

# Welcome to PHYSTAT-2samples

Workshop devoted to Goodness of Fit  
and 2-Sample Testing with multi-D data

1<sup>st</sup> and 2<sup>nd</sup> June 2023

# Topic of Meeting

## Goodness of Fit:

Comparing a data set with expectation (Null Hypothesis), expressed as functional form, possibly with unknown parameters;

and

## 2-Sample Testing:

Both data and expectation are in the form of data samples e.g. Expectation based on the Standard Model, but available as a sample of Monte Carlo simulated events; or can involve two separate data samples.

In both cases, this meeting deals with data in several dimensions.

N.B. These consist of just having a single Hypothesis. 'Hypothesis Testing', in which data are compared with 2 different hypotheses (e.g. Just the Standard Model = Null Hypothesis; or Standard Model plus some specific form of New Physics) is a different topic.

## Examples of Usage:

Topics of very widespread application in Particle Physics analyses. Include:

Checking that monitoring data from the detector are consistent with established norms

Seeing whether the data are consistent with Standard Model expectations, with any deviations being possibly an indicator of New Physics.

Checking whether data from ATLAS and CMS are consistent.

Is Fast Simulation generated by ML consistent with Full Simulation?

# TALKS and SPEAKERS

Range of Machine Learning methods in Particle Physics  
Ben Nachman (Lawrence Berkeley National Lab.)

Goodness of fit by Neyman-Pearson testing  
Gaia Grosso (Universita e INFN, Padova)

Applications to deep generative models  
Raghav Kansal (Univ. of California San Diego)

Optimal Transport for Goodness of Fit and 2-sample testing  
Larry Wasserman (Carnegie Mellon University)

Multivariate model assessment without chi-squared  
Sara Algeri (University of Minnesota)

Kernel methods for 2-sample and goodness of fit testing  
Arthur Gretton (UCL)

Comparing distributions of high dimensional complex data  
Ann B Lee (Carnegie Mellon University)

Classifier-based 2 sample testing for model independent searches for New Physics  
Mikael Kuusela (Carnegie Mellon University)

Motivation for meeting came from Raghav Kansal suggesting to give talk to CMS Statistics Committee; and from Maurizio Pierini pointing out that this should target a wider audience. Thanks to both of you.

Website contains reading material provided by speakers.  
Will contain slides and videos of talks.

Questions:

Mainly at end of talk. Please 'raise hand' or put in 'chat box'.  
Occasionally, ask for specific clarification during talk via 'chat-box'.

N.B. PHYSTAT subscribes to code of civil behaviour (e.g. APS "Code of Conduct" <https://www.aps.org/meetings/policies/code-conduct.cfm> )  
This means that we encourage discussion, but require that it refrains from being aggressive, or more extreme.

Enjoy the meeting!

Any questions, suggestions, etc to [olaf.behnke@cern.ch](mailto:olaf.behnke@cern.ch) or to [l.lyons@physics.ox.ac.uk](mailto:l.lyons@physics.ox.ac.uk)