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Neutrons at FASER

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The search for longer-lived mediators/particles at FASER is commonly conducted using standard model particles that are produced at the ATLAS proton-proton interaction point (IP). Since there is a magnetic field close to the IP, charged particles are deflected away from the beamline, leaving only neutral particles. This limits BSM searches to only those that arise from neutral SM particles such as neutral mesons, photons, etc. There is, however, a large flux of neutrons that survive up till the TAN iron dump, which can be utilized for BSM searches. Apart from directly producing BSM particles from neutrons, they can also be produced from the charged/neutral SM particles produced at the neutron-on-dump facility. In this study, we utilize the neutron and eta meson fluxes to investigate protophobic gauge bosons, and we also use the neutron-induced flux of photons, electrons, and positrons to study electrophilic and photophilic ALPs. For the protophobic gauge boson models, we see that the eta and neutron flux complement each other such that FASER2 is sensitive to masses and couplings much beyond current bounds. We realize that the presence of electrons and positrons at the neutron dump makes FASER sensitive to electrophilic ALPs. We also observe that the larger but softer photon flux can probe photophilic ALPs with couplings weaker than those previously explored.

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