

## Astrophysical dark matter

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THE 'dark' matter is called 'dark' as it does not radiate or absorb light. It has only gravitation and weak interactions. There are two types of dark matters: the hot dark matter (HDM) and the cold dark matter (CDM). Hot dark matter occurred during the earlier stage of the universe while the cold dark matter occurred later. Examples of cold dark matter may be neutron stars, black holes and brown dwarfs. These objects are not directly observables as they do not emit. But their presence can be detectable due to their strong gravitational effects on the surroundings.

Neutrinos are the hot dark matter. They have extremely low mass and go only the weak interaction. There are many sources of neutrinos in our universe. Our sun is one of the best sources. There are other particles called WIMP also are examples of hot dark matter. WIMP means



CERN Axion Solar Telescope

weakly interacting massive particles. Intensive research is being going on to detect neutrinos and WIMPs. Through CERN Axion Solar Telescope in Switzerland, solar neutrinos are being detected and WIMPs are being detected in Italy through CRESST (Cryogenic Rare Event Search with Superconducting Thermometers).

**CERN Axion Solar Telescope** First evidence for dark matter was formed by Zwicky in galaxy clusters in 1933. In the later 1940s, Gamow, Alpher and Herman predicted cosmic radiation background with temperature of a few Kelvin. Penzias and Wilson in 1965 discovered the cosmic microwave background (CMB). It was later realized

through numerical simulations that cosmological structure formation could be explained with the paradigm of cold dark matter (CDM). This is further confirmed by the cosmic background explorer (COBE) satellite in 1992.

Initially, our universe was smooth and featureless. Then gradually it becomes more and

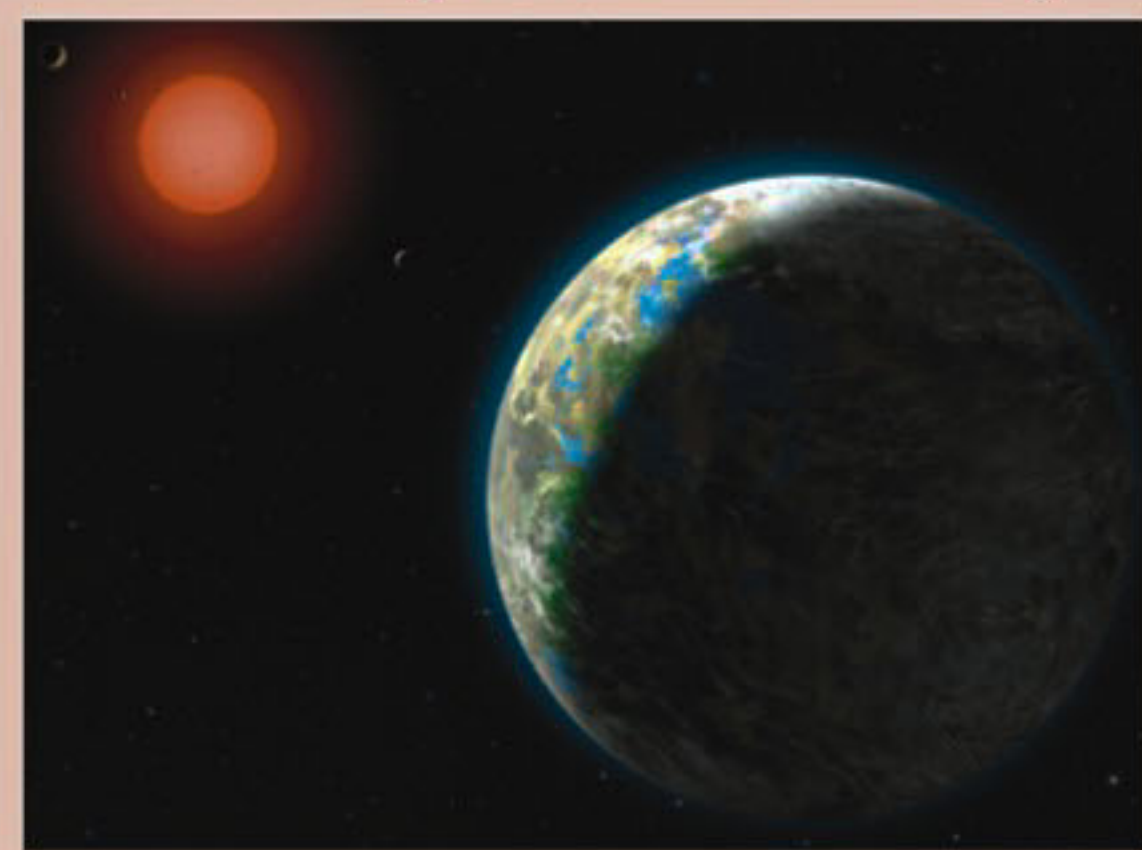
more organized with the formation stars, galaxies and cluster of galaxies. The space between the galaxies is filled with hot gas. This hot gas emits radiations in the x-ray region. By studying the temperature distribution in the hot gas scientists measured how much materials are squeezed due to strong gravity.

It was turn out through this measurement that five time more materials are in the cluster than that predicted by other means. Scientists then concluded that most of the materials in the universe are invisible. This invisible stuff is called 'dark matter' - a term initially coined by Fritz Zwicky who discovered evidence for missing mass in galaxies in the 1930s. There is currently much ongoing research by scientists attempting to discover exactly what this dark matter is, how much there is, and what effect it may have on the future of the Universe as a whole.

The author is a Plasma Physicist and Professor at BRAC University.

### 2010 IN RETROSPECT

#### Planets beyond solar family



THE discovery of a planet orbiting a dim dwarf star about 20 light-years from Earth has encouraged astronomers in their hunt for habitable, and maybe even inhabited, worlds elsewhere in the galaxy astronomers suspect that dozens of potentially habitable worlds will be discovered as the number of known exoplanets continues to climb.

**Dark glimmers** An excess of gamma rays emanating from the galaxy's center may indicate the presence of dark matter, an exotic material that has never been observed but must exist to keep galaxies and galaxy clusters from flying apart.

**LHC revs up** The Large Hadron Collider sets a record for the highest-energy collision of subatomic particles.

**Early light dawns** The Planck spacecraft obtains the sharpest view yet of the early universe while an older craft looking just as far back in time refines the age of the cosmos

**Milky Way bubbles** Astronomers discover two giant blobs of gamma rayemitting gas above and below the galaxy's center, probably produced by the supermassive black hole presumed to lurk there.

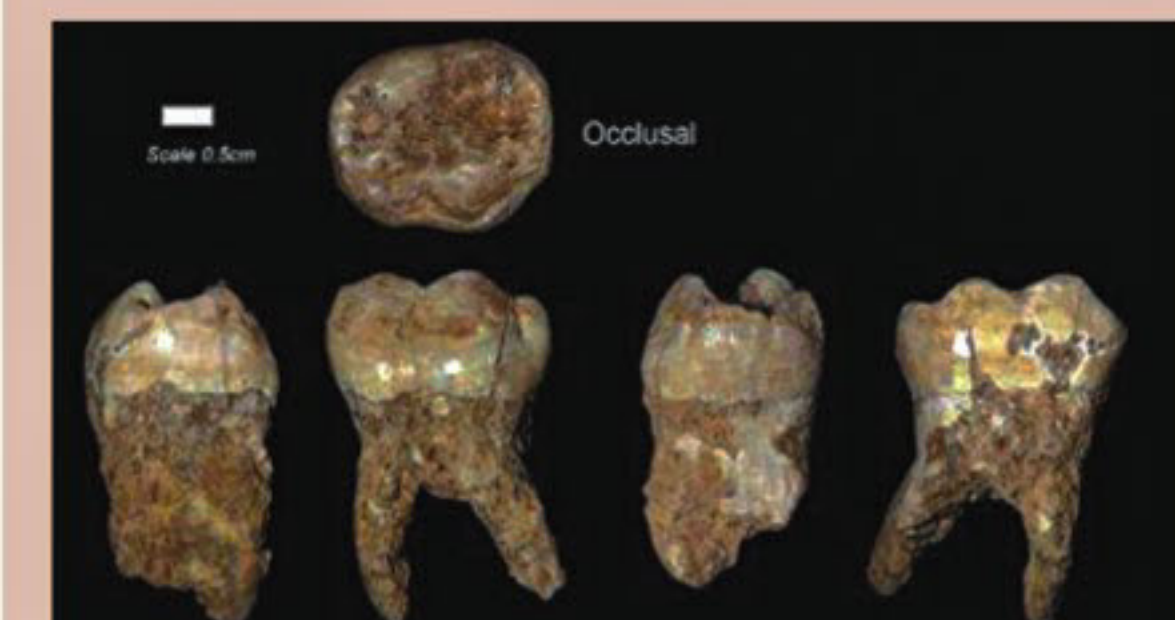
**Full of stars** The abundance of red dwarfs in eight nearby galaxies suggests the stellar population of the universe may be three times current estimates

Source: Science News

### OUR ORIGINAL HOME!

### TRAPPED IN CAMERA

#### Oldest human remains



Human teeth found in the Qesem Cave

ISRAELI archaeologists have discovered human remains dating from 400,000 years ago, challenging conventional wisdom that Homo sapiens originated in Africa, the leader of excavations in Israel said on Tuesday.

Avi Gopher, of Tel Aviv University's Institute of Archaeology, said testing of stalagmites, stalactites and other material found in a cave east of Tel Aviv indicates that eight teeth uncovered there could be the earliest traces so far of our species.

"Our cave was used for a period of about 250,000 years -- from about 400,000 years ago to about 200,000 years ago," he told AFP.

"The teeth are scattered through the layers of the cave, some in the deeper part, that is to say from 400,000 years and through all kinds of other layers that can be up to 200,000 years. The oldest are 400,000 years old", he added."

That calls into question the widely held view that Africa was the birthplace of modern man, said Gopher, who headed the dig at Qesem Cave.

"It is accepted at the moment that the earliest Homo sapiens that we know is in east Africa and is 200,000 years old, or a little less. We don't know of anywhere else where anyone claims to have an earlier Homo sapiens," he said.

Gopher said the first teeth were discovered in 2006 but he and his team waited until they had several samples, then conducted years of testing, using a variety of dating methods, before publishing their findings.

Digging continues at the cave, the university said, with researchers hoping to "uncover additional finds that will enable them to confirm the findings published up to now and to enhance our understanding of the evolution of mankind, and especially the appearance of modern man."

Source: AFP

## Elusive Saharan cheetah

OBAIDUR RAHMAN

THE mysterious Saharan Cheetah is an ultra-secretive elusive creature. A sub-species of cheetah, it is also known as the Northwest African cheetah. It was only back in 2009 that scientists from the Zoological Society of London were able to photograph one for the first time using a nighttime camera trap in the Algerian deserts. And very recently (December, 2010) scientists from the Saharan Conservation Fund (SCF) photographed the wild cat in the deserts of the Termit Massif, Niger. As these cats are very rare, the International Union for Conservation of Nature (IUCN) has classified them as critically endangered species. And naturally the image captured by the scientists from SCF has created a great enthusiasm among the conservationists as many believe that fewer than 10 of such cats survive in the harsh deserts of Termit, Niger. Experts also believe that the total number of Saharan Cheetah (scientific name *Acinonyx jubatus hecki*) is somewhere around 250.

The scientists from the SCF took the photograph of the wild cat as part of the Saharan Carnivore Project (covering an area of 2,800 square kilometers) led by researcher John Newby and Tim Wachter, an effort supported by the University of Oxford. And using spot patterns which are unique to each individual of this cheetah species, this survey identified four different Saharan cheetahs and managed to take the picture of only one.

Now, what is so special about this particular creature? The truth is almost nothing is known about the Saharan cheetah until now. This Northwest African cheetah is found in the Sahara desert and savannahs of North and West Africa including



A camera trap recently captured the elusive Saharan cheetah in a vast desert in Niger, Africa

Algeria, Niger, Mali, Benin, Burkina Faso and Togo. But it is not yet known if Saharan cheetahs are more closely related to other cheetahs in Africa, or those living in Iran, which make up the last remaining wild population of Asiatic cheetahs. It has been found that the Saharan cheetahs are quite different in physical appearance form other common cheetahs with their distinct nearly white color with spot patterns that fade from black over the spine to light brown on the legs. But as far as behavioral pattern is concerned, according to Dr. Thomas Rabeil of SCF, "Very little is known about the behavioral differences between the two cheetahs, as they have never been studied in the wild."

Experts believe that this wild cat endures extremely high temperatures (113 degrees Fahrenheit or 45 degrees Celsius) of the desert and appears to survive without any permanent source of water which is quite extraordinary. Scientists believe that these creatures probably satisfy their water requirements through the moisture in their prey along with having extremely effective physiological and

behavioral adaptive capabilities. Numerous attempts have been made to track down the Saharan cheetahs, most of which are unsuccessful. This clearly suggests that these wild cats roam considerable distances to hunt their preys. These preys include antelopes such as the addax, Dorcas Gazelle, Rhim Gazelle and Dama Gazelle. And it is the indiscriminate poaching of this wild species that has rendered it so endangered. According to John Newby "They are suspected of taking goats and even baby camels (owned by nomad tribes), and as a result are persecuted just like most other large predators". The researcher concludes by adding, "The more we know about the animal, the better we can conserve it, including pinpointing key areas for extra protection. The cheetah's presence adds weight to arguments for the entire zone's protection as a nature reserve and strengthens our ability to raise support for conservation activities".

The contributor is a freelance science writer.

### PLACEBO EFFECT

### DO YOU KNOW?

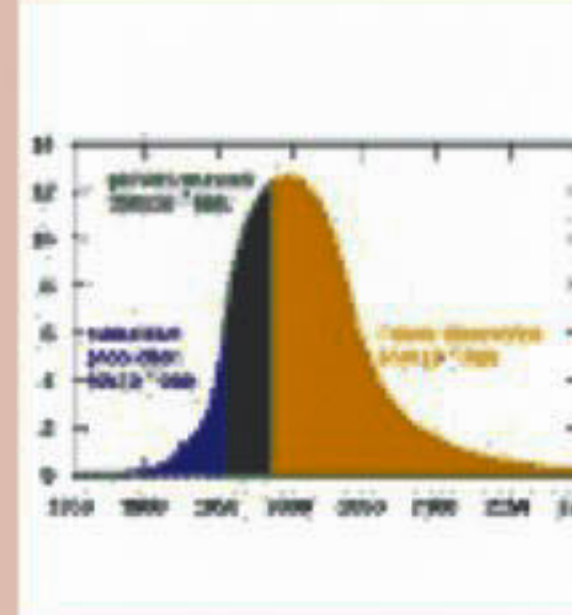
#### The body-mind connection



Medical science is only beginning to understand the ways in which the mind influences the body. The placebo effect, for example, demonstrates that people can at times cause a relief in medical symptoms or suffering by believing the cures to be effective - whether they actually are or not. Using processes only poorly understood, the body's ability to heal itself is far more amazing than anything modern medicine could create.

Source: Live Science

#### What's the Hubbert Peak Theory?



peak oil. The theory is named after American geophysicist M. King Hubbert, who created a method of modeling the production curve given an assumed ultimate recovery volume.

The Hubbert peak theory posits that for any given geographical area, from an individual oil-producing region to the planet as a whole, the rate of petroleum production tends to follow a bell-shaped curve. It is one of the primary theories on

### HOLEY PAST

#### When black hole was born

MOST galaxies in the universe, including our own Milky Way, harbor supermassive black holes varying in mass from about one million to about 10 billion times the size of our sun. To find them, astronomers look for the enormous amount of radiation emitted by gas which falls into such objects during the times that the black holes are "active," i.e., accreting matter. This gas "infall" into massive black holes is believed to be the means by which black holes grow.

Now a team of astronomers from Tel Aviv University, including Prof. Hagai Netzer and his research student Benny Trakhtenbrot, has determined that the era of first fast growth of the most massive black holes occurred when the universe was only about 1.2 billion years old -- not two to four billion years old, as was previously believed -- and they're growing at a very fast rate.

The results will be reported in a new paper soon to appear in The Astrophysical Journal.

The new research is based on observations with some of the largest ground-based telescopes in the world: "Gemini North" on top of Mauna Kea in Hawaii, and the "Very Large Telescope Array" on Cerro Paranal in Chile. The data obtained with the advanced instrumentation on these telescopes show that the black holes that were active when the universe was 1.2 billion years old are about ten times smaller than the most massive black holes that are seen at later times. However, they are growing much faster.

The measured rate of growth allowed the researchers to estimate what happened to these objects at much earlier as well as much later times. The team found that the very first black holes, those that started the entire growth process when the universe was only several hundred million years old, had masses of only 100-1000 times the mass of the sun. Such black holes may be related to the very first stars in the universe. They also found that the subsequent growth period of the observed sources, after the first 1.2 billion years, lasted only 100-200 million years.

Source: Science Daily

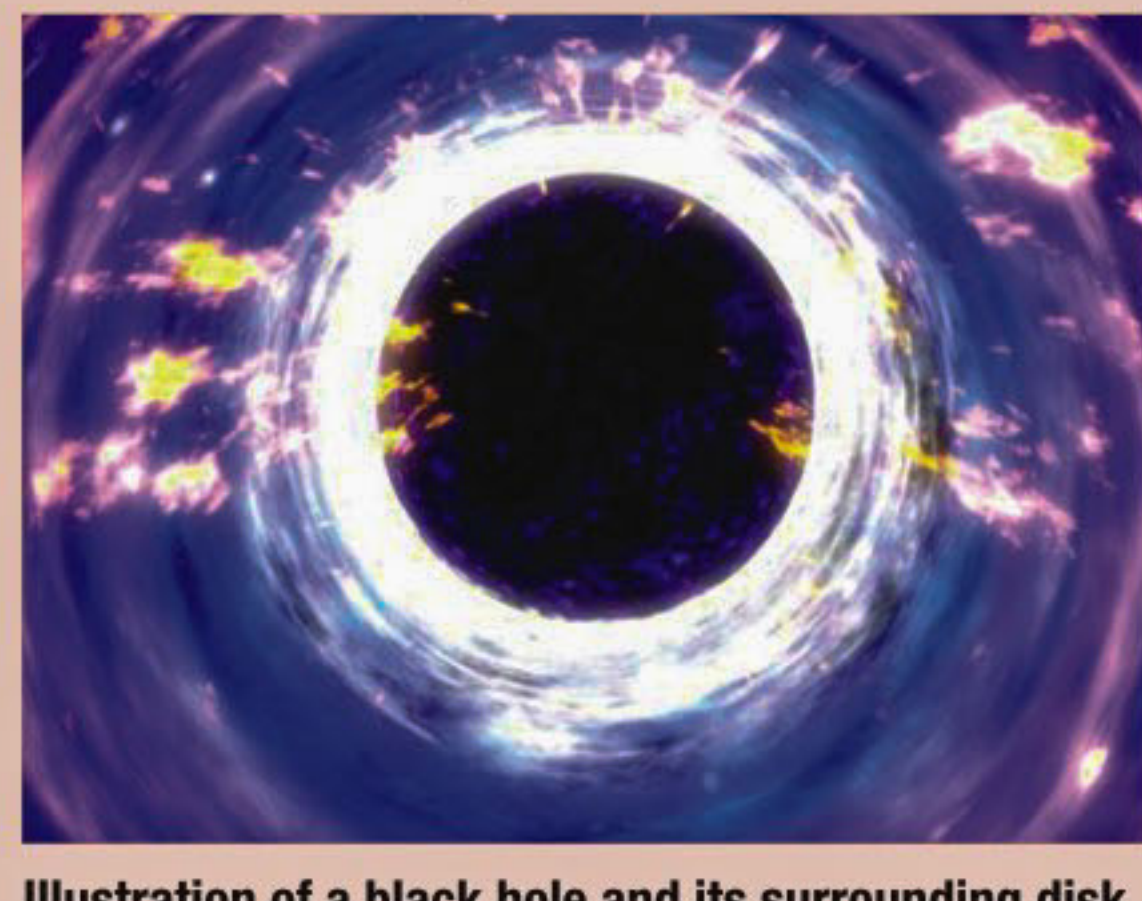


Illustration of a black hole and its surrounding disk