

11/29/04

LAST WEEK!

Class evaluation on Wednesday - NEED VOLUNTEER

Administer on Wednesday, return to Astronomy Department

Local news -Thanksgiving surprise

ROTSE robotic telescope discovered a new
supernovae SN 2004gk in the Virgo cluster
Saturday morning, HET confirmed Type Ic
Saturday night



Pic of the day: Saturn's moon, Tethys

Final - Saturday, December 11, 7:00 PM

Painter Hall - 4.42 (NOT WELCH)

Extra credit sky-watch reports are due by 5 PM on Monday, December 6. Crummy weather is part of the game for astronomers!

Kip Thorne & Co (Thorne - Black Holes and Time Warps: Einstein's Outrageous Legacy)

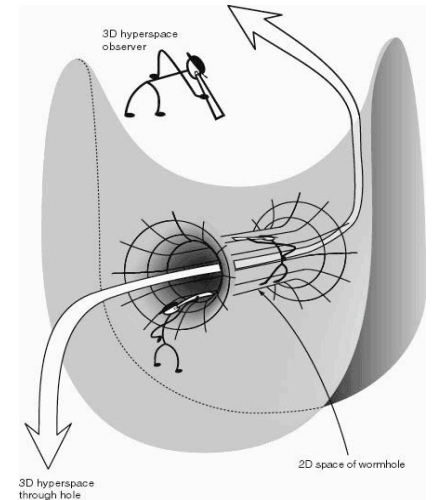
Worm holes are automatically time machines!

Igor Novikov elaborated

Twin paradox - twin who accelerates out and back in space will be younger than the twin who stays behind (special relativity).

Do this (conceptually) with one mouth of a worm hole or lower one mouth into strong gravity where time runs slower.

Time “connects” differently through the wormhole and in the surrounding space - one mouth is “younger”



Can, in principle, travel back in time (but not before the time the machine is constructed)

Go in one mouth, come out in the past, go around in normal space, meet yourself before you go in.

Time travel paradoxes - Grandfather Paradox, Suicide

Pool Ball Paradox (purely mechanical, get people, intention and will out of the analysis) - fire pool ball through time machine to deflect itself before it went in so could not have deflected

Novikov - there is no paradox - Physics always works out so that a paradox is avoided

Pool ball just nicks, Grandfather ducks.

Future is already “there” in space-time

Premise of many famous time travel movies (Back to the Future) undone, cannot change the future by tinkering in the past.

Implication - no free will

We just live through time with impression we are making choices

Novikov - I exert my free will to fly around the room or to walk through solid walls

Physics says I cannot - what's the big deal?

Likewise - I cannot will a time travel paradox, physics says “no.”

Ultimate resolution - will not know if worm holes can be constructed, even in principle, without a theory of *quantum gravity*.

Hawking - vacuum fluctuation energy (from uncertainty principle applied to vacuum) can go into wormhole, come out in past, pile up at mouth where began, quickly build up huge energy density, curve space, slam worm hole shut.

Maybe, but cannot actually compute that process without a theory of quantum gravity to handle the change in the “connectivity” of space time.

Need quantum gravity theory of singularity, quantum foam, worm holes

The best current candidate for a theory of Quantum Gravity is String Theory

See Brian Green - The Elegant Universe

(<http://www.pbs.org/wgbh/nova/elegant/>)

Hyperspace is an intrinsic aspect of string theory - 10 dimensions of space, plus time.

Background - pre-Einstein late 19th, early 20th Century

Where does space curve to?

Riemann (1826 -1866), Lobachevsky (1792 - 1856)

Theory of curved space, non-Euclidian geometry

Notions of 4D hyperspace affected art/culture turn of 20th century

Tesseract - 4D hypercube (Elegant Universe link)

3D “unfolding” of tesseract in Salvadore Dali’s

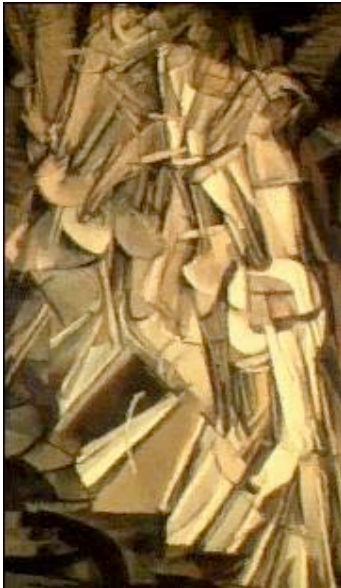
Crucifixion (Corpus Hypercubas)



Notions of seeing from different directions at once

Perspective of Cubism

Picasso -



Deschamps - *Nude Descending A Staircase*

Contemporary Brazilian artist Marcos Novak -
3D projections of 4D objects

