

THE PHYSICS OF INTERSTELLAR - ADS/CFT AND THE TESSERACT

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ABSTRACT.

Part 1.

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*Key words and phrases.* AdS/CFT.

Part 2. Talk

1. TALK

I’m going to throw around a lot of technical terms because I am not going to pull any punches.  
An example of a quantum field theory is what’s called the standard model of particle physics.

2. TALK NOTES

Black holes Ch. 5, contain no matter but have surfaces called event horizons, circumference proportional to mass, I. Foundations 2 Our Universe in Brief. Thorne (2014) [1]  
gravitational lensing, distortion, bending of light rays.  
It seems likely from the quest to understand quantum gravity that our universe is a membrane (physicists call it a ”brane”) residing in a higher-dimensional ”hyperspace” to which physicists give the name ”bulk” (Ch. 4, 21), when physicists carry Einstein’s relativistic laws int bulk, they discover the possibility of gravitational anomalies, anomalies triggered by physical fields that reside in the bulk.  
Ch. 4, Warped Time and Space, and Tidal Gravity  
”Einstein’s law of time warps”, 1959 Bob Pound, Glen Rebca, Mössbauer effect.  
Einstein realized if time can be warped by massive bodies.  
Robert Reasenberg and Irwin Shapiro of Harvard, 1976-77 radio transmission signals from Earth to spacecraft and back, if space were flat, roundtrip travel would’ve changed gradually and steadily. By constant c, distance from Earth to spacecraft had to be longer than expected passing near Sun.  
Ch. 21 5th dim.  
Tidal Gravity Einstein’s laws dictate planets, stars, spacecraft move along straightest paths. (geodesic)  
Riemann tensor, tendex lines.  
Schwarzschild metric, warped spacetime around a nonspinning black hole, Kerr metric for spinning black hole.  
Lynden-Bell, quasars, Lynden-Bell 1797.  
Gannon’s theory, any wormhole is traversable only if threaded by exotic matter.  
VI. Extreme Physics 21 The Fourth and Fifth Dimensions, 1984, Green, Schwarz, our universe is a brane embedded in a bulk that has 1 time dim and 9 space dims, a bulk with 6 more space dims than our brane, superstring theory  
”The nature of Bulk Beings, and Their Gravity”  
Physicists: all particles, all forces and fields confined to our brane, except gravity, and warping of spacetime associated with gravity.  
Ch 23: Confining Gravity - The Trouble with Gravity in 5 dims  
If the bulk does exist, then its space must be warped.  
String theory insists that gravity in the bulk is also described by force lines. Because bulk’s extra dim., there are 3 transverse dims into which gravity can spread instead of just 2. Therefore, if bulk exists and is not warped, then density of force lines and thence gravity’s strength should decrease as 1/*r*<sup>2</sup> it must be warped in some manner that prevents gravity from spreading into 5th dim  
The Anti-DeSitter Warp  
1999 Randall, Sundrum, Anti-deSitter warping. 37  
Confine AdS warping to a thin layer around our brane, a ”sandwich”. Place 2 confining branes.  
Gregory, Rubakov, Sibiryakov AdS sandwich  
Witten shown AdS sandwich is unstable.  
A bulk field is a collection of force lines that resides in 5-dim. bulk.  
cf. Bulk Fields Control the Strengh of Gravity. But if bulk does exist, then relativistic laws allow G to change.  
Exotic matter that repels gravitationally, alternative, bulk fields may hold the wormhold open.  
”Protecting Our Universe from Destruction”  
for gravity in our universe to obey Newton’s inverse square law to high accuracy, our brane must be sandwiched between 2 confining branes with AdS warping between them.  
footnote 42 According to Einstein’s relativistic laws, the dark energy that (presumably) makes the expansion of our universe accelerate has a 2nd. effect; it produces an enormous tension in our brane; Einstein’s laws also dictate that, in order for spacetime outside AdS sandwich to be free of warping, each confining brane must have internal pressure that’s half as big as our own brane’s internal tension.  
Einstein’s relativistic laws applied to bulk and branes.  
Bulk fields somehow exert a force on it, pushing back its proper, straight shape.  
naked singularity - singularity not hidden beneath a black hole’s event horizon, singularity outside a black hole.  
Matthew Choptuik, imploding gravitational wave. naked singularity.  
BKL Singularity inside a Black hole Einstein’s laws taught us these singularities are unstable. Vladimir Belinsky, Isaac Khalatnikov, and Eugene Lifshitz in 1971 BKL singularity inside a Black Hole, Garfinkle at Oakland University confirmed guess. BKL singularities are allowed by Einstein’s relativistic laws. A Black Hole’s Infalling and Outflying Singularities. 1991 Eric Poisson and Werner Israel discovered second singularity, grows with time as the black hole ages.  
lae 2021, 3rd singularity discovered by Donald Marolf, Amos Ori, it’s outflying singularity that grows as black hole ages, produced by stuff (gas, dust, light, gravitational waves, etc) that fell into black hole *before you fell in, upscattered stuff gets compressed, by black hole’s extreme slowing of time, into a thin layer rather like a sonic boom (a ”shock front”)*.

1955 John Wheeler pointed out existence of quantum foam with wormhole sizes  $10^{-35}$  meters, *Planck length*.  
Andrew Abrahams and Chuck Evans at UNC repeated Choptuik’s simulations using gravitational wave not scalar wave and got same result, a naked singularity.

28 Into Gargantua

2013 Falling into a black hole, 1985, we physicists thought core of all black holes were inhabited by chaotic, destructive BKL singularities. 2 additional singularities discovered, inside black holes, gentle singularities.  
infalling singularity, produced by stuff that falls into Gargantua long after Cooper falls in (long after, measured by external universe’s or Earth’s time. If Cooper is hit by that singularity and survives, the universe’s far future will e in his past.  
Signals from aboe are Doppler shifted to red by Cooper’s high speed, which compensates blue shift produced by hole’s gravitational pull.  
outflying singularity, from stuff that fell into Gargantua before the Ranger, not after it. Slingshot around a suitable intermediate-mass black hole soon after leaving Endurance. Cooper sees light from objects tat fell into Gargantua before him and still falling inward. He can see them in reflected light from the accretion disk above.

29 The Tesseract

From Point to Line to Square to Cube to Tesseract.  
If we take a point, and move it in 1 dimension, we get a line. The line has 2 faces, they are points. If we take a line, and move it in a dimension perpendicular to the line, we get a square. It has 4 faces, the 4 sides. If we take a square and move it in the 3rd. dimension perpendicular to it, we get a cube. It has 6 faces, the 6 squares. If we take a cube and move it in the 4th. dimension, we get a tesseract. It has 8 faces, the 8 cubes.  
Cooper made of atoms of E, nuclear fields, can exist only in 3 dims. He reside in 1 of tesseract’s 3 space-dim. faces. Transports 3 dim. Cooper, lodged in its 3-dim. face, through the bulk.  
distance from Gargantua to Earth is about 10 billion light-years as measures in our brane (our universe), however as measured in bulk, that distance is only about 1 AU.  
3 cm thick AdS layer that encases our brane to reach Murph’s bedroom.  
Back face of tesseract coincides with Murph’s bedroom. everything in Murph’s bedroom, including Murphs herself is also inside the tesseract’s back face.  
6 views of Murph’s bedroom seen by Cooper  
All 6 light rays have to pass through intermediate cubes (tesseract faces) before reaching Murphs’ bedroom

2.0.1. *More Notes*. Riff.

- 2.1. **Riffs**. To make the unknown, known.  
Aim to be rapidfire, shoot for time 10 mins. 5 mins.

REFERENCES

[1] Kip Thorne. **The Science of Interstellar**. W.W. Norton and Company. 2014.