Visualizing Curved Space
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Introduction & Purpose

Introduction

• General Relativity: Space-time curvature causes gravity

• Geodesics: Shortest distance between two points on curved surface

• Existing models try to explain motion & acceleration

Purpose

• Our model does not rely on motion, only curvature

• Use electric field (E field) mapping to demonstrate curvature

Curvature of Sphere

Equation of Sphere

\[ \bar{r} = \{ r \cos u \sin v, r \sin u \sin v, r \cos v \} \]

Use Gaussian curvature to compare surface shape to electric field shape.

Gaussian Curvature of Sphere

\[ K = \frac{LN - M^2}{EF - G^2} = r^{-2} \]

Model Setup & Procedure

Materials (Fig. 1)

• Semi-conductive paper
• Copper O-rings
• Conductive paint (glue)
• 12V source
• Volt meter

Procedure

• Cut paper into strips. Wrap around sphere. Glue on electrodes. Measure voltages.

Results

Electric Field Behavior

From Gauss’s Law and Gaussian Curvature we conclude:

\[ E = \frac{\Phi \sqrt{K}}{2\pi \sin \theta} \]

Discussion

• Relating E and K is more difficult for other shapes

• Depends on placement of charge since K is not constant

• Data does not need more precision.