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ET press release: Press results

20. Oktober 2008

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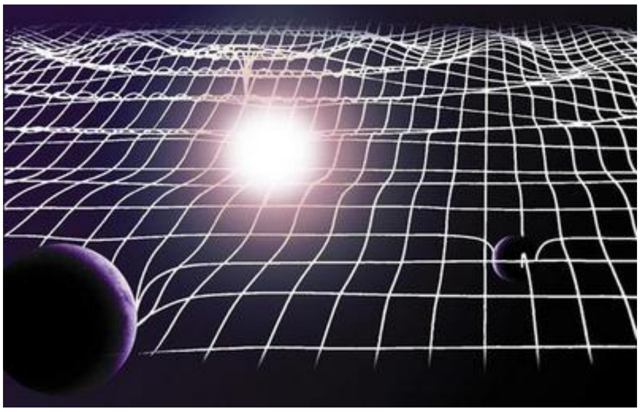
20.10.2008 Startblatt

Hannover: Albert-Einstein-Institut an Entwicklungsstudie zum Einstein-Teleskop beteiligt



Bildquelle: (c) infn.it - Die Europäische Kommission hat drei Millionen Euro für eine Entwicklungsstudie zum Einstein-Teleskop bereitgestellt, an der sich auch das Albert-Einstein-Institut beteiligt.

Die Europäische Kommission hat jetzt im Zuge des 7. Rahmenprogramms (FP7) drei Millionen Euro für eine Entwicklungsstudie zum Einstein-Teleskop (ET) – ein pan-europäisches Gravitationswellen-Observatorium – bereitgestellt und hat damit einen entscheidenden Schritt zur Beobachtung des Universums mit Gravitationswellen getan. Sie unterstreicht mit dieser Förderung die Bedeutung der Gravitationswellenforschung für die Grundlagen- und die angewandte Forschung in Europa. “Mit dieser Entscheidung erkennt die Europäische Kommission die Erfolge der Gravitationswellenobservatorien GEO600 und Virgo an und ebnet den Weg zum ersten pan-europäischen Gravitationswellendetektor”, so Jacques Colas, Direktor des Europäischen Gravitationswellenobservatoriums (EGO) und Projektkoordinator der Entwicklungsstudie für das Einstein-Teleskop. Das Einstein-Teleskop ist eines der sogenannten “Glorreichen Sieben” in Europa und damit eines der Projekte, die vom ASPERA-Netzwerk für die zukünftige Entwicklung der Astroteilchenphysik in Europa empfohlen werden.

Gravitationswellen sind winzige Verzerrungen der Raumzeit, die schon von Albert Einstein vorhergesagt wurden. Sie direkt zu messen, ist eine der wichtigsten und grundlegendsten Herausforderungen der modernen Physik. Die direkte Beobachtung von Gravitationswellen wird völlig neue Einblicke in unser Universum ermöglichen, bis hin zu seiner Entstehung. Keine andere Technologie eröffnet diese Möglichkeiten.

Das Projekt Einstein-Teleskop (ET)

ET ist ein gemeinsames Projekt von acht europäischen Forschungsinstituten. Die Federführung hat EGO, ein italienisch-französisches Konsortium mit Sitz in der Nähe von Pisa (Italien) übernommen. Neben EGO sind beteiligt: Das Instituto Nazionale di Fisica Nucleare (INFN) aus Italien, das französische Centre National de la Recherche Scientifique (CNRS), das deutsche Albert-Einstein-Institut (AEI) an der Leibniz Universität Hannover, die Universitäten von Birmingham, Cardiff und Glasgow aus Großbritannien sowie die Niederländische Vrije Universiteit Amsterdam.

Die jetzt von der Europäischen Kommission bereitgestellten Mittel werden im Laufe der nächsten drei Jahre für eine Entwicklungsstudie für das Einstein-Teleskop verwendet. Diese Entwicklungsstudie ist ein wichtiger Schritt zur dritten Generation von Gravitationswellenobservatorien. Ziel der Studie ist, die Anforderungen an den Standort für ET, die benötigte Infrastruktur und nicht zuletzt das Gesamtbudget zu definieren.

Michele Punturo, Wissenschaftskoordinator der Studie sagt dazu: “Während die ersten beiden Detektorgenerationen das Feld für die Gravitationswellenastronomie bereits eröffnen werden, erwarten wir von der dritten Generation ein Observatorium, das hundert Mal empfindlicher ist als die gegenwärtigen Detektoren. Auf diese Weise vergrößert sich das beobachtbare Volumen des Universums um den Faktor eine Million.” Zudem wird man das gesamte auf der Erde messbare Frequenzspektrum von 1 Hz bis 10 kHz erfassen können. “Dadurch wird ET eine neue Tür in der Gravitationswellenforschung aufstoßen”, so Punturo weiter. Dieses anspruchsvolle Ziel wird durch die Kombination aller gegenwärtig bekannten Technologien in einem einzigen Observatorium erreicht.

Harald Lück vom AEI an der Leibniz Universität Hannover, stellvertretender wissenschaftlicher Koordinator der Studie und Leiter der derzeitigen technologischen Upgrades des deutsch-britischen Detektors GEO600 ergänzt: “Das Einstein-Teleskop ist ein gemeinsamer Plan aller europäischen Gravitationswellenforscher. Er ist mit den Projekten unserer amerikanischen Partner gut synchronisiert, von den gegenwärtigen Detektoren über die Observatorien der zweiten Generation – die in den nächsten Jahren Daten erheben werden – bis hin zum Einstein-Teleskop.”

“Die Beobachtung von Gravitationswellen wird, zusätzlich zur Bestätigung der Allgemeinen Relativitätstheorie, andere weitreichende Konsequenzen haben: Zum ersten Mal werden wir einen Blick in die “Kinderstube” unseres Universums werfen können”, so Harald Lück. Bisher kann der Himmel nur im elektromagnetischen Spektrum (z.B. Radiowellen, Röntgenstrahlung und sichtbares Licht) sowie durch die Analyse kosmischer Strahlen und Neutrinos beobachtet werden. Über die Anfangszeit unseres Universums vom Urknall bis 380.000 Jahre danach geben diese Methoden keinen Aufschluss, da das Universum erst dann durchlässig für elektromagnetische Strahlung wurde. Die verschiedenen Theorien über das frühe Universum konnten bisher also nicht experimentell verifiziert werden. Mit der direkten Beobachtung von Gravitationswellen wird es nun aller Voraussicht nach erstmals möglich sein, bis in die erste Trillionstel Sekunde nach dem Urknall zurück zu „lauschen“. Damit werden völlig neue Informationen über das Universum zugänglich sein – die Gravitationswellenastronomie wird der Wissenschaft also vollkommen neue Bereiche eröffnen.

Das globale Netzwerk

Die Gravitationswellenforschung ist eine globale Herausforderung, denn viele Quellen von Gravitationswellen können nur dann genau untersucht werden, wenn mehrere Interferometer an verschiedenen Orten gleichzeitig Daten aufnehmen. Daher arbeiten die amerikanischen und europäischen WissenschaftlerInnengruppen seit langem eng zusammen: im Bereich der Technologieentwicklung, bei der Entwicklung von Methoden der Numerischen Relativitätstheorie – also beispielsweise der Simulation von Gravitationswellensignalen – sowie bei der Entwicklung neuer Methoden und Werkzeuge für die Datenanalyse. Das Gemeinschaftsprojekt ET wird diese weltweite Kollaboration noch weiter stärken.

Status der jetzt laufenden Detektoren

Gegenwärtig arbeiten in Europa mehrere Gravitationswellendetektoren der ersten Generation: Das deutsch-britische Observatorium GEO600 wird, finanziert von Science and Technology Facilities Council (STFC), Max Planck Gesellschaft (MPG) sowie dem Land Niedersachen, in der Nähe von Hannover betrieben, das französisch-italienisch-niederländische Virgo-Projekt ist in Cascina bei Pisa angesiedelt. Die Daten dieser Interferometer werden mit denen der drei amerikanischen LIGO-Interferometer zusammengeführt. Im gesamten Datenpool wird derzeit nach Gravitationswellensignalen aus astrophysikalischen Systemen gesucht.

Die Suchmethoden, mit denen die Datensätze nach Gravitationswellensignalen durchforstet werden und die in der Analyse verwendeten Algorithmen sind das Ergebnis vieler Jahre Forschungs- und Entwicklungsarbeit in Europa und den USA. Heute werden auf der internationalen Suche nach den ersten direkten Gravitationswellensignalen viele der Datenanalyseteams von europäischen WissenschaftlerInnen geleitet.

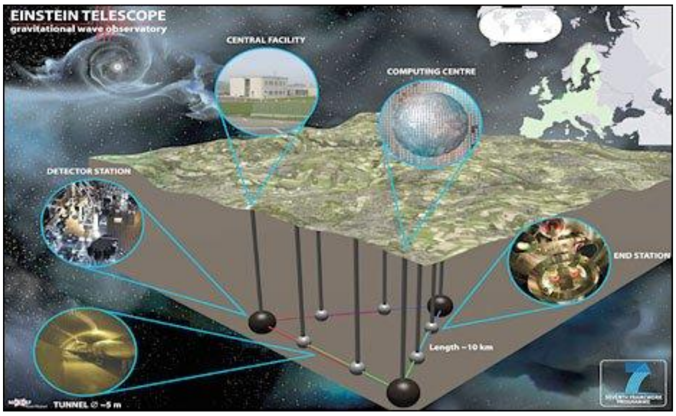
Im Laufe des nächsten Jahrzehnts werden alle interferometrischen Gravitationswellendetektoren zu Instrumenten der zweiten Generation aufgerüstet. Die Empfindlichkeit von Virgo und LIGO in den tieferen Frequenzen (bis etwa ein Kilohertz) wird durch den Einsatz von Technologien, die unter anderem in Europa entwickelt wurden, etwa verzehnfacht. GEO600 wird insbesondere in der Breitband-Beobachtung von hohen Frequenzen Pionierarbeit leisten, auch hier durch die Entwicklung und den Einsatz neuer Technologien. Sollten die derzeit arbeitenden Instrumente nicht die ersten direkten Nachweise von Gravitationswellen erbringen, wird dies mit großer Sicherheit von der zweiten Detektorgeneration erwartet.

ET passt gut in dieses Szenario. Nach dem Abschluss der Entwicklungsstudie und der folgenden technischen Vorbereitungsphase könnte voraussichtlich 2017 oder 2018 mit dem Bau begonnen werden, nachdem die Instrumente der zweiten Generation ihre Arbeit aufgenommen haben. An der für die dritte Detektorengeneration erforderlichen Technologie wird in zahlreichen Ländern innerhalb und außerhalb Europas geforscht, auch in den USA und Japan. Alle Detektoren der dritten Generation, die irgendwann einmal gebaut werden, werden eng zusammenarbeiten müssen, genau wie die Detektoren der früheren Generationen.

http://www.startblatt.net/news/de/20081020135163353

20.10.2008 BBC News

The universe and how it began...
Scientists in Cardiff are working what the Einstein Telescope will be able to do. Graphic courtesy of Cardiff University



Einstein Telescope project (Graphic courtesy of Cardiff University)

Scientists in Wales are hoping their research will help reveal information about the origins of the universe.
Professor Bangalore Sathyaprakash of Cardiff University said he and his team were in the early stages of work which could help unlock its secrets.
The physicists are part of the Einstein Telescope project, which has just received 3m euros for its design stage.

It is the first stage of European research that could be as significant as the Big Bang experiment in Geneva. Prof Sathyaprakash, from the university's school of physics and astronomy, said the work would lead to the building of "a third-generation gravitational wave observatory" which would help scientists gain a better understanding of the universe.

Gravitational waves are triggered by the movement of massive objects in space, such as the collision of stars and the vibrations from black holes.
The waves were predicted in 1916 by Albert Einstein as part of his theory of general relativity, but have not yet been detected directly.

> *"In five to seven years I think we will be big news"*
> *Professor Sathyaprakash, Cardiff University*

"I think it's going to be very exciting for both Cardiff and our own group here," he said. "It's at the cutting edge. It's at the forefront of physics research. "When built, the underground detector would be comparable to Cern (the European Organization for Nuclear Research) in size and the quality of science it promises to deliver, although the cost is probably much smaller since our tunnels will be empty except for a powerful laser going up and down."

The Large Hadron Collider on the Swiss-French border is re-creating conditions just after the Big Bang in an attempt to answer fundamental questions of science and the universe itself. The collider is currently shut off until next year while engineers investigate a magnet failure.

Professor Sathyaprakash said his "dream" was to create a "Cern-like facility for gravitational radiation". He is leading the design study to decide exactly what the Einstein Telescope will be able to do and how it will be set up. "The ultimate goal of any gravitational wave detector or telescope is to look at the birth of the universe," he said.

Black Holes
"In five to seven years I think we will be big news when current detectors will be upgraded to 10 times better sensitivity than they are today to advanced detectors, and make the first direct detection of gravitational waves. "Einstein Telescope will go beyond the advanced detectors and should help us understand the origins of the universe and its workings far better than we are able to do today." Prof Sathyaprakash said the research would also help reveal information about ultra-dense nuclear matter, the warping of space and time close to Black Holes and gamma ray bursts.

The team at Cardiff has received a 300,000 euros share of the 3m euros to work on this first stage. Other research institutes from England, Scotland, Germany, Italy, Holland and France are involved in the project. The design study will take three years and scientists hope the Einstein Telescope will be ready some time about 2020.

http://news.bbc.co.uk/2/hi/uk_news/wales/south_east/7674761.stm

19.10.2008 Gair Rhydd

Cardiff University students take part in the Einstein Telescope project

Scientists from the school of Physics and Astronomy will coordinate Work Package 4, which will make up part of the worldwide project.

Professor Sathyaprakash, who is heavily involved with the project explained: " The Einstein Telescope will help us explore geometry of space time near black holes, solve the enigma of gamma-ray bursts and provide insight into the problem of dark matter and dark energy – believed to make up most of the mass in the Universe."

The students involved in Work package 4 deals with the working out of different geometric, mechanical and optical configurations of the Einstein telescope.

The professor congratulated Cardiff students, he said: "It is incredibly exciting that Wales-based physicists will play such a central role in bringing Europe to the forefront of the most promising new development."

http://www.gairrhydd.com/news/878/cardiff-students-look-to-einstein-in-telescope-project

17.10.2008 Wales Online

Welsh scientists probe beginning of time

By Sally Williams, Western Mail

A TEAM of Welsh academics is helping to design a revolutionary telescope in a quest to find out how the universe began.

They believe the telescope would make it possible to measure distance and time between cosmic forces far more accurately than ever before – right back to when life began in the Big Bang. The team, from Cardiff University, has been given a share of 3m (£2.3m) through the European Commission FP7 programme for preliminary studies for the Einstein Telescope (ET). The telescope will be built "virtually" on computers before it is decided where to create the real thing.

Bangalore Sathyaprakash, professor and head of Gravitational Physics at Cardiff University, said his 20-strong team aimed to help design the telescope to explore the universe with gravitational waves. "The direct detection of gravitational waves – tiny distortions of space-time predicted by Albert Einstein – is one of the most important and fundamental research areas of modern science," he said. "Their direct observation will allow us totally new insights into our universe inaccessible to any other technology – including clues as to its very beginning. "It is very exciting for us because it will be our chance to put Einstein's Theory of Gravity to the ultimate test possible," he said.

The telescope will not be a conventional one looking out to space but will be a gravitational wave detector. It will be underground and triangular in shape, with sides that are 10km long, with a moving laser. Prof Sathyaprakash explained: "In past centuries, when engineers were building dams or bridges, it was very important for them to have an accurate measure of distances between parts. "Now, if we are to understand the dimensions of the universe, where it comes from and where it is going, we need to be able to measure distance very accurately too. "Gravity is very weak, you only have to jump to see that and it is hard to detect. "We hope the telescope will have the power and sensitivity to detect gravitational radiation that Einstein says is produced by anything that moves and accelerates. We want to look at stellar objects in infancy.
We want to study the origin of Gamma Ray Bursts that emit more energy in a few seconds than a star does in a lifetime. When black holes collide it is the most luminous event you will ever see. We hope the telescope will tell us how black holes interact with each other."

The European Commission said gravitational wave research is important for basic and applied scientific research in Europe. Michele Punturo, scientific coordinator of the ET design study, said: "We expect this third-generation observatory to be 100 times more sensitive than current detectors. The observable volume of the universe will increase by a factor of a million."

ET is a joint project of eight European research institutes, including the Universities of Birmingham and Glasgow from the UK. The funds granted now by the European Commission will be used in a design study for ET over the next three years.

"Observation of gravitational waves would have far-reaching consequences, aside from verifying the General Theory of Relativity: It would become possible to cast an eye on the 'early childhood' of our universe for the first time," added Harald Lück, deputy scientific co-ordinator of the ET Design Study.

"The information thus available to us can reach us from the past only from a time at least 380,000 years after the Big Bang. Epochs dating back further have remained hidden, as the universe became transparent for electromagnetic radiation only at that time. The various theories on the early universe have therefore remained unverified experimentally.

"The direct measurement of gravitational waves may allow 'listening' back as far as the very first trillionth of a second following the Big Bang: This would give us totally new information about our universe: with gravitational wave astronomy, totally new areas of science will become accessible."

http://www.walesonline.co.uk/news/wales-news/2008/10/17/welsh-scientists-probe-beginning-of-time-91466-22054165/

<u>17.10.2008 Wales Online</u>

Scientists aim telescope at the Big Bang

By Sally Williams, South Wales Echo

CARDIFF researchers are helping to design a revolutionary Einstein Telescope that aims to see right back in time – as far back as the Big Bang.

They believe the telescope would make it possible to measure distance and time between cosmic forces such as black holes, far more accurately than ever before.

The team from Cardiff University have been given a share of 3m (£2.3m) through a European Commission programme for studies for the Einstein Telescope (ET).

Bangalore Sathyaprakash, Professor and head of Gravitational Physics at Cardiff University, said his 20-strong team aim to help the telescope to explore the universe with gravitational waves.

"The direct detection of gravitational waves – tiny distortions of space-time predicted by Albert Einstein – is one of the most important and fundamental research areas of modern science," he said.

"Their direct observation will allow us totally new insights into our universe inaccessible to any other technology - including clues as to its very beginning.

"It is very exciting for us because it will be our chance to put Einstein's Theories to the ultimate test possible."

Harald Lück, deputy scientific coordinator of the ET Design Study, added: "Observation of gravitational waves would have far-reaching consequences, aside from verifying the General Theory of Relativity: It would become possible to cast an eye on the 'early childhood' of our universe for the first time.

"The information currently available to us can reach us from the past, only from a time at least 380,000 years after the Big Bang."

http://www.walesonline.co.uk/news/wales-news/2008/10/17/scientists-aim-telescope-at-the-big-bang-91466-22052742/

Uni-Physiker tüfteln an „Einstein-Teleskop“

Hannovers Forscher wollen Gravitationswellendetektor der Zukunft bauen / Partner in europäischer Projektstudie

VON JULIANE KAUNE

Der Name ist Programm: „Einstein-Teleskop“ wird die zukunftsweisende Apparatur heißen, die Schwerkraftwellen im All nachspüren soll, deren Existenz Albert Einstein vorausgesagt hatte. An der Entwicklung dieses völlig neuartigen Gravitationswellen-Observatoriums der dritten Generation wirken die Physiker der Leibniz-Uni ganz entscheidend mit. Das Team um Prof. Karsten Danzmann ist eine von acht europäischen Forschergruppen, die die Vorarbeiten für das hochempfindliche Teleskop leisten werden, das voraussichtlich 2018 in Betrieb gehen soll. Mit drei Millionen Euro fördert die Europäische Kommission die dreijährige Projektstudie. Und schon jetzt gilt als sicher, dass die Uni-Physiker das technische Innenleben des Super-Teleskops in ihrem bestehenden Observatorium „Geo 600“ in Ruthe bei Sarstedt testen werden.

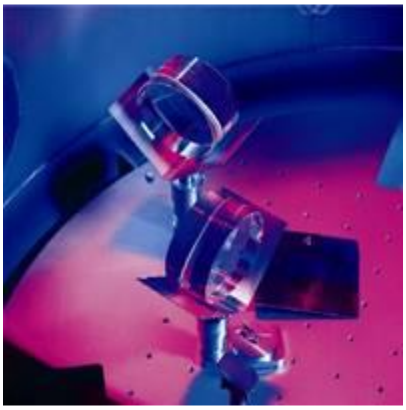
Mit dem „Einstein-Teleskop“, kurz ET genannt, wollen die Forscher in ganz neue Dimensionen vordringen. Im Vergleich zu den Gravitationswellendetektoren, die bereits in Betrieb sind, sei ET rund 100-mal empfindlicher, erklärt Danzmann: „Auf diese Weise vergrößert sich das beobachtbare Volumen des Universums um den Faktor eine Million.“ Das bedeute, dass die Forscher auf ihrer Suche nach den Ursprüngen des Alls künftig in völlig ungeahnte Weiten vorstoßen werden.

An der Projektstudie sind auch Wissenschaftler aus Italien, Frankreich, Großbritannien und den Niederlanden beteiligt. Ziel ist es, mit ET ein gemeinsames europäisches Observatorium zu entwickeln – in Absprache mit Kollegen in den USA, die den Gravitationswellen ebenfalls auf der Spur sind. Die Studie soll dazu beitragen, die Standortbedingungen, die benötigte Infrastruktur und das Gesamtbudget für ET zu ermitteln. Danzmann hält es für möglich, dass das Super-Teleskop, das vermutlich unter der Erde gebaut wird, in einem der früheren Salzlager in Norddeutschland errichtet werden könnte. In fünf Jahren würden in kleinerem Maßstab erste Prototypen für ET fertig sein, schätzt er. Diese sollten dann in „Geo“ eingesetzt und weiterentwickelt werden. Der Detektor in Ruthe gilt seit Jahren als Erprobungsinstrument für die jeweils neueste Generation der Observatorien.

Aus dem Fördertopf der Europäischen Kommission erhalten die hannoverschen Forscher zunächst rund 400 000 Euro. Davon könnten drei neue Wissenschaftler eingestellt werden, sagt Danzmann.

17.10.2008 Innovatives Niedersachsen

Universität Hannover an Horchposten im All beteiligt



Forscher der Leibniz Universität Hannover sind Einstein dicht auf den Fersen. Sie wirken an der Entwicklung eines neuartigen Gravitationswellen-Observatoriums mit, mit dem die Wissenschaftler erstmals einen Blick in die Kinderstube unseres Universums werfen wollen. Das so genannte Einstein-Teleskop ist ein gemeinsames Projekt von acht europäischen Forschungsinstituten; eine vorbereitende Entwicklungsstudie wird jetzt mit drei Millionen Euro von der Europäischen Union gefördert.

Gravitationswellen sind winzige Verzerrungen der Raumzeit, die schon 1915 von Albert Einstein vorhergesagt wurden. Sie künden von Sternexplosionen, vom Zusammenprall Schwarzer Löcher und sogar vom Urknall selbst. Sie direkt zu messen, ist eine der wichtigsten und grundlegendsten Herausforderungen der modernen Physik, denn bisher kann der Himmel nur im elektromagnetischen Spektrum (zum Beispiel Radiowellen, Röntgenstrahlung und sichtbares Licht) sowie durch die Analyse kosmischer Strahlen und Neutrinos beobachtet werden. Diese Methoden geben aber keinen Aufschluss über die Anfangszeit des Universums. Mit der direkten Beobachtung von Gravitationswellen wollen die Wissenschaftler erstmals bis in die Zeit direkt nach dem Urknall zurück horchen.

Das Albert-Einstein Institut an der Universität Hannover ist an dem Gemeinschaftsprojekt mit seinem Observatorium GEO 600 beteiligt – ein deutsch-britischer Gravitationswellendetektor, der in Ruthe bei Sarstedt betrieben wird. Hier sollen die Forscher das Innenleben des Einstein-Teleskops der dritten Generation testen. Die europäische Neuentwicklung wird 100-mal empfindlicher sein als die gegenwärtigen Detektoren und vergrößert das beobachtbare Volumen des Universums um den Faktor eine Million. Zudem wird das gesamte messbare Frequenzspektrum von 1 Hertz bis zu 10 Kilohertz erfasst. Dadurch wollen die Wissenschaftler eine neue Tür in der Gravitationswellenforschung aufstoßen. Das Einstein-Teleskop soll voraussichtlich von 2017 oder 2018 an gebaut werden.

http://www.innovatives.niedersachsen.de/138.html?&no_cache=1&tx_ttnews[tt_news]=3430&tx_ttnews[backPid]=1

16.10.2008 Agenzia Giornalistica Italia

Spazio: Tre Milioni di Euro per L'Einstein Telescope (ET)

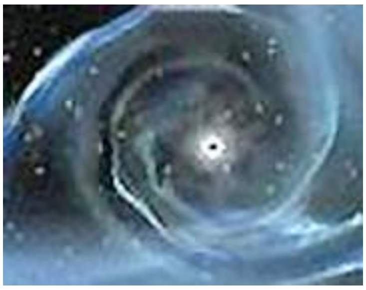
Roma - Assegnando tre milioni di euro del programma FP7 allo studio preliminare dell'Einstein Telescope (ET) - un osservatorio per onde gravitazionali pan-europeo - la Commissione Europea ha fatto un passo decisivo verso l'esplorazione dell'universo con le onde gravitazionali. Con questo riconoscimento, la Commissione conferma l'importanza della ricerca sulle onde gravitazionali per la ricerca scientifica, di base e applicata, in Europa. "Con la sua decisione, la Commissione Europea riconosce le conquiste fatte dagli osservatori di onde gravitazionali Virgo e GEO600, e getta le basi per lo sviluppo del primo rivelatore di onde gravitazionali pan-europeo", afferma Jacques Colas, direttore dell'Osservatorio Gravitazionale Europeo (EGO) e coordinatore del programma di Studio del Progetto per l'Einstein Telescope.

L'Einstein Telescope e' uno dei 'Magnifici Sette' progetti europei, raccomandati dal network ASPERA per lo sviluppo futuro della fisica delle astroparticelle in Europa. La rivelazione diretta delle onde gravitazionali - le piccolissime distorsioni dello spazio-tempo previste da Albert Einstein - e' una delle piu' importanti e fondamentali aree di ricerca della scienza moderna. La loro rivelazione diretta rendera' possibili visioni completamente nuove del nostro universo - inclusi indizi sui primissimi istanti dopo la sua nascita - inaccessibili a qualsiasi altra tecnologia. Il progetto ET vede coinvolti otto istituti di ricerca europei, sotto la direzione di EGO. I partecipanti sono EGO, il consorzio italo-francese sito vicino a Pisa, l'Istituto Nazionale italiano di Fisica Nucleare (Infn), il Centro Nazionale per la Ricerca Scientifica francese (Cnrs), l'Istituto tedesco Albert Einstein (AEI) di Hannover, le universita' di Birmingham, Cardiff e Glasgow per il Regno Unito e la Vrije Universiteit di Amsterdam per l'Olanda. I finanziamenti assegnati oggi dalla Commissione Europea saranno utilizzati nei prossimi tre anni per lo Studio di Progetto per ET. Lo Studio di Progetto e' un passo importante verso la terza generazione di osservatori di onde gravitazionali, perche' definisce le caratteristiche richieste per il sito, le infrastrutture e le tecnologie necessarie, e stabilisce inoltre il budget complessivo. "Le prime due generazioni di rivelatori lanceranno l'era dell'astronomia con le onde gravitazionali - spiega Michele Punturo, coordinatore scientifico del Einstein Telescope Design Study - e ci aspettiamo che questa terza generazione raggiunga una sensibilita' di un centinaio di volte maggiore degli attuali rivelatori. Il volume di universo osservabile aumentera' di un fattore un milione". (AGI)

http://www.agi.it/research-e-sviluppo/notizie/200810161249-eco-rt11088-art.html

16.10.2008 Corriere della Sera

Nuovo osservatorio europeo per la caccia alle misteriose onde gravitazionali
L'Einstein Telescope avrà una sensibilità cento volte maggiore rispetto agli attuali rilevatori



E' una delle imprese più difficili e affascinanti che fisici e astrofisica abbiano davanti e nonostante la mancanza di successi insistono per arrivare ad un risultato. Stiamo parlando della caccia alle onde gravitazionali per le quali gli scienziati italiani hanno una tradizione che risale a Edoardo Amaldi e all'Università di Roma dove da tempo si lavora su questo fronte. Inoltre, vicino a Pisa è in attività l'antenna Virgo nato da un progetto dell'Istituto nazionale di fisica nucleare assieme agli scienziati francesi. E questa stazione condivide il lavoro con i tre interferometri americani LIGO, ampliando le possibilità di intercettazione.

IN EUROPA - In Europa è in funziona anche un altro osservatorio, GEO600, nato da una collaborazione tra tedeschi e britannici. Ma nonostante i grandi sforzi internazionali finora le famose onde gravitazionali sono sfuggite alla cattura. Queste sono previste dalla teoria generale della relatività e dovrebbero essere emesse da un corpo materiale accelerato, un po' come una carica elettrica accelerata lancia onde elettromagnetiche. Tali onde, poi, dovrebbero diffondersi nello spazio attraverso un gravitone. Finora né le onde né il gravitone sono stati rilevati con sicurezza.

EINSTEIN TELESCOPE - Per affrontare con mezzi più adeguati la sfida il settimo programma quadro di ricerca dell'Unione Europea ha assegnato tre milioni di euro per uno studio preliminare dell'Einstein Telescope, cioè un osservatorio europeo specificatamente dedicato alla ricerca delle onde gravitazionali. «E' la terza generazione di questo tipo di osservatori ed avrà una sensibilità cento volte maggiore rispetto agli attuali rilevatori», nota Michele Punturo, coordinatore scientifico del nuovo progetto. «Oltre a consentire la verifica della teoria della relatività generale – aggiunge Harald Luck, vicecoordinatore scientifico dello strumento – l'osservazione delle fantomatiche onde permetterebbero per la prima volta di dare uno sguardo alla prima infanzia dell'Universo».

http://www.corriere.it/scienze_e_tecnologie/08_ottobre_16/onde_gravitazionali_5f52458a-9b90-11dd-a5ca-00144f02aabc.shtml

16.10.2008 Italia Lavoro TV

Ricerca Italiana nel Mondo - Commissione Europa Finanzia Progetto "ET": Osservatorio per onde gravitazionali pan-europeo

Assegnando tre milioni di euro del programma FP7 allo studio preliminare dell'Einstein Telescope (ET), la Commissione Europea ha fatto un passo decisivo verso l'esplorazione dell'universo con le onde gravitazionali. Con questo riconoscimento, la Commissione conferma l'importanza della ricerca sulle onde gravitazionali per la ricerca scientifica, di base e applicata, in Europa.

"Con la sua decisione, la Commissione Europea riconosce le conquiste fatte dagli osservatori di onde gravitazionali Virgo e GEO600, e getta le basi per lo sviluppo del primo rivelatore di onde gravitazionali pan-europeo", afferma Jacques Colas, direttore dell'Osservatorio Gravitazionale Europeo (EGO) e coordinatore del programma di Studio del Progetto per l'Einstein Telescope. L'Einstein Telescope è uno dei 'Magnifici Sette' progetti europei, raccomandati dal network ASPERA per lo sviluppo futuro della fisica delle astroparticelle in Europa.

La rivelazione diretta delle onde gravitazionali – le piccolissime distorsioni dello spazio-tempo previste da Albert Einstein – è una delle più importanti e fondamentali aree di ricerca della scienza moderna. La loro rivelazione diretta renderà possibili visioni completamente nuove del nostro universo – inclusi indizi sui primissimi istanti dopo la sua nascita - inaccessibili a qualsiasi altra tecnologia.

Il progetto ET vede coinvolti otto istituti di ricerca europei, sotto la direzione di EGO. I partecipanti sono EGO, il consorzio italo- francese sito vicino a Pisa, l'Istituto Nazionale italiano di Fisica Nucleare (Infn), il Centro Nazionale per la Ricerca Scientifica francese (Cnrs), l'Istituto tedesco Albert Einstein (AEI) di Hannover, le università di Birmingham, Cardiff e Glasgow per il Regno Unito e la Vrije Universiteit di Amsterdam per l'Olanda.

I finanziamenti assegnati oggi dalla Commissione Europea saranno utilizzati nei prossimi tre anni per lo Studio di Progetto per ET. Lo Studio di Progetto è un passo importante verso la terza generazione di osservatori di onde gravitazionali, perché definisce le caratteristiche richieste per il sito, le infrastrutture e le tecnologie necessarie, e stabilisce inoltre il budget complessivo.

''Le prime due generazioni di rivelatori lanceranno l'era dell'astronomia con le onde gravitazionali – spiega Michele Punturo, coordinatore scientifico del Einstein Telescope Design Study - e ci aspettiamo che questa terza generazione raggiunga una sensibilità di un centinaio di volte maggiore degli attuali rivelatori. Il volume di universo osservabile aumenterà di un fattore un milione.'' Inoltre, questo strumento dovrebbe essere sensibile a onde gravitazionali nell'intero intervallo di frequenze accessibile sulla terra, da 1 Hz a 10 kHz.

"Questo permette a ET di aprire una nuova frontiera nella ricerca sulle onde gravitazionali'', afferma Punturo. L'ambizioso obiettivo sarà raggiunto combinando in un singolo osservatorio tutte le tecnologie d'avanguardia oggi conosciute.

"La comunità di ricerca sperimentale sulle onde gravitazionali in Europa vanta un piano di sviluppo ben consolidato, sincronizzato con i piani statunitensi, che va dagli attuali osservatori e dagli interferometri di seconda generazione – che dovrebbero prendere dati entro pochi anni – al progetto Einstein Telescope", aggiunge Harald Lück, vice coordinatore scientifico dello Studio di Progetto di ET e coordinatore della fase di aggiornamento del rivelatore GEO600.

"Oltre a consentire la verifica della Teoria della Relatività Generale, l'osservazione delle onde gravitazionali avrebbe
conseguenze di enorme portata: per la prima volta, sarebbe possibile dare uno sguardo alla 'prima infanzia' del nostro universo", sostiene Harald Lück. Ad oggi, l'osservazione del cielo è limitata al solo spettro elettromagnetico (ad esempio, telescopi radio e a raggi X e astronomia nel visibile) e all'osservazione dei raggi cosmici e dei neutrini. L'informazione resa disponibile da questo tipo di osservazioni può raggiungerci dal passato solo entro un tempo di almeno 380'000 anni dopo il Big Bang: le epoche precedenti sono nascoste, perché solo in quel momento l'universo è diventato trasparente alla radiazione elettromagnetica. Per questo, non è ancora stato possibile verificare sperimentalmente le diverse teorie sviluppate per descrivere le fasi iniziali dell'universo. La misura diretta delle onde gravitazionali, invece, consentirebbe di 'ascoltare' indietro nel tempo fino al primissimo millesimo di miliardesimo di secondo successivo al Big Bang e questo porterebbe informazioni completamente nuove sul nostro universo. Quindi, con l'astronomia possibile attraverso le onde gravitazionali diverranno accessibili aree della scienza completamente nuove.

La ricerca sulle onde gravitazionali richiede uno sforzo globale perché l'informazione completa su molte sorgenti di onde gravitazionali può essere ottenuta solo con molti interferometri che lavorino contemporaneamente in luoghi diversi. Con questo obiettivo, le comunità statunitense, germano-britannica, italo-francese, e olandese stanno lavorando a fianco a fianco da molto tempo. Condividono lo sviluppo delle tecnologie, i metodi di relatività numerica, nonché i metodi e gli strumenti per l'analisi dei dati. Il progetto europeo comune ET contribuirà a sviluppare ulteriormente questa collaborazione a livello mondiale.

Attualmente, sono attivi in Europa molti rivelatori di onde gravitazionali di prima generazione. L'osservatorio tedesco-britannico GEO600, finanziato da STFC1 e MPG2, è operativo vicino ad Hannover, mentre il progetto italo-francese Virgo è sito a Cascina, vicino a Pisa. Questi interferometri condividono i loro dati con i tre interferometri americani LIGO e stanno oggi portando avanti una ricerca estensiva sulle onde gravitazionali da sistemi astrofisici. La ricerca delle onde gravitazionali dall'insieme di questi dati e gli algoritmi usati nell'analisi sono il risultato di molti anni di ricerca e sviluppo in Europa e negli Stati Uniti. L'Italia, grazie al lavoro dei ricercatori INFN, ha avuto da sempre una posizione leader in questo ambito, culminata, attualmente, nella realizzazione del rivelatore Virgo, vicino a Pisa. Oggi gli scienziati europei stanno guidando molte delle azioni di analisi dei dati ottenuti in questa caccia internazionale alla rivelazione diretta delle onde gravitazionali.

Nella prossima decade, tutti i rivelatori interferometrici per onde gravitazionali passeranno a una fase avanzata, divenendo strumenti di seconda generazione. Le sensibilità di Virgo e LIGO guadagneranno un fattore dieci, circa, alle frequenze più basse (fino a un chilohertz) utilizzando tecnologie sviluppate in Europa e altrove. GEO sarà pioniere nell'esplorazione a larga banda delle alte frequenze, al di sopra del chilohertz, ancora una volta sviluppando nuove tecnologie. Se gli attuali strumenti non dovessero ottenere le prime rivelazioni di onde gravitazionali, ci si può aspettare che questo avvenga, con buona probabilità, con gli interferometri di seconda generazione. Il progetto ET si inserisce perfettamente in questo scenario. Dopo il completamento della fase di Studio del Progetto e una successiva fase di preparazione tecnica, l'effettiva costruzione potrebbe iniziare probabilmente nel 2017 o 2018, subito dopo l'avvio degli strumenti di seconda generazione.

La tecnologia necessaria per i rivelatori di terza generazione è in fase di studio in molti paesi oltre che in Europa, inclusi gli Stati Uniti e il Giappone. Tuttavia, i rivelatori di terza generazione eventualmente costruiti in punti diversi del globo dovranno necessariamente portare avanti osservazioni congiunte, come avviene già oggi con i rivelatori di prima generazione.

http://www.italiannetwork.it/news.aspx?ln=it&id=5110

16.10.2008 Alice Notizie Scienze e Tecnologie

Fisica/ Osservatorio ET: nuova finestra aperta sull'Universo
Finanziato da Commissione Europea con tre milioni di euro

Assegnati tre milioni di euro del programma FP7 allo studio preliminare dell'Einstein Telescope (ET) - un osservatorio per onde gravitazionali pan-europeo . Un passo importante con il quale la Commissione Europea riconosce l'importanza degli studi sulle onde gravitazionali per la ricerca scientifica di base e applicata, in Europa. La rivelazione diretta delle onde gravitazionali, le piccolissime distorsioni dello spazio-tempo previste da Albert Einstein , è, infatti, una delle più importanti e fondamentali aree di ricerca della scienza moderna. La loro rivelazione diretta renderà possibili visioni completamente nuove del nostro universo - inclusi indizi sui primissimi istanti dopo la sua nascita - inaccessibili a qualsiasi altra tecnologia Il progetto ET , uno dei 'Magnifici Sette' progetti europei, raccomandati da ASPERA per lo sviluppo futuro della fisica delle astroparticelle in Europa, vede coinvolti otto istituti di ricerca europei, sotto la direzione dell'Osservatorio Gravitazionale Europeo (EGO). I partecipanti sono EGO, il consorzio italo-francese sito vicino a Pisa, l'Istituto Nazionale italiano di Fisica Nucleare (Infn), il Centro Nazionale per la Ricerca Scientifica francese (Cnrs), l'Istituto tedesco Albert Einstein (AEI) di Hannover, le università di Birmingham, Cardiff e Glasgow per il Regno Unito e la Vrije Universiteit di Amsterdam per l'Olanda. "Con la sua decisione, la Commissione Europea riconosce le conquiste fatte dagli osservatori di onde gravitazionali Virgo e GEO600, e getta le basi per lo sviluppo del primo rivelatore di onde gravitazionali pan-europeo", ha detto Jacques Colas, direttore di EGO e coordinatore del Programma di Studio del Progetto per ET. I finanziamenti assegnati oggi dalla Commissione Europea saranno utilizzati nei prossimi tre anni per lo Studio di Progetto per ET, un passo ulteriore verso la terza generazione di osservatori di onde gravitazionali, perché definisce le caratteristiche richieste per il sito, le infrastrutture e le tecnologie necessarie, e stabilisce inoltre il budget complessivo. "Le prime due generazioni di rivelatori lanceranno l'era dell'astronomia con le onde gravitazionali - spiega Michele Punturo, coordinatore scientifico del Einstein Telescope Design Study - e ci aspettiamo che questa terza generazione raggiunga una sensibilità di un centinaio di volte maggiore degli attuali rivelatori. Il volume di universo osservabile aumenterà di un fattore un milione.".

"Oltre a consentire la verifica della Teoria della Relatività Generale, l'osservazione delle onde gravitazionali avrebbe conseguenze di enorme portata: per la prima volta, sarebbe possibile dare uno sguardo alla 'prima infanzia' del nostro universo", sostiene Harald Lück, vice coordinatore scientifico dello Studio di Progetto di ET e coordinatore della fase di aggiornamento del rivelatore GEO600 Ad oggi, l'osservazione del cielo è limitata al solo spettro elettromagnetico e all'osservazione dei raggi cosmici e dei neutrini. La misura diretta delle onde gravitazionali, invece, consentirebbe di 'ascoltare' indietro nel tempo fino al primissimo millesimo di miliardesimo di secondo successivo al Big Bang e questo porterebbe informazioni completamente nuove sul nostro universo.

http://notizie.alice.it/notizie/scienze_e_tecnologie/2008/10_ottobre/16/fisica_osservatorio_et_nuova_finestra_aperta_sull_universo,16473798.html?pmk=rss

16.10.2008 Cardiff University

Cardiff scientists share 3M Euros to search cosmos for gravitational waves

16 October 2008

Two neutron stars orbiting each other radiate gravitational waves.

Credit: Max Planck Institute for Gravitational Physics

A team of scientists from Cardiff School of Physics and Astronomy are part of a Europe-wide project which could uncover the very origins of the universe.

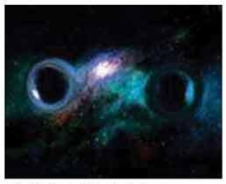
The European Commission has allocated 3M Euros to a design study - the Einstein Telescope project – which could finally find proof of one of the great scientist's key theories.

Direct detection of gravitational waves – tiny distortions of space-time first predicted by Einstein - is one of the most important and fundamental research areas of modern science. The direct measurement of waves has the potential to allow 'listening' back as far as the *very first trillionth of a second* following the Big Bang. This could potentially provide completely new information about the universe and open up entirely new areas of science.

The project will combine cutting edge technologies to support development of the first pan-European gravitational wave observatory. The result will be a gravitational wave detection device one hundred times more sensitive than detectors. For the first time scientists will have the capability to probe the early childhood of the universe as well as verify ultra-strong gravity predictions of Einstein's General Theory of Relativity.

Funded for three years, the study is an important step towards the development of third generation gravitational wave observatories. Scientists at the School of Physics and Astronomy led by Professor Bangalore Sathyaprakash form one of four technical working groups, and will be responsible for coordinating the development of the science case for different geometric, mechanical and optical configurations of the Einstein Telescope. The physicists will also coordinate with the rest of the team, receiving inputs on the science potential, prioritise the list of scientific benefits and gauge the scope of alternative proposals for different configurations of the detector.

The EC grant is funded from within the 7th *Framework Programme for Research and Technological Development.*



Colliding black holes

Credit: Max Planck Institute for Gravitational Physics/ MildeMarketing Science Communication

Professor Sathyaprakash, whose group is already an integral member of the LIGO Scientific Collaboration and involved in all the major current gravitational-wave interferometer projects, LIGO, Virgo, GEO 600 and LISA, said: "The grant confirms the importance of gravitational wave research for both basic and applied scientific research in Europe and is a decisive step by the European Commission towards the exploration of the universe with gravitational waves.

"It is incredibly exciting that Wales-based physicists will play such a central role in bringing Europe to the forefront of the most promising new development in the quest to understand the history and future of the Universe and the emergence of the field of Gravitational Wave Astronomy. Einstein Telescope will help us explore geometry of space time near black holes, solve the enigma of gamma-ray bursts and provide insight into the problem of dark matter and dark energy – believed to make up most of the mass in the Universe."

The Einstein Telescope is one of the 'Magnificent Seven' European projects recommended by the ASPERA network for the future development of astroparticle physics in Europe and is a joint project of eight European research institutes, under the direction of European Gravitational Observatory.

Jacques Colas, director of the European Gravitational Observatory (EGO) and project coordinator of the design study for the Einstein Telescope said: "With its decision, the European Commission recognizes the achievements made by the gravitational wave observatories GEO600 and Virgo, and paves the way for the development of the first pan-European gravitational wave detector".

The eight European research institutes, under the direction of EGO involved in the project are an Italian French consortium located near Pisa (Italy), Istituto Nazionale di Fisica Nucleare (INFN) from Italy, the French Centre National de la Recherche Scientifique (CNRS), the German Albert Einstein Institute (AEI) Hannover, Cardiff University, the Universities of Birmingham and Glasgow from United Kingdom, and the Dutch Vrije Universiteit Amsterdam.

Related links

School of Physics and Astronomy

Cardiff Gravitational Physics Group

The Einstein Telescope Project

http://www.cardiff.ac.uk/news/articles/cardiff-scientists-share-3m-euros-to-search-cosmos-for-gravitational-waves.html

16.10.2008 University of Glasgow

European Commission funds design study for unique future observatory

The European Commission has made a decisive step towards the exploration of the universe with gravitational waves by allocating three million Euro within the FP7 programme for preliminary studies for the Einstein Telescope (ET) – a pan-European gravitational wave observatory.

With this grant, the commission confirms the importance of gravitational wave research for both basic and applied scientific research in Europe.

"The European Commission recognises the achievements made by the gravitational wave observatories GEO600 and Virgo, and paves the way for the development of the first pan-European gravitational wave detector", says Jacques Colas, director of the European Gravitational Observatory (EGO) and project coordinator of the design study for the Einstein Telescope. The Einstein Telescope is one of the 'Magnificent Seven' European projects recommended by the ASPERA network for the future development of astroparticle physics in Europe.

The direct detection of gravitational waves – tiny distortions of space-time predicted by Albert Einstein - is one of the most important and fundamental research areas of modern science. Their direct observation will allow us totally new insights into our universe inaccessible to any other technology – including clues as to its very beginning.

The Einstein Telescope Project (ET)

ET is a joint project of eight European research institutes, under the direction of EGO. The participants are EGO, an Italian French consortium located near Pisa (Italy), Istituto Nazionale di Fisica Nucleare (INFN) from Italy, the French Centre National de la Recherche Scientifique (CNRS), the German Albert Einstein Institute (AEI) Hannover, the Universities of Glasgow, Cardiff and Birmingham from United Kingdom and the Dutch Vrije Universiteit Amsterdam.

The funds granted now by the European Commission will be used in a design study for ET over the next three years. The design study is an important step towards the third generation of gravitational wave observatories, defining the specifications for the required site and infrastructure and the necessary technologies, and lastly also the total budget needed.

Michele Punturo, scientific coordinator of the Einstein Telescope design study: "The first two generations will already launch the age of gravitational wave astronomy, and we expect this third generation observatory to be a hundred times more sensitive than current detectors. The observable volume of the universe will increase by a factor of a million." Additionally all frequencies that can be measured on Earth, the entire range between 1 Hz and 10 kHz, should be detected by this instrument. "This allows ET to open a new door in gravitational wave research", says Punturo. The ambitious goal will be reached by combining the cutting edge of all currently known technologies in a single observatory.

Harald Lück, deputy scientific coordinator of the ET Design Study and coordinator of the upgrade of the GEO600 detector adds: "The European experimental gravitational wave research community presents a well consolidated development plan, which is synchronized with the US plans, from the current observatories and the second generation interferometers - scheduled to take data in a few years - to the Einstein Telescope project."

"Observation of gravitational waves would have far-reaching consequences, aside from verifying the General Theory of Relativity: It would become possible to cast an eye on the "early childhood" of our universe for the first time," says Harald Lück. Up to now observation of the sky is limited to the electromagnetic spectrum (e.g. radio and X-ray telescopes and astronomy in visible light) and observation of cosmic rays and neutrinos. The information thus available to us can reach us from the past only from a time at least 380,000 years after the Big Bang. Epochs dating back further have thus far remained hidden, as the universe became transparent for electromagnetic radiation only at that time. The various theories on the early universe have therefore remained unverified experimentally. The direct measurement of gravitational waves may allow 'listening' back as far as the very first trillionth of a second following the Big Bang: This would give us totally new information about our universe: with gravitational wave astronomy, totally new areas of science will become accessible.

The global network

Gravitational wave research is a global effort because the full information about many gravitational wave sources can only be obtained with several interferometers working simultaneously in different places.

Therefore the US, German-British, Italian-French, and Dutch scientific communities have been working together closely for a long time. They share technology development, numerical relativity methods and data analysis methods and tools. The joint European project ET will help to further improve this world wide collaboration.

Status of current detectors

Currently, several first generation gravitational wave detectors are active in Europe. The German-British GEO600 observatory, funded by STFC1 and MPG2, is operating close to Hanover while the French-Italian-Dutch Virgo project is located in Cascina near Pisa (Italy). These interferometers pool their data with the three American LIGO interferometers and are currently doing extensive searches for gravitational waves from astrophysical systems.

Searches for gravitational waves from these data sets and the algorithms used in the analysis are the result of many years of research and development in Europe and the U.S. Today European scientists are leading several of the analyses efforts in this international pursuit for the direct detection of gravitational waves.

During the next decade all interferometric gravitational wave detectors will be upgraded to second-generation instruments. Virgo and LIGO will gain a factor of about ten in sensitivity at lower frequencies (up to about a kilohertz) using technology developed in Europe and elsewhere.

GEO will pioneer high frequency wide-band observing above one kilohertz, again deploying new technologies. If the current instruments do not make the first detections of gravitational waves, it can confidently be expected that this will be done by the second-generation interferometers.

The ET project fits well into this scenario. In fact, after the completion of the design study and of a subsequent technical preparation phase, the effective construction could begin, probably in the year 2017 or 2018, after the second generation observatories have started operating.

The technology required for third generation detectors is being studied in several countries besides Europe, including the USA and Japan. All third-generation detectors that are eventually built will need to perform joint observations together (as the previous generation detectors do).

http://www.gla.ac.uk/news/headline_95505_en.html

16.10.2008 Informationsdienst Wissenschaft, Uni-Protokolle, Leibniz Universität Hannover

Europäische Kommission finanziert Entwicklungsstudie für einzigartiges Zukunftsobservatorium

Die Europäische Kommission hat jetzt im Zuge des 7. Rahmenprogramms (FP7) drei Millionen Euro für eine Entwicklungsstudie zum Einstein-Teleskop (ET) - ein pan-europäisches Gravitationswellen-Observatorium - bereitgestellt und hat damit einen entscheidenden Schritt zur Beobachtung des Universums mit Gravitationswellen getan.
Sie unterstreicht mit dieser Förderung die Bedeutung der Gravitationswellenforschung für die Grundlagen- und die angewandte Forschung in Europa. "Mit dieser Entscheidung erkennt die Europäische Kommission die Erfolge der Gravitationswellenobservatorien GEO600 und Virgo an und ebnet den Weg zum ersten pan-europäischen Gravitationswellendetektor", so Jacques Colas, Direktor des Europäischen Gravitationswellenobservatoriums (EGO) und Projektkoordinator der Entwicklungsstudie für das Einstein-Teleskop.
Das Einstein-Teleskop ist eines der sogenannten "Glorreichen Sieben" in Europa und damit eines der Projekte, die vom ASPERA-Netzwerk für die zukünftige Entwicklung der Astroteilchenphysik in Europa empfohlen werden.

Gravitationswellen sind winzige Verzerrungen der Raumzeit, die schon von Albert Einstein vorhergesagt wurden. Sie direkt zu messen, ist eine der wichtigsten und grundlegendsten Herausforderungen der modernen Physik. Die direkte Beobachtung von Gravitationswellen wird völlig neue Einblicke in unser Universum ermöglichen, bis hin zu seiner Entstehung. Keine andere Technologie eröffnet diese Möglichkeiten.

Das Projekt Einstein-Teleskop (ET)
ET ist ein gemeinsames Projekt von acht europäischen Forschungsinstituten. Die Federführung hat EGO, ein italienisch-französisches Konsortium mit Sitz in der Nähe von Pisa (Italien) übernommen. Neben EGO sind beteiligt: Das Instituto Nazionale di Fisica Nucleare (INFN) aus Italien, das französische Centre National de la Recherche Scientifique (CNRS), das deutsche Albert-Einstein-Institut (AEI) an der Leibniz Universität Hannover, die Universitäten von Birmingham, Cardiff und Glasgow aus Großbritannien sowie die Niederländische Vrije Universiteit Amsterdam.

Die jetzt von der Europäischen Kommission bereitgestellten Mittel werden im Laufe der nächsten drei Jahre für eine Entwicklungsstudie für das Einstein-Teleskop verwendet. Diese Entwicklungsstudie ist ein wichtiger Schritt zur dritten Generation von Gravitationswellenobservatorien. Ziel der Studie ist, die Anforderungen an den Standort für ET, die benötigte Infrastruktur und nicht zuletzt das Gesamtbudget zu definieren.

Michele Punturo, Wissenschaftskoordinator der Studie sagt dazu: "Während die ersten beiden Detektorgenerationen das Feld für die Gravitationswellenastronomie bereits eröffnen werden, erwarten wir von der dritten Generation ein Observatorium, das hundert Mal empfindlicher ist als die gegenwärtigen Detektoren. Auf diese Weise vergrößert sich das beobachtbare Volumen des Universums um den Faktor eine Million." Zudem wird man das gesamte auf der Erde messbare Frequenzspektrum von 1 Hz bis 10 kHz erfassen können. "Dadurch wird ET eine neue Tür in der Gravitationswellenforschung aufstoßen", so Punturo weiter. Dieses anspruchsvolle Ziel wird durch die Kombination aller gegenwärtig bekannten Technologien in einem einzigen Observatorium erreicht.

Harald Lück vom AEI an der Leibniz Universität Hannover, stellvertretender wissenschaftlicher Koordinator der Studie und Leiter der derzeitigen technologischen Upgrades des deutsch-britischen Detektors GEO600 ergänzt: "Das Einstein-Teleskop ist ein gemeinsamer Plan aller europäischen Gravitationswellenforscher. Er ist mit den Projekten unserer amerikanischen Partner gut synchronisiert, von den gegenwärtigen Detektoren über die Observatorien der zweiten Generation - die in den nächsten Jahren Daten erheben werden - bis hin zum Einstein-Teleskop."

"Die Beobachtung von Gravitationswellen wird, zusätzlich zur Bestätigung der Allgemeinen Relativitätstheorie, andere weitreichende Konsequenzen haben: Zum ersten Mal werden wir einen Blick in die "Kinderstube" unseres Universums werfen können", so Harald Lück. Bisher kann der Himmel nur im elektromagnetischen Spektrum (z.B. Radiowellen, Röntgenstrahlung und sichtbares Licht) sowie durch die Analyse kosmischer Strahlen und Neutrinos beobachtet werden. Über die Anfangszeit unseres Universums vom Urknall bis 380.000 Jahre danach geben diese Methoden keinen Aufschluss, da das Universum erst dann durchlässig für elektromagnetische Strahlung wurde. Die verschiedenen Theorien über das frühe Universum konnten bisher also nicht experimentell verifiziert werden. Mit der direkten Beobachtung von Gravitationswellen wird es nun aller Voraussicht nach erstmals möglich sein, bis in die erste Trillionstel Sekunde nach dem Urknall zurück zu "lauschen". Damit werden völlig neue Informationen über das Universum zugänglich sein - die Gravitationswellenastronomie wird der Wissenschaft also vollkommen neue Bereiche eröffnen.

Das globale Netzwerk

Die Gravitationswellenforschung ist eine globale Herausforderung, denn viele Quellen von Gravitationswellen können nur dann genau untersucht werden, wenn mehrere Interferometer an verschiedenen Orten gleichzeitig Daten aufnehmen. Daher arbeiten die amerikanischen und europäischen Wissenschaftlergruppen seit langem eng zusammen: im Bereich der Technologieentwicklung, bei der Entwicklung von Methoden der Numerischen Relativitätstheorie - also beispielsweise der Simulation von Gravitationswellensignalen - sowie bei der Entwicklung neuer Methoden und Werkzeuge für die Datenanalyse. Das Gemeinschaftsprojekt ET wird diese weltweite Kollaboration noch weiter stärken.

Status der jetzt laufenden Detektoren

Gegenwärtig arbeiten in Europa mehrere Gravitationswellendetektoren der ersten Generation: Das deutsch-britische Observatorium GEO600 wird, finanziert von STFC, MPG sowie dem Land Niedersachen, in der Nähe von Hannover betrieben, das französisch-italienisch-niederländische Virgo-Projekt ist in Cascina bei Pisa angesiedelt. Die Daten dieser Interferometer werden mit denen der drei amerikanischen LIGO-Interferometer zusammengeführt. Im gesamten Datenpool wird derzeit nach Gravitationswellensignalen aus astrophysikalischen Systemen gesucht.

Die Suchmethoden, mit denen die Datensätze nach Gravitationswellensignalen durchforstet werden und die in der Analyse verwendeten Algorithmen sind das Ergebnis vieler Jahre Forschungs- und Entwicklungsarbeit in Europa und den USA. Heute werden auf der internationalen Suche nach den ersten direkten Gravitationswellensignalen viele der Datenanalyseteams von europäischen Wissenschaftlern geleitet.

Im Laufe des nächsten Jahrzehnts werden alle interferometrischen Gravitationswellendetektoren zu Instrumenten der zweiten Generation aufgerüstet. Die Empfindlichkeit von Virgo und LIGO in den tieferen Frequenzen (bis etwa ein Kilohertz) wird durch den Einsatz von Technologien, die unter anderem in Europa entwickelt wurden, etwa verzehnfacht. GEO600 wird insbesondere in der Breitband-Beobachtung von hohen Frequenzen Pionierarbeit leisten, auch hier durch die Entwicklung und den Einsatz neuer Technologien. Sollten die derzeit arbeitenden Instrumente nicht die ersten direkten Nachweise von Gravitationswellen erbringen, wird dies mit großer Sicherheit von der zweiten Detektorgeneration erwartet.

ET passt gut in dieses Szenario. Nach dem Abschluss der Entwicklungsstudie und der folgenden technischen Vorbereitungsphase könnte voraussichtlich 2017 oder 2018 mit dem Bau begonnen werden, nachdem die Instrumente der zweiten Generation ihre Arbeit aufgenommen haben.

An der für die dritte Detektorengeneration erforderlichen Technologie wird in zahlreichen Ländern innerhalb und außerhalb Europas geforscht, auch in den USA und Japan. Alle Detektoren der dritten Generation, die irgendwann einmal gebaut werden, werden eng zusammenarbeiten müssen, genau wie die Detektoren der früheren Generationen.

Erklärung zu den Abkürzungen:
STFC: Science and Technology Facilities Council; http://www.scitech.ac.uk/
MPG: Max Planck Gesellschaft; http://www.mpg.de/english/portal/index.html

Weitere Information:
http://www.et-gw.eu/
http://geo600.aei.mpg.de/
http://www.virgo.infn.it/
http://www.aspera-eu.org/index.php?option=com_content&task=blogsection&i...

Fotos:
http://geo600.aei.mpg.de/documents/the-geo600-photo-album
http://wwwcascina.virgo.infn.it/Outreach/Outreach.html

http://www.idw-online.de/pages/de/news283704
http://www.uni-protokolle.de/nachrichten/id/165228/
http://www.uni-hannover.de/de/aktuell/presseinformationen/archiv/details/06303/
http://innovations-report.de/html/schlagwort/Einstein_Teleskop-1-115976.html

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Ultramassive: as big as it gets
A black hole can consume anything in its path. These monsters can become huge — but perhaps only so huge.

By Charles Petit. If asked to name stupendously amazing things in space, most people would probably pick black holes. These evil-tinged clowns of the universe are definite wows. Insatiable is their middle name.

Grand and merciless, voracious and monstrous, pure appetite and deep mystery. The biggest fatten themselves in galaxy cores mainly via a seemingly limitless hunger for a main source of sustenance: fat, circular wads of gas that gather around the black holes and are sometimes given a name to delight any glutton, Polish doughnuts. Black holes cloak their innards behind an “event horizon,” from inside which no message can be sent (which explains the one-liner physics joke: “Two protons walk into a black hole”).

What a parade of jaw-droppers that is. Well listen up, this just in: It looks like there is a limit to the superlatives. Black holes can’t eat everything. If a new analysis from a Yale astronomer is correct, even black holes run out of steam, and at a fairly precise point. The biggest black holes may reach only a few tens of billions of times the mass of the sun.

To be sure, that’s huge. Most galaxies harbor central black holes of a few million solar masses (about 4 million for the Milky Way). Fifty million light-years away in Virgo, the giant elliptical galaxy M87 is believed to harbor one having about 3 billion solar masses. The record heft for a suspected black hole, 3.5 billion light-years away and part of a double–black-hole system with a partner’s orbit that reveals its mass with some precision, is 18 billion solar masses.

Any possible cap on the size of these monsters occupying galactic centers shouldn’t diminish the place of black holes in popular imagination. And for astronomers, the newly proposed mass limit illustrates how the status of black holes, as both scientific challenge and principal player in the universe’s appearance, is on the rise.

Astrophysicists and cosmologists thought they had black holes pretty well pegged about 10 years ago. Black holes eat, they grow and they can sure produce a bright light from X-ray to radio wavelengths while on a binge. Their quasar-pumping conversion of matter to outward-beamed energy as they consume gas, dust and the occasional unlucky star is believed to reach about 40 percent efficiency. It’s not only E=mc2 at which black holes excel. They also provide wonderful playgrounds for a panoply of other Einsteinian gymnastics.

They bend time, warp space and, along their borders, they spawn a fizz of evanescent virtual particles popping in and out of space's fabric.

But all in all, to many pros interested in the big picture, black holes have been seen as intriguing and flashy character actors, bit players in the grand story of galaxy evolution and in the overall distribution of ordinary matter in the universe. Even supermassive black holes' gravity, after all, dominates only a few parsecs radius in the crowded hearts of galaxies many thousands of parsecs across.

A consuming influence
A budding new paradigm is that black holes—in a dance of mutual self-regulation—may influence almost everything about galactic origins, growth, form and ultimate fates. They are not just the overstuffed kernels in the middle of galaxies. For reasons not fully understood, it appears that the sizes of central black holes and the masses of their galaxies, especially the central bulges, are almost perfectly in step.

The relation has become clear only since the late 1990s. Even the halo mass of dark matter—the mysterious invisible stuff that seems to make up more than 80 percent of all matter—around galaxies seems correlated with the size of supermassive black holes in galactic centers. That is a surprise. And when the black holes stop growing, galaxies themselves appear to stop evolving. “Now, we think we cannot understand galaxies without understanding black holes,” says Abraham “Avi” Loeb, director of the Institute for Theory and Computation at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass.

The proposed limit on black hole mass comes from Yale University cosmologist Priyamvada Natarajan and Chilean astronomer Ezequiel Treister of the European Southern Observatory. Their paper, to appear in the Monthly Notices of the Royal Astronomical Society, was posted online in August.

Declaring an upper mass limit to black holes is notable, even were such a limit not part of a bigger relationship to overall galactic physics. For one thing, it would give bounds to the specs of the black hole bestiary.

Ignoring hypothetical mini–black-holes of subatomic size that might briefly form under exotic conditions, astronomical black hole taxonomy would go like this, from smallest to largest: Substellar-mass or primordial black holes, still unproven, proposed by physicist Stephen Hawking to have formed in the dense soup of particles shortly after the Big Bang. A stellar-mass black hole is what remains after some supernovas. Intermediate-mass black holes, conjectured to form from runaway mergers of stars into dense clusters that undergo gravitational collapse, would be 100 to a million times as massive as the sun. Next up are supermassive black holes, which can grow as gas accretes into galactic centers and when galaxies hosting central black holes merge. The Milky Way's central black hole, at 4 million solar masses, is supermassive. And at the top of the scale are ultramassive black holes, the name Natarajan gives those with 10 billion to a few tens of billion solar masses.

Natarajan, a native of New Delhi, went in 1997 from MIT to the University of Cambridge in England as a graduate student during a transition time in black hole and cosmology studies. Experts were already suspecting that extremely massive galactic black holes in the current universe are not as common as one would expect. The fast growth of numerous quasars—galactic core black holes glowing fiercely as matter falls into them—seen at great distances and as they were long ago, implied that many were bound to reach masses exceeding 10 billion suns. There is no way to see how those black holes turned out at the end of their quasar days, but astronomers can check nearby galaxies that presumably went through similar youths. And the current universe seems to have a shortage of the fatties that it appears should have grown from earlier epochs.

A basic picture of black hole growth had been worked out in the 1970s and 1980s by Bohdan Paczynski of Warsaw University (and later Princeton) and others. When Paczynski died in 2007, his obituaries all mentioned Polish doughnuts. That was his name for the fat rings of gas that ought to form in any gas-rich region around a large black hole. These torus-shaped rings would feed a steady stream of matter into a hot, brilliantly glowing flat disk of plasma spiraling down—the inner accretion disk. Most of the matter spirals down to its doom, while some gets ejected as powerful polar jets—gouts of radiation.

The result can be a quasar that shines from a region smaller than Earth's orbit of the sun with a brilliance 100 times that of the rest of the quasar's host galaxy. To achieve such power, the quasar must be bumping up against a barrier called the Eddington Limit. The limit's namesake, English astronomer Arthur Stanley Eddington, in the early 20th century worked out how brightly a star can shine before its radiation pressure starts blowing its outer layers into space. Turned around and applied to black holes, that limit is the brightness at which a black hole's accretion disk is so great that it stops more gas from falling in. And to reach that, a quasar of a million solar masses must nearly triple its mass every 10 million to 100 million years. By the time it reaches a billion solar masses, it consumes 20 suns' worth of gas every year.

A quasar's brightness is related to how much matter the black hole is consuming. When matter stops falling in, the light goes out. Each quasar shines for only a few hundred million years. But there was no obvious reason why galaxies should run short of gas to feed into Polish doughnuts that quickly.

Stunting growth

Working in a Cambridge group headed by Great Britain's Astronomer Royal, Martin Rees, Natarajan first decided 10 years ago to calculate how a supermassive black hole might shut off its own food supply and stop growing. Rees, in partnership with University of Oxford cosmologist Joseph Silk, at about the same time worked out one plausible way. "As the black hole grows, we felt it would expel a lot of energy in a jet. It sort of fans out and clears a bubble in surrounding gas," Silk says.

For her thesis, Natarajan worked out another plausible way: A quasar, fueled by a growing, supermassive black hole, reaches a point at which its radiation not only slows the infall of more gas, but also turns the gas around and clears out a large region around itself—leaving a nearly gas-free or "dry" galaxy. This, she estimated, would occur as the black hole reached about 10 billion solar masses.

With this theoretical exercise complete, Natarajan a few years ago tackled another aspect of galactic behavior that would eventually lead her back to how black holes might stunt their own growth. She worked with Marta Volonteri—a former fellow Cambridge postdoc now at the University of Michigan in Ann Arbor—who had developed a model for how the mysterious dark matter would behave early in the universe. Specifically, the astronomers wanted to see how dark matter's clumping under gravity shapes evolution of galaxies that form from the regular matter accompanying them.

Observations with space telescopes had shown that quasars started to pop off when the universe was less than a billion years old, and at immense power. Small black holes cannot do the job. That takes black holes of around a billion solar masses.

Earlier theorists had thought the seeds of galactic black holes were sown by the collapse of the first, immense "Generation III" stars, but those looked too puny to grow fast enough to get quasars going so soon. The two women joined a cadre of cosmologists imagining a direct-collapse model. In it, the first galaxies would form mostly from hydrogen and early stars within blobs of cold dark matter. And in these galaxies' dense centers, gas would congregate so fast it would spiral directly into multimillion-mass black holes, not stopping to form stars first.

With their primordial dark matter blobs set up in their model—each with one or several galaxies and each of those equipped with sizable, often quasar-worthy black holes—the two scientists ran the process to the present time. Out came a universe with, sure enough, galaxies, galaxy clusters and black holes in the middles. But, as others have found, the model predicted more immense galaxies and more black holes of 10 billion solar masses and beyond than are actually evident in nearby (and therefore current) regions.

To be certain, Natarajan needed a more complete history of quasars over the lifetime of the universe for closer comparison with the model, so she could see better where reality and mathematical simulations had parted ways. Her coauthor of the recent paper, Chilean astronomer Treister, gathered the necessary stats from the ground-based Sloan Digital Sky Survey and from some of the most powerful new telescopes in the heavens, including the Chandra X-ray Observatory and Europe's Integral, a gamma-ray observatory. These data informed her not only on the optically obvious quasars shining at visible wavelengths and first identified in the 1960s, but also on roughly twice as many others cloaked by the belts of dust and gas feeding them.

"This was the aha moment," Natarajan says. Early models showing that black holes can turn off their own feeding station were combined with models of galaxy evolution and the populations of quasars and other active galactic nuclei over time. "The only way to fit the data is to physically cut off the ability of black holes to grow beyond some point, and that is at about 10 billion solar masses."

Physically, she explains, the largest black holes reach the end of the line by heating gas not only in their own vicinity but, in a final stage of frenzied luminosity, heating gas throughout their enormous host galaxies and often among the galaxies of the clusters where they reside. Furthermore, it appears that black holes can keep the gas too hot to settle in large quantities back to the galaxy's nucleus or to form stars through most of the galaxy's bulk. Only in the past 10 years have other observations, in fact, revealed that the thin gas permeating massive galactic clusters is heated to tens of millions of degrees. “Nobody expected that,” says Harvard’s Loeb. “So galaxies reach the point where you don’t make stars. This must be intimately related to black hole growth and why it stops.”

Case closed? Not likely. Oxford’s Silk, one of the grand figures in contemporary cosmology, calls the paper “very nicely done, very competent,” but also says that “this is pretty speculative territory.” He continues: “She starts with a weak set of assumptions. You don’t really know how to make the first, seed galactic black holes in the first place. The first galaxies and the first halos of dark matter were not so big. How exactly did billion-mass black holes form? It is one thing to say that, if you have the right ingredients, you can make the cake. But these ingredients are not so natural, I think.”

Natarajan expresses similar concern about those original seeds. “The big question that remains is the early merging history of dark matter halos. This has opened up an absolutely new theoretical simulation to see if we can understand the formation of those black hole seeds.” New instruments may help explore that question. Some answers may come in 10 years or so when a joint NASA and European trio of widely spaced satellites, called the Laser Interferometer Space Antenna or LISA, may detect the gravitational waves from black holes forming and coalescing in distant galaxies. That could provide vital info on the origin of the seeds for eventual, supermassive black holes.

While the scaffolding of a coherent hypothesis linking galaxy evolution and massive black hole behavior is rising, it is not a monument yet. Other questions loom as well. It remains a puzzle that objects of such enormous difference in scale—gigantic galaxies and tiny (if massive) black holes in their centers—seem to move in smooth coordination of growth and evolution. Says Michigan’s Volonteri, “Yes, black hole growth has to stop at some point. Priya [Natarajan] suggests black holes stop their own growth.”

Then Volonteri adds, “Are black holes stopping the galaxies too? Or are the galaxies stopping the black holes?”

SIDEBAR: Black Hole Taxonomy

Black holes can be classified into categories based on size, which depends directly on mass. Apart from small “primordial” black holes that possibly formed in the early universe, the least massive are the size of a large city; the largest are huge enough to reach from the sun out beyond Neptune. New research suggests that there is a limit to how massive a black hole can become.

Stellar-Mass Black Holes

About 5 to 10 solar masses, formed when a massive star exhausts its fuel, central pressure falls and the core collapses to black hole density. (A shock wave blasts the rest of the star off in a supernova). The Hubble Space Telescope image above is of a supernova remnant in the constellation Cassiopeia.
SIZE: Roughly 30 kilometers across, or about 10 km longer than Manhattan.
MASS: 5 suns\

Intermediate-Mass Black Holes

About 100 to a million solar masses, conjectured to form in dense star clusters from a merger of stars into a giant mass that then undergoes runaway gravitational collapse.

SIZE: About 60,000 km across, or almost five times Earth’s diameter. If a stellar-mass black hole were the size of the period at the end of this sentence, this black hole would be about 2 feet across.
MASS: 10,000 suns

Supermassive Black Holes

From a million to a few billion solar masses, formed by accretion of gas in galactic centers and by mergers of black holes as their host galaxies collide. The Milky Way’s central black hole is in this group. The above Hubble image shows the collision of two galaxies.

SIZE: About 25 million km across, it would fit within Mercury’s orbit around the sun. If a stellar-mass black hole were period-sized, this black hole would be 250 meters across.
MASS: 4 million suns
(central black hole in the Milky Way)

Ultramassive Black Holes
Newly proposed category for black holes from 10 billion to tens of billions of solar masses. At such sizes, the event horizon diameter can reach hundreds of billions of kilometers.

SIZE: 60 billion km across, it would stretch from the sun to far past Neptune, even beyond some distant comets. If a stellar-mass black hole were a period, this black hole would stretch from Cleveland to Washington, D.C.
MASS: 10 billion suns

http://www.sciencenews.org/view/feature/id/37403/title/Ultramassive_as_big_as_it_gets

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