learning, data analysis, high performance computing (CPU based), databases, applied data science and data visualisation provided by the CDT programme. On top of these I have undergone a variety of other courses as part of my particle physics PhD programme including a C++ course and a deep learning workshop applying a convolutional neural network to images using Keras.

Whilst writing the content (in Python) for a machine learning course for CLWB in 2018 I applied k-means clustering, random forest classification, random forest regression and principle component analysis from sci-kit learn. A long short term memory neural network regression was implemented using Keras with TensorFlow backend. I also analysed time series data using an autoregressive integrated moving average model.

Whilst at University in Texas I analysed time series data using R producing an 84 page econometric portfolio.

My final year particle masters project in 2017 involved pattern recognition and reconstruction of particle tracks using C++ and Matlab.

I used ELK and Matlab to produce publishable standard work during a Summer internship in Condensed Matters Physics at the University of Bristol in 2016. The work was published in the Physical Review Letters Journal in 2019.

Interests:
I am a member of the learn-tech (previously CLWB) interest group where we discuss the wide ranging impacts of rapidly developing technology and bring interesting developments, events and conferences to each others attention. My interests lie in the applications of data science to a variety of areas as well as particle physics from the internet of things, blockchain, quantum, cyber security, finance, the environment, transport, social media and healthcare, to politics and the resulting implications on the economy, policy and regulation. I find the potential applications in the medical sector such as developing simulations for vaccines particularly impactful. As a result,

I take advantage of the Jean-Golding institute events and other lecture series and workshops within and outside of the University to expand my knowledge across the field.

Goals and Desires:
Over the next three years my goal is to obtain my Doctorate in Particle Physics whilst continually gaining as many skills as possible. I am looking forward to immersing myself in my industrial placement, making a successful contribution and learning during it.

Post PhD I want to begin a successful and enjoyable career in industry with a company/institution which challenges me and provides me with opportunities to learn and grow. I do not intend on setting any limits on what I want to achieve.