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CompEx II: A Pathway in Search of BSM Physics using Compton Scattering

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Compton scattering has been shown to be very sensitive to the speed of light measured \emph{w.r.t.} to electrons in Compton scattering process [1]. For photons of energies in the range 9 – 46 MeV and a 1.16 GeV electron beam, a constraint on vacuum refractive index, $(n - 1) < 1.4 \times 10^{-8}$ was imposed using the Compton polarimeter at Hall - C of Jefferson Lab (JLab). Constancy and anisotropy of vacuum refractive index serves as a strong way to probe the predictions of theories beyond the standard model (BSM), especially those that predict breaking of local Lorentz and CPT symmetries. Absence of sidereal modulation of the vacuum refractive index was then used to constrain the Minimal Standard Model Extension (MSME) parameters of $\sqrt{\kappa_X^2 + \kappa_Y^2} < 8.6 \times 10^{-10}$ and $\sqrt{(2c_{TX} - (\tilde{\kappa}_{0+}^{YZ})^2 + (2c_{TY} - (\tilde{\kappa}_{0+}^{ZX})^2} < 8.6 \times 10^{-10}$ [2]. These preliminary set of measurement above is being followed up by measurements using the 11.5 GeV electron beam at JLab which will improve the above constraints by two orders of magnitude. Also, the follow up measurement will allow us to probe the photon energy dependence of vacuum refractive index which provides for another means to test local Lorentz and CPT symmetries. Furthermore, quantum gravity models predict crystalline nature of space at Planck scales which may manifest as vacuum birefringence that can be probed by Compton scattering using circularly polarized light [3]. Measurements of vacuum birefringence at Planck scales may also be used to probe correlated holographic noise providing a glimpse into the quantum nature of space at its finest resolution. Efforts being made towards the realization of phase-2 of the series of Compton Experiments (CompEx) aimed towards probing the various aspects of BSM Physics models along with the results from phase-1 will be presented.

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