

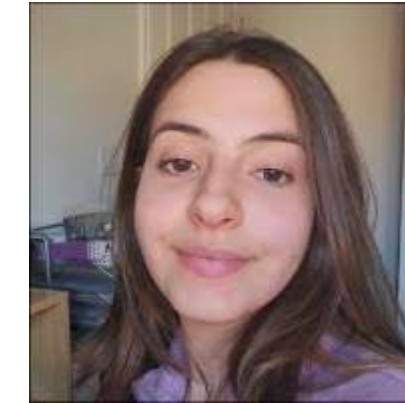
# **nuSTORM Meeting**

## **Theory Discussion**

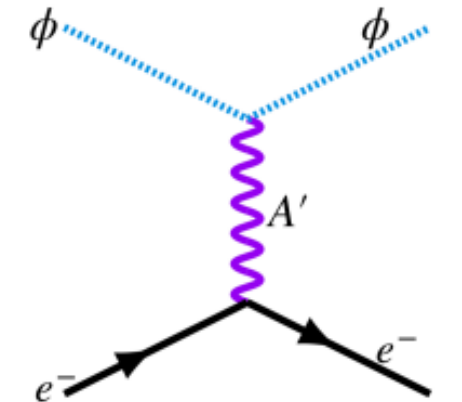
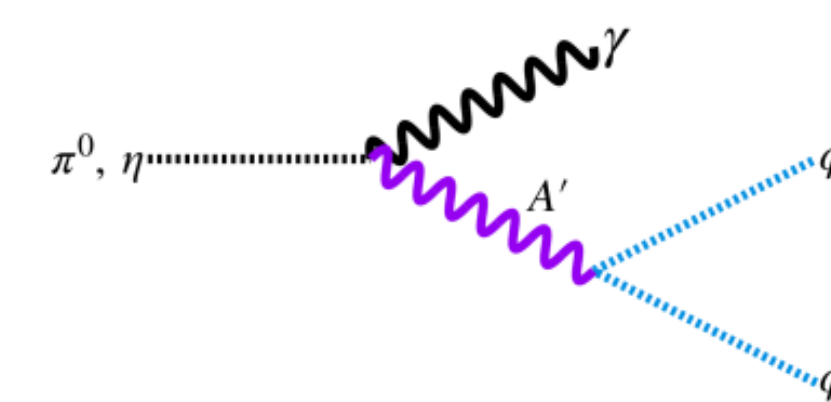
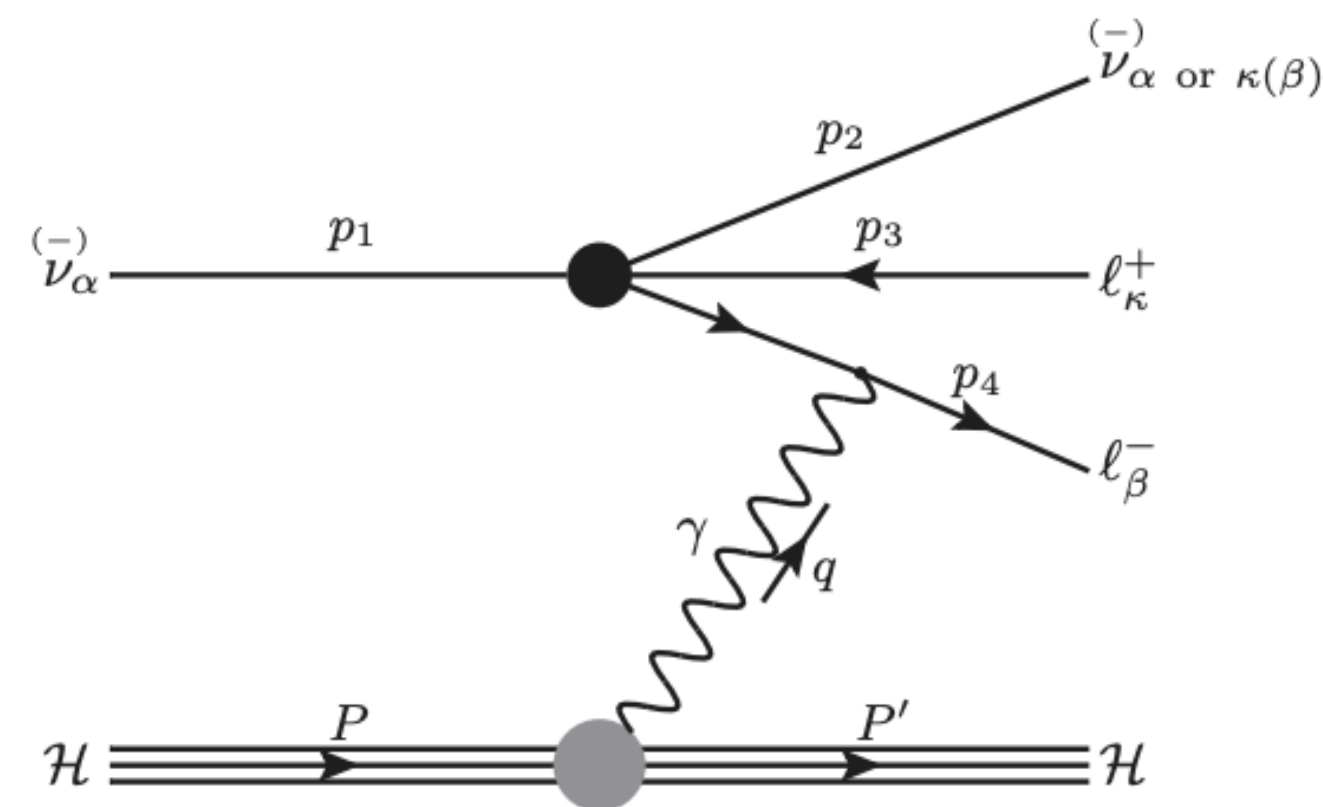
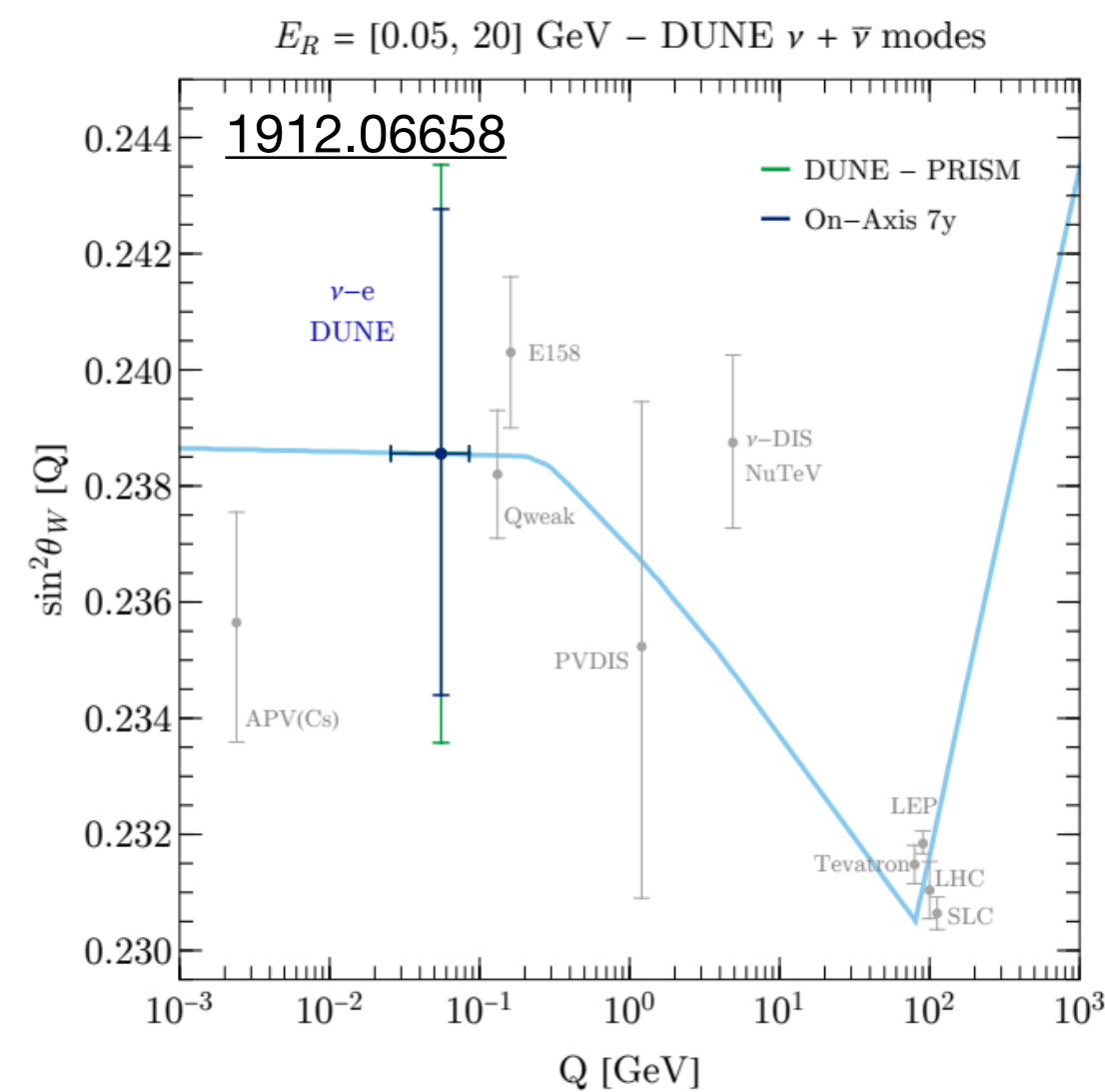
**Jessica Turner**

**Institute for Particle Physics Phenomenology, Durham University**

- (B)SM Theory Effort since summer 2023: myself, Yuber Perez-Gonzalez, Jack Franklin & Athina Vogiatzi



- SM: nuSTORM constraining power on  $\sin^2(\theta_W)$  & SM tridents
- BSM: nuSTORM constraining power on large extra dimensions, BSM tridents & dark matter HNLs well motivated and being studied by John Plows

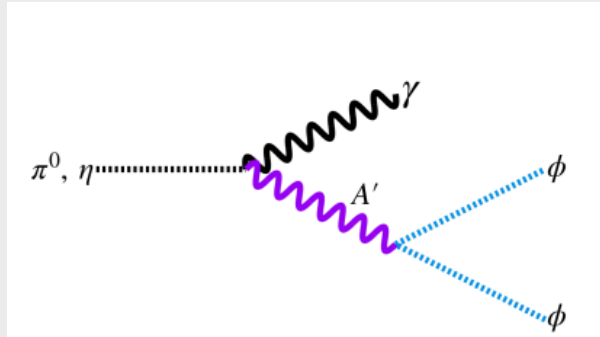


# Standard Model

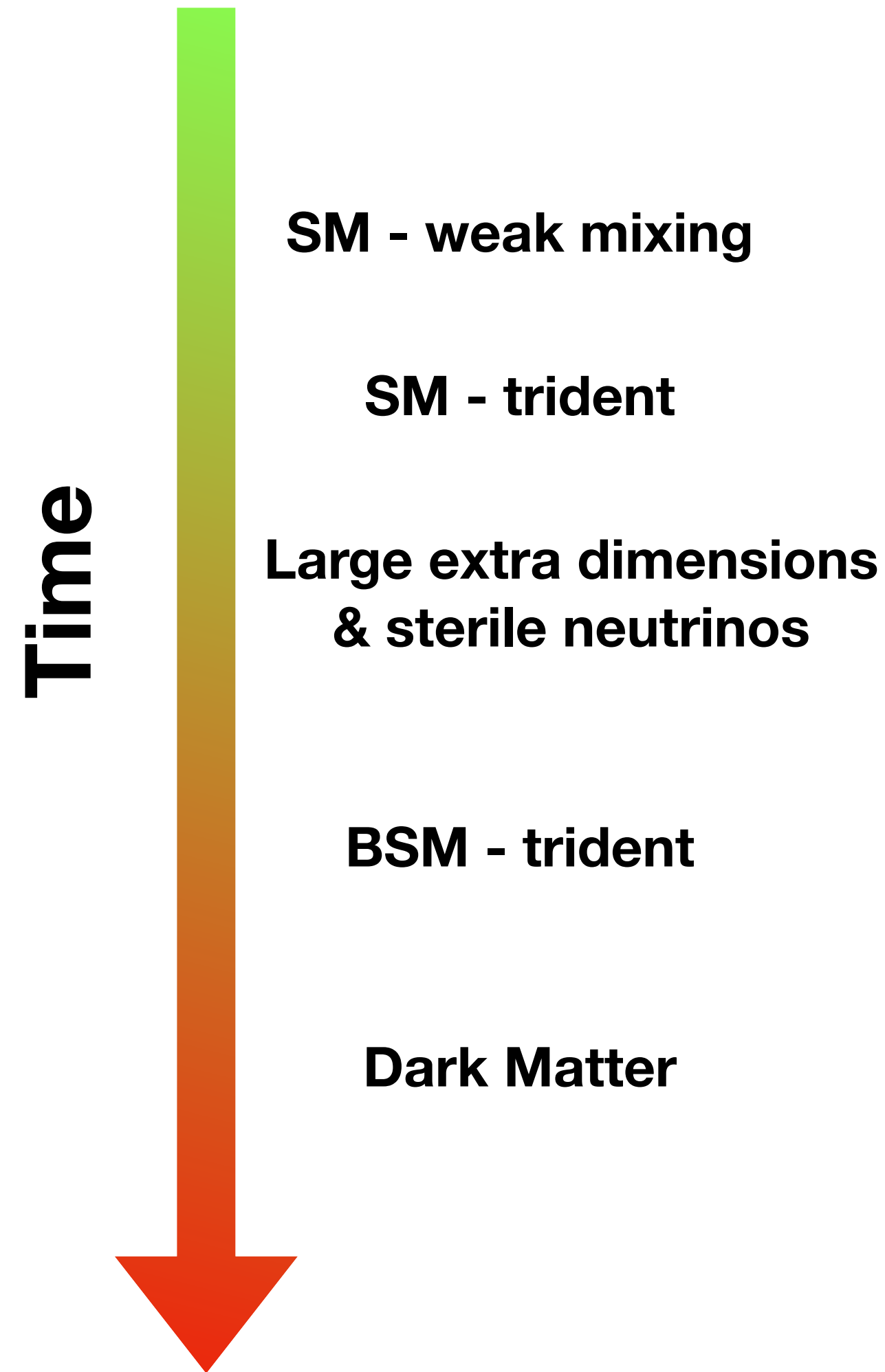
\*See talk by Yuber

Model/parameter	Motivation	Signal	Experimental Requirements	Projected Timeline
$\sin^2(\theta_W)$ at low $Q^2$	Limited measurements of weak mixing angle at low $Q^2$	$\nu_e - e$ scattering $(-)$ $\nu_\mu - e$ scattering	<ol style="list-style-type: none"> <li>1. Flux Normalisation major uncertainty.</li> <li>2. Magnetising detector would reduce misID e and photon*</li> <li>3. Good <b>electron energy &amp; angular resolution</b> (1 deg) improve sensitivity</li> </ol>	<p>Jan 2024</p> <p>Analysis pipeline already setup</p>
Standard Model Tridents	<p><b>Only measured trident is dimuon</b> &amp; other flavour channels not explored</p>	$\mu^+\mu^-, \mu^\pm e^\mp, e^\pm e^\mp$	<ol style="list-style-type: none"> <li>1. Tiny cross section, so small statistics. <b>How big a detector is feasible?</b></li> <li>2. Particle misidentification may be an issue. Can the detector be magnetised to discriminate electron and photon?  <math>\pi^\pm \Leftrightarrow \mu^\pm</math>  <math>\gamma \Leftrightarrow e</math> </li> </ol>	<p>Mar 2024</p> <p>Analysis pipeline set up need differential cross sections</p>

# Beyond the Standard Model

Model/parameter	Motivation	Signal	Experimental Requirements	Projected Timeline
Large extra dimensions (Steriles)	Possible explanations of the smallness of neutrino masses	Disappearance Probability	1. If detector baseline was adjustable we can probe short oscillations, what is baseline of FD?	Jan 2024  Athina is in process of calculating known LED oscillation probabilities, need to plug into pipeline. sterile straightfoward
BSM tridents	Promote $L_\alpha - L_\beta$ ( $\alpha, \beta = e, \mu, \tau$ ) To gauge symmetry Rich phenomenology related to g-2 Introduces $Z'$	Enhanced Rates of $\mu^+ \mu^-$ , $\mu^\pm e^\mp$ , $e^\pm e^\mp$ For low $M_{Z'}$	1. Particle misidentification may be an issue. Can the detector be magnetised to discriminate electron and photon?	Mar 2024
Light Dark Matter	New dark photon Couples to $\pi^0/\eta$ And decays to scalar DM 	$\phi - e$ Elastic scattering	1. Background is SM neutrino elastic scattering. For certain masses of dark matter and photon, signal can exceed background. <b>Sensitivity improves greatly if detector can be moved off axis. Is this possible?</b>	Apr 2024

# Projected Timeline & Prioritisation



- SM observable sensitivities prioritised
- Well motivated **neutrino BSM** scenarios will also be considered
- If time permits DM detection will be considered

- Is 100 ton LArTPC with 50 m baseline reasonable? Can the detector be movable parallel and perpendicularly?
- So far we have been using signal neutrinos from muon decay. Would be good to include neutrinos from pion decay as they have larger flux