Science Café

Sunday, December 16, 2018 (2:00-3:30 P.M.)

Points, Lines and Infinitesimals

Issues with using geometry as a language to describe our Universe

Jeff Baugher

Physical Theorist
Ph.D. Candidate and Researcher
Wright State University

Meeting at Ijams Nature Center

rsvp@knoxsciencecafe.org

Everyone is Invited!
Free to attend!

Kid's Café provided

There will be a brief NOVA video presentation followed by an hour of Questions and Discussion with refreshments

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Points, Lines and Infinitesimals: Issues with using geometry as a language to describe our Universe.

- Jeff Baugher (Aiken SC)
- BSEE Wright State University
- PhD candidate Wright State University
  - Studied MEMS @ Air Force Institute of Technology WPAFB Dayton Ohio
  - Path of my research: MEMS>study of: elasticity>elasticity tensors>tensors in gravity>General Relativity>Cosmological Constant problem>history of geometry>axiomatic method to field equations

What are infinitesimals?

Definition of the Derivative of a Function

The **derivative** of f at x is given by

$$f'(x) = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

provided the limit exists. For all x for which this limit exists, f' is a function of x.

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x}$$

$$= \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

$$= f'(x).$$

-Larson, Hostetler, Edwards, 97

What are infinitesimals?

- Way too many definitions and concepts to cover in this presentation
- Goal of presentation is to present a new concept of variable infinitesimals and what opportunities this could present
- But what is the context….

Context for infinitesimals

- Einstein Field Equation (EFE) is best description of gravity currently known.
- EFE is now shown with another term within it, the Cosmological Constant, Λ or CC.
- In 1998, the observed phenomenon now called Dark Energy was first observed.

Context for infinitesimals

- The Dark Energy Task Force (DETF) was established by the Astronomy and Astrophysics Advisory Committee (AAAC) and the High Energy Physics Advisory Panel (HEPAP) as a joint sub-committee to advise the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation on future dark energy research.
  - https://arxiv.org/ftp/astro-ph/papers/0609/0609591.pdf
- DETF states that the CC seems to be the best geometrical fit for observation of Dark Energy but could be evidence that General Relativity is incomplete or incorrect.

Context for infinitesimals

- The CC term Λ is understood to include the "metric" g as well as the *infinitesimal* terms dx or ∂x.

$$\Lambda g_{\mu\nu}\partial x_{\mu}\partial x_{\nu}$$

Context for infinitesimals

- EFE is derived from the concept of non-Euclidean geometry, which is derived from the concept of Euclidean geometry, plus "curvature" and non-curvature or curving and parallel lines.
- Euclidean geometry is derived from a set of primitive notions of points, lines and planes through the axiomatic method.

Context for infinitesimals

- Therefore the EFE, including the CC term, is made of the primitive notions.

Issue and Hypothesis development

- Issue: “An alternative explanation of the accelerating expansion of the Universe is that general relativity or the standard cosmological model is incorrect.”-DETF
- Hypothesis 1: General Relativity is founded upon the primitive notions of points, lines and planes. These primitive notions are not logically consistent.
- Hypothesis 2: Primitive notions of *locations* and *relative line segments* provide a logically consistent geometric foundation for a gravitational field equation.

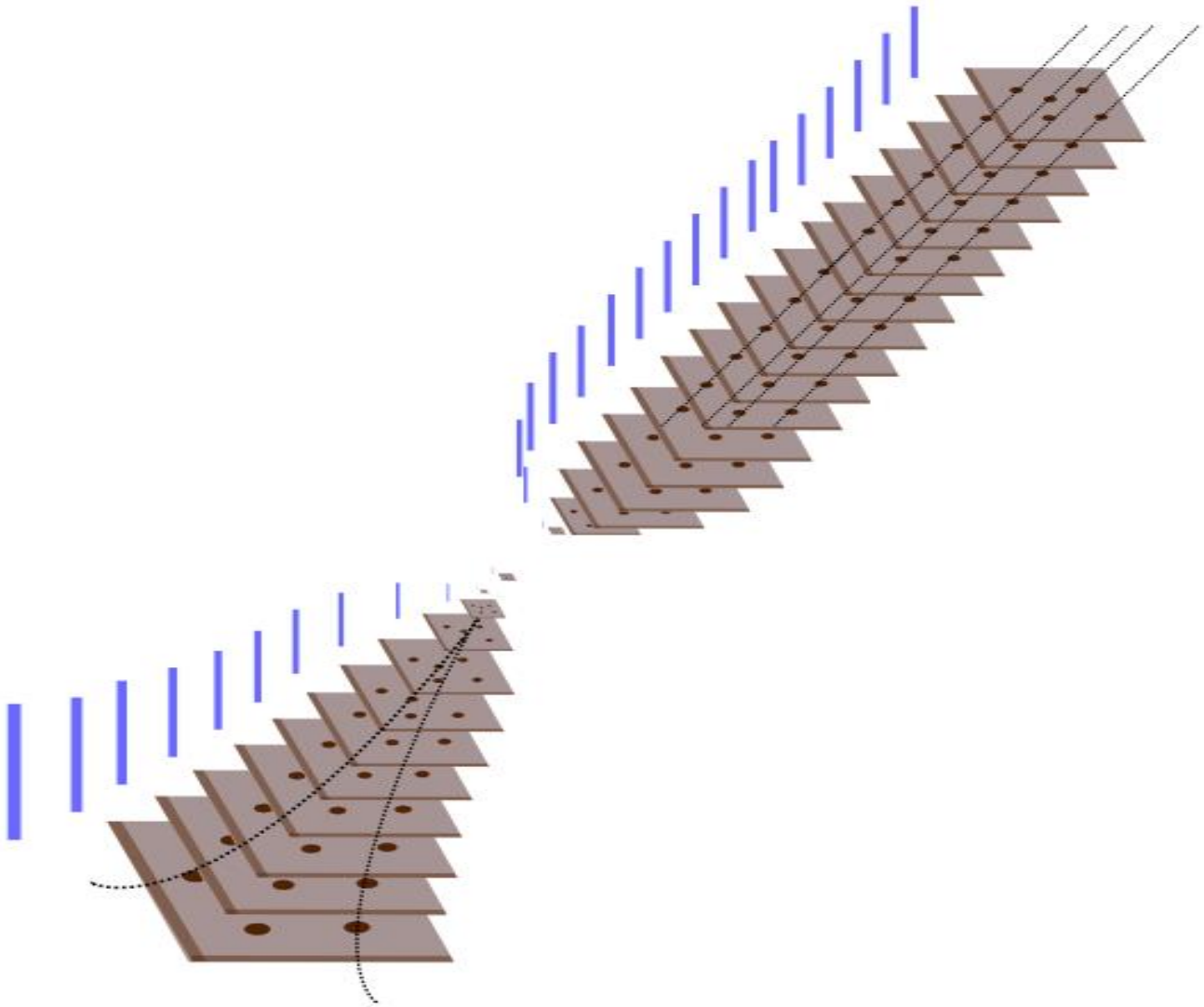
Locations and relative line segments

- Can derive Euclidean geometry
- Can derive integral and differential calculus
- Gives three variable infinitesimals
  - New solutions to old geometric paradoxes (Torricelli's parallelogram and Zeno's)
  - Similar geometric concepts to that of non-Euclidean geometry
    - Planar
    - Elliptical
    - Hyperbolic
    - Parabolic
  - Provides counterargument to "parallelism" and "curvature" with the concept of varying infinitesimal "area"

Locations and relative line segments

If the distance between these locations is not the same as between the another location, then they are curved relative to each other

Locations and relative line segments



Locations and relative line segments

1 case of "dBdB" with many different meanings?

BB = area

infinitesimal element of area $\stackrel{?}{=}$ dBdB $\stackrel{?}{=}$ infinitesimal change of area

$$g_{\mu\nu}\partial B_\mu \partial B_\nu$$

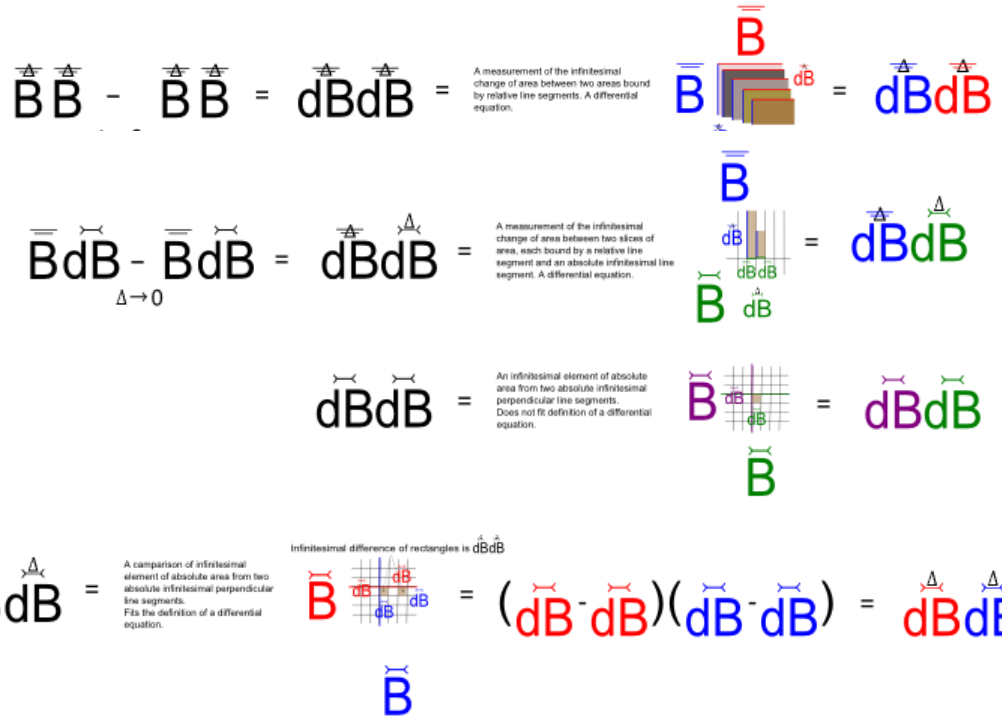
If $g_{\mu\nu}$={-1,1,1,1} means flat and no energy or momentum then…

$$\Lambda g_{\mu\nu}\partial B_\mu \partial B_\nu$$

…what would $\Lambda g_{\mu\nu}$={-5,5,5,5} mean?

Liebnizian Notation vs Refined Liebnizian Notation

4 cases of "dBdB"



Locations and relative line segments

- Gives three variable infinitesimals
  - Philosophical Interpretations of three variable infinitesimals
    - an infinitesimal “length” of time or space (amount of time or spatial length)
    - an infinitesimal difference of the “length” of time or space (the difference of spacing between temporal or spatial events, clock tick amounts or wavelengths)
    - infinitesimal change of wavelength or clock ticking rate
- Requires examination of three concepts
  - The concept of measurement, quantities or amounts in geometry (The Calculus)
  - The concept of philosophical equivalence to geometry, i.e. space, time, energy, momentum, etc… (The Philosophy)
  - The concept of notational representation of geometry (The Notation)
- I refer to this research as CPNG, the Calculus, Philosophy and Notation of Geometry

2019 Goals

- Develop flow of energy theorem that has slightly different interpretation than that Noether's Theorem
- Publication in any major fundamental physics journal
- Pre-proposal for physical research to Breakout Labs

Is Dark Energy mystery serious enough to reconsider the primitive notions that underly our understanding of physics?: Report of the DETF abstract

Dark energy appears to be the dominant component of the physical Universe, yet there is no persuasive theoretical explanation for its existence or magnitude. The acceleration of the Universe is, along with dark matter, the observed phenomenon that most directly demonstrates that our theories of fundamental particles and gravity are either incorrect or incomplete. Most experts believe that nothing short of a revolution in our understanding of fundamental physics will be required to achieve a full understanding of the cosmic acceleration. For these reasons, the nature of dark energy ranks among the very most compelling of all outstanding problems in physical science. These circumstances demand an ambitious observational program to determine the dark energy properties as well as possible.

Citations

-Report of the Dark Energy Task Force, Albrecht, et. al. (2006) arXiv:astro-ph/0609591

- Larson, R., Hostetler, R., Edwards, B., Calculus. New York: Houghton Mifflin, 2002.