

Employment:

- **Postdoctoral research associate**, University of Liverpool, 2023 - current

Education:

- **D. Phil. (Particle Physics)**, University of Oxford, 2020 – 2024
- **M. Sc. Mathematical and Theoretical Physics**, University of Oxford, 2019 – 2020
Distinction (1st class)
- **B. Sc. Applied Physics**, National Technical University of Athens, 2014-2019
Excellent (1st class)

Interests:

- **Beyond the Standard Model:** The Standard Model as we know it is demonstrably wrong, as neutrino oscillations cannot occur if neutrinos have zero mass. Therefore, exotic physics is not only exciting, but expected to be true, in some still-undetermined energy range. At neutrino experiments, one can search for various different exotic signatures such as heavy neutral leptons, axion-like particles, or Higgs portal scalars, which all may provide hints as to how the Standard Model is incomplete.
- **Neutrino fluxes:** Human-made accelerators / colliders produce neutrinos either directly (from primary interactions) or indirectly (from decays of intermediate particles). Since neutrinos only interact weakly, constraining their energy spectrum is difficult, as they cannot be deflected via electromagnetic fields. The energy spectrum informs the kind of neutrino interactions likely to happen in a detector. Therefore, the accurate simulation, and in-situ constraint of, neutrino fluxes is a crucial step for neutrino oscillation experiments, as well as for interaction experiments and rare-search analyses.
- **Neutrino mass:** Neutrinos oscillate, which means they acquire mass through some mechanism; since they are posited to be left-chiral, this cannot be done via a “standard” Higgs coupling in the Standard Model. Apart from this intriguing fact, the absolute mass scale of the observed neutrinos is still known only to a factor $O(0.1 \text{ eV})$ – direct measurements of the neutrino mass such as at KATRIN could act both to either confirm or exclude the inverted mass hierarchy, and to constrain cosmological models for large-scale structure formation (as neutrino mass impacts large-scale structure given a certain cosmic evolution model, such as the ubiquitous Λ CDM or more unconventional cosmic histories)

Projects:

- **VALOR:** I am part of the VALOR neutrino oscillation fitter. I am coordinating the production of modern oscillation predictions including realistic systematic uncertainties, and we are coordinating efforts with the PROfit group to understand our sterile neutrino sensitivity in SBN.
- **G4BNB:** I am cross checking the SBN flux prediction using updated GEANT4 simulations, validating against the miniBooNE flux prediction. It has been shown that there are numerous ill-understood effects regarding particle elastic reinteractions inside the target which I am working to characterise, as these could have a significant impact on low-energy neutrino fluxes.
- **SBND Release Manager:** I manage the releases for SBN-wide software.

- **SBND Operations:** As part of the SBND CRT group, I am conducting studies on the timing resolution of the frontal electronic boards with a view for getting O(ns) event timing (down from about ~ 4 ns currently). I also plan to be onsite in the 2025 Summer shutdown, to help perform tests on the A-frames of the CRT needed by the CRT group. I am also developing the SBND DQM for the CRT side of things.

Past projects:

- **Exotic long-lived particle simulations.** I am upgrading the GENIE BeamHNL module to simulate generic long-lived particles, from beamline or atmospheric contexts, and on deploying this in modern experiments such as SBND, ProtoDUNE, and T2K.
- **D. Phil. thesis, “Search for Heavy Neutral Leptons in the MINERvA detector”.** HNL are hypothesised heavy neutrinos with masses $\mathcal{O}(\geq 0.1 - 1 \text{ GeV}/c^2)$. I searched for a signal signature $HNL \rightarrow \mu + \pi$ with overlapping muon-pion pairs in the MINERvA detector for HNL below the kaon mass, exploiting the high-energy NuMI beam and the MINERvA dE/dX reconstruction. We are now exploring the possibility of using the double-MIP selection for extracting a constraint on coherent pion production.
- **BeamHNL generator.** I developed in conjunction with my supervisor, Dr. Xianguo Lu, a detailed simulation of HNL production, propagation, and decay in accelerator neutrino beamlines. This is now part of the popular GENIE neutrino event generator, used widely by neutrino experiments to generate Monte Carlo samples. The generator is easily configurable, experiment-agnostic, and supports multiple tuning options depending on the user’s needs. See Publications.
- **MSc dissertation, “Massive neutrinos in the formation of large-scale structure”.** I studied how to constrain the sum of active neutrino masses using cosmological measurements in the early and late Universe, by examining the effect of neutrino mass on various cosmological parameters.
- **BSc thesis, “Conformal symmetry in cosmology”.** I used the “embedding space” formalism to derive the 3-point correlator of fields with arbitrary spin, which has applications in constraining the higher-moment spectra from the cosmic microwave background. I applied this to the case of 3 spin-2 fields, which can constrain the non-Gaussianity of the primordial density fluctuations. [Manuscript \(in Greek\)](#)
- **CERN summer student project (2018).** I worked on analysing CERN North Area test beam data to develop a new clustering algorithm for the Micromegas muon trackers that form part of the ATLAS New Small Wheel. The algorithm extended reconstruction to the realistic case of multiple clusters per tracking plane and obtained the best-fit track using a Hough transform.

Publications:

- K.-J. Plows and X.-G. Lu, Modeling heavy neutral leptons in accelerator beamlines, [Phys. Rev. D **107**\(2023\) 055003](#).
- K.-J. Plows on behalf of the MINERvA collaboration, MINERvA medium-energy physics results (proceedings at ICHEP 2022), [PoS ICHEP2022 557](#).

Conferences and seminars:

- Invited talk, *Modelling Heavy Neutral Leptons in GENIE: the BeamHNL module*, Path to Dark Sector Discoveries at Neutrino Experiments workshop (06/Jun/2023: Fort Collins, CO, USA)
- Talk, [Modelling Heavy Neutral Leptons in Accelerator Beamlines](#), UK HEP Forum 2022 (23/Nov/2022: Abingdon, UK)
- Talk, [Beam-produced Heavy Neutral Lepton simulation in GENIE](#), International School of Nuclear Physics, 43rd Course (21/Sep/2022: Erice, Italy)

- Talk (on behalf of the MINERvA collaboration), [*MINERvA medium-energy physics results*](#), ICHEP 2022 (07/Jul/2022: Bologna, Italy)
- Talk, [*Heavy Neutral Lepton Search at MINERvA*](#), New Perspectives 2022 (21/Jun/2022: remote) -- **awarded 2nd place prize for Best Talk**
- Talk (on behalf of the MINERvA collaboration), [*Medium-Energy era results from MINERvA*](#), Lake Louise Winter Institute 2022 (23/Feb/2022: Lake Louise, Canada)
- Talk, *Benchmarking GiBUU theory cross-sections with the MINERvA ME flux*, IHEP: JUNO atmospheric neutrino interaction meeting (01/Apr/2021: remote)

Teaching:

2022-24: I have tutored students taking the C4 Particle Physics module of the Oxford MSc in Physics.