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Numerical predictions of GEM sheet nonlinear mechanical properties under large deformations

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The deformed shape of the perforated holes in the Gas Electron Multiplier (GEM) are proven to have great effect on the electron gain. Numerical calculations are required to optimized the GEM sheet configuration for maximum gain. In this paper, three methods are used to numerically predict the nonlinear mechanical properties of the GEM foil using finite element method. The hexagonal pattern of the perforated holes creates orthotropic response on the GEM sheet under deformation. In all methods, the properties are measured under large strains up to 0.1. In the first method, isotropic properties are predicted in the direction of the longitudinal alignment of the GEM sheet. In the second method, directional normal and shear moduli as well as the directional Poisson ratios are calculated using solid brick elements. In the third method, shell elements are used to predict the flexure rigidity of the GEM sheet and the equivalent sectional moment of inertia. The results show variation of about 25% of the normal and shear moduli in longitudinal and transvers directions. However, the directional Poisson rations are nearly similar. The results show that the GEM sheet stiffens with deformations.

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