



Acuity Newsletter

Department of Basic Sciences & Humanities

Message from Principal's Desk

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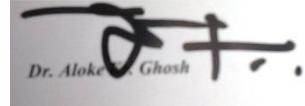
Mr. Sanjiban
Mukhopadhyay



It gives me immense pleasure to pen a few words for our in-house Basic Sciences and Humanities departmental newsletter "ACUITY" exclusively meant for enriching the knowledge of the budding technologists in various fields and I believe such departmental newsletter will be beneficial for all.

I congratulate the efforts of the members of The Editorial Board that they have brought out this issue of the newsletter in such a beautiful form. It is because of their selfless and untiring efforts that we see the newsletter enriched with variety of articles.

Once again, I extend my hearty congratulations to the entire team and wish the newsletter a great success.

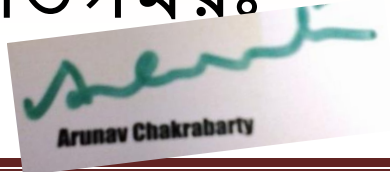

Dr. Alok Ghosh

Message from the Head of the Department

'A journey of thousand miles begins with a single step': With this conviction we decide to initiate this venture to progress in our pursuit of knowledge and excellence in academia. The task, we know, is not simple and requires united endeavour for accomplishment. I hope that your enthusiastic cooperation will lead

us to light. তমসো মা

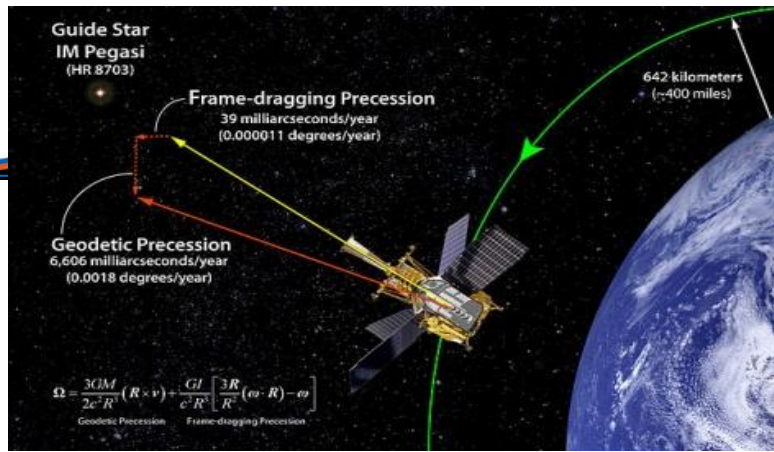
জ্যোতির্গময়ঃ


Arunav Chakrabarty



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BriePhys

❖
Researchers at the Niels Bohr institute made superfast light source from artificial atom

❖
 Thuo, an assistant professor of materials science and engineering of Iowa state university developed micro-sized, liquid-metal particles for heat-free soldering

❖
 A group of scientists from RIKEN Centre for Emergent Matter Science in Japan detect the enigmatic spin momentum of light

Physics

Gravitoelectromagnetism

Gravitoelectromagnetism, abbreviated GEM, refers to a set of formal analogies between the equations for electromagnetism and relativistic gravitation, specifically between Maxwell's field equations and the Einstein field equations for general relativity. Gravitomagnetism is a widely used term referring specifically to the kinetic effects of gravity, in analogy to the magnetic effects of moving electric charge. The most common version of GEM is valid only far from isolated sources, and for slowly moving test particles. The approximate reformulation of gravitation as described by general relativity in the weak field limit makes an apparent field appear in a frame of reference different from that of a freely moving inertial body. This apparent field may be described by two components that act respectively like the electric and magnetic fields of electromagnetism, and by analogy these are called the **gravitoelectric** and **gravitomagnetic** fields, since these arise in the same way around a mass that a moving electric charge is the source of electric and magnetic fields. The main consequence of the gravitomagnetic field, or velocity-dependent acceleration, is that a moving object near a rotating massive object will experience acceleration not predicted by a purely Newtonian (gravitoelectric) gravity field. More subtle predictions, such as induced rotation of a falling object and precession of a spinning object are among the last basic predictions of general relativity to be directly tested.

According to general relativity, the gravitational field produced by a rotating object (or any rotating mass–energy) can, in a particular limiting case, be described by equations that have the same form as in classical electromagnetism. Starting from the basic equation of general relativity, the Einstein field equation, and assuming a weak gravitational field or reasonably flat space-time, the gravitational analogs to Maxwell's equations for electromagnetism, called the "GEM equations", can be derived. GEM equations compared to Maxwell's equations in SI units are:

GEM equations	Maxwell's equations
$\nabla \cdot \mathbf{E}_g = -4\pi G\rho_g$	$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$
$\nabla \cdot \mathbf{B}_g = 0$	$\nabla \cdot \mathbf{B} = 0$
$\nabla \times \mathbf{E}_g = -\frac{\partial \mathbf{B}_g}{\partial t}$	$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$
$\nabla \times \mathbf{B}_g = -\frac{4\pi G}{c^2} \mathbf{J}_g + \frac{1}{c^2} \frac{\partial \mathbf{E}_g}{\partial t}$	$\nabla \times \mathbf{B} = \frac{1}{\epsilon_0 c^2} \mathbf{J} + \frac{1}{c^2} \frac{\partial \mathbf{E}}{\partial t}$

For a test particle whose mass m is "small", in a stationary system, the net (Lorentz) force acting on it due to a GEM field is described by the following GEM analog to the Lorentz force equation:

GEM equation	EM equation
$\mathbf{F}_g = m(\mathbf{E}_g + 4\mathbf{v} \times \mathbf{B}_g)$	$\mathbf{F}_e = q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$

Although GEM may hold approximately in two different reference frames connected by a Lorentz boost, there is no way to calculate the GEM variables of one such frame from the GEM variables of the other, unlike the situation with the variables of electromagnetism. Indeed, their predictions will probably conflict with each other.

-ARNAB BANERJEE



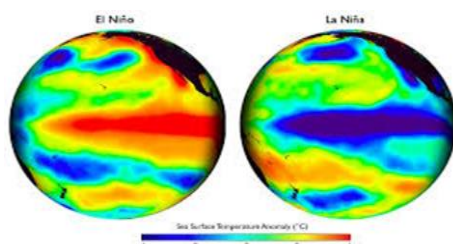
Chemistry & Environment

6σ

Six Sigma is a set of techniques and tools for process improvement. It was introduced by engineer Bill Smith while working at Motorola in 1986. Jack Welch made it central to his business strategy at General Electric in 1995. Today, it is used in many industrial sectors. Six Sigma seeks to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes. It uses a set of quality management methods, mainly empirical, statistical methods, and creates a special infrastructure of people within the organization, who are experts in these methods. Each Six Sigma project carried out within an organization follows a defined sequence of steps and has specific value targets, for example: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, and increase profits. By Chandan Bhukta

Developing processes and products that are "sustainable" and have reduced "carbon footprint" have been important goals. CO₂ is abundant, renewable, and inexpensive. During the last several years, the polymer industry has been exploring renewable feedstock's such as CO₂ for producing polymers. Development in carbon dioxide-based polymers has been in the production of polycarbonates. Aliphatic polycarbonates can be directly produced by reacting epoxides with carbon dioxide. In addition, aromatic polycarbonates based on bisphenol A (BPA) can be produced by reacting an epoxide with carbon dioxide to produce an intermediate. CO₂-based polymers containing up to 50% carbon dioxide are produced. This report examines the production of CO₂-based polymers, specifically poly(propylene carbonate), poly(propylene carbonate) polyol, and BPA polycarbonate. This report will be of value to those companies engaged in the production of CO₂-based polymers and the conventional petroleum-derived feedstock-based polymers by Dr. Srikanta Samanta

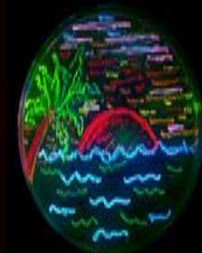
Chem-Call



El Niño?

Near the end of each calendar year, ocean surface temperatures warm along the coasts of Ecuador and northern Peru. In the past, local residents referred to this annual warming as "El Niño," meaning "The Child," due to its appearance around the Christmas season. The appearance of El Niño signified the end of the fishing season and the arrival of the time for Peruvian fishermen to repair their nets and maintain their boats. Every two to seven years a much stronger warming appears along the west coast of South America, which lasts for several months and is often accompanied by heavy rainfall in the arid coastal regions of Ecuador and northern Peru. Over time the term El Niño began to be used in reference to these major warm episodes. **La Niña?** It is characterized by anomalously cool water in the central and east-central equatorial Pacific. Both El Niño and La Niña result in changes in the intensity and distribution of rainfall in the Tropics and in changes in the patterns of sea level pressure and atmospheric circulation that affect many areas worldwide. The El Niño/ La Niña phenomena are the main sources of year-to-year variability in weather and climate for many areas of the world. El Niño and La Niña tend to alternate in an irregular cycle, which is often referred to as the **ENSO cycle**. By Dr. Srikanta Samanta

CO₂ Based Polymer Using CO₂ as a feedstock instead of conventional petroleum-derived raw materials is used to produce polymers.



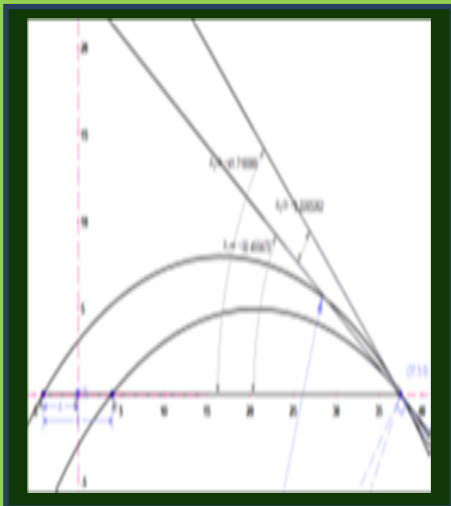
BioArt is an art practice where humans work with live tissues, bacteria, living organisms, and life processes. Using scientific processes such as biotechnology (including technologies such as genetic engineering, tissue culture, and cloning) the artworks are produced in laboratories, galleries, or artists' studios



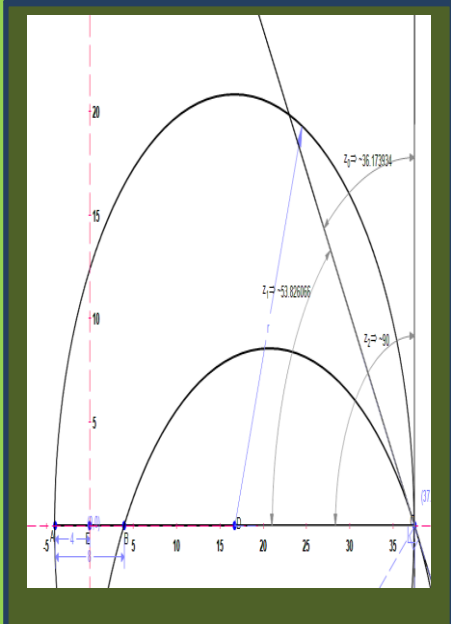
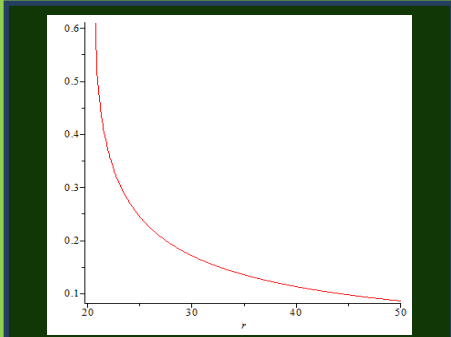
Mathematics On the Soccer Field

Soccer is one of the most popular sports in the world today. There are two teams each consisting of 11 player that aim to score the most goals in 90 minutes while following a certain set of rules. Players can use their entire bodies, except their hands, to move the ball around the playing field. Each team has a goalie who is allowed to use their hands to stop the ball when an opposing team tries to shoot it into the net. Many people go throughout their lives without considering the math behind everyday activities. Millions of people play soccer every day, but how many of them take the time to calculate the precise angle to shoot before heading to the field?

What is the “best” location for a corner kick?



I looked at corner kicks with a curve on the ball that has a radius of r . Since my field has the dimensions of 120 yards x 75 yards, and the middle of the goal lays on the origin, the kick would be taken from the point $(37.5, 0)$. By creating lines tangent to the two circles (the balls maximum and minimum path that will make a radius decreases created more of a curve the angle that the player has increases. goal) I could see the angle that a player would have to kick the ball to make a goal given that the ball follows that path for a certain r value. I was also able see in Geometry Expressions the angle that they would need to kick it from the x axis (the goal line), to make the goal. Figure shows that when putting spin on the ball where r is approximately 31.18 a player would have to shoot in a space of 9.2265262 degrees, between 32.493472 degrees and 41.719998 degrees. Next, I wanted to see what the “best” value for r would be when taking a corner kick. The best value is going to be when the player has the largest angle that they can shoot while still making the goal. I was able to see this when graphing the corner kick angle against r in Maple. The y axis shows the angle in radians and the x axis shows the value of r in the curved kick. By looking at this graph I could tell that the maximum angle a player would have would be slightly over .6 radians (35 degrees) when the radius in the curve was around 20. To look at this closer I went back to my picture in Geometry Expressions. I knew that I needed to change the variable r to be around 20 so that the angle (z_0) would be around .6 radians or 35 degrees. A player cannot kick more than 90 degrees because it would be out of the playing field so I knew that z_2 could not be more than 90 degrees. After moving my picture around a bit I found this point which is shown to the left. The best possible outcome would be if a player always kicks the ball in an arc with a radius of 20.75 between 53.826066 degrees and 90 degrees giving them an area of 36.173934 degrees to shoot. Keep in mind that this is purely mathematical; many players would not be able to continuously put this amount of curvature on the ball.



When doing real life testing I got a curve with a radius of roughly 35 to 40 yards for a corner kick. If 35 was put in for the value of r on the diagram the angle that a player would have to shoot would be significantly reduced to 7.7678817 degrees. Just by looking at this picture, and from my testing of curvature, one could tell that the amount of curve on this ball was unrealistic although a 20.75 yard radius isn't far off the realistic values for curves I got. Although the values of the radius were not realistic, it made it clear that the more curvature a player can put on a ball then the bigger the angle they have to shoot from the corner (see figure).

By: Arghadip Roy

FOR YOU !!What will be the width of a wall to block the entire goal in a straight free kick?





English & Communication

Communiqué



Participation!
It's what all my work has been about." – Pete Seeger

Pete Seeger has embodied the ideals of folk music—communication, entertainment, social comment, historical continuity, inclusiveness.

Not a city of romance, but a city of chaos

2015 is almost a wrap for the world, but the year has a terrible meaning to France. This year started with an outbreak of rage regarding the Charlie Hebdo case in Paris, and ended with a terrorist attack in Paris. These two incidents, both taking place in the heart of Paris, have made the city a place of hatred and chaos. Paris is no more a safe place for honeymooners, it is not a place to enjoy the majestic beauty of the Eiffel Tower as well. The very word 'Paris' is now synonymous to massive destruction. On 7 January 2015 at about 11:30 local time, two brothers, Saïd and Chérif Kouachi, forced their way into the offices of the French satirical weekly newspaper *Charlie Hebdo* in Paris. Armed with assault rifles and other weapons, they killed 11 people and injured 11 others in the building. After leaving, they killed a French National Police officer outside the building. The gunmen identified themselves as belonging to the Islamist terrorist group Al-Qaeda's branch in Yemen, who took responsibility for the attack. Several related attacks followed in the Île-de-France region, where a further five were killed and 11 wounded. France raised its Vigipirate terror alert and deployed soldiers in Île-de-France and Picardy. A massive manhunt led to the discovery of the suspects, who exchanged fire with police. The brothers took hostages at a signage company in Dammartin-en-Goële on 9 January and were shot dead when they emerged from the building firing. On 11 January, about two million people, including more than 40 world leaders, met in Paris for a rally of national unity, and 3.7 million people joined demonstrations across France. The phrase *Je suis Charlie* has become a common slogan of support at the rallies and in social media. The staff of *Charlie Hebdo* continued with the publication, and the following issue print ran 7.95 million copies in six languages, in contrast to its typical print run of 60,000 in only French. The attacks in Paris on the night of Friday 13 November by gunmen and suicide bombers hit a concert hall, a major stadium, restaurants and bars, almost simultaneously - and left 130 people dead and hundreds wounded. The attacks were described by President Francois Hollande as an "act of war" organised by the Islamic State (IS) militant group. Shootings and bomb blasts left 130 people dead and hundreds wounded, with more than 100 in a critical condition. "Three co-ordinated teams" were believed to have been behind the attacks, according to Paris chief prosecutor Francois Molins. In the days immediately after the attacks, French police carried out hundreds of raids across the country, as the search for suspects continued. Raids also took place in the Belgian city of Brussel. Investigators of the Paris attacks have found evidence they believe shows some of the terrorists used encrypted apps to hide plotting for the attacks, officials briefed on the investigation tell CNN. This is the first time investigators have made that assertion. Among the apps officials found used by the terrorists were WhatsApp and Telegram, both of which boast of end-to-end encryption that protects the privacy of their users and are difficult to decrypt. Previously officials have said they found encrypted apps on cell phones recovered from the crime scenes. But they stopped short of saying they believed the apps were used in plotting the attacks. ~By Debarati Biswas

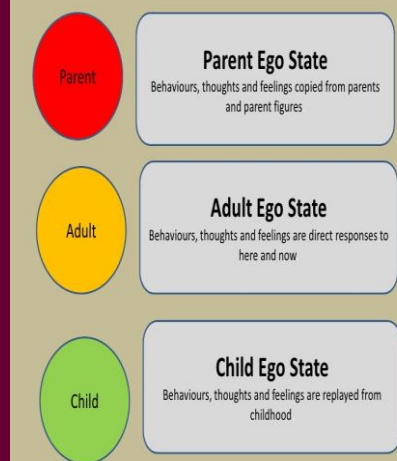
Transactional Analysis and Communication

Transactional analysis or TA is a branch of psychotherapy developed by Eric Berne. His definition of it is "a theory of personality and a systematic psychotherapy for personal growth and change". Knowing about TA can be very useful for improving our communication skills. TA is about how people are structured psychologically and is both a theory of communication and a theory of child development. Berne's model is a three part ego-state model. An ego state is "A consistent pattern of feeling and experience directly related to a corresponding consistent pattern of behaviour".

There are three ego states in Berne's model:

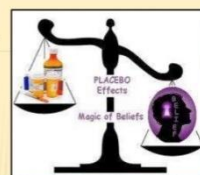
- Parent,
- Adult,
- Child.

Ego states are irrespective of age and are capitalised to differentiate from the normal use of the words parent, adult and child.





THE PLACEBO EFFECT



pla-ce-bo ef-fect

1. A positive effect or cure, produced by a placebo "drug" or treatment. The effect is not caused by the placebo. The effect is solely due to the patient's belief in the treatment.

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Magic, Mantra, Miracle & Science: by

Arunav Chakrabarty

❖ **Eating Fire:**

Camphor burns at 300°C and its flame always grows upward whereas the human skin up to 1200°C for three seconds. Eating burning camphor is very simple. Put the burning camphor in extended tongue. Let it burn for a few seconds and close the mouth.



❖ **Making an amulet shed holy ash or bhabhuti :**

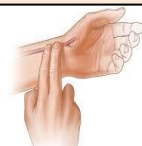
Take a sealed aluminium amulet and tie a thread on it. Mix some crystals of Mercuric Chloride with some amount of alum and apply it on one side of the amulet secretly. Tie the amulet on the arm of a volunteer such that the side, which had been rubbed with chemicals, touches the body. The volunteer feels the amulet growing hot and bhabhuti marks appear on the arm. The reaction of mercuric chloride with alum generates heat and the reaction of mercuric chloride with aluminium amulet forms aluminium oxide that looks like bhabhuti.



Putting Hand into boiling Oil: Squeeze a few drops of lemon into a pot, carefully remove the seeds, and then fill it with sufficient ground nut oil. Keep the pot on a stove and light it. Bubbles start coming to the surface and the oil seems to be boiling. But it is actually the lime juice, which has settled at the bottom due to its higher density that starts boiling first. And bubbles rise up to the surface giving the impression that the oil is boiling.

Fire by Spitting: Metallic sodium starts an exothermic reaction if it comes in contact with water, and the effect is so intense that things caught fire. People keep metallic sodium hidden under papers or twigs and spit. Glycerin and Potassium Permanganate also create the same effect.

Stopping the PULSE : For stopping pulse you need two lemons that you hold in the right armpit. Get your pulse rate by any competent person and then slightly press the armpit, the blood flow through the arm becomes slow and reduction of pulse rate can be observed.



Lighting Candles without matchstick: Take two candles. Spread chromic acid powder in one candle and the other one is dipped in ethyl/methyl alcohol. Chant a mantra and touch the second candle with the first one. You will get the light.



Reading a letter in a sealed envelop: Tell any one to write a sentence in a paper. Keep the paper in an envelop. Utter some mantras. Then rub a cotton or flower dipped in ether on the envelop. The matter which is written in the paper will be visible. As ether is volatile after a few seconds it will disappear.

A new
Magic, mantra, Miracle !!
We three are there. YOU
, Science and Acuity!

Cutting banana by mantra: All you need is a long needle, a banana, and water. Insert the needle through a ridge of the banana up to the inner layer of the opposite side. Move the needle in such a way that it dissects the banana into two pieces. Chant a mantra and throw water in the banana. The magic will happen.



Turning turmeric powder into sindoor: Apply slaked lime on your index finger secretly. Put turmeric powder in the other palm and show it to the audience. Chant mantras and put your index finger and mix it. Turmeric will transfer to sindoor red.