- **Black Holes (Amanda Lear)**
- I'm trying to understand why
  Like a black hole in the sky….
- A door opening on a new dimension…
  It’s another time
  And it's another space
  It’s something that science can't describe
  No one has ever seen (???)
  No one has ever been
  A black hole in the sky, why?

Supermassive black hole at the Galactic Center

- Amanda Lear: A black hole in the sky, why?

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- ***Joint Institute for Nuclear Research, Dubnan high, Russia***

- XXIXth International Workshop High Energy Physics, IHEP, Protvino, Russia
- 28 June, 2013

Outline of my talk

- Introduction
- Crafoord prize and its winners
- Shadows for Kerr as a tool to evaluate BH characteristics
- Shadows around Reissner-Nordstrom BHs
- Observations of BH at Sgr A and a tidal Reissner-Nordstrom BH
- Bright star trajectories around BH at GC as a tool to evaluate BH parameters and DM cluster
- Conclusions

References

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Shadows as a tool to evaluate black hole parameters and a dimension of spacetime

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ABSTRACT

Shadow formation around supermassive black holes were simulated. Due to enormous progress in observational facilities and techniques of data analysis researchers approach to opportunity to measure shapes and sizes of the shadows at least for the closest supermassive black hole at the Galactic Center. Measurements of the shadow sizes around the black holes can help to evaluate parameters of black hole metric. Theories with extra dimensions (Randall–Sundrum II braneworld approach, for instance) admit astrophysical objects (supermassive black holes, in particular) which are rather different from standard ones. Different tests were proposed to discover signatures of extra dimensions in supermassive black holes since the gravitational field may be different from the standard one in the general relativity (GR) approach. In particular, gravitational lensing features are different for alternative gravity theories with extra dimensions and general relativity. Therefore, there is an opportunity to find signatures of extra dimensions in supermassive black holes. We show how measurements of the shadow sizes can put constraints on parameters of black hole in spacetime with extra dimensions.

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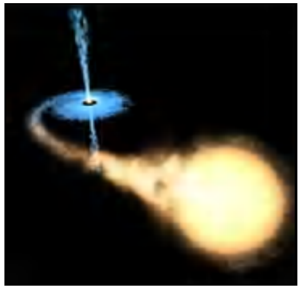
Published online: 31 March 2005; | doi:10.1038/news050328-8

Black holes 'do not exist'

Philip Ball

These mysterious objects are dark-energy stars, physicist claims.

Black holes are staples of science fiction and many think astronomers have observed them indirectly. But according to a physicist at the Lawrence Livermore National Laboratory in California, these awesome breaches in space-time do not and indeed cannot exist.



Black holes, such as the one pictured in this artist's impression, may in fact be pockets of 'dark energy'.

Over the past few years, observations of the motions of galaxies have shown that some 70% the Universe seems to be composed of a strange 'dark energy' that is driving the Universe's accelerating expansion.

George Chapline thinks that the collapse of the massive stars, which was long believed to generate black holes, actually leads to the formation of stars that contain dark energy. "It's a near certainty that black holes don't exist," he claims.

Black holes are one of the most celebrated predictions of Einstein's general theory of relativity, which explains gravity as the warping of space-time caused by massive objects. The theory suggests that

a sufficiently massive star, when it dies, will collapse under its own gravity to a single point.

But Einstein didn't believe in black holes, Chapline argues. "Unfortunately", he adds, "he couldn't articulate why." At the root of the problem is the other revolutionary theory of twentieth-century physics, which Einstein also helped to formulate: quantum mechanics.

> **"It's a near certainty that black holes don't exist."**
>
> George Chapline
> Lawrence Livermore National Laboratory

In general relativity, there is no such thing as a 'universal time' that makes clocks tick at the same rate everywhere. Instead, gravity makes clocks run at different rates in different places. But quantum mechanics, which describes physical phenomena at infinitesimally small scales, is meaningful only if time is universal; if not, its equations make no sense.

This problem is particularly pressing at the boundary, or event horizon, of a black hole. To a far-off observer, time seems to stand still here. A spacecraft falling into a black hole would seem, to someone watching it from afar, to be stuck forever at the event horizon, although the astronauts in the spacecraft would feel as if they were continuing to fall. "General relativity predicts that nothing happens at the event horizon," says Chapline.

Quantum transitions

However, as long ago as 1975 quantum physicists argued that strange things do happen at an event horizon: matter governed by quantum laws becomes hypersensitive to slight disturbances. "The result was quickly forgotten," says Chapline, "because it didn't agree with the prediction of general relativity. But actually, it was absolutely correct."

This strange behaviour, he says, is the signature of a 'quantum phase transition' of space-time. Chapline argues that a star doesn't simply collapse to form a black hole; instead, the space-time inside it becomes filled with dark energy and this has some intriguing gravitational effects.

Outside the 'surface' of a

dark-energy star, it behaves much like a black hole, producing a strong gravitational tug. But inside, the 'negative' gravity of dark energy may cause matter to bounce back out again.

If the dark-energy star is big enough, Chapline predicts, any electrons bounced out will have been converted to positrons, which then annihilate other electrons in a burst of high-energy radiation. Chapline says that this could explain the radiation observed from the centre of our galaxy, previously interpreted as the signature of a huge black hole.

He also thinks that the Universe could be filled with 'primordial' dark-energy stars. These are formed not by stellar collapse but by fluctuations of space-time itself, like blobs of liquid condensing spontaneously out of a cooling gas. These, he suggests, could be stuff that has the same gravitational effect as normal matter, but cannot be seen: the elusive substance known as dark matter.

Top

References

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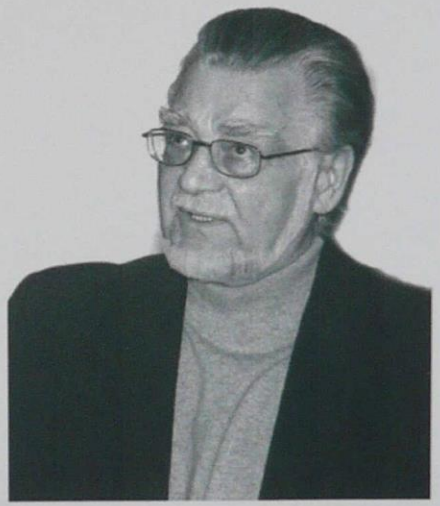
BHs is a consequence of black failure in knowledge of mathematics

шно продолжать заниматься важной и интересной научной работой, не остав-
своих прочих интересов.

Коллеги по кафедре общей ядерной физики

«Черные дыры» — это следсвие черного провала в знаниях математики



общей теории относительности
рждается, что уравнения ОТО со-
кат решения, отвечающие «чер-
дырам». Это некие сферически-
метричные материальные объекты,
редоточенные в области, из которой
жу никакие сигналы выйти не мо-
Они проявляют себя лишь в грави-
ионном взаимодействии с другими
ми. Их внутренняя структура ока-
ается недоступной для изучения. Т.е.
ные дыры» — непознаваемые объ-
!

Эта непознаваемость уже сама по себе
жна была бы вызвать подозрение, так
объект создавался природой по за-
ам причинно-связанных процессов.
жна была бы возникнуть потреб-
ть более внимательно проанализиро-
ход рассуждений, приведших к шварцшильдовскому решению для метриче-
х коэффициентов в галилеевых координатах, содержащему «черные дыры».
Так в чем же там дело? А дело в следующем. При получении решения Шварц-
льда в галилеевых координатах в качестве внешнего решения некоего кусочно-
рерывного линейного дифференциального уравнения второго порядка бралось

Rev. John Michell: *Phil. Trans. R. Soc. London,* ***74****, 35–57 (1784)*:

VII. *On the Means of diſcovering the Diſtance, Magnitude, &c. of the Fixed Stars, in conſequence of the Diminution of the Velocity of their Light, in caſe ſuch a Diminution ſhould be found to take place in any of them, and ſuch other Data ſhould be procured from Obſervations, as would be farther neceſſary for that Purpoſe. By the Rev.* John Michell, *B. D. F. R. S. In a Letter to* Henry Cavendiſh, *Eſq. F. R. S. and A. S.*

Read November 27, 1783.

Rev. John Michell: *Phil. Trans. R. Soc. London,* ***74****, 35–57 (1784)*:

16. Hence, according to article 10, if the ſemi-diameter of a ſphære of the ſame denſity with the ſun were to exceed that of the ſun in the proportion of 500 to 1, a body falling from an infinite height towards it, would have acquired at its ſurface a greater velocity than that of light, and conſequently, ſuppoſing light to be attracted by the ſame force in proportion to its vis inertiæ, with other bodies, all light emitted from ſuch a body would be made to return towards it, by its own proper gravity.

2012 Crafoord Prize in Astronomy Goes to Genzel & Ghez

The Royal Swedish Academy of Sciences has decided to award the Crafoord Prize in Astronomy 2012 to Reinhard Genzel, Max Planck Institute for Extraterrestrial Physics, Garching, Germany and Andrea Ghez, University of California, Los Angeles, USA, "for their observations of the stars orbiting the galactic centre, indicating the presence of a supermassive black hole".

The Dark Heart of the Milky Way

This year's Crafoord Prize Laureates have found the most reliable evidence to date that supermassive black holes really exist. For decades Reinhard Genzel and Andrea Ghez, with their research teams, have tracked stars around the centre of the Milky Way galaxy. Separately, they both arrived at the same conclusion: in our home galaxy resides a giant black hole called Sagittarius A*.

Reinhard Genzel, Prof. Dr.
Max Planck Institute for Extraterrestrial Physics, Garching

Curriculum Vitae

Born on March 24, 1952 in Bad Homburg v.d.H. Study of physics Bonn Univ., doctorate Max Planck Institute for Radioastronomy Bonn (1978), Postdoctoral Fellow, Harvard-Smithsonian Center for Astrophysics (1978-1980), Cambridge, MA, Associate Professor of Physics and Associate Research Astronomer, Space Sciences Laboratory, University of California, Berkeley (1981- 1985), Full Professor of Physics, University of California, Berkeley (1985-1986), Director and Scientific Member at the Max Planck Institute for Extraterrestrial Physics (since 1986), Honorary Professor Munich Univ. (since 1988), Full Professor of Physics University of California Berkeley (since 1999).

American citizen. Born 1965 in New York City, NY, USA. Ph.D. 1992 at California Institute of Technology, Pasadena, CA, USA. Professor at University of California, Los Angeles, CA, USA.

The Anna-Greta and Holger Crafoord Fund

PHOTO: MARKUS MARCETIC

BACK ROW: LENNART NILSSON, WALTER FISCHER, GUNNAR ÖQUIST, GEORGIA DESTOUNI, SVANTE LINDQVIST. **FRONT ROW:** MARGARETA NILSSON, WALTER MUNK, H.M. KING CARL XVI GUSTAF, H.M. QUEEN SILVIA, EBBA FISCHER.

The Fund was established in 1980 by a donation to the Royal Swedish Academy of Sciences from Anna-Greta and Holger Crafoord. The Crafoord Prize was awarded for the first time in 1982. The purpose of the Fund is to promote basic scientific research worldwide in the following disciplines:

ASTRONOMY AND MATHEMATICS

GEOSCIENCES

BIOSCIENCES WITH EMPHASIS ON ECOLOGY

POLYARTHRITIS

Support to research takes the form of an international prize awarded annually to outstandig scientists, and of research grants to individuals or institutions in Sweden. Both awards and grants are made according to the following order:

year 1: Astronomy and Mathematics
year 2: Geosciences
year 3: Biosciences
year 4: Astronomy and Mathematics
year 5: Geosciences
year 6: Biosciences
etc.

Prizes awarded

The Crafoord Prize has been awarded:

PHOTO: MARKUS MARCETIC

WALTER MUNK

2010 **Walter Munk**, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA, USA, "*for his pioneering and fundamental contributions to our understanding of ocean circulation, tides and waves, and their role in the Earth's dynamics*".

TOSHIO HIRANO CHARLES DINARELLO TADAMITSU KISHIMOTO

2009 **Charles Dinarello**, University of Colorado School of Medicine, Denver, USA, **Tadamitsu Kishimoto**, Osaka University, Japan and **Toshio Hirano**, Osaka University, Japan, "*for their pioneering work to isolate interleukins, determine their properties and explore their role in the onset of inflammatory diseases*".

MAXIM KONTSEVICH (LEFT) AND EDWARD WITTEN (RIGHT)

2008 **Maxim Kontsevich**, IHÉS, France, and **Edward Witten**, Institute forAdvanced Study, USA, "*for their important contributions to mathematics inspired by modern theoretical physics*", and **Rashid Alievich Sunyaev**, Max Planck Institute for Astrophysics, Germany, "*for his decisive contributions to high-energy astrophysics and cosmology, in particular processes and dynamics around black holes and neutron stars and demonstration of the diagnostic power of structures in the background radiation*".

1993 **SEYMOUR BENZER**, California Institute of Technology, USA, "*for his pioneering genetical and neurophysiological studies on behavioural mutants in the fruit fly, Drosophila melanogaster*", and **WILLIAM D. HAMILTON**, University of Oxford, UK, "*for his theories concerning kin selection and genetic relationship as a prerequisite for the evolution of altruistic behavior*".


SEYMOUR BENZER

1992 **ADOLF SEILACHER**, Institut und Museum für Geologie und Paläontologie, Germany, "*for his innovative research concerning the evolution of life in interaction with the environment as documented in the geological record*".

1991 **ALLAN R. SANDAGE**, The Observatories of the Carnegie Institution of Washington, USA, "*for his very important contributions to the study of galaxies, their populations of stars, clusters and nebulae, their evolution, the velocity-distance relation (or Hubble relation), and its evolution over time*".


ALLAN R. SANDAGE

1990 **PAUL R. EHRLICH**, Stanford University, USA, "*for his research on the dynamics and genetics of fragmented populations and the importance of the distribution pattern for their survival probabilities*", and **EDWARD O. WILSON**, Harvard University, USA, "*for the theory of island biogeography and other research on species diversity and community dynamics on islands and in other habitats with differing degrees of isolation*".

1989 **JAMES VAN ALLEN**, University of Iowa, USA, "*for his pioneering exploration of space, in particular the discovery of the energetic particles trapped in the geomagnetic field which forms the radiation belts – the Van Allen belts – around our planet Earth*".

1988 **PIERRE DELIGNE**, Institute for Advanced Study, USA, and **ALEXANDRE GROTHENDIECK**, Université des Sciences et Techniques du Languedoc, France, "*for their fundamental research in algebraic geometry*". (Mr Grothendieck declined his prize.)

1999 **John Maynard Smith**, University of Sussex, Great Britain, **Ernst Mayr**, Harvard University, Cambridge MA, USA, and **George C. Williams**, State University of New York, USA, "*for their fundamental contributions to the conceptual development of evolutionary biology*".

ERNST MAYR

1998 **Don L. Anderson**, California Institute of Technology, Pasadena CA, USA, and **Adam M. Dziewonski**, Harvard University, Cambridge MA, USA, "*for their fundamental contributions to our knowledge of the structures and processes in the interior of the Earth*".

1997 **Fred Hoyle**, UK and **Edwin E. Salpeter**, Cornell University, Ithaca, NY, USA, "*for their pioneering contributions to the study of nuclear processes in stars and stellar evolution*".

1996 **Lord Robert M. May**, University of Oxford, UK, "*for his pioneering ecological research concerning theoretical analysis of the dynamics of populations, communities and ecosystems*".

LORD ROBERT M. MAY

1995 **Willi Dansgaard**, Københavns Universitet, Denmark, and **Nicholas Shackleton**, University of Cambridge, UK, "*for their fundamental work on developing and applying isotope geological analysis methods for the study of climatic variations during the Quaternary period*".

WILLI DANSGAARD (LEFT) AND NICHOLAS SHACKLETON (RIGHT)

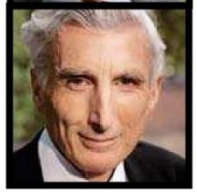
1994 **Simon Donaldson**, University of Oxford, UK, "*for his fundamental investigations in four-dimensional geometry through application of instantons, in particular his discovery of new differential invariants*", and **Shing-Tung Yau**, Harvard University, USA, "*for his development of non-linear techniques in differential geometry leading to the solution of several outstanding problems*".

2007 **Robert L. Trivers**, Rutgers University, USA, for his fundamental analysis of social evolution, conflict and cooperation.

ROBERT L. TRIVERS

2006 **Wallace S. Broecker**, Lamont-Doherty Earth Observatory, Columbia University, USA, "*for his innovative and pioneering research on the operation of the global carbon cycle within the ocean atmosphere-biosphere system, and its interaction with climate*".

2005 **James E. Gunn** and **P. James E. Peebles**, Princeton University, USA, and **Sir Martin J. Rees**, Cambridge University, UK, "*for contributions towards understanding the large-scale structure of the Universe*".



P. JAMES E. PEEBLES (ABOVE) AND LORD MARTIN J. REES

2004 **Eugene C. Butcher**, Stanford University, USA, and **Timothy A. Springer**, Harvard Medical School, USA, "*for their studies on the molecular mechanisms involved in migration of white blood cells in health and disease*".

2003 **Carl R. Woese**, University of Illinois, USA, "*for his discovery of a third domain of life*".

2002 **Dan P. McKenzie**, University of Cambridge, UK, "*for fundamental contributions to the understanding of the dynamics of the lithosphere, particularly plate tectonics, sedimentary basin formation and mantle melting*".

2001 **Alain Connes**, IHÉS and Collège de France, Paris, "*for his penetrating work on the theory of operator algebras and for having been a founder of the non-commutative geometry*".

2000 **Ravinder N. Maini** and **Marc Feldmann**, both of the Kennedy Institute of Rheumatology, London, UK, "*for their definition of TNF-alpha as a therapeutic target in rheumatoid arthritis*".