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GRAVITATIONAL WAVES DETECTED 100 YEARS AFTER EINSTEIN'S PREDICTION
LIGO Opens New Window on the Universe with Observation of Gravitational Waves from Colliding Black Holes

引力波终被探测—爱因斯坦百年预言证实！

LIGO 探测到双黑洞碰撞产生的引力波，打开了一扇观察宇宙的新窗口

For the first time, scientists have observed ripples in the fabric of spacetime called gravitational waves, arriving at the earth from a cataclysmic event in the distant universe. This confirms a major prediction of Albert Einstein's 1915 general theory of relativity and opens an unprecedented new window onto the cosmos.

有史以来，科学家第一次观测到了时空纤维中的涟漪——引力波，这一来自遥远宇宙的灾变性事件所产生的信号。这一探测证实了阿尔伯特·爱因斯坦在 1915 年的广义相对论的一个重要预言，并打开了一扇前所未有的探索宇宙的新窗口

Gravitational waves carry information about their dramatic origins and about the nature of gravity that cannot otherwise be obtained. Physicists have concluded that the detected gravitational waves were produced during the final fraction of a second of the merger of two black holes to produce a single, more massive spinning black hole. This collision of two black holes had been predicted but never observed.

起源于剧烈物理活动的引力波，携带着关于其源头和关于引力的独一无二的信息。物理学家们确信他们探测到了来自两个黑洞最后并合瞬间的引力波，这两个黑洞最终形成了一个更重的快速旋转的黑洞。这一现象长久以来就被理论预言，然而在此之前却一直没被观测到。

The gravitational waves were detected on September 14, 2015 at 5:51 a.m. Eastern Daylight Time (9:51 a.m. UTC) by both of the twin Laser Interferometer Gravitational-wave Observatory (LIGO) detectors, located in Livingston, Louisiana, and Hanford, Washington, USA. The LIGO Observatories are funded by the National Science Foundation (NSF), and were conceived, built, and are operated by Caltech and MIT. The discovery, accepted for publication in the journal *Physical Review Letters*, was made by the LIGO Scientific Collaboration (which includes the GEO600 Collaboration and the Australian Consortium for Interferometric Gravitational Astronomy) and the Virgo Collaboration using data from the two LIGO detectors.

这一引力波信号于美东夏令时 2015 年 9 月 14 日凌晨 5:51 分 (北京时间当天下午 5:51 分)，由一对分别位于路易斯安那州列文斯顿 (Livingston, Louisiana) 和华盛顿州汉福德 (Hanford, Washington) 的激光干涉引力波观测台 (LIGO) 探测到。LIGO 天文台是由美国国家科学基金资助，由加州理工和麻省理工构思、建造并运行的。这一发现是由 LIGO 科学合作组织 (包含 GEO600 组织和澳大利亚干涉引力天文协会) 以及 Virgo 组织使用来自两台 LIGO 探测器的数据后做出的。本次发现被物理评论快讯 (Physical Review Letters) 期刊接受发表。

LIGO research is carried out by the LIGO Scientific Collaboration (LSC), a group of more than 1000 scientists from universities around the United States and in 14 other countries. More than 90 universities and research institutes in the LSC develop detector technology and analyze data; approximately 250 students are strong contributing members of the collaboration. The LSC detector network includes the LIGO interferometers and the GEO600 detector. The GEO team includes scientists at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute, AEI), Leibniz Universität Hannover, along with partners at the University of Glasgow, Cardiff University, the University of Birmingham, other universities in the United Kingdom, and the University of the Balearic Islands in Spain.

LIGO 的研究工作由 LIGO 科学合作组织 (LSC) 完成 , 这一合作组织包含来自美国和其他 14 个国家的 1000 多名科学家。LSC 中的 90 多家大学和研究所参与研发了探测器所使用的技术 , 并分析其产生的数据 ; 在组织中 , 有约 250 名做出重要贡献的成员是学生。LSC 探测网络包括 LIGO 干涉仪和 GEO600 探测器。GEO 团队包括来自德国马克斯-普朗克引力物理研究所 (阿尔伯特·爱因斯坦研究所 (AEI)) , 汉诺威莱布尼兹大学与格拉斯哥大学 , 加迪夫大学 , 伯明翰大学 , 其他英国的大学以及西班牙的巴利阿里群岛大学。

LIGO was originally proposed as a means of detecting these gravitational waves in the 1980s by Rainer Weiss, professor of physics, emeritus, from MIT; Kip Thorne, Caltech's Richard P. Feynman Professor of Theoretical Physics, emeritus; and Ronald Drever, professor of physics, emeritus, also from Caltech.

LIGO 这种用激光干涉探测引力波的方法最初是在上世纪 80 年代提出的 , 主要的提出人有 MIT 物理教授、荣休教授雷纳·韦斯 (Rainer Weiss) , 加州理工的理查德·费曼理论物理讲座教授、荣休教授基普·索恩 (Kip Thorne) 以及同样来自加州理工的物理教授、荣休教授罗纳德·德雷弗 (Ronald Drever) 。

Virgo research is carried out by the Virgo Scientific Collaboration, a group of more than 250 physicists and engineers belonging to 18 different European laboratories: 6 with Centre National de la Recherche Scientifique (CNRS) in France; 8 with the Istituto Nazionale di Fisica Nucleare (INFN) in Italy; Nikhef in the Netherlands; the Wigner Institute in Hungary; the POLGRAW group in Poland; and the European Gravitational Observatory (EGO), the laboratory hosting the Virgo interferometer.

室女座引力波探测器 (Virgo) 的研究工作由 Virgo 科学合作组织完成 , 这一组织包含 250 多名物理学家和工程师 , 分别隶属于 18 个不同的欧洲的实验室 , 包括法国国家科学研究中心 (CNRS) 的 6 家研究所、意大利国立天体物理研究所 (INFN) 的 8 家研究所、荷兰国家核物理及高能物理研究所、匈牙利维格纳研究所 , 波兰引力研究组和安置室女座引力波探测器的欧洲引力天文台。

The discovery was made possible by the enhanced capabilities of Advanced LIGO, a major upgrade that increases the sensitivity of the instruments compared to the first generation LIGO detectors, enabling a large increase in the volume of the universe probed—and the discovery of gravitational waves during its first observation run. The US National Science Foundation leads in financial support for Advanced LIGO. Funding organizations in Germany (Max Planck Society), the U.K. (Science and Technology Facilities

Council, STFC) and Australia (Australian Research Council) also have made significant commitments to the project. Several of the key technologies that made Advanced LIGO so much more sensitive have been developed and tested by the German UK GEO collaboration. Significant computer resources have been contributed by the AEI Atlas cluster, the LIGO Laboratory, Syracuse University, and the University of Wisconsin-Milwaukee. Several universities designed, built, and tested key components for Advanced LIGO: The Australian National University, the University of Florida, Stanford University, Columbia University of New York, and Louisiana State University.

这一发现得益于高新激光干涉仪引力波天文台 (Advanced LIGO) 探测能力的大大提升。对比第一代 LIGO 探测器 , Advanced LIGO 的重要升级工作使得仪器的灵敏度大大增强 , 从而可以大大增加了可探测的宇宙空间 , 也直接导致在其第一次观测运行中发现引力波。 美国国家科学基金会主导了高新激光干涉的财政支持。德国的马克斯-普朗克学会 , 英国的科学与技术设施委员会和澳大利亚的澳大利亚研究基金会等资助机构均对本项目作出了巨大贡献。使高新探测器灵敏度大大提高的几项关键技术由德国-英国的 GEO 合作组织开发并测试。主要的计算机资源由 AEI 的 Atlas 机群 , LIGO 实验室 , 雪城大学和威斯康星大学密尔沃基分校贡献。一些大学设计、建造并测试了 Advanced LIGO 的关键部分 : 澳大利亚国立大学 , 佛罗里达大学 , 斯坦福大学 , 纽约哥伦比亚大学和路易斯安那州立大学。