

Introducing myself

Professor at Sussex (UK)

moved here with a Beatriz Galindo senior post
at Alan Turing Institute (London) until end of this year

Theoretical physicist

work on formal stuff with lots of model building

SUSY, XDIMS, CHMs, DM, GW, AdS / CFT...

A decade ago started to connect more with experiment

was affiliated to ATLAS 2011-2012

published pheno studies with CMS and ATLAS exps.

As a prof in the UK, co-direct centre for Data Science and organise transversal activities with other areas (health, social, economic...)

Machine learning

More data and more model-independent studies for new phenomena require more sophisticated statistical techniques

Natural to me to start working with ML
Main areas I focus on at the moment are:

Supervised ML searches for NP using multi-dimensional kinematics
[examples 1,2]

Move to raw features: from distributions \rightarrow events [example 4]

Transfer to other areas [example 4]

Unsupervised: Anomaly detection [in progress]

Example 1: use ML for EFT@LHC

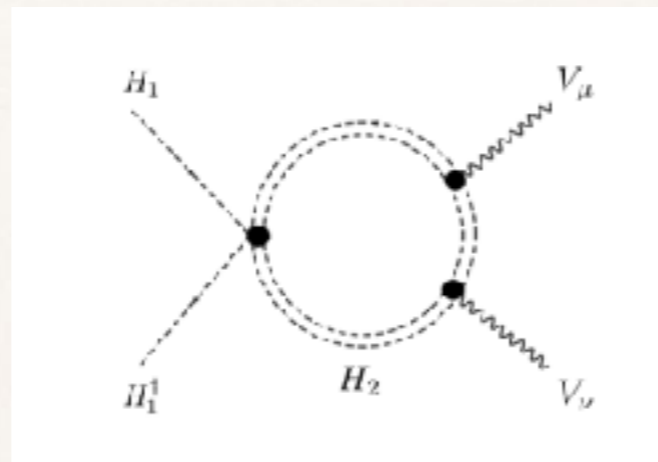
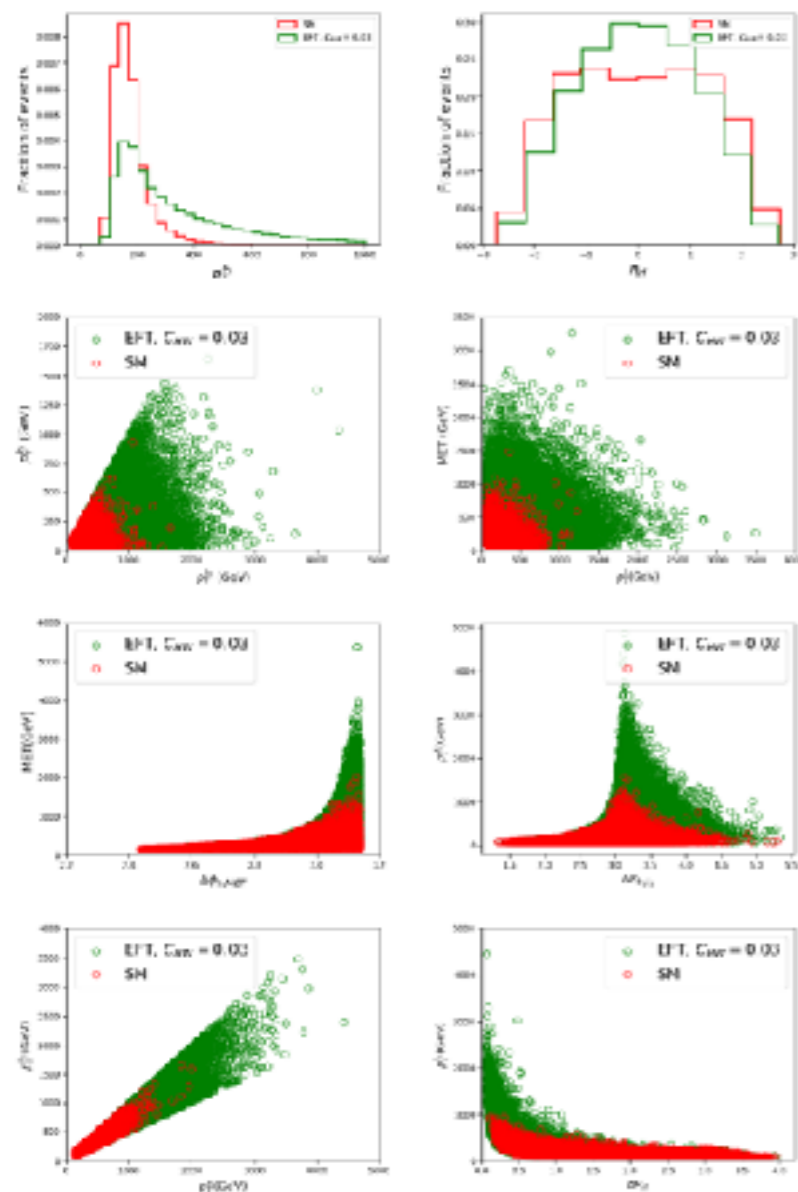
FREITAS, KAUR AND VS. 1902.05803. PUBLISHED PRD. ARXIV [HEP-PH](#).

Interpretation LHC data in terms of EFT is a hot topic

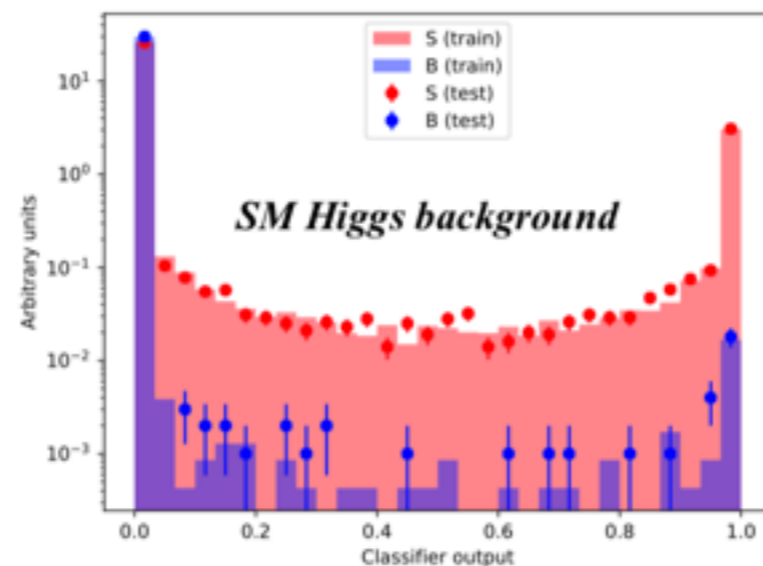
EFT: many theoretical parameters, need many experimental inputs

Leading global fit using kinematic information

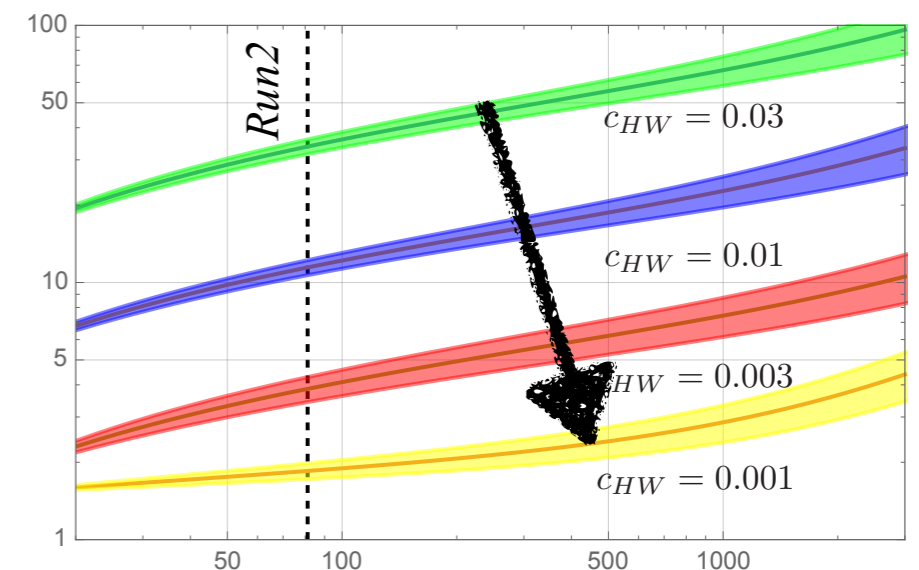
Tested use of ML to extract properties



shallow FC NN
included syst. and minimize
over asimov significance



*Asimov significance vs Luminosity
systematics 50%*



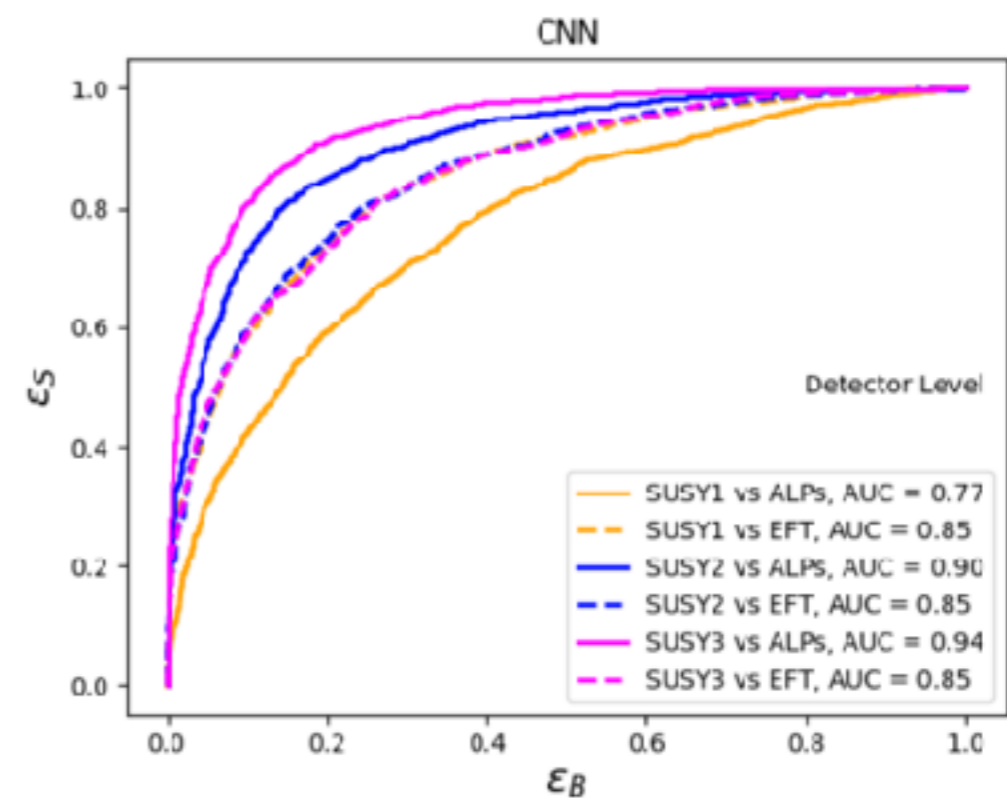
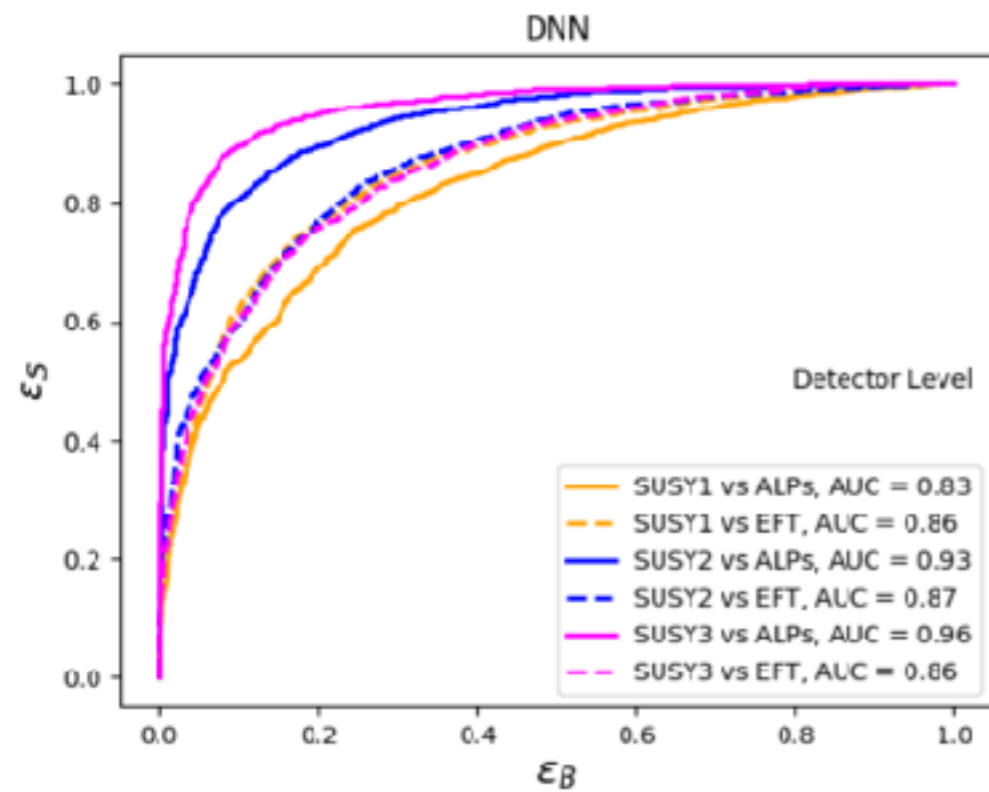
Example 2: disentangling DM scenarios

KAUR, VS AND SOUGHTON. 1910.06058. ARXIV: [HEP-PH](#)

Many theories of new physics can give DM-like signatures
(mono-X) not just a WIMP

compared WIMPs vs EFT-DM vs ALP in monojet

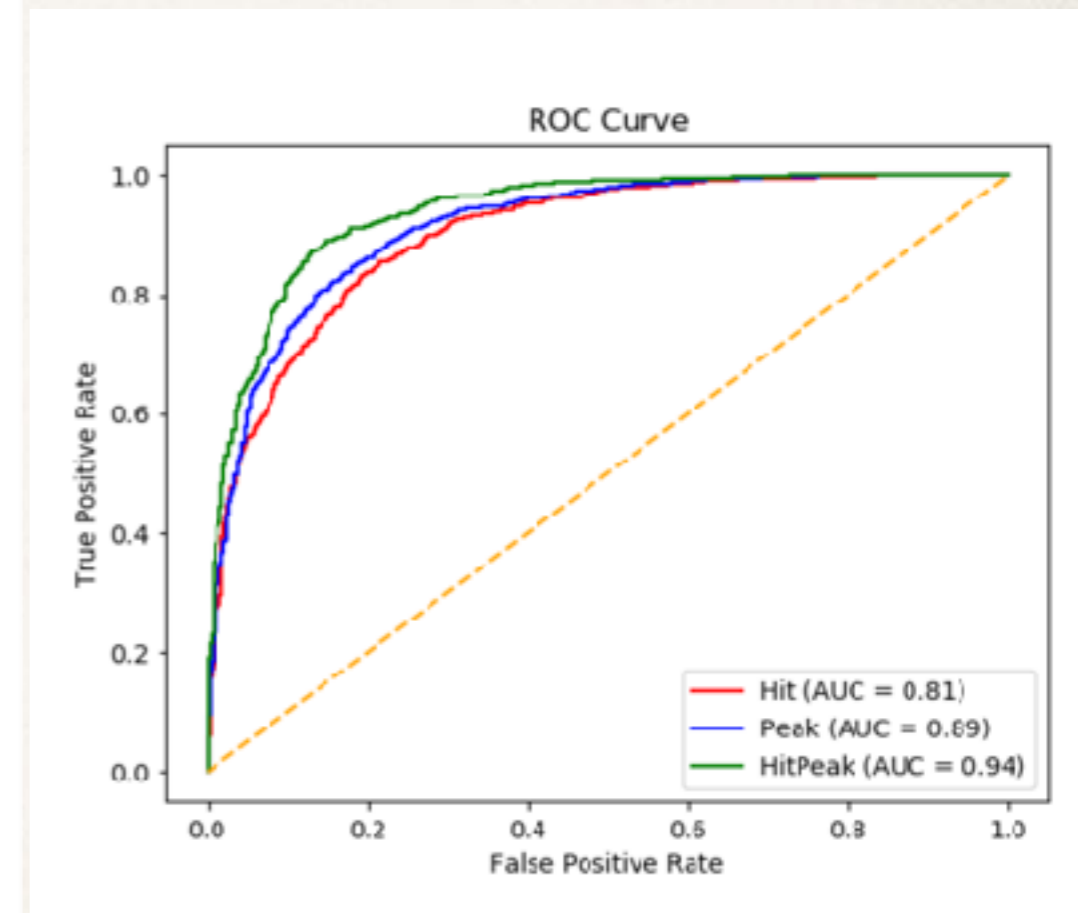
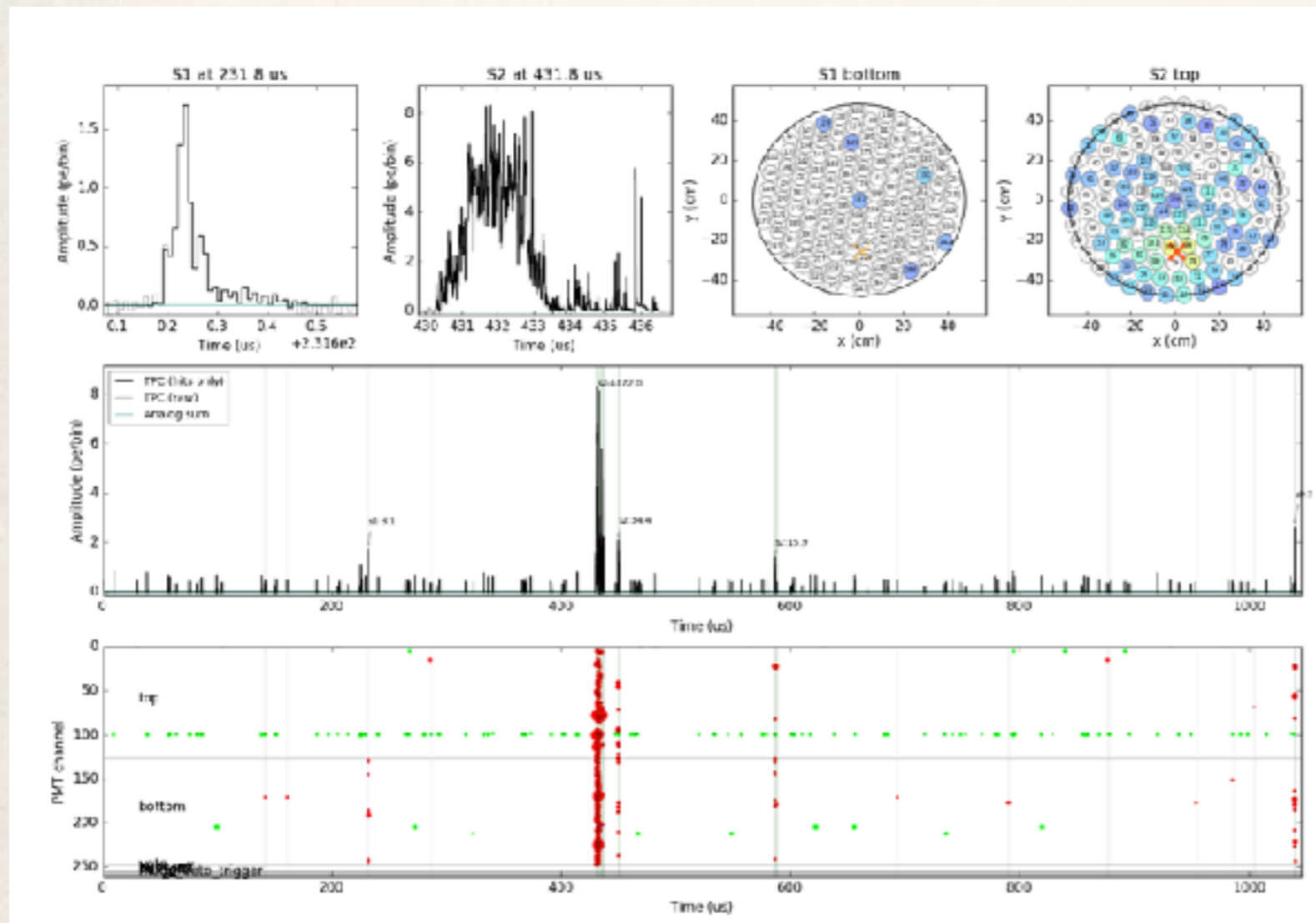
Used a DNN and a CNN (with images=prob. kinematic distrs.)



Example 3: Raw features in DM DD

KAUR, MARS, RICHARDS AND VS. TOMORROW. ARXIV: [ASTRO-PH.IM](#)

XENON1T collaboration. Look at DM WIMP vs main background
Use as inputs for a CNN architecture the event displays



Example 4. Application to medical diagnosis

ELKINS, FREITAS, VS. 1906.11282. ARXIV: [CS.CV](#).

Using a detailed XRay database, very imbalanced dataset, 14 possible diagnosis, lots of overlaps
Elkins expert doctor

Reduced resolution images, developed an app (heroku) for diagnosis using *Fast.AI*
focus on developing countries with no access to high-level facilities
Accepted in

Journal of Medical Artificial Intelligence

