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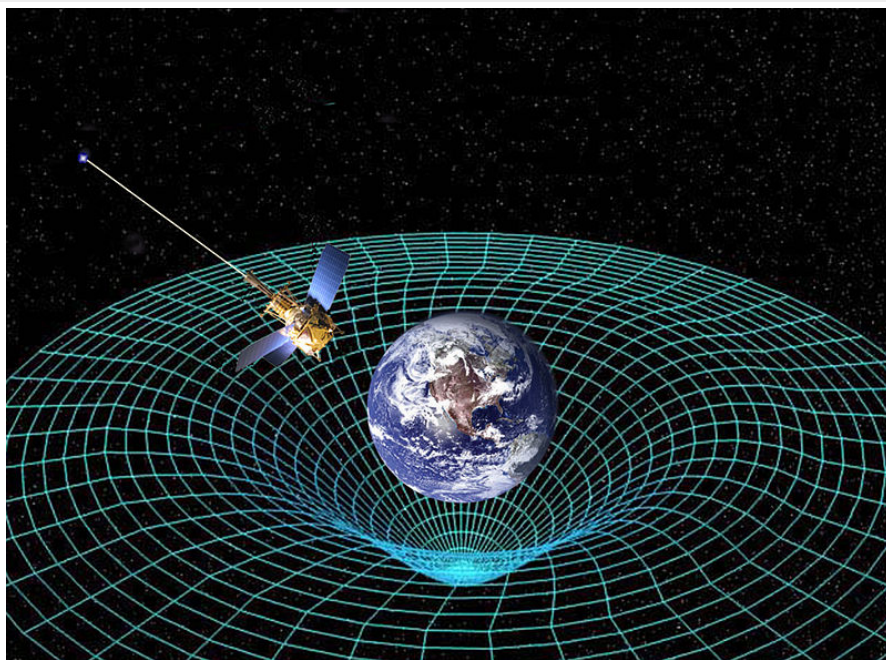
THURSDAY, JULY 19, 2012

## A Wrinkle In Space-Time, How Shockwaves Could Crinkle Space

Math shows how shockwaves could crinkle space

Mathematicians at UC Davis have come up with a new way to crinkle up the fabric of space-time -- at least in theory.

Two-dimensional analogy of spacetime distortion. Matter changes the geometry of spacetime, this (curved) geometry being interpreted as gravity. The grid lines do not represent the curvature of space but instead represent the coordinate system imposed on the curved spacetime, which would be rectilinear in a flat spacetime.



Credit: Wikipedia

"We show that space-time cannot be locally flat at a point where two shock waves collide," said Blake Temple, professor of mathematics at UC Davis. "This is a new kind of singularity in general relativity."

The results are reported in two papers by Temple with graduate students Moritz Reintjes and Zeke Vogler, respectively, both published in the journal Proceedings of the Royal Society A.

Einstein's theory of general relativity explains gravity as a curvature in space-time. But the theory starts from the assumption that any local patch of space-time looks flat, Temple said.

A shock wave (also called shock front or simply "shock") is a type of propagating disturbance.

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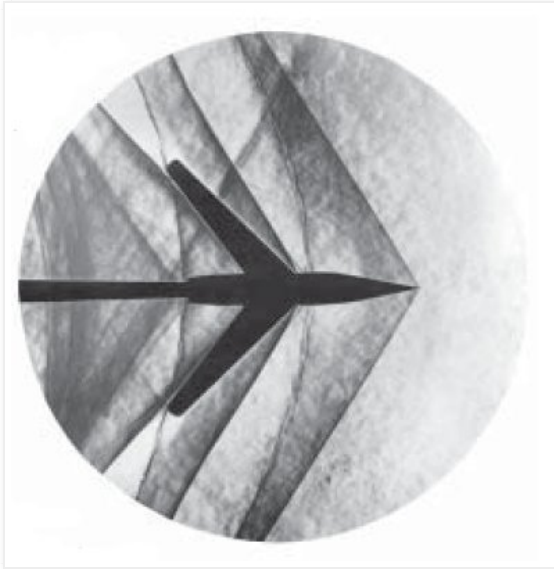
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A singularity is a patch of space-time that cannot be made to look flat in any coordinate system, Temple said. One example of a singularity is inside a black hole, where the curvature of space becomes extreme.

Temple and his collaborators study the mathematics of how shockwaves in a perfect fluid can affect the curvature of space-time in general relativity. In earlier work, Temple and collaborator Joel Smoller, Lamberto Cesari professor of mathematics at the University of Michigan, produced a model for the biggest shockwave of all, created from the Big Bang when the universe burst into existence.

A shockwave creates an abrupt change, or discontinuity, in the pressure and density of a fluid, and this creates a jump in the curvature. But it has been known since the 1960s that the jump in curvature created by a single shock wave is not enough to rule out the locally flat nature of space-time.

Vogler’s doctoral work used mathematics to simulate two shockwaves colliding, while Reintjes followed up with an analysis of the equations that describe what happens when shockwaves cross. He found this created a new type of singularity, which he dubbed a “regularity singularity.”

What is surprising is that something as mild as interacting waves could create something as extreme as a space-time singularity, Temple said.

Temple and his colleagues are investigating whether the steep gradients in the space-time fabric at a regularity singularity could create any effects that are measurable in the real world. For example, they wonder whether they might produce gravity waves, Temple said. General relativity predicts that these are produced, for example, by the collision of massive objects like black holes, but they have not yet been observed in nature. Regularity singularities could also be formed within stars as shockwaves pass within them, the researchers theorize.

Reintjes, now a postdoctoral scholar at the University of Regensburg, Germany presented the work at the International Congress on Hyperbolic Problems in Padua, in June.

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### [Final environmental rules for solar power released](#)

RenewablesBiz

Two federal departments will publish the Final Programmatic Environmental Impact Statement (PEIS) for solar energy development in six southwestern states—Arizona, California, Colorado, Nevada, New Mexico, and Utah. The final Solar PEIS is a milestone ...

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Chicago Daily Herald

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The LRV-17 is built from Arovex, a carbon fibre nano-composite system (carbon fibre reinforced plastic enhanced with carbon nanotubes or CFRP-CNT) that reduces structural weight, allowing for more efficient fuel usage and increased range. Zyvex ...

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Zyvex Marine, the division of Zyvex Technologies that employs molecular nanotechnology to marine design, engineering and manufacturing, has launched the Long Range Vessel, LRV-17. It is the first manned boat to be made of nano-composite materials.

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[The Value of the Global Fuel Cell Stack Supply Chain](#)

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BUSINESS WIRE)--The fuel cell supply chain, made up of companies that provide high-quality, economically competitive critical components for the fuel cell stack, is an area that has been somewhat overlooked. Indeed, the fuel cell industry faces a ...

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Torque News

The U.S. Department of Energy has targeted a \$30/kW goal for automotive fuel cell costs in order to make them market viable. The United Kingdom's Carbon Trust has targeted \$36/kW as the goal. In their analysis of ITM Power's new membrane technology, ...

[Ceramic Fuel Cells Limited Cashflow Report for the](#)

Power Engineering Magazine

RNS Number : 3304I Ceramic Fuel Cells Limited 24 July 2012 Tuesday 24 July 2012 Cashflow Report for the June Quarter Ceramic Fuel Cells Limited (AIM / ASX: CFU) a leading developer of small generators that use fuel cell technology to convert natural ...

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[Mantra Energy Announces New Patent for its Mixed](#)

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Mantra's development of an alternate fuel cell has direct synergies with its carbon capture and recycling (CCR) technology, the Electroreduction of Carbon Dioxide (ERC) process. The ERC process aims to capture CO2 from industrial activities, such as ...

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ABC Online

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The Biological SCENE

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Patent Office Grants NaturalNano Key Patent for Use of Halloysite NanoTubes in Polymeric Nanoparticle Composite as Strengthening and Performance Enhancing Component. ROCHESTER, NY, Jul 24, 2012 (MARKETWIRE via COMTEX) -- NaturalNano, ...

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... announced that the US Patent & Trademark Office has issued to the Company a patent covering the use of NNAN's proprietary Halloysite NanoTubes (HNT) in polymeric composite materials including Nano-particle Fillers as a key strengthening component ...

[New Apple patent integrates dock connector with iPod](#)

Australian Macworld

This patent displays a method of charging an iPod nano via integrating the power socket with the clip on the reverse of the device. The clip is extended and attached to charging points on a dock connector. A new adaptor for the current range of dock ...

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[Apple Patents Explore iPod Charging, Noise](#)

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In a patent application originally filed in 2011, Apple could be investigating new ways to keep your iPod cordless by eliminating the 30-pin dock connector and using instead electrical terminals fixed to the clip on the nano's back. The clip could have ...


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We took that patent to the experts, to the National Measurement Institute, and they looked at this patent and compared it to international definitions and concluded that ZinClear-IM is in fact a nano-material. RACHEL CARBONELL: Antaria then told the ...

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They use inorganic nanocrystals incorporating rare-earth metals, but attach organic "antenna" molecules to the nanocrystals. The antennae capture the IR photons, then the nanocrystal converts two IR captured photons to a single visible photon.

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Chemistry World

US scientists have developed a pH sensor based on nanocrystal quantum dots designed to be used in a biological pH range. pH is an important factor in monitoring tumour health and the efficacy of anticancer treatments, and the sensor could be injected ...

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It recently hired Vice President of Manufacturing and Operations Daniel Russell, who is responsible for managing the manufacturing and engineering team and scaling up nanocrystal production. It also hired Shree Deshpande as vice president of business ...

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Atomic force microscope (AFM) image of ultra-high surface density quantum dots formed by reducing the amount of gallium irradiation to 3 monolayer at a growth temperature of 30°C. An ultra-high surface density of  $7.3 \times 10^{11}/\text{cm}^2$  was achieved.

[Researchers from University of Colorado Describe](#)  
Equities.com

By a News Reporter-Staff News Editor at Physics Week -- Current study results on Quantum Dots have been published. According to news reporting out of Boulder, Colorado, by VerticalNews editors, researchers stated "We have synthesized alkylselenide ...

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ElectroIQ

July 24, 2012 -- Global Semiconductor Alliance (GSA) recently named Jalinous (Jay) Esfandyari, MEMS product marketing manager, STMicroelectronics, as its MEMS Working Group chairman and Ken Potts, group director of marketing, Strategic Planning, ...

[ST expects MEMS growth in Q3, but cuts 2012 capex](#)

ElectroIQ

ST said the "global economic environment has weakened" through the end of Q2, but expects new product momentum, particularly in micro electro mechanical systems (MEMS), microcontrollers, and power MOSFETs & IGBTs, to drive sequential growth, said ...

[Yole updates World MEMS Players database for 2012](#)

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World MEMS Players 2012 database provides an overview of the worldwide MEMS market with an easy access to the MEMS players. World MEMS Players 2012 database gives a complete overview of the worldwide MEMS fabs. It includes contacts, business ...

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AZoNano.com

It is not possible to create these miniaturized components using traditional techniques. These components may promote rapid analysis using small sample volumes at a lower cost. The research group has synthesized materials that facilitate concurrent ...

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Engadget

We accomplished this task using commercially available equipment at the state-of-the-art Nanofabrication Facility at the University of California, Santa Barbara (UCSB)." Jim Nelson, CEO of Solar3D, said, "This is a major accomplishment for Solar3D.

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I am a senior market analyst for Innovative Research and Products Inc. which provides custom market research on cutting edge technology topics

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[Man makes microscopic Olympic Torch](#)

The Press Association

He was trying to make an antenna to help funnel a wave of light into and out of a quantum dot - a portion of matter whose smallest parts are confined in all three spatial dimensions. The 28-year-old PhD student came up with the nano-torch a month ago ...

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Moreover, the self-assembled quantum dot groups emitted powerful photoluminescence, which indicates

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### [Novel Nano Bio-Sensor Able to Detect Lactate](#)

Equities.com

Novel Nano Bio-Sensor Able to Detect Lactate Contents [FARS News Agency]. Al Bawaba Ltd. Their proposed bio-sensor involves a nanocomposite, consisting of functionalized carbon nanotubes and magnetic iron oxide nanoparticles, used in a process ...

### [Bio-Retina to enter clinical trials in 2013](#)

Gizmag

Nano Retina has now developed the Bio-Retina - a tiny (3 x 4 mm) microchip implant that is inserted into the eye and glued to the retina in a minimally invasive procedure. It does not treat AMD, but rather seeks to relieve the blindness resulting from AMD.

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### [UM Regents Vote on Pharma Manufacturing](#)

The Ann Arbor Chronicle

At this point, the conflict-of-interest item is a retroactive disclosure of consulting services with NanoBio Corp. from Feb. 10, 2012, through June 30, 2012, with a value not to exceed \$54000. The firm's owner, James Baker, is a UM medical professor ...

### [Advanced Manufacturing Confab Announces All-Star](#)

EON: Enhanced Online News (press release)

GREENSBORO, N.C.--(BUSINESS WIRE)--North Carolina's Joint School of Nanoscience & Nanoengineering, the Center of Innovation for Nanobiotechnology (COIN), the NanoBusiness Commercialization Association (NanoBCA), and the North Carolina ...

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AZoNano.com

P2i, a developer of liquid repellent nano-coating technology, and Trekmates, an outdoor accessories manufacturer, have won the OutDoor INDUSTRY AWARD 2012 for the DRY Mountain Lite Mitt that the two companies developed in collaboration.

### [P2i to Demonstrate Aridion Nano-Coating at CEA](#)

Azom.com

At CEA LineShows, P2i, a provider of liquid repellent nano-coating technology, will display its Aridion nano-coating that gives superior protection to electronic devices against summer splashes and spills caused by the pool and at the beach. The ...

[100% effective nanocoating](#)

Sustainable Nonwovens

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ThomasNet Industrial News Room

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Microfluidics expert Dolomite has enhanced its world leading Mitos P-Pump range with the introduction of intelligent closed-loop Flow Control which provides unparalleled control of flow rates from 70 nl/min to 5 ml/min. ... Dolomite Introduces Hotplate ...

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[Silver Nanowire Composite Films Used In Transparent](#)

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Product Design &amp; Development

Dr. Yong Zhu, an assistant professor of mechanical

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[Flexible silver nanowire-based transparent conductors](#)  
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Transparent conductors are an important component in many of today's technologies. These conductors are used extensively in LCD TV displays, cell phones, e-readers, touch screens, computer monitors and many other commercial devices. Additionally ...

[Silver nanowire conductors could mean better](#)  
Gizmag

"Ag [silver] nanowires (NWs) have higher conductivity than carbon nanotubes (CNTs) or other metal nanowires," he told us. "As such, the conductivity of AgNW stretchable conductor in our case is higher than other CNT based stretchable conductors." ...

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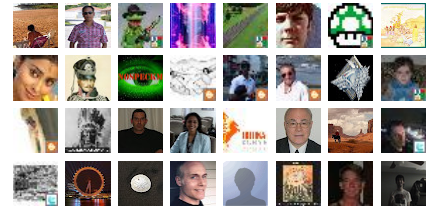
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