Contribution ID: **216** Type: **Oral Presentation**

Investigating the photon shielding factors of the silicate glass system from 1 MeV up to 15 MeV, Using the X-COM and GEANT4 simulating software

Thursday 10 July 2025 12:10 (20 minutes)

This study investigates the radiation shielding capabilities of silicate glasses (S1–S4) across photon energies ranging from 1 to 15 MeV. Using Phy-X, XCOM, and GEANT4 simulations, key shielding parameters were estimated, including the mass attenuation coefficient (MAC), linear attenuation coefficient (LAC), half-value layer (HVL), tenth-value layer (TVL), mean free path (MFP), and effective atomic number (Z_{eff}). The glasses exhibited maximum photon shielding performance at 1 MeV, with LAC values of 0.18398, 0.17842, 0.17696, and 0.14718 cm^{-1} for S1 through S4, respectively.

The LAC was observed to decay exponentially with increasing energy, while the MAC began to decrease exponentially around 4 MeV. These reductions in shielding effectiveness are attributed to increased Al_2O_3 content and decreased CaO content within the glass matrix. Additionally, HVL and TVL were analyzed in relation to material density. As density decreased from 2.90 to 2.76 g/cm^3, HVL increased correspondingly, with values at 1 MeV measured as 3.76758 cm (S1), 3.88481 cm (S2), 3.91705 cm (S3), and 3.97937 cm (S4). The HVL also increased significantly with photon energy, nearly tripling between 1 and 15 MeV.

These results provide a comprehensive assessment of silicate glasses as potential materials for high-energy radiation shielding applications, highlighting their energy-dependent attenuation behavior and compositional influence on shielding performance.

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Session Classification: Nuclear, Particle and Radiation Physics-1

Track Classification: Track B - Nuclear, Particle and Radiation Physics