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Vigyan Prasar

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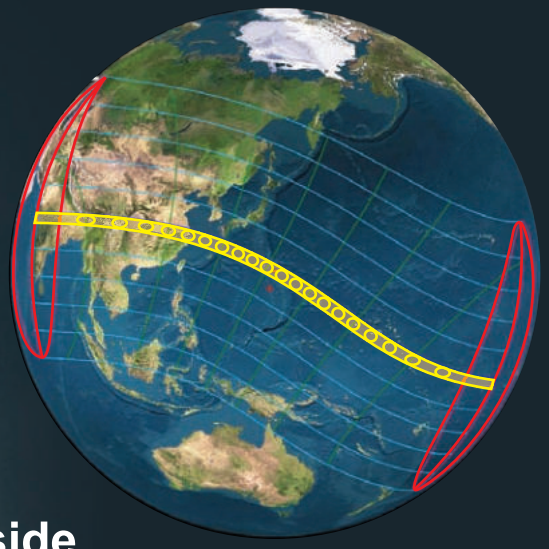
# Total Solar Eclipse of 22 July 2009



## Inside



... think scientifically, act scientifically... think scientifically, act scientifically... think scientifically, act...

# Angels, Demons and Science Communicators

Just before the Large Hadron Collider (LHC) at European Organisation for Nuclear Research (CERN) was switched on, television channels were abuzz with reports that it would produce black holes that would destroy the Earth. During popular science talks, often there were questions with serious concerns over the possible fate of our planet as a result. LHC was switched on 10 September 2008 for the first time - and of course, nothing happened! Many heaved a sigh of relief! Incidentally, LHC would be the largest and the most complex particle accelerator in the world. On 19 September 2008, the operations were halted due to a serious fault. Due to the time required to repair the resulting damage and to add additional safety features, the LHC is now scheduled to be operational again in September 2009. But, now there is yet another perceived danger from LHC, the seed of which can be found in a recently released blockbuster *Angels and Demons*. And the danger? Antimatter - the supposedly deadly ingredient of a weapon of unsurpassed destructive power that LHC may produce!

*Angels and Demons* is a bestselling mystery-thriller novel written by American author Dan Brown. It revolves around the quest of a fictional Harvard University symbologist to uncover the mysteries of a secret society and to unravel a plot to annihilate Vatican City using antimatter stolen from LHC. I recently saw the brilliant film adaptation of the novel, released with the same title in May 2009. Though the novel is a work of fiction, and the way antimatter is put to use in the novel is also fiction, antimatter itself certainly is not. *Angels and Demons* does provide ample thrill, but it also spreads unscientific notions.

We see signature of antimatter in cosmic rays which are high-energy charged particles that strike the Earth from outer space and produce cascades of showers of secondary rays and particles when they collide with the atmospheric particles. Antimatter is routinely made in high-energy collisions inside particle smashers the world over. In hospitals, radioactive molecules that emit antimatter particles are used for imaging in the technique known as positron emission tomography. What is antimatter anyway? And how to reduce the impact of unscientific notions such works of fiction spread?

It turns out that every particle has an antiparticle with the same mass but the opposite electric charge. Thus, the proton has the negatively charged antiproton, and the electron has the positively charged anti-electron, also called positron. Even neutral particles can have antiparticles. The neutron has no charge. How can it have an antiparticle, then? Quarks - the smaller particles that it is made of - have charge. Turn these quarks into 'antiquarks' by flipping their charges, and you have an antineutron! It is these antiparticles that make up the antimatter.

The first hint of the existence of antimatter came in 1928 as a consequence of the work of the British theoretical physicist P. A. M. Dirac. He had been doing research into the equations that govern the motion of elecrons in electric and magnetic fields. At slow speeds the physics was well understood, but the development of theory of relativity in 1905 suggested that the description was bound to go wrong if the electrons were moving at speeds close to the speed of light. When Dirac came to solve his equation, he discovered that it produced two solutions. One solution described the electron perfectly, the other a particle with the same mass but opposite electric charge. However, no such particle was known at that time. The problem was resolved when Carl David Anderson discovered the positron in 1933 in cosmic rays. This particle was the second solution to Dirac's equation.

Notoriously, matter and antimatter destroy each other, or annihilate, whenever they come into contact. No doubt, Dan Brown is correct here! An electron and a positron mutually destruct in a puff of light consisting of two photons sent out in precisely opposite directions, each with an energy corresponding exactly to the mass of the electron (and positron). According to the theory, matter and antimatter were created in equal amounts at the big bang, the moment the universe came into being. If so, both should have annihilated each other totally in the first

*Contd. on page...24*

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# Swine Flu (H1N1 Influenza)

## The latest outbreak

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### The 2009 Swine flu outbreak

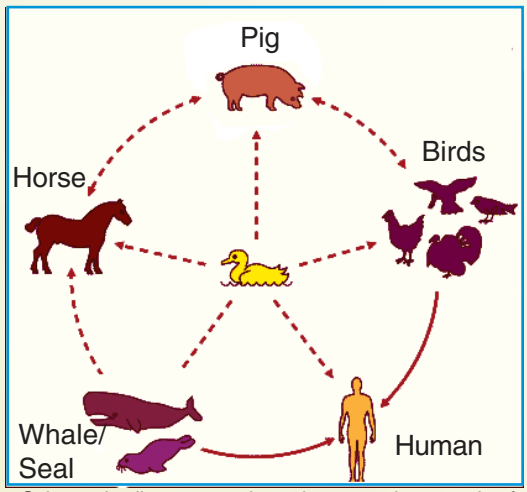
An outbreak of swine flu or influenza A virus subtype H1N1 began in Mexico in April 2009 and then it was reported in other parts of the world. Soon it became apparent that a pandemic was "imminent". For describing the spread of a disease two words namely, "pandemic" and "epidemic" are used. Pandemic means the prevalence of an infectious disease over a much larger region than in case of an epidemic. Further, compared to an epidemic, a pandemic affects a far higher number of people. A pandemic may even affect the global population. We usually call it an epidemic when an illness or health-related issue shows more cases than it is normally expected.

Typical influenza is an acute viral infection characterised by chills, fever, headache and cough. Muscle weakness, aching joints, and loss of appetite may follow. Cases vary from mild to very severe. It may also be fatal. Usually small outbursts of influenza occur regularly in winter, but occasionally pandemics sweep across the world. Influenza still remains a disease to reckon with. Seasonal epidemics around the world kill thousands of people annually.

The 2009 outbreak was first detected in Mexico City on 18 March where there was a sudden increase in cases of influenza-like illness. Initially the Mexican authorities thought it to be "late-season flu" outbreak and not a new virus strain. It was only when U.S. labs confirmed a swine flu outbreak that Mexican officials sent respiratory specimen of a 4-year old boy afflicted with flu for testing. It tested positive for swine flu.

The Mexican authorities announced the epidemic on 23 April 2009. On 29 April 2009 the World Health Organisation (WHO) raised its alert level to Phase 5 out of the 6 maximum. Phase 5 alert level means occurrence of human-to-human spread of the virus to at least two countries in one WHO region. The declaration of Phase 5 is a strong signal that a pandemic is imminent and there is not much time left for the planning and implementing mitigation measures. The US Centers for Disease Control and Prevention (CDC) also expressed concerns that the outbreak could become a worldwide flu pandemic.

By 3 June 2009, sixty-six countries officially reported 19,273 cases of influenza A (H1N1) infection including 117 deaths. So far India has reported 15 confirmed cases of infection. Over 80% of reported deaths have taken place in Mexico, which has led to speculation that Mexico may have been in the midst of an unrecognised epidemic for many months prior to the current outbreak. A study published in the May 11 issue of the journal *Science* estimated Mexico alone might have had 23,000 cases of swine flu by 23 April, the day it announced the epidemic.




*Schematic diagram to show the natural reservoir of influenza A viruses and the interspecies transfer of the virus.*

### What causes a pandemic?

To cause an influenza pandemic the virus must be entirely new or one which has not circulated widely in the human population and for which there is no vaccine. In a pandemic not all people become infected, but nearly all become susceptible to infection. The severity of an influenza pandemic is measured by the number of cases of severe illness and deaths it causes. The speed of spread of the disease depends on the contagiousness of the virus.

A pandemic may be a global disease outbreak. The disease spreads easily person-to-person, causes serious illness, and can sweep across the country and around the world in a very short time. An influenza pandemic may be caused by either swine (pig) or avian (bird) flu viruses.

### Containment is not the answer

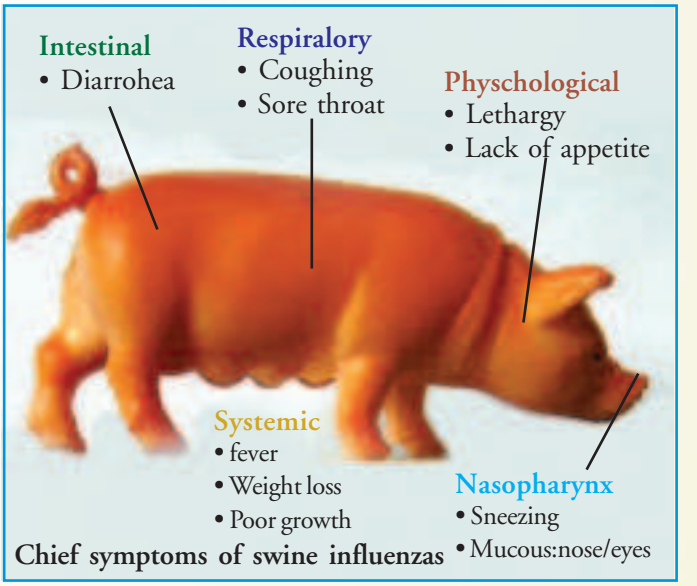
After the few days of the outbreak it became obvious that containment is no longer a feasible option. So it was pointed out that countries should concentrate on mitigating the effect of the virus. After the outbreak many countries advised their citizens to avoid non-essential travel to affected regions. Countries started screening international passengers at airports and seaports and if necessary quarantined foreign visitors. In Hong Kong an entire hotel was quarantined with 240 guests because one guest was found to have swine flu. On 28 May 2009 the Chinese government confined 21 US students and three teachers to their hotel rooms after it was found one passenger on their plane to China showed symptoms of swine flu. There are many such examples. Although the FAO and the WHO have stated that so far there is no proof to indicate that the H1N1 virus is transmitted through eating cooked pork or pork products, some countries including Serbia, China, and Russia, have banned the import and sale of pork products as a precautionary measure.

### Debates over name

There is lot of debate over the name of the 2009 flu outbreak. In the first days

of the outbreak the mass media called it "swine flu". There was reason for it. Based on its genetic structure, scientists identified the virus as a type of swine influenza virus that originally came from a strain that live in pigs. The name "swine flu" was opposed by some authorities. Tom Vilsack, the US Agriculture Secretary opposed it on the ground that it may lead to the misconception that consumption of pork is unsafe. The US Centres for Disease Control and Prevention (CDC) calls it "Novel influenza A (H1N1)". The European Commission adopted the term "novel flu virus". The National Institute of Health of the Netherlands now calls it "Mexican flu", though in that country it was originally called "pig flu". The authorities in Taiwan call it "H1N1 flu" or "new flu". The World Organisation for Animal Health terms it "North American influenza". The World Health Organisation (WHO) has decided to term the new influenza virus as "Influenza A (H1N1)" or "Influenza A (H1N1) virus, human" so that it does not give rise to the misconception of eating pork being unsafe. Some other names like "H1N1 influenza", "2009 H1N1 flu" and "swine-origin influenza" have also been proposed. We use the term "swine flu" in the title of the article, as this term has been widely used in the mass media.

Though, it originated in pigs, the current strain is now a human-to-human transmitted virus. It no longer requires contact with swine



**Chief symptoms of swine influenzas**

## Influenza A viruses

Viruses are a large group of infectious agents ranging from 10 to 250 nanometres in diameter and composed of a protein sheath surrounding a nucleic acid core. Viruses are capable of infecting all animals, plants and bacteria. They are totally dependent on living cells for reproduction and they do not have independent metabolism of their own.

It is interesting to note that though influenza is an important disease of humans, the disease-causing virus was first isolated from poultry. In 1878, there was a disease causing high mortality in domestic fowl. The disease was named "fowl plague". The causative agent was shown to be a virus in 1901. But it took more than 50 years to find out the close relationship between this agent and mammalian influenza viruses. Actually it was demonstrated in 1955 that the causative agent (the virus) was responsible for a new disease of pigs, which was called "swine influenza". It was first described during the 1918 human pandemic.

Influenza viruses cause outbreaks of acute respiratory disease known as "influenza" or "flu". The word "influenza" has its origin in 15th century Italy. The influenza viruses are classified as members of the family *Orthomyxoviridae*. The name of the family "Orthomyxoviridae" is derived from two Greek words—"*orthos*" meaning "straight" and "*myxa*" meaning "mucus". The influenza viruses have the ability to bind to mucus. The family *Orthomyxoviridae*, which is a family of RNA viruses, has five genera—influenzavirus A, influenzavirus B, influenzavirus C, Isavirus and Thogtovirus. The first three genera (influenzavirus A, B, and C) contain viruses that cause influenza. Each genus includes one species or type—Influenza A virus, Influenza B virus and Influenza C virus. While influenza A and C viruses infect multiple species, influenza B virus almost exclusively infect humans.

Influenza viruses are further classified based on the viral surface proteins hemagglutinin (HA or H) and neuraminidase (NA or N). So far 15 H subtypes or stereotypes (H1 to 15) and 9 N subtypes (N1 to 9) of influenza A virus have been identified.

A lot of information is available on the antigenic, structural and biological characteristics of influenza viruses. They are medium-sized viruses with a diameter of 80 to 120 nm. They have a spherical or filamentous morphology. Once the influenza virus infects a host cell, its primary objective is to produce multiple copies of itself so that it can attack more cells. Multiplication is achieved by a viral enzyme called polymerase. It not only makes copies of the genetic material of the virus but also makes the host cell machinery work for synthesising viral proteins.

## Natural hosts of influenza A viruses

The principal natural hosts of influenza A viruses are ducks and other waterfowls. All the 15 HA and 9 NA virus subtypes are found in them. What is interesting to note is that unlike in other species, influenza viruses target the gastrointestinal tract of waterfowl rather than the respiratory tract. In waterfowls infections are completely sub-clinical without exception. The migratory behaviour of waterfowl combined with the ability of the virus to thrive in cold lake water make waterfowls an immense natural reservoir of influenza viruses. Sometimes the viruses present in waterfowls get transmitted to other host species. Direct virus transmission from waterfowls to pigs, horses, mink, domestic poultry and aquatic mammals has been reported. There are also cases where influenza viruses from birds are directly transmitted to humans, H5N1 and H9N2, viruses of avian origin, were found in humans in Hong Kong.

## How an influenza virus is scientifically named

Following the recommendation of the WHO Expert Committee in 1953, the influenza viruses are classified into types A, B, and C based on their

ribonucleoprotein antigens. Further it was recommended that influenza viruses be designated by a uniform code indicating the type of the virus, place of origin, strain serial number and year of isolation. For example if a virus is named A/India/2/70 it would mean the virus is of A type, its strain serial number is 2, it originated in India in the year 1970. The present system of nomenclature followed was introduced in 1980. It designates the type, host, place, strain number (if any), the year of isolation and antigenic subtype of a virus.

## Symptoms

Symptoms in humans infected with swine influenza A virus include fever, cough, sore throat, body aches, headache, chills, and fatigue. In some cases dyspnea, vomiting, diarrhoea, and myalgia (pain in the muscle) are also observed. Though rare, conjunctivitis has also been reported.

Certain symptoms may require emergency medical attention. In children, for instance, those might include blue lips and skin, dehydration, rapid breathing, excessive sleeping and significant irritability including a lack of desire to be held. In adults, shortness of breath, pain in the chest or abdomen, sudden dizziness or confusion may indicate the need for emergency care. In both children and adults, persistent vomiting or the return of flu-like symptoms that include a fever and cough may require medical attention.

## How can it be diagnosed?

Influenza is diagnosed by virus isolation or by detection of viral antigen, viral RNA or specific antibody. To diagnose H1N1 influenza infection, a respiratory specimen would generally need to be collected within the first 4 to 5 days of illness (when an infected person is most likely to be contagious). However, some persons, especially children, may be infectious for 10 days or longer.

## History of influenza A virus pandemics

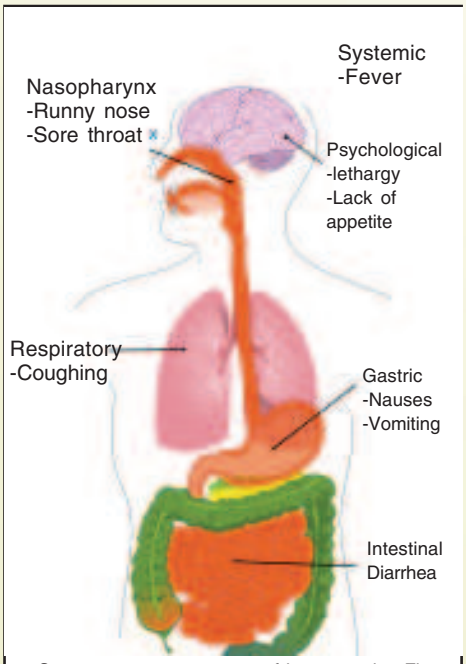
The influenza A virus caused the following three major global pandemics:

| Pandemic | Year | Influenza A virus subtype | Estimated deaths (in millions) |
|---|---|---|---|
| Spanish flu | 1918-19 | H1N1 | 50 |
| Asian flu | 1957 | H2N2 | 2 |
| Hong Kong flu | 1968-69 | H3N2 | 1 |

In addition to the above major global pandemics, the virus also caused several pandemic threats in the 20th century, which included the pseudo-pandemic of 1947, the 1976 swine flu outbreak, and the 1977 Russian flu.

## H1N1—a new strain of influenza virus

The influenza A virus subtype H1N1 is a new strain of influenza virus. We do not know where and in which species the virus originated. It has been speculated that the virus first evolved around September 2008. It then circulated in the human population for several months before it started infecting in April 2009. The virus has not been seen previously in either humans or animals.



Some common symptoms of human swine Flu

A new influenza virus (an antigenically different strain) may appear by one of the following three mechanisms:

1. Direct transfer
2. Genetic re-assortment
3. Re-emergence

In direct transfer an entire virus comes from another species. This is perhaps what happened in 1918, when the H1N1 "Spanish flu" virus entered the human population.

When two different strains of influenza virus infect the same host, it leads to genetic re-assortment because gene segments can be exchanged in mixed infections.

Sometimes a virus, which had caused an epidemic in the past, might re-emerge. For example, the H1N1 "Russian flu" virus, which was in circulation in humans prior to 1950, re-emerged in 1977.

It is believed that the present H1N1 virus is the result of genetic re-assortment of four known strains of influenza A virus subtype H1N1: North American swine influenza; North American avian influenza; human influenza; and two swine influenza viruses typically found in Asia and Europe. It has been demonstrated that several of the proteins of the virus are most similar to strains that cause mild symptoms in humans. This has led to the thinking that the virus is unlikely to cause severe symptoms for most people. At present it is not known how serious this new virus is compared with other influenza viruses. How the disease came to humans is not yet known. H1N1 appears to be more contagious than seasonal influenza.

At this stage there no vaccine available to prevent infection by the H1N1 virus. The H1N1 flu virus strains causing the current outbreak are very different from human H1N1 viruses and, therefore, vaccines for this past human seasonal flu would not provide protection from these H1N1 flu viruses.

## How does it spread?

The swine flu virus is spread in exactly the same way as ordinary colds and flu. Like regular "seasonal influenza", the H1N1 flu spreads through the air from coughs and sneezes or touching those infected. It should be emphasised that the disease is not transmitted by eating cooked pork or by being in close proximity to pigs. One may be infected if one touches something with flu viruses on it and then touches one's mouth or nose.

A flu virus can spread through the droplets that come out of the nose and

mouth when someone coughs or sneezes. If someone coughs or sneezes without covering the face, the droplets can spread about one metre. If you are very close to the person you might breathe them in. Or, if someone coughs or sneezes into their hand, the droplets containing the virus are easily transferred to surfaces that the person touches.

Everyday items at home and in public places, such as door handles, the TV remote control, hand rails and computer keyboards may have traces of the virus. The virus can survive for several hours on these surfaces. If you touch these surfaces and touch your face, the virus can enter your system and you can become infected.

Evidence from previous pandemics suggests that one person will infect two others, and that influenza spreads particularly rapidly in closed communities such as schools or residential homes.

People are most infectious soon after they develop symptoms, although they can spread the virus for up to five days after the start of symptoms (for children this is seven days).

## The virus can mutate

Till date the disease has been milder outside Mexico. However, it may not remain so in the coming months. It is a matter of concern that the virus could mutate again in the coming months and the new form could be responsible for a new and potentially more dangerous flu outbreak. On 22 May WHO chief Dr. Margaret Chan advised that the virus must be closely monitored in the southern hemisphere where it could mix with ordinary seasonal influenza and change in unpredictable ways. She pointed out that "In cases where the H1N1 virus is widespread and circulating within the general community, countries must expect to see more cases of severe and fatal infections". According to her "This is a subtle, sneaky virus." Influenza viruses are known for mutation and unpredictable behaviour.

## Dos and Don'ts

Standard personal precautions against influenza are recommended for preventing infection by the virus.

- One should wash hands with soap and water or with alcohol-based hand sanitizers, particularly after coming from public places
- One should not touch the mouth, nose or eyes, as these are primary modes of transmission.
- If coughing, one should cough into a tissue and dispose of the tissue. One should immediately wash one's hands after coughing.
- One should disinfect household surfaces with a disinfectant or a diluted bleach solution.
- If one gets sick one should stay home from work, school, or social gatherings generally to avoid infecting others.
- One should avoid close contact with sick people.
- Cover your nose and mouth when you cough or sneeze.

### Latest update

On June 11, 2009, the Director General of WHO decided to raise the level of Influenza pandemic alert from phase 5 to phase 6. On June 15, 2009, 76 countries officially reported 35,928 cases of influenza-A (H1N1) infection, including 163 deaths. According to the WHO update on June 15, 2009 India had 16 confirmed laboratory-cases.

People use surgical masks, but there is no definite knowledge about how far it is fool-proof. There are no established exposure limits for biological agents such as swine flu virus. While it is advisable to use surgical masks, it is not known with certainty that they will prevent swine flu infection. One should remember that facial masks are not foolproof. They may be beneficial in crowded places or for people who are in close contact with infected persons. It is important to note that "close contact" is defined as 3 feet (91 cm) or less by the World Health Organization and 6 feet (1.8 m)or less by the U.S. Occupational Safety and Health Administration.

## Influenza antiviral drugs

There are two influenza antiviral medications that are recommended for use against H1N1 flu. The drugs that are used for treating H1N1 flu are called oseltamivir (Tamiflu) and zanamivir (Relenza). These two neuraminidase inhibitors are found to be effective against all influenza A virus subtypes. Amantadine and rimantadine, which inhibit viral replication by blocking the M2 ion channel, are also used.

Influenza antiviral drugs also can be used to prevent influenza when they are given to a person who is not ill but who has been or may be near a person with H1N1 influenza.

## Vaccines

A vaccine is a suspension of attenuated bacteria or virus or fraction thereof that is injected to produce immunity. Though antiviral drugs can be used for controlling influenza in humans, vaccination is the major means to control influenza in humans and it is the only means in pigs. Influenza vaccines are typically developed to cope with seasonal flu to minimise infection rates, but it has not stopped killing of people by the virus. Following the method of Jonas Salk, who developed the first vaccine against the poliovirus in 1955, most of the world's flu vaccines use an injection of "killed virus".

In case of a more severe outbreak a vaccine will be less effective in preventing its spread. The quality of the existing health services in a country influences the impact of any pandemic. The same virus that causes mild symptoms in countries with strong system of health services can be devastating in countries where health service systems are weak.

At present there is no vaccine for the H1N1 virus because it is a new strain. However, efforts are on to make available a suitable vaccine soon.

## Let's remain prepared for any eventuality

The chance of a pandemic or an epidemic cannot be eliminated. But we can build up preparedness for minimizing its effect. The presence of a strong health-care system in a country is essential to start mitigating effort immediately. Creating a scientific awareness in the society is also essential. In the absence of proper information people become unnecessarily panicky and fail to take proper precautionary measures. So far most of the recent swine flu cases have been milder, but there is a possibility that it may become more severe. Let us be prepared to deal with any eventuality.

# Total Solar Eclipse of 22 July 2009

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## Longest total solar eclipse of the century

Nearly ten years ago on 11 August 1999, we had an opportunity of witnessing a total solar eclipse from India. After such a long wait we are again having an opportunity to witness a total solar eclipse on 22 July 2009. The upcoming eclipse will be longest total solar eclipse till 2114. The eclipse will start from western coast of India and cross through Nepal, Bangladesh, Bhutan, Burma, China, Japan's Ryukyu Islands and finally end in Pacific Ocean. The maximum total eclipse lasting 6 min 39 sec will be seen in the North Pacific Ocean at 24° 13' N and 144° 07' E. However, a partial eclipse will be visible within the much broader path of the Moon's penumbral shadow, which includes India, most of eastern Asia, Indonesia and the Pacific Ocean (Figure 1). In this article, we describe the salient features of this great event with emphasis on the Indian circumstances. The local circumstances tables for the partial and total phases have been reproduced from the India Meteorological Department's Positional Astronomy Centre, Kolkata. The figures have been reproduced from the NASA Bulletin on Total Solar Eclipse of 22 July 2009.

## TSE 2009

Total solar eclipse will be visible from many cities of India including Surat, Vadodara, Indore, Bhopal, Jabalpur, Allahabad, Varanasi, Patna, and Siliguri (Figure 2). The central line of the Moon's shadow will start at 06:21 IST from India's western coast. At the start of eclipse, the track of totality will be 205 km wide. At Surat, people will experience the totality for 3 min 14 sec and Sun will be only 3° above the northeastern horizon (Figure 3). Almost at the same time, lakhs of people at Indore will witness the totality for 3 min 5 sec (Figure 3). At Indore, the Sun will be around 6° above the horizon. The city of Bhopal, another city falling in the path of totality, lies 40 km north of the central line (Figure 4). At this distance, the duration of totality will be 3 min 9 sec starting at 06:22 IST. The path of totality stretches diagonally from the western coast to northeastern part of India, which covers nearly 2/3 of the country. Other larger cities falling in the belt of totality are Varanasi and Patna from where the eclipse will be visible for about 3 min 07 sec and 3 min 47 sec, respectively (Figure 5). Places near Patna could be the best choice to observe the eclipse because from these places the Sun will be around 13° and 14° above the horizon respectively. The city of Kolkata is located about 500 km away from the central line of totality in the southeast. The people of Kolkata will view a partial eclipse of magnitude 0.911, that is, 91.1 per cent of the Sun's disc would be covered by the Moon. The path of totality will cross eastern Nepal and northern Bangladesh and reach the India-China border at 06:35 IST. The longest totality visible from land area in ocean would be 6 min 39 sec in the Ryuku Islands of Japan almost at local noon. The path of totality will then move towards southeast in the Pacific Ocean and the Moon's shadow will lift off the Earth at around 09:48 IST. The totality will be visible on Earth for about 3 h 25 min and the path of totality will travel about approximately 15,150 km on the Earth's surface.

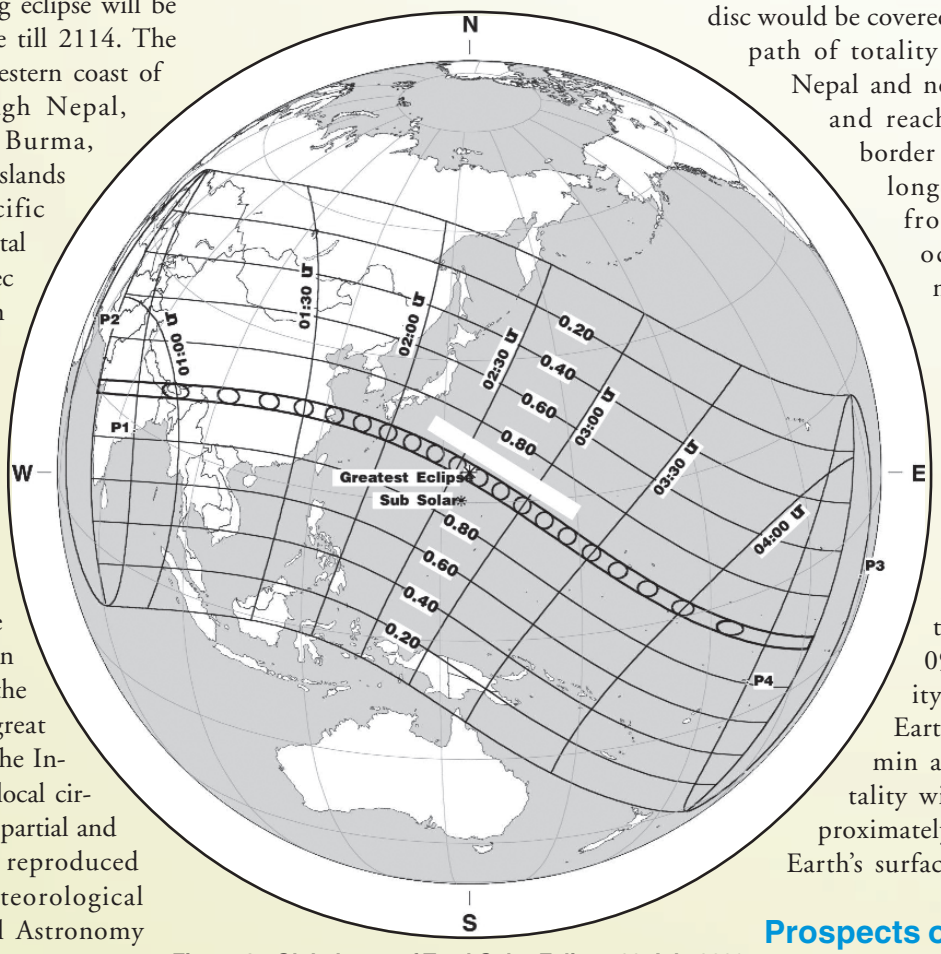


*Figure 1 : Global map of Total Solar Eclipse 22 July 2009*

## Prospects of watching the eclipse

The total solar eclipse begins at early morning; in fact, most of the cities in India will see the Sun rising partially eclipsed. Eclipse lovers will have to wake-up early in the morning to see the totality. But even if one manages to wake-up early in the morning it is difficult to say whether he or she will be able

Astronomy

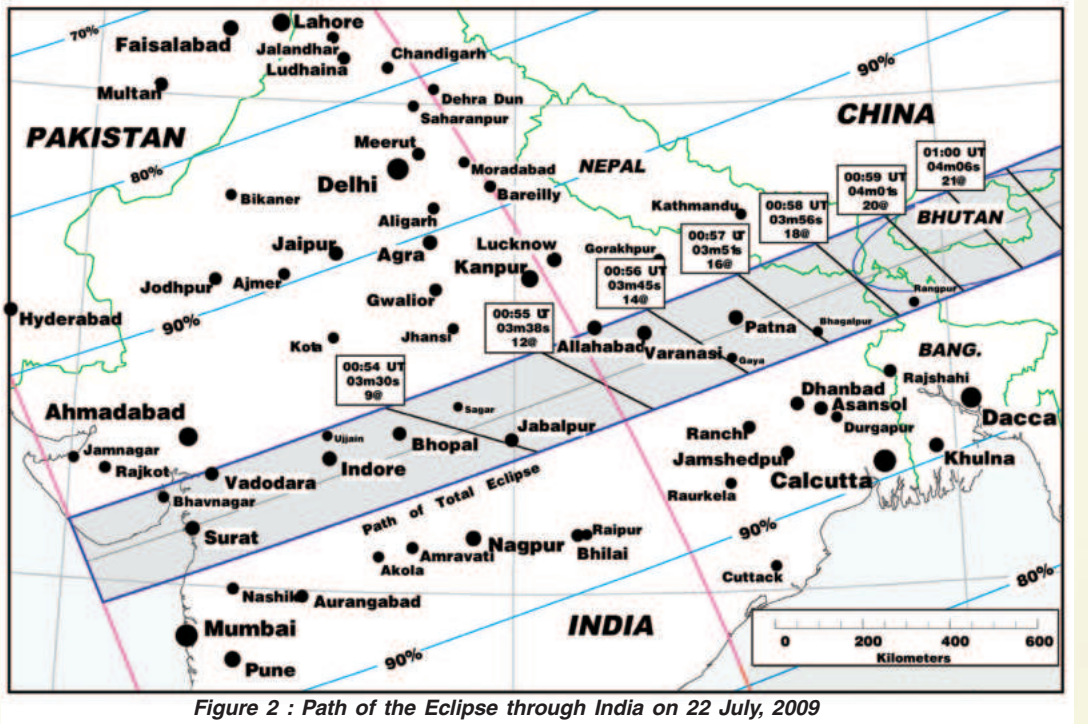


*Figure 2 : Path of the Eclipse through India on 22 July, 2009*

to see the eclipse. The reason is that in July the Indian monsoon is at its peak and at most places will have cloud covered skies.

According to the weather forecasts based on the observations of past years and satellite data, the probability of visibility of the eclipse in India is quite low. According to the charts, Bhopal has a 50% chance of overcast skies. The mean cloudiness at Allahabad is 77% the figure drops to 63% east of Patna. The probability of cloudiness goes up again at Guwahati and Dibrugarh at around 85%. The figures are not promising at all. The only thing which we can do is to hope that the sky be clear at the time of totality.

The beginning and end of the eclipse vary from place to place. The local circumstances for the partial phases and total eclipse are given in Table 1 and Table 2, respectively. These tables are from the Positional Astronomy Centre, India Meteorology Department, Kolkata. In Table 1, the first column gives the name of the city; second to sixth gives the beginning eclipse, greatest phase, magnitude (ratio of the area of the solar disc observed to the total areas of the solar disc), obscuration, ending of eclipse and time of sunrise, respectively. All the timings are in Indian Standard Time. In Table 2, the first column gives the name of the city; second to seventh gives the beginning eclipse, beginning of totality, greatest phase, magnitude, ending of totality, ending of eclipse and time of sunrise, respectively.

## Sky during totality

The sky during totality as seen from the Patna at 06:25 IST is shown in Figure 6. This is almost same with little change in the position of bright planets and stars as seen from the other places where totality would be seen from India. The brightest planets visible during the total eclipse will be Mars, Venus and Mercury located at 65°, 54° and 6° altitude in the eastern sky, respectively. The planets Uranus and Neptune are difficult to spot. However, the planet Jupiter is about 10° above the western horizon but again difficult to spot because of scattering of light at the horizon. Easy to locate bright stars include Procyon, Sirius, Betelgeuse, Rigel and Capella.

## What Vigyan Prasar plans to do

It is a great coincidence that the Total Solar Eclipse of 22 July 2009 falls during the year 2009, designated as the International Year of Astronomy. VP aims at celebrating it by bringing out a variety of software (books, CDs, posters, radio and TV serial, etc.) for various target groups and by organising training programmes and field level activities. Vigyan Prasar has chalked out an ambitious campaign for this purpose. It is also an opportunity to address superstitions associated with astronomical phenomena. The salient features of the activities undertaken/to be undertaken by Vigyan Prasar as part of its outreach campaign on the International Year of Astronomy and Total Solar Eclipse of 22 July 2009 are given below:

**1. Master Resource Persons (MRP) Training:** Vigyan Prasar in collaboration with NCSTC is undertaking four MRP Training programmes for resource persons from different regions/states of India. These programmes will be organised during June-July 2009. The trained resource persons would in turn train communicators in their respective states/provinces, deliver talks and conduct activities on popular aspects of astronomy.

**2. Radio serial on astronomy:** A 52-episode radio programme on astronomy is being produced with AIR. The broadcast of the serial has started from first week of March. It is broadcast from 119 AIR stations in 19 major Indian languages.

**3. Television serial on astronomy:** Production of a 26-episode television serial on astronomy in Hindi has begun. The programme would be telecast during the year from the National Channel of Doordarshan on Sunday mornings in the slot 0900-0930 hrs. Subsequently, the 26-episodes would be dubbed into 12 major Indian languages and telecast from the regional Doordarshan Kendras (TV Stations) through regional network of Doordarshan.

**4. Publications:** Eight titles on various aspects of astronomy would be brought out. At present the books are at various stages of production. These titles would also be translated into other Indian languages.

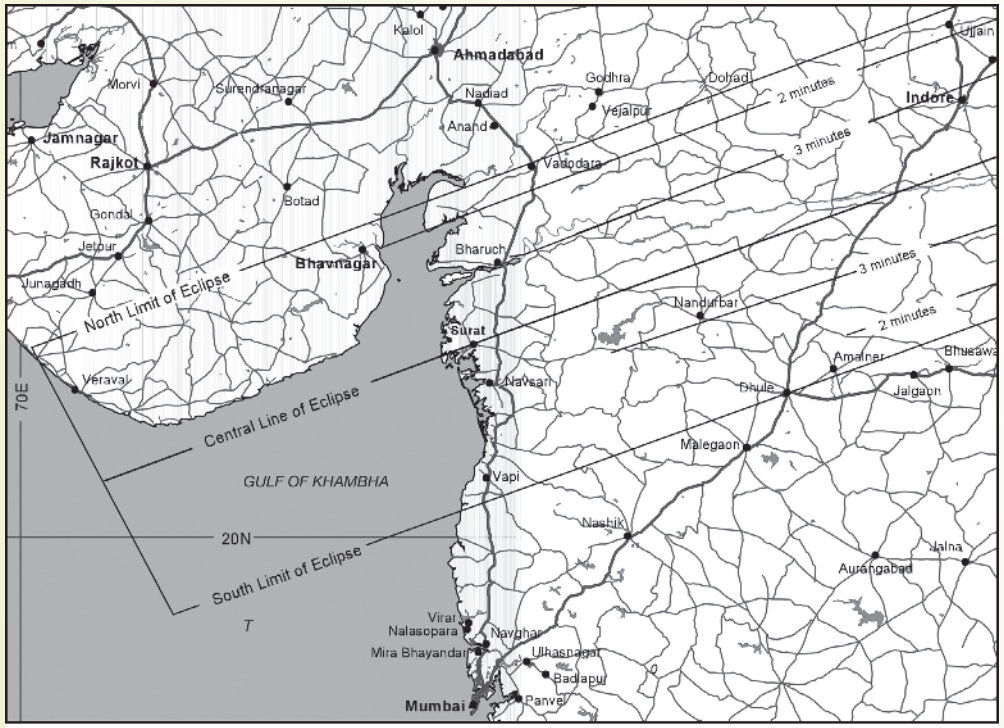


*Figure 3 : Start of the eclipse*

**5. Activity kit:** A low-cost activity kit-cum-educational package containing 25-30 activities on basic aspects/phenomena of astronomy is developed in English and Hindi.

**6. Development of CD and posters:** A CD on eclipses and posters on different topics of astronomy would be developed.

**7. Astronomy awareness workshops:** Telescope making workshops would be organised in different parts of the country.

**8. National Campaign on Total Solar eclipse - 22 July 2009:** Vigyan Prasar in collaboration with other central and state level agencies like NCSTC, State Councils and Education Departments is organising a national campaign to view the solar eclipse safely. A special training-cum-activity package has been developed for science clubs. Five programmes have already been organised with the Department of Education, Government of Delhi.

## E-day, 22 July 2009

Despite the fact that the weather conditions are likely to be far from ideal over the Indian sub-continent, the fact still remains that there is always a chance of seeing the eclipse, The experience of totality may not be as spectacular as it was in 1980 or 1995 since the eclipse would take place soon after sunrise. It should still be possible to have a grand view of the solar corona.

As stated earlier, this is going to be the longest total solar eclipse of this century. Events like this are a great opportunity for the science communicators to reinforce their efforts to inculcate a scientific temper among the people. No opportunity offered by a natural phenomenon should ever be missed for the purposes of science and technology communication. Let us not miss this spectacular event of this year. Let us bring the thrill of watching this grand event to the people and at the same time help them to develop a scientific outlook.

## Do's and Don'ts for observing solar eclipse

### Dos

- Before onset of totality, it is best to view only a projected image of the Sun.
- Project the image of the Sun on a shaded wall through a pin hole.
- A small mirror covered with a piece of paper having circular hole of diameter (1-2 cm) can be used to project the image of the Sun on a shaded wall.
- A small telescope or binoculars can be used to project the image of the Sun on white card/screen/wall. If binocular or telescope has any plastic parts, take necessary precautions to protect them from heating and melting by sunlight.

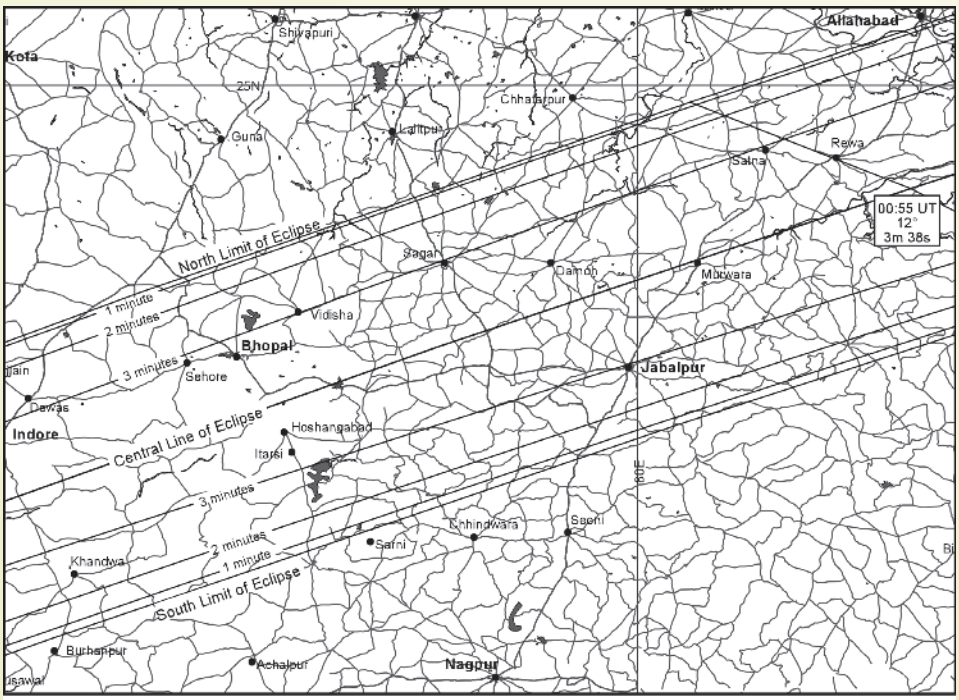


Fig 4: Totality in Madhya Pradesh

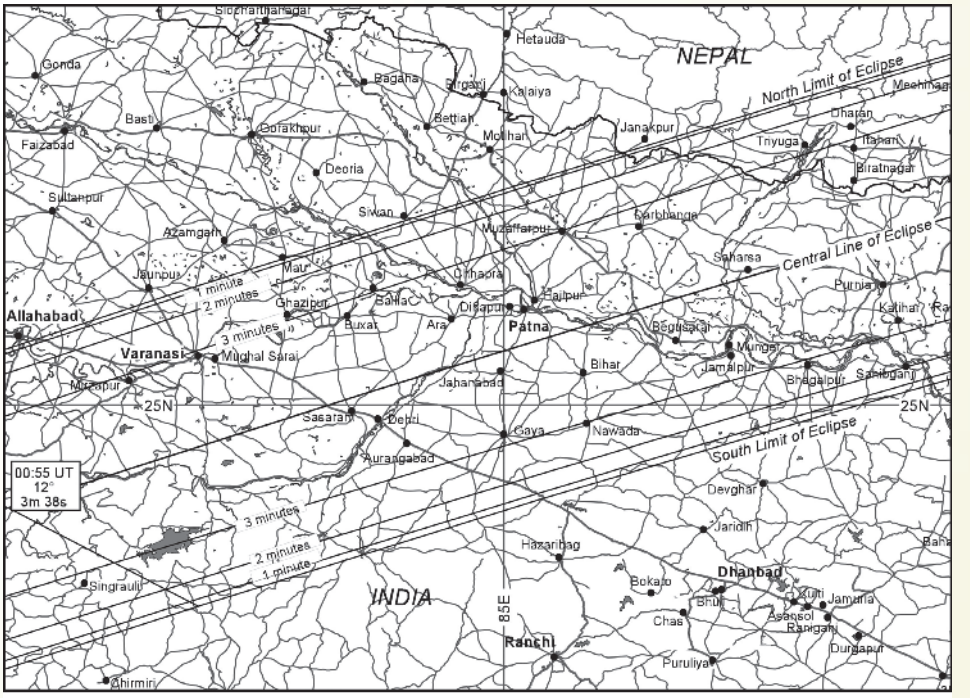


*Figure 6 : Totality in Uttar Pradesh, Bihar and Nepal*

- Direct viewing of the partially eclipsed Sun should be done only using a scientifically tested filter certified to be safe. A dark welder's glass (No. 14) is ideal. The filter provided in the Vigyan Prasar kit can also be used; use only one of your eyes to view the eclipse. In all cases, please examine the filter before use. A filter with pin holes/ scratches must not be used. Don't touch, fold or wipe the film with your fingers, under any circumstances. Any scratch or fold on the film would render it unsafe for viewing the eclipsed Sun.
- During totality you may look directly at the Sun, but only intermittently.
- Preferably, an experienced person should accompany eclipse watchers to announce the beginning and end of the totality.

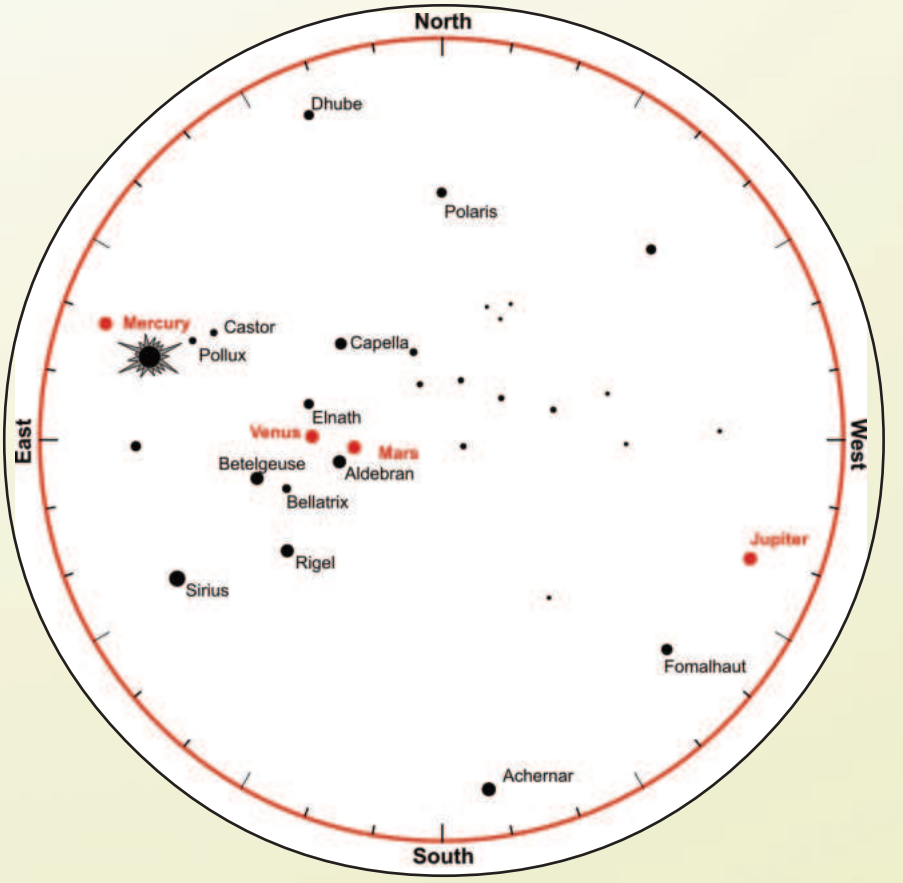


*Figure 6 : Sky during Totality from Patna*

## Don'ts

- Don't attempt to observe the partial or annular phase of any solar eclipse with naked eyes.
- Never look at the Sun through a telescope or binoculars (In fact, you don't need these instruments to watch a solar eclipse).
- Don't use any filter that simply reduces the visible intensity of the Sun. Fifty-two per cent of the Sun's rays are in the infra-red region of the spectrum. Damage to the eye is predominantly caused by this invisible infra red energy.
- Don't use smoked glass, colour film, sunglasses, non-silver black-and-white film, photographic neutral density filters, or polarising filters. They are not safe. Don't use solar filter designed to thread into eye pieces and often sold with inexpensive telescope.
- Don't look at a reflection of the Sun from coloured water.
- Don't look at the totality eclipsed Sun continuously: do it for a few seconds, intermittently.

## References


1. Total Solar Eclipse of 2009 July 22, NASA Reference Publication NASA/TP-2008-214169 (March 2008) by Fred Espenak and Jay Anderson.
2. *Eclipse Events of the Year*, Positional Astronomy Centre, India Meteorological Department, Kolkata, website http://www.packolkata.org/
3. Figures 1, 2, 3, 4 and 5 are reproduced from NASA Reference Publication NASA/TP-2008-214169 (March 2008) by Fred Espenak and Jay Anderson.

# Table 1
## LOCAL CIRCUMSTANCES OF THE PARTIAL PHASE RELATING TO CERTAIN PLACES IN INDIA

| Place | Eclipse begins | Greatest phase | Magnitude | Obscuration | Eclipse ends | Sunrise |
|---|---|---|---|---|---|---|
| Agartala | 5h 29.5m | 6h 28.5m | 0.926 | 0.922 | 7h 34.9m | 4h 50m |
| Ahmedabad | -- | 6h 23.7m | 0.973 | 0.977 | 7h 20.5m | 6h 06m |
| Aizawl | 5h 29.7m | 6h 29.4m | 0.911 | 0.904 | 7h 36.5m | 4h 44m |
| Ajmer | -- | 6h 25.3m | 0.891 | 0.878 | 7h 22.5m | 5h 52m |
| Allahabad | 5h 30.3m | 6h 25.5m | 0.998 | 1.000 | 7h 26.7m | 5h 24m |
| Amritsar | -- | 6h 28.4m | 0.740 | 0.686 | 7h 23.8m | 5h 40m |
| Bangalore | -- | 6h 20.6m | 0.719 | 0.660 | 7h 17.0m | 6h 03m |
| Bhubaneswar | 5h 28.3m | 6h 24.4m | 0.862 | 0.841 | 7h 27.2m | 5h 18m |
| Cannanore | -- | 6h 20.4m | 0.710 | 0.648 | 7h 15.5m | 6h 13m |
| Chandigarh | 5h 35.7m | 6h 27.9m | 0.786 | 0.745 | 7h 24.9m | 5h 34m |
| Chennai | -- | 6h 21.0m | 0.693 | 0.627 | 7h 18.1m | 5h 52m |
| Cochin | -- | 6h 20.2m | 0.640 | 0.562 | 7h 14.3m | 6h 13m |
| Cuttack | 5h 28.3m | 6h 24.5m | 0.869 | 0.850 | 7h 27.3m | 5h 17m |
| Dehra Dun | 5h 34.9m | 6h 27.7m | 0.811 | 0.775 | 7h 25.6m | 5h 30m |
| Delhi | -- | 6h 26.6m | 0.852 | 0.828 | 7h 24.6m | 5h 37m |
| Dwarka | -- | 6h 23.8m | 0.953 | 0.954 | 7h 19.1m | 6h 21m |
| Gandhinagar | -- | 6h 23.8m | 0.968 | 0.972 | 7h 20.6m | 6h 05m |
| Guwahati | 5h 30.4m | 6h 29.9m | 0.998 | 1.000 | 7h 36.7m | 4h 43m |
| Hardwar | 5h 34.5m | 6h 27.5m | 0.823 | 0.791 | 7h 25.5m | 5h 31m |
| Hazaribagh | 5h 29.2m | 6h 25.8m | 0.987 | 0.992 | 7h 28.8m | 5h 14m |
| Hubli | -- | 6h 21.0m | 0.821 | 0.788 | 7h 17.8m | 6h 09m |
| Hyderabad | -- | 6h 21.7m | 0.851 | 0.826 | 7h 20.4m | 5h 52m |
| Imphal | 5h 30.3m | 6h 30.7m | 0.935 | 0.934 | 7h 38.7m | 4h 37m |
| Jaipur | -- | 6h 25.5m | 0.890 | 0.876 | 7h 23.3m | 5h 46m |
| Jalandhar | -- | 6h 28.2m | 0.753 | 0.703 | 7h 24.0m | 5h 39m |
| Jammu | 5h 38.6m | 6h 29.1m | 0.708 | 0.646 | 7h 24.0m | 5h 38m |
| Kanyakumari | -- | 6h 20.2m | 0.566 | 0.474 | 7h 12.9m | 6h 11m |
| Kavalur | -- | 6h 20.7m | 0.693 | 0.627 | 7h 17.1m | 5h 59m |
| Kavaratti | -- | 6h 20.4m | 0.701 | 0.637 | 7h 14.1m | 6h 26m |
| Kohima | 5h 30.6m | 6h 31.2m | 0.963 | 0.967 | 7h 39.4m | 4h 35m |
| Kolhapur | -- | 6h 21.4m | 0.874 | 0.856 | 7h 18.3m | 6h 10m |
| Kolkata | 5h 28.8m | 6h 26.4m | 0.911 | 0.904 | 7h 30.9m | 5h 04m |

| | | | | | | |
|---|---|---|---|---|---|---|
| Koraput | -- | 6h 22.9m | 0.848 | 0.824 | 7h 23.8m | 5h 33m |
| Kozhikode | -- | 6h 20.3m | 0.686 | 0.618 | 7h 15.2m | 6h 13m |
| Kurnool | -- | 6h 21.2m | 0.804 | 0.767 | 7h 19.2m | 5h 56m |
| Lucknow | 5h 31.3m | 6h 26.1m | 0.945 | 0.946 | 7h 26.6m | 5h 26m |
| Madurai | -- | 6h 20.3m | 0.618 | 0.536 | 7h 14.7m | 6h 05m |
| Mangalore | -- | 6h 20.5m | 0.748 | 0.695 | 7h 16.1m | 6h 14m |
| Midnapore | 5h 28.7m | 6h 25.9m | 0.917 | 0.911 | 7h 29.9m | 5h 08m |
| Mt. Abu | -- | 6h 24.4m | 0.926 | 0.922 | 7h 21.0m | 6h 03m |
| Mumbai | -- | 6h 22.1m | 0.961 | 0.964 | 7h 18.9m | 6h 12m |
| Murshidabad | 5h 29.3m | 6h 27.1m | 0.965 | 0.969 | 7h 31.8m | 5h 01m |
| Mysore | -- | 6h 20.5m | 0.709 | 0.647 | 7h 16.2m | 6h 07m |
| Nagpur | -- | 6h 23.1m | 0.960 | 0.963 | 7h 22.8m | 5h 43m |
| Nalgonda | -- | 6h 22.1m | 0.892 | 0.879 | 7h 21.0m | 5h 51m |
| Nashik | -- | 6h 22.4m | 0.983 | 0.988 | 7h 19.8m | 6h 06m |
| Nellore | -- | 6h 21.2m | 0.739 | 0.684 | 7h 19.1m | 5h 51m |
| Nowgang | 5h 30.6m | 6h 30.6m | 0.995 | 0.999 | 7h 38.0m | 4h 39m |
| Panaji | -- | 6h 21.1m | 0.842 | 0.814 | 7h 17.4m | 6h 14m |
| Pondicherry | -- | 6h 20.7m | 0.661 | 0.588 | 7h 17.0m | 5h 56m |
| Port Blair | 5h 33.5m | 6h 26.3m | 0.518 | 0.419 | 7h 25.7m | 5h 04m |
| Pune | -- | 6h 21.9m | 0.935 | 0.933 | 7h 19.1m | 6h 09m |
| Puri | 5h 28.3m | 6h 24.2m | 0.848 | 0.823 | 7h 26.9m | 5h 19m |
| Raipur (M.P.) | -- | 6h 23.5m | 0.937 | 0.935 | 7h 24.5m | 5h 33m |
| Rajamundry | -- | 6h 22.1m | 0.801 | 0.763 | 7h 21.9m | 5h 40m |
| Rajkot | -- | 6h 23.6m | 0.974 | 0.979 | 7h 19.6m | 6h 14m |
| Ranchi | 5h 29.0m | 6h 25.5m | 0.966 | 0.971 | 7h 28.6m | 5h 14m |
| Sambalpur | 5h 28.5m | 6h 24.2m | 0.920 | 0.914 | 7h 26.4m | 5h 23m |
| Shillong | 5h 30.1m | 6h 29.7m | 0.978 | 0.983 | 7h 36.5m | 4h 44m |
| Silchar | 5h 30.0m | 6h 29.9m | 0.946 | 0.947 | 7h 37.3m | 4h 42m |
| Simla | 5h 35.9m | 6h 28.1m | 0.778 | 0.734 | 7h 25.1m | 5h 32m |
| Srinagar | 5h 40.2m | 6h 30.1m | 0.666 | 0.595 | 7h 24.1m | 5h 35m |
| Sringeri | -- | 6h 20.6m | 0.759 | 0.710 | 7h 16.6m | 6h 11m |
| Tamenlong | 5h 30.3m | 6h 30.5m | 0.945 | 0.946 | 7h 38.4m | 4h 38m |
| Tanjore | -- | 6h 20.5m | 0.633 | 0.553 | 7h 15.8m | 6h 00m |
| Tirunelveli | -- | 6h 20.3m | 0.584 | 0.496 | 7h 13.5m | 6h 09m |
| Trichur | -- | 6h 20.3m | 0.657 | 0.583 | 7h 14.7m | 6h 12m |
| Trivandrum | -- | 6h 20.2m | 0.585 | 0.497 | 7h 13.2m | 6h 12m |
| Udaipur | -- | 6h 24.3m | 0.938 | 0.936 | 7h 21.5m | 5h 59m |
| Vijaywada | | 6h 21.8m | 0.798 | 0.759 | 7h 20.9m | 5h 45m |

**Note:** 1. "— " Eclipse begins before the Sun rises at the stations.
2. All timings are in Indian Standard Time (IST)

# Table 2
## LOCAL CIRCUMSTANCES RELATING TO CERTAIN PLACES IN INDIA WHER THE TOTAL PHASE IS VISIBLE

| Place | Eclipse begins (First contact) | Totality begins (Second contact) | Greatest phase | Magnitude | Totality ends (Third contact) | Eclipse ends (Fourth contact) | Sunrise time |
|---|---|---|---|---|---|---|---|
| Surat | -- | 6h 21m 16.1s | 6h 22m 54.7s | 1.029 | 6h 24m 33.4s | 7h 19m 53.1s | 6h 08m |
| Bharuch | -- | 6h 21m 21.4s | 6h 22m 59.6s | 1.027 | 6h 24m 37.7s | 7h 20m 01.4s | 6h 07m |
| Bhavanagar | -- | 6h 21m 40.3s | 6h 23m 04.9s | 1.015 | 6h 24m 29.5s | 7h 19m 42.5s | 6h 11m |
| Daman | -- | 6h 21m 42.0s | 6h 22m 35.2s | 1.004 | 6h 23m 28.5s | 7h 19m 22.5s | 6h 11m |
| Indore | -- | 6h 21m 50.9s | 6h 23m 27.6s | 1.020 | 6h 25m 04.3s | 7h 21m 47.9s | 5h 54m |
| Itarsi | -- | 6h 21m 58.3s | 6h 23m 23.2s | 1.013 | 6h 24m 48.1s | 7h 22m 30.8s | 5h 48m |
| Bhopal | -- | 6h 22m 11.5s | 6h 23m 47.7s | 1.019 | 6h 25m 23.9s | 7h 22m 51.3s | 5h 47m |
| Vidisha | -- | 6h 22m 14.6s | 6h 23m 50.1s | 1.018 | 6h 25m 25.6s | 7h 22m 56.4s | 5h 46m |
| Sagar | -- | 6h 22m 18.0s | 6h 24m 00.6s | 1.023 | 6h 25m 43.1s | 7h 23m 35.8s | 5h 42m |
| Khandwa | -- | 6h 22m 17.2s | 6h 22m 58.8s | 1.002 | 6h 23m 40.5s | 7h 21m 27.7s | 5h 54m |
| Panchmarhi | -- | 6h 22m 24.5s | 6h 23m 26.7s | 1.005 | 6h 24m 28.9s | 7h 22m 53.4s | 5h 45m |
| Silvassa | -- | 6h 22m 27.8s | 6h 22m 33.5s | 1.000 | 6h 22m 39.2s | 7h 19m 33.2s | 6h 09m |
| Jabalpur | -- | 6h 22m 32.0s | 6h 24m 03.0s | 1.014 | 6h 25m 33.9s | 7h 24m 21.5s | 5h 37m |
| Vadodara | -- | 6h 22m 41.3s | 6h 23m 20.6s | 1.002 | 6h 23m 59.9s | 7h 20m 27.0s | 6h 05m |
| Maihar | -- | 6h 22m 50.7s | 6h 24m 36.3s | 1.024 | 6h 26m 21.9s | 7h 25m 10.4s | 5h 33m |
| Ujjain | -- | 6h 22m 51.1s | 6h 23m 40.7s | 1.003 | 6h 24m 30.3s | 7h 21m 56.6s | 5h 53m |
| Rewa | -- | 6h 23m 00.2s | 6h 24m 48.5s | 1.027 | 6h 26m 36.8s | 7h 25m 44.0s | 5h 30m |
| Mirzapur | 5h 30m 02.4s | 6h 23m 54.1s | 6h 25m 27.7s | 1.014 | 6h 27m 01.3s | 7h 26m 57.9s | 5h 23m |
| Chhatarpur | -- | 6h 24m 06.5s | 6h 24m 36.9s | 1.001 | 6h 25m 07.2s | 7h 24m 35.6s | 5h 36m |
| Varanasi | 5h 30m 03.1s | 6h 24m 10.2s | 6h 25m 44.1s | 1.014 | 6h 27m 17.9s | 7h 27m 34.2s | 5h 20m |
| Chhapra | 5h 29m 5 7.0s | 6h 24m 23.5s | 6h 26m 14.1s | 1.024 | 6h 28m 04.6s | 7h 28m 51.0s | 5h 14m |
| Gaya | 5h 29m 34.6s | 6h 24m 26.7s | 6h 26m 04.3s | 1.015 | 6h 27m 41.9s | 7h 29m 00.9s | 5h 13m |
| Bankipore | 5h 29m 51.3s | 6h 24m 29.3s | 6h 26m 24.7s | 1.032 | 6h 28m 20.1s | 7h 29m 23.4s | 5h 12m |
| Patna | 5h 29m 57.3s | 6h 24m 37.7s | 6h 26m 31.1s | 1.026 | 6h 28m 24.5s | 7h 29m 29.5s | 5h 11m |
| Daltonganj | 5h 29m 19.6s | 6h 25m 03.3s | 6h 25m 22.9s | 1.000 | 6h 25m 42.5s | 7h 27m 48.1s | 5h 19m |
| Darbhanga | 5h 30m 11.1s | 6h 25m 17.8s | 6h 26m 56.0s | 1.015 | 6h 28m 34.2s | 7h 30m 06.6s | 5h 09m |
| Muzaffarpur | 5h 30m 11.6s | 6h 25m 15.5s | 6h 26m 48.8s | 1.013 | 6h 28m 22.0s | 7h 29m 49.4s | 5h 09m |
| Bhagalpur | 5h 29m 41.6s | 6h 25m 36.4s | 6h 27m 03.3s | 1.010 | 6h 28m 30.2s | 7h 31m 06.2s | 5h 04m |
| Purnia | 5h 29m 48.1s | 6h 25m 36.8s | 6h 27m 17.6s | 1.015 | 6h 28m 58.4s | 7h 31m 29.3s | 5h 03m |
| Katihar | 5h 29m 42.8s | 6h 25m 53.1s | 6h 27m 14.1s | 1.008 | 6h 28m 35.1s | 7h 31m 29.2s | 5h 03m |
| Siliguri | 5h 30m 26.7s | 6h 26m 33.0s | 6h 28m 26.7s | 1.022 | 6h 30m 20.3s | 7h 33m 11.5s | 4h 56m |
| Coochbehar | 5h 30m 16.2s | 6h 26m 48.8s | 6h 28m 44.6s | 1.023 | 6h 30m 40.4s | 7h 34m 08.4s | 4h 52m |
| Darjeeling | 5h 30m 35.6s | 6h 27m 01.9s | 6h 28m 30.4s | 1.010 | 6h 29m 58.9s | 7h 33m 07.1s | 4h 56m |
| Sibsagar | 5h 31m 20.6s | 6h 31m 39.5s | 6h 32m 17.0s | 1.001 | 6h 32m 54.4s | 7h 40m 45.0s | 4h 29m |
| Thimpu | 5h 30m 54.9s | 6h 28m 01.3s | 6h 29m 25.5s | 1.009 | 6h 30m 49.7s | 7h 34m 45.7s | 4h 49m |
| Itanagar | 5h 31m 12.0s | 6h 29m 54.7s | 6h 31m 38.7s | 1.013 | 6h 33m 22.7s | 7h 39m 28.5s | 4h 34m |
| Dibrugarh | 5h 31m 39.7s | 6h 30m 55.7s | 6h 32m 44.8s | 1.015 | 6h 34m 33.9s | 7h 41m 20.3s | 4h 28m |
| Gangtak | 5h 30m 46.2s | 6h 27m 45.8s | 6h 28m 49.9s | 1.004 | 6h 29m 54.1s | 7h 33m 36.5s | 4h 54m |

**Note :** **1.** " — " Eclipse begins before the Sun rises at the stations.
**2.** All timings are in Indian Standard Time (IST)

# Breast Cancer:
## Cures and the after-life

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> **Live all you can; it's a mistake not to. It doesn't so much matter what you do in particular, so long as you have your life. If you haven't had that what have you had?**
>
> **—*Henry James* in *The Ambassadors***

Early diagnosis greatly improves the odds of survival in women who develop cancer of the breast. When detected early, the disease has a very high survival rate, and patients who reach this stage often go on to live long, healthy lives. Survival rates are lower for cancers that have spread locally, and they are very low for cancers that have metastasised, or spread, to distant parts of the body.

### Diagnosis

Breast cancer may be first discovered by the patient as a result of regular breast self-examination. However, a lump, an abnormal area on a mammogram, or other changes in the breast can be caused by cancer or by other, less serious problems (Figure 1). To find out the cause of any of these signs or symptoms, a woman's doctor does a careful physical exam and asks about her personal and family medical history. In addition to checking general signs of health, the doctor may do one or more of the breast exams.

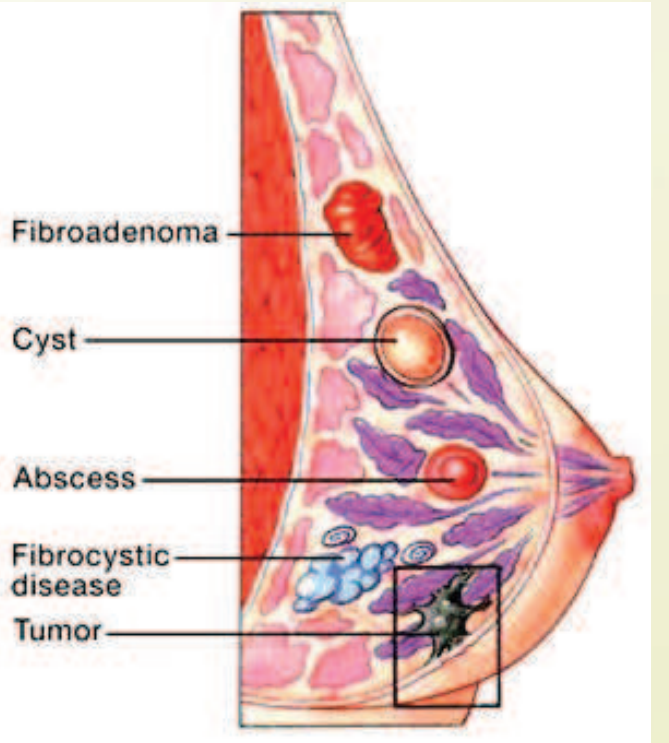
**Palpation:** The doctor can tell a lot about a lump, that is, its size, its texture, and whether it moves easily by carefully feeling the lump and the tissue around it. Benign lumps often feel different from cancerous ones.

**Mammography:** X-rays of the breast can give the doctor important information about a breast lump. If an area on the mammogram looks suspicious or is not clear, additional mammograms may be needed.

**Ultrasonography:** Using high-frequency sound waves, ultrasonography can often show whether a lump is solid or filled with fluid. This test may be used along with mammography.

Based on these tests, the doctor may decide that nothing further needs to be done. Or may opt to keep the patient under regular watch. Often, however, fluid or tissue is removed from the breast to make a diagnosis. A surgeon is best equipped for making a proper evaluation. He may ask for any of the following tests:

**Fine needle aspiration:** A thin needle is used to remove fluid from a breast lump. This procedure may show whether a lump is a fluid-filled cyst or a solid mass. The tissue removed from the lump is sent to the pathologist for microscopic examination.




**Needle biopsy:** Using special techniques, tissue can be removed with a needle from an area that is suspicious on a mammogram but cannot be felt. Tissue removed in a needle biopsy goes to a lab to be checked by a pathologist for cancer cells.

**Surgical biopsy:** The surgeon cuts out part or all of a lump or suspicious area. A pathologist examines the tissue under a microscope to check for cancer cells.

### Treatment

Through continuing research into new treatment methods, women now have more treatment options and hope for survival than ever before. The treatment options for each woman depend on the size and location of the tumour in her breast, the results of lab tests including hormone receptor tests, and the stage or extent of the disease.

Methods of treatment for breast cancer are local or systemic. Local treatments are used to remove, destroy, or control the cancer cells in a specific area. Surgery and radiation therapy are local treatments. Systemic treatments are used to destroy or control cancer cells throughout the body. Chemotherapy and hormonal therapy are systemic treatments. A patient may have just one form of treatment or a combination. Different forms of treatment may be given at the same time or one after another.

### Surgery

Surgery is the most common treatment for breast cancer. Several types of surgery may


be performed. The doctor can explain each of them in detail, discuss and compare the benefits and risks of each type, and describe how each will affect the patient's appearance. An operation to remove the breast is a mastectomy. Breast reconstruction is often an option at the same time as the mastectomy, or later on. An operation to remove the cancer but not the breast is called breast-sparing surgery or breast-conserving surgery.

*Lumpectomy* and *partial mastectomy* are types of breast-sparing surgery. They usually are followed by radiation therapy to destroy any cancer cells that may remain in the area. In most cases, the surgeon also removes lymph nodes under the arm to help determine whether cancer cells have entered the lymphatic system. In lumpectomy, the surgeon removes the breast cancer and some normal tissue around it. In partial mastectomy, the surgeon removes the cancer and a larger area of normal breast tissue around it. Occasionally, some of the lining over the chest muscles below the tumour is removed as well. Some of the lymph nodes under the arm may also be removed.

In *simple mastectomy*, the surgeon removes the whole breast. Some of the lymph nodes under the arm may also be removed.

In *modified radical mastectomy*, the surgeon removes the whole breast, most of the lymph nodes under the arm, and often the lining over the chest muscles. The smaller of the two chest muscles is also taken out to help in removing the lymph nodes.

In *radical mastectomy*, the surgeon removes the breast, the chest muscles, all of the lymph nodes under the arm, and some additional fat and skin. For many years, this operation was considered the standard one for women with breast cancer, but it is very rarely used today and only in cases of advanced cancer in which the cancer has spread to the chest muscles.

Breast reconstruction, the surgery to rebuild a breast's shape, is often an option after mastectomy. Women considering reconstruction should discuss this with a plastic surgeon before having a mastectomy.

## Radiotherapy

Radiotherapy is the use of high-energy rays to kill cancer cells and stop them from growing. The rays may come from radioactive material outside the body and be directed at the breast by a machine. This is known as external radiation. The radiation can also be in the form of implant radiation. This comes from radioactive material placed directly in the breast in thin plastic tubes. Some women receive both kinds of radiation therapy.

For external radiation therapy, patients go to the hospital or clinic every day. When this therapy follows breast-sparing surgery, the treatments are given 5 days a week for 5 to 6 weeks. At the end of that time, an extra 'boost' of radiation is sometimes given to the place where the tumour was removed. The boost may be either external or internal, using an implant. Patients stay in the hospital for a short time for implant radiation.

Radiation therapy, alone or with chemotherapy or hormone therapy, is sometimes used before surgery to destroy cancer cells and shrink tumours. This approach is most often used in cases in which the breast tumour is large or not easily removed by surgery.

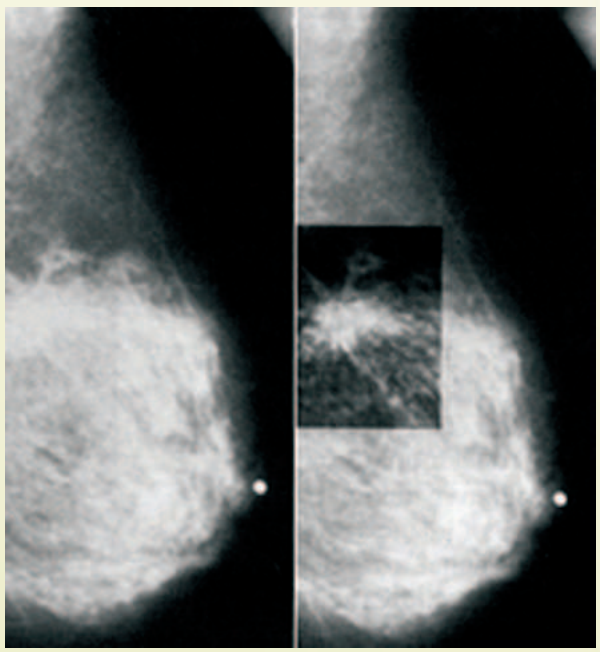
## Chemotherapy

Chemotherapy is the use of drugs to kill cancer cells. Chemotherapy for breast cancer is usually a combination of drugs. The drugs may be given by mouth or by injection. Either way, chemotherapy is a systemic therapy because the drugs enter the bloodstream and travel throughout the body.

Chemotherapy is given in cycles: a treatment period followed by a recovery period, then another treatment, and so on. Most patients have chemotherapy in an outpatient part of the hospital, or at the doctor's office. Depending on which drugs are given and the woman's general health, however, she may need to stay in the hospital during her treatment.

## Hormonal therapy

Hormonal therapy is used to keep cancer cells from getting the hormones



they need to grow. This treatment may include the use of drugs that change the way hormones work or surgery to remove the ovaries, which make female hormones. Like chemotherapy, hormonal therapy is a systemic treatment; it can affect cancer cells throughout the body.

## Breast reconstruction

After a mastectomy, some women decide to wear a breast form. Others prefer to have breast reconstruction, either at the same time as the mastectomy or later on. Various procedures are used to reconstruct the breast. Some use silicone or saline implants, while others use tissue moved from another part of the woman's body.

## Rehabilitation

Rehabilitation is a very important part of breast cancer treatment. The health care team makes every effort to help women return to their normal activities as soon as possible. Recovery will be different for each woman, depending on the extent of the disease, the type of treatment, and other factors.

Exercising after surgery can help a woman regain motion and strength in her arm and shoulder. It can also reduce pain and stiffness in her neck and back. Carefully planned exercises should be started as soon as the doctor says the woman is ready, often within a day or so after surgery. Exercising begins slowly and gently and can even be done in bed. Gradually, exercising can be more active, and regular exercise becomes part of a woman's normal routine. Often, lymphoedema after surgery can be prevented or reduced with certain exercises and by resting with the arm propped up on a pillow. If lymphoedema occurs, the doctor may suggest exercises and other ways to deal with this problem. For example, some women with lymphoedema wear an elastic sleeve or use an elastic cuff to improve lymph circulation. The doctor also may suggest other approaches, such as medication, massage, or use of a machine that compresses the arm. The woman may be referred to a physical therapist or another specialist.

## Follow up care

Regular follow-up exams are important after breast cancer treatment. The doctor will continue to check the woman closely to be sure that the cancer has not returned. Regular checkups usually include examinations of the breasts, chest, underarm, and neck. From time to time, the woman has a complete physical exam and a mammogram. Some women may also have additional tests.

A woman who has had cancer in one breast has an increased risk of developing cancer in her other breast. She should report any changes in the treated area or in the other breast to her doctor right away.

Also, a woman who has had breast cancer should tell her doctor about other physical problems if they come up, such as pain, loss of appetite or weight, changes in menstrual cycles, unusual vaginal bleeding, or blurred vision. She should also report dizziness, coughing or hoarseness, headaches, backaches, or digestive problems that seem unusual or that don't go away. These symptoms may be a sign that the cancer has returned, but they can also be signs of various other problems. It is important to share your concerns with a doctor. ■

# Recent Developments in Science and Technology

□ Biman Basu
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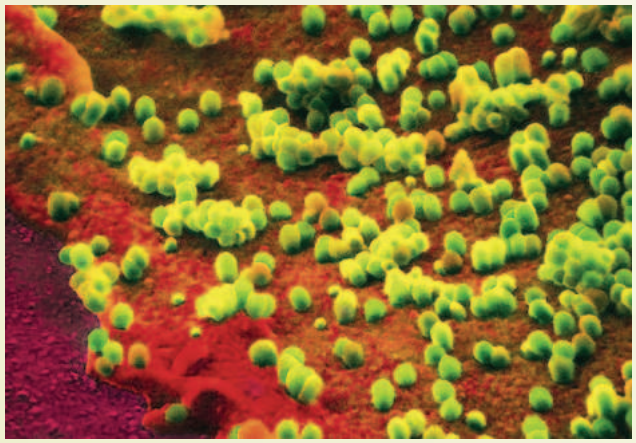
## New vaccines for H1N1 Flu

The scare over the global spread of the H1N1 virus that causes a deadly form of influenza has prompted scientists to take steps to develop a vaccine against the virus as soon as possible. The disease was earlier known as 'swine flu' because it is caused by a virus that is transmitted to humans from pigs. The H1N1 virus has the potential to cause a global pandemic in view of today's faster communication means and international air traffic. First reported in Mexico in late March this year, the virus had spread to 74 countries and 28,000 cases had been officially reported by the second week of June. Still not much is known about the virus. Scientists are yet to figure out how virulent the virus is and how easily it spreads. It is also not known whether the virus could prove much deadlier in a second wave around the world, as was the case for the 1918 flu, which ultimately killed millions. It is known, however, that once the virus gets into the human system it can easily spread to other humans through air as aerosol or by contact. At present the only protection against the disease is to prevent infection by identifying and quarantining suspected patients.



*Scanning electron micrograph (in false colour) showing killer H1N1 virus (green)*

However, public-health officials caution against becoming too complacent, and the Centers for Disease Control (CDC), in Atlanta, USA and others are taking steps to produce a vaccine, especially in view of the fact that the flu season is just beginning in the Southern Hemisphere, where the virus could mutate to become more pathogenic.

Influenza vaccines generally contain a dead or weakened form of a circulating virus. Currently, vaccines are routinely manufactured for the seasonal influenza that afflicts 3 million to 5 million people every year. But since the H1N1 virus is new, there is no vaccine currently available made with this particular virus. According to the World Health Organisation (WHO), making a completely new influenza vaccine will take some time. One key unknown for the manufacture of a vaccine is yield of vaccine virus production, since some strains do not grow as well as the others. Nonetheless, the first doses of Influenza A (H1N1) vaccine could be available in five to six months from identification of the pandemic strain. The regulatory approval will be conducted in parallel with the manufacturing process. Regulatory authorities have put into place expedited processes that do not compromise on the quality and safety of the vaccine.

The CDC is currently growing a seed stock of the H1N1 virus that will be distributed to vaccine manufacturers around the world for production of a vaccine. However, existing methods for making flu vaccines carry some disadvantages: they are relatively slow and require large amounts of the virus to be grown in chicken eggs. But alternative methods for making vaccines have received a significant boost in recent years, especially after the appearance of avian flu in several countries.

The leading vaccine manufacturer Novartis has already developed a vaccine for seasonal flu by growing the virus in cell culture, using methods similar to those employed to make biological drugs and other products; it has been approved for use in Europe. The advantage of the new technique is that cell culture can be expanded enormously. Thousands of litres of cells can be cultured easily, whereas there is a limited capacity to produce chicken eggs. The company is now using both cell-culture-based and egg-based technology to create an H1N1 vaccine.

Others are developing vaccines that use only portions of the virus, and are thus easier to grow in cells. Researchers at Vaccine Research Centre of the National Institute for Allergy and Infectious Diseases (NIAID), in Baltimore, USA, are developing DNA-based vaccines, in which circular pieces of DNA containing the virus's hemagglutinin (HA) gene are grown in bacteria. The researchers have already developed an H5N1 (avian influenza virus) vaccine using this technology which is currently undergoing human trials.

## Physicists see the cosmos in a tea cup

A professor and a graduate student of Duke University in Durham, North Carolina, USA have found a "universal principle" that they say unites the interplay of light and shade on the surface of a tea cup with the way gravity distorts the light of distant galaxies. What is more, they think scientists will be able to use violations of this principle to map unseen clumps of mysterious "dark matter" in the universe.

Light rays naturally reflect off a cylindrical surface like the inside surface of a tea cup in a curving pattern that comes to a point in the centre and is brightest along its edge. Mathematicians and physicists call that shape a 'cusp curve,' and they call the bright edge a "caustic." According to Arlie Petters, a physicist and mathematician at

*The caustic (bright curved shape) produced when light is reflected by a cylindrical surface. (Credit: Henrik Wann Jensen, UCSD)*

Duke University, it happens because a lot of light rays can pile up along curves.

Caustics also show up in gravitational lensing, a phenomenon caused by galaxies so massive that their gravity bends and distorts light from more distant galaxies, as predicted by Einstein's general theory of relativity. Petters, who is also a gravitational lensing expert, believes that gravitational force of the galaxies is so powerful that some light rays are also going to pile up along curves. He says, "As with any illumination pattern, some areas will be brighter than others, and the brightest parts will be along these caustic curves." Understanding data from telescope surveys, he adds, requires understanding the distortions inherent in lensing. These sometimes warp a distant point of light into multiple and magnified copies of themselves.

Petters and other researchers had previously found that, if such a light source seems to be juxtaposed within the confines of a caustic arch, two duplicate images will appear to be positioned abnormally close to each other and also seem equally bright. And because these clones are of seemingly equal brightness, subtracting luminosity of one from the other results in a difference of zero.

In a paper published in the March 23 *Journal of Mathematical Physics*, Petters and graduate student Amir Aazami extended the mathematics of a tea cup cusp curve to include what they called "higher order caustics," where the interplay of light and gravity may extend further into space time and undergo various forms of "caustic metamorphosis" in the process. Aazami was testing out a special case of their evolving caustics theorem called an 'elliptic umbilical' (a mathematical formula that models the creation of hair-like structures in optics created by light reflecting off a curved surface) by using a technical computing software program called 'Mathematica' when he noticed a pattern. Petters concluded that Aazami had found a universal mathematical principle so pervasive that it can impose balance on the most complicated gravitational lensing illusions.

The Duke researchers said that for the simplest caustics, the theorem has already been corroborated by a few gravitational lensing observaions. And they expect the higher order caustics to be observed once the Large Synoptic Survey Telescope (LSST), now being assembled in Chile, begins "the most massive survey of the sky known" in a few years. According to Petters, if a violation of their theorem is noticed; for example, if there are two pairs of lensed images that are close to each other but not equally bright, the reason would be some substructure in the galaxy, which may turn out to be dark matter. By using the LSST in conjunction with their theorem, astronomers would be able to identify dark matter substructures in complex galactic systems. "It's amazing how what we can see in a coffee cup extends in to a mathematical theorem with effects in the cosmos," he says.

## Scientists create heart cells

Heart muscle, also known as cardiac muscle, is found only in the heart, where it forms the muscles of the atria and the ventricles. It is a type of involuntary striated muscle found only in the heart. The heart muscle is responsible for more than two billion beats in a person's lifetime, but it never gets tired. This is what makes heart muscles special.

Until recently, it was commonly believed that heart muscle cells cannot regenerate and people live with the same heart cells they are born with. However, a study reported on 3 April 2009 in the journal *Science* showed that heart muscles do regenerate, but very slowly – only about 1% cells per year. Now a team of scientists at the Gladstone Institute of Cardiovascular Disease, San Francisco, USA, have identified for the first time key genetic factors that drive the process of generating new heart cells. The discovery, reported in the 9 April 2009 issue of the journal *Nature*, provides important new directions on how stem cells may be used to repair damaged hearts.

For decades, scientists were unable to identify a single factor that could turn non-muscle cells into beating heart cells. Using a clever approach, the Gladstone team led by Benoit Bruneau found that a combination of three genes could do the trick. Two of the three genes encode proteins called transcription factors, which are master regulators that bind to DNA and determine which genes get activated or shut off. The two transcription factors, GATA4 and TBX5, cause human heart disease when mutated and also cooperate with each other to control other genes. When Bruneau and colleague added different combinations of transcription factors to mouse cells, these two seemed important for pushing cells into heart cells – but they were not enough. Finally they found a cardiac-specific protein called BAF60c, which helps determine whether the two transcription factors can gain access to the DNA regions they were supposed to turn on or off.

Working with mouse embryos about a week old, Bruneau and colleagues discovered that the trio of proteins – the transcription factors, GATA4 and TBX5, and the cardiac-specific protein BAF60c – could direct certain embryonic cells to form cardiac-muscle cells, called cardiomyocytes. The new cells not only produced proteins characteristic of early heart cells, but they eventually started to beat. In the past, human trials of cell therapies for heart disease, which have mostly used stem cells derived from a patient's own blood, have yielded mixed results. It may be that transplanting cardiomyocytes rather than undifferentiated cells will prove more effective.

According to the scientists, the fact that it is possible to turn partially differentiated cells into heart-muscle cells is good news for future therapies. It may now be possible to turn those scar-tissue cells into cardiomyocytes and restore the function that has been lost.

## An ant species with no males discovered

Researchers have discovered a South American leaf-cutter ant species that is exclusively female. The ants of the species *Mycocepurus smithii* have evolved to reproduce only when queens clone themselves. No male of the species has ever been found. The researchers used DNA profiling to confirm that each member of the colony was genetically identical to the queen. Other ants, such as fire ants can also reproduce asexually, but they have working sexual organs, and have both males and females in a population.

***Ants of* Mycocepurus smithii *species, which have no males and reproduce asexually***

The ants of the *M. Smithii* species cultivate a garden of fungus inside their colony grown with pieces of dead vegetables and other insects. It is this capacity for farming which initially prompted the researchers, led by Anna Himler of the University of Texas at Austin, USA, into investigating the species, but closer inspection raised questions about the ants' sex life. The researchers carried out six separate tests on the ants, including field surveys of colonies from Panama to Argentina, examining the reproductive system of queen ants, and testing the genes of clones and their mothers, but failed to uncover any males. The findings, reported online on 15 April 2009 in the *Proceedings of the Royal Society* B (doi:10.1098/rspb.2009.0313) run counter to scientific theories that say asexuality is an evolutionary disadvantage because it eliminates mutations and generates genetic diversity more slowly than sexual reproduction.

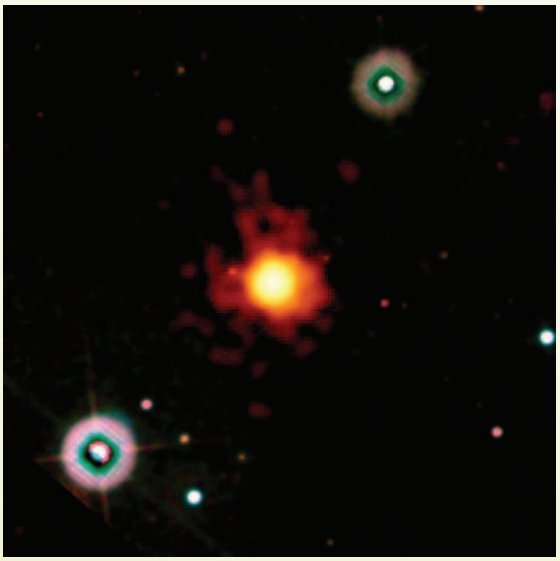
The researchers also tested whether bacteria could be the cause of the ants' asexuality and whether treating females with antibiotics or changing the fungus they fed on would stimulate the production of males, but without success. One possible advantage of asexual reproduction, according to the researchers, could be that it avoids the need to find a mate and the efforts associated with mating.

## Most distant object in the universe spotted

Astronomers have spotted the most distant object yet confirmed in the universe – a self-destructing star that exploded 13.1 billion light years from Earth, making it the most distant object detected in the universe. The burst, dubbed GRB 090423, was detected by NASA's *Swift* satellite on 23 April 2009 and was observed by research teams in the US and UK within minutes of its discovery. Some of the first ground-based observations were made on Mauna Kea in Hawaii with the United Kingdom Infrared Telescope and the Gemini North telescope. To gauge an object's distance, astronomers measure how much an object's light has been stretched, or reddened, by the expansion of space. As determined from the spectrum of the afterglow, light from this burst was found to have a red shift of 8.2, the largest red shift measured for any object so far. In other words, the light waves coming from the explosion have been stretched to 8.2 times their original length. The observations demonstrated that the record-breaking explosion occurred when the universe was only 630 million years old; that is, about 100 million years older than the previous record, which was held by an ancient galaxy. It happened at a time when the first stars and galaxies were lighting up space.

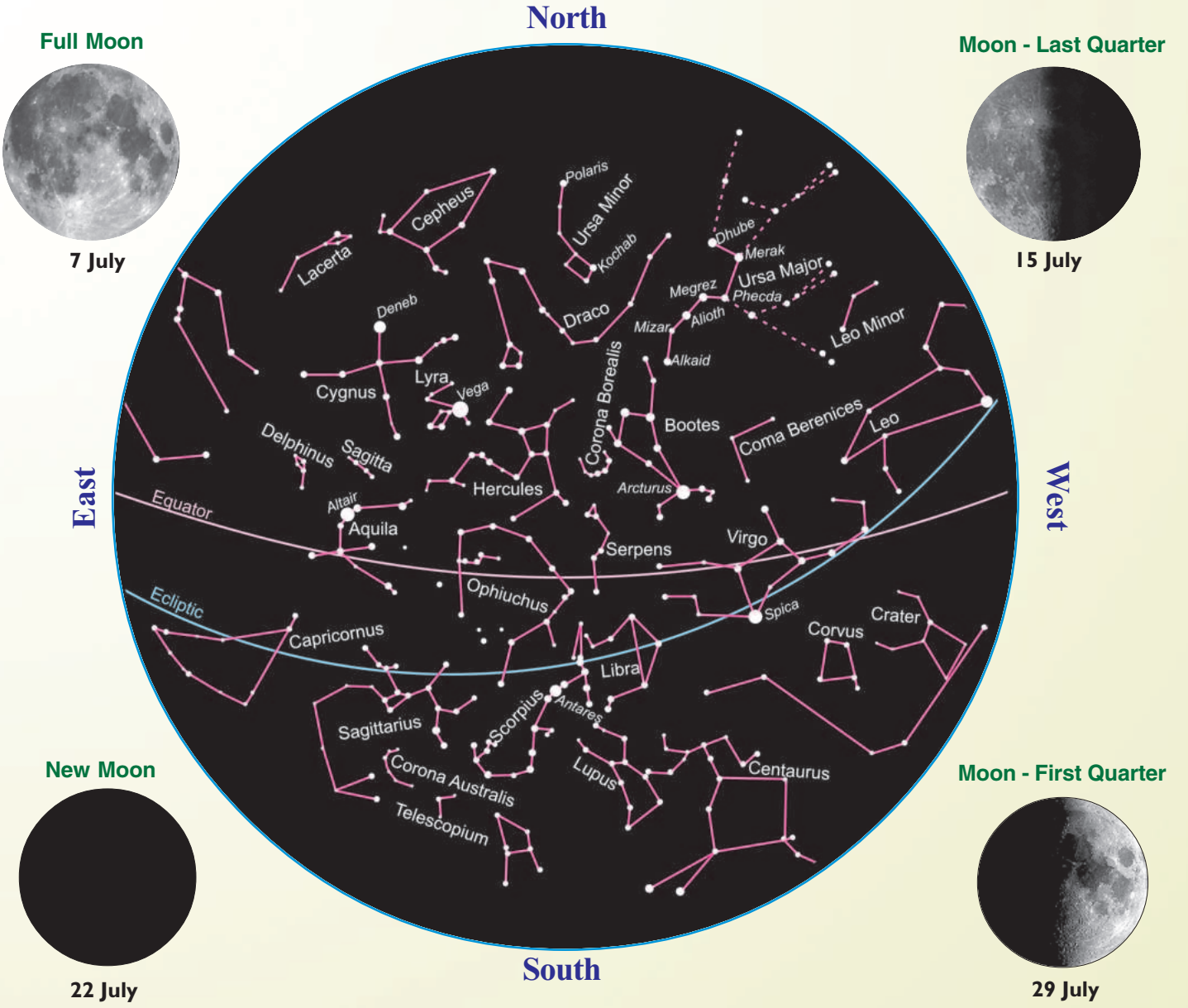
The energetic event observed on 23 April was a gamma-ray burst (GRB) – the brightest type of stellar explosion. GRBs occur when massive, spinning stars collapse to form black holes and spew out jets of gas at nearly the speed of light. These jets send gamma rays towards the Earth, along with infrared 'afterglows' at other wavelengths, which are produced when the jet heats up surrounding gas. GRBs are named using the date they are discovered; in the present case it is GRB 090423 because it was discovered in 2009 on April 23.

According to the astronomers, this discovery proves the importance of gamma-ray bursts in probing the most distant parts of the universe. They can now be confident that even more remote bursts will be found in the future, which will open a window to studying the very first stars. If astronomers can find more gamma-ray bursts at even greater distances, they could use their spectra to determine how quickly the universe became transparent and what was responsible for the process.



***GRB 090423 as seen by NASA's* Swift *satellite. The image is a composite of data from Swift's UV/Optical and X-Ray telescopes. (Credit: NASA/Swift/Stefan Immler)***

# Sky Map for July 2009




The sky map is prepared for viewers in Nagpur (21.090 N, 79.090 E). It includes constellations and bright stars. For viewers south of Nagpur, constellations of the southern sky will appear higher up in the sky , and those of the northern sky will appear nearer the northen horizon. Similarly, for viewer north of Nagpur, constellations of northern sky will appear higher up in the sky, and those of the southern sky will appear nearer the southern horizon. The map can be used at 10 PM on 1 July, at 9 PM on 15 July and at 8 PM on 31 July.


## Tips to use sky map:

(1) Choose a place away from city lights/street lights. (2) Hold the sky-map overhead with North in the direction of Polaris. (3) Use a pencil torch for reading the sky map. (4) Try to identify constellation as shown in the map one by one.

## Visibility of Planets⁺ (IST)

| | Rising | Setting | In the Zodiac |
|---|---|---|---|
| Mercury | 05:45 | 19:08 | Taurus-Gemini-Leo |
| Venus | 02:45 | 15:54 | Taurus-Gemini- |
| Mars | 02:07 | 15:16 | Aries-Taurus |
| Jupiter | 20:51 | 08:14 | Capricorns |
| Saturn | 09:46 | 22:10 | Leo |
| Uranus* | 22:28 | 10:18 | Pisces |
| Neptune* | 20:51 | 08:16 | Capricorns |

⁺Time shown is subject to vary (± 1 hr) from place to place.
*Not naked eye object

## Sky Event

| Date | IST | Event |
|---|---|---|
| 04 | 12:29 | Earth at aphelion |
| 07 | 15:09 | Penumbral Lunar Eclipse |
| 08 | 03:09 | Moon at apogee |
| 11 | 03:41 | Moon-Jupiter |
| 14 | 07:38 | Mercury Superior Conjunction |
| 19 | 10:44 | Moon-Venus |
| 22 | 01:46 | Moon at perigee |
| 22 | 08:05 | TOTAL SOLAR ECLIPSE |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Astronomy

## Editorial (Contd. from page 43)

second or so, and the cosmos should be full of light and nothing else! But we are here, and so are planets, stars and galaxies!

So, where is all the antimatter, anyway? It is likely that there might be some subtle difference in the physics of matter and antimatter that left the early universe with a surplus of matter. Alternatively, the annihilation was not total in those first few seconds of the creation of the universe. Somehow, matter and antimatter managed to escape each other's fatal grasp. Who knows, somewhere out there, in some mirror region of the cosmos, antimatter is lurking and has coalesced into anti-stars, anti-galaxies and maybe even anti-life! If an anti-galaxy were to collide with a regular galaxy, the resulting annihilation would be of unimaginably huge proportions. But, we are yet to see any such signs. However, it is also true there are many regions of the universe that are too far away for us ever to see.

Let us now consider how we can "produce" antimatter. How do we produce and hold a substance that simply vanishes the moment it comes into contact with anything? Even to produce anti-hydrogen with one antiproton and one anti-electron (positron), the simplest anti-atom, one requires a near perfect vacuum. Encounter with a mere single atom of air would destroy any antiparticle. And how do we trap the antiparticles? Certainly not through conventional means! We would need to use electric and magnetic fields for the purpose. We may note that anti-hydrogen was isolated in 2002 at CERN by bringing together antiprotons from a particle accelerator and positrons from a sodium radioactive source in a magnetic trap. But, let us remember anti-hydrogen *is* neutral, and hence such success is only momentary. Magnetic traps may work for charged particles, not for neutral atoms. Hence, it can slip right through the magnetic field! Then, how did they transport antimatter in the small canister containing antimatter in *Angels and Demons*?

True, at the moment we have enough difficulty even to produce and tame anti-hydrogen. But, can we ever expect to make anti-helium, anti-carbon, and all the anti-elements, thereby producing an anti-periodic table? Shall we be able to produce organic anti-molecules made from anti-carbon? The problem is to build one sub-atomic anti-particle at a time and then assemble several of them successively to build anti-atoms of heavier anti-elements! So, what are our chances of making anything more complex than anti-hydrogen? Almost zero, indeed, though not quite zero!

And what about the antimatter bomb which is the central part of *Angels and Demons* plot? How much energy would be released in the annihilation of 1 gram of antimatter with 1 gram of matter (which makes 2 grams)? Using Einstein's formula $E=mc^2$, it is easy to find that 2 grams of matter-antimatter annihilation corresponds to energy equivalent of 42.8 kilotonnes of TNT (trinitrotoluene, a high explosive). Now, twenty kilotonnes of TNT is the equivalent of the atom bomb that destroyed Hiroshima. This implies that one 'only' needs half a gram of antimatter to be equally destructive as the Hiroshima bomb, since the other half gram of (normal) matter is easy enough to find. At CERN about $10^7$ antiprotons are produced per second and there are $6x10^{23}$ of them in a single gram of antihydrogen. At this rate, it would take roughly two billion years to produce half gram of anti-hydrogen! And 1 billion years to produce 1/4 gram of antimatter stolen from LHC in *Angels and Demons!* Now, ¼ gram of antimatter would produce energy equivalent to 10 kilotonnes of TNT, but what was cited in the movie was 5 kilotonnes. Apparently the energy from the normal matter was not taken into account!

Antimatter is made by accelerating particles and smashing them into each other, a process which requires a very large amount of energy. For this reason, antimatter poses no realistic threat as a tool of destruction, since it requires much more energy to create than is released upon annihilation. This is why it cannot be used as an energy source. In addition, antimatter is not portable in real life, although in the movie, scientists transport it in a canister.

We may note that antimatter has many useful applications too, other than destroying cities. For instance, in PET (positron emission tomography) scans mentioned earlier, a patient is injected with sugar labelled with a radioactive tracer through a vein. The sugar goes to areas in the body with high metabolism, showing places of high activity. Meanwhile, the radioactive portion decays and releases a positron (an anti-electron), which very quickly finds an electron in surrounding tissue, and they annihilate into two gamma-ray photons. With many such photons, doctors can create a 3D image of areas inside the body. Antimatter may also help physicists solve some of the biggest mysteries in science, such as the origins of the universe, why particles have mass, and what the universe is made of.

There is likelihood that movies like *Angels and Demons* could spread wrong notions, at times even misinformation, among the people. But they give an excellent opportunity to science communicators to dispel the myths such movies create, and present science in the correct perspective through lectures, talks, discussions, articles, and programmes on radio and television. In particular, *Angels and Demons* is one of the finest examples where angels and demons both come together and offer a wonderful opportunity to science communicators to speak about the true nature of antimatter (and matter); and generate a fresh interest in science among the people.

Meanwhile, I must admit the movie is quite enjoyable! It may be interesting to note that a physicist at CERN who advised on the *Angels and Demons* movie is rumoured to be the inspiration for Leonardo Vetra, an antimatter scientist in the original story!

□ **Vinay B. Kamble**

## YOUR OPINION

*Dream 2047* has been inviting your opinion on a specific topic every month. The reader sending the best comments will receive a popular science book published by VP. Selected comments received will also be published in *Dream 2047*. The comments should be limited to 400 words.

***This month's topic:***

**"In a multilingual country like India, does teaching of science in regional languages in school facilitate better quality of higher education in science?"**

Response should contain full name; postal address with pincode and email ID, if any; and should be accompanied by a recent passport size photograph. Response may be sent by email (**opinion@vigyanprasar.gov.in**) or by post to the address given below. If sent by post, "**Response: *Dream 2047* July 2009**" should be clearly written on the envelope.

**Vigyan Prasar**
A-50, Institutional Area, Sector-62, NOIDA 201 307
Phone: 91-120-240 4430/35 Fax: 91-120-240 4437
Email: info@vigyanprasar.gov.in Website: www.vigyanprasar.gov.in

## Winners of "Your Opinion" contest for March 2009.

**Topic:** "Do our science students get enough hands-on experience in school to motivate them to take up higher studies and a career in science?"

**1. Shreerang Deshpande,**
Hublikar Plots, Second Cross,
'Shreerang' Bldg.,
Sadhankeri,
Dharwad-580008, Karnataka

"When we look at the past of many of our successful scientists, we find that many of them were either poor and spent most of the time out of school, or haven't even seen what a school is! This means that those who do not spend time in our so-called modern schools can get enough hands-on experience and motivation to go for a career in science. In many of our schools, students are taught only to memorise and not *learn* science, which becomes a huge burden on them. Also, they have to complete all their home work and assignments within a short time, failing which they often get very severe punishments. If this is the case, how can we expect the students to think originally – so essential for doing serious science?"

**2. Jyoti Bhatia**
8, Pradeep Kumar Society, (2nd Floor)
Gabriel Street, Mahim,
Mumbai-400016

"If all schools are not imparting enough hands-on experience, the Education Boards across country should take care to make sure that all schools have proper lab facilities and conduct projects and workshops in science to motivate students in science. Students must be assigned various science projects to work upon for their minds to grow and enable them to take up a career in science."

**3. Atul Mankar**
PGT Biology
Kendriya Vidyalaya Diphu
District: Karbi Anglong
Assam 782460

"Classroom science can bring only boredom. Science is a stepwise study, it has to be experienced, and without experiencing science actually by doing it, we cannot motivate the students towards science as a carrier. Schools should advertise science in the form of science fairs and activities. Students should have good access to international scientific and technical journals and internet."

**The winners will receive a copy of VP Publication**