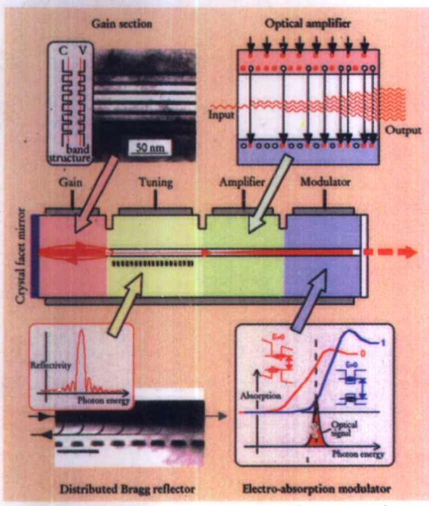
Modern English for Latest Technologies

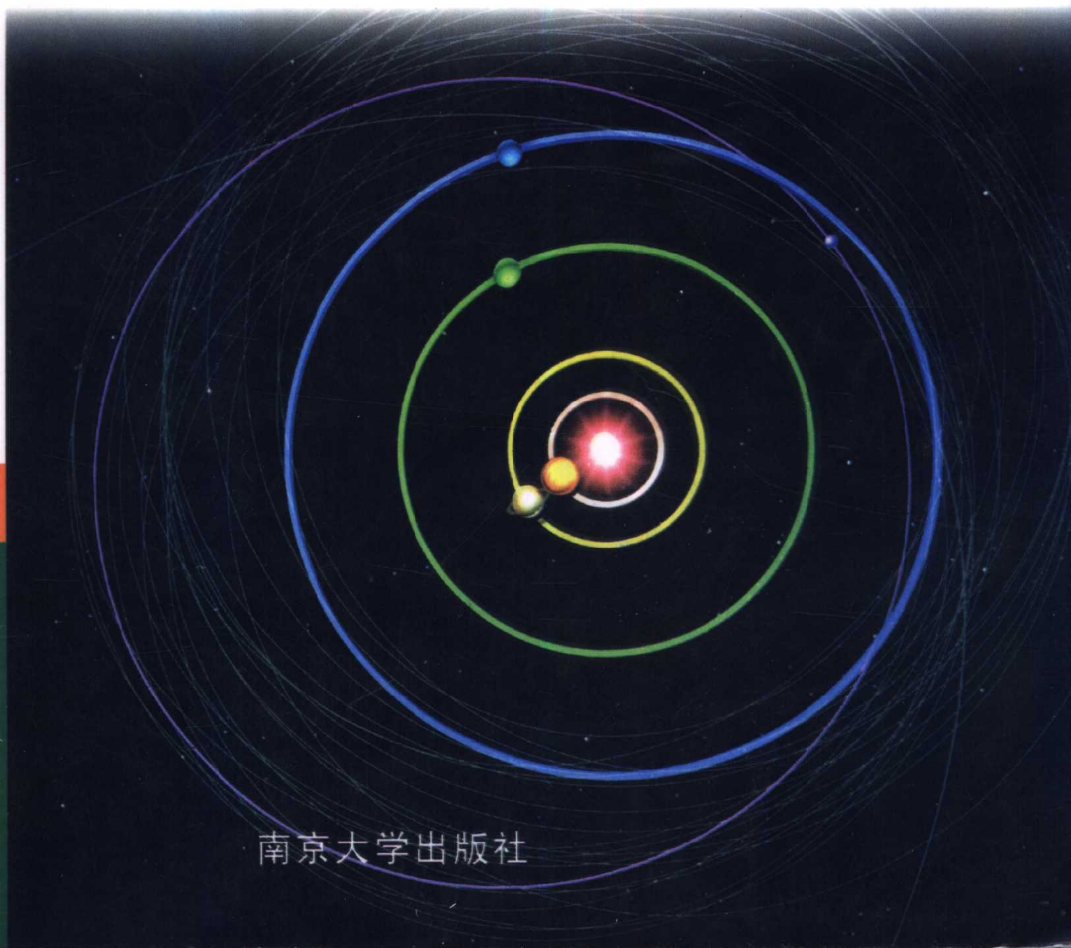
主编 吴宗森



最新 科技英语教程

（物理及天文学卷）

周叔麟 萧耐园 杨正举 编著



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主　编　吴宗森
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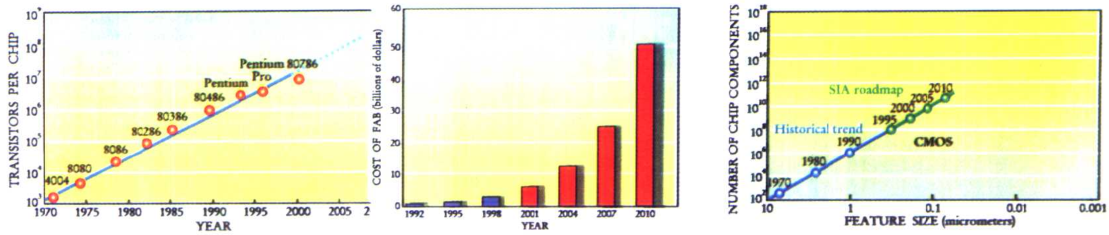

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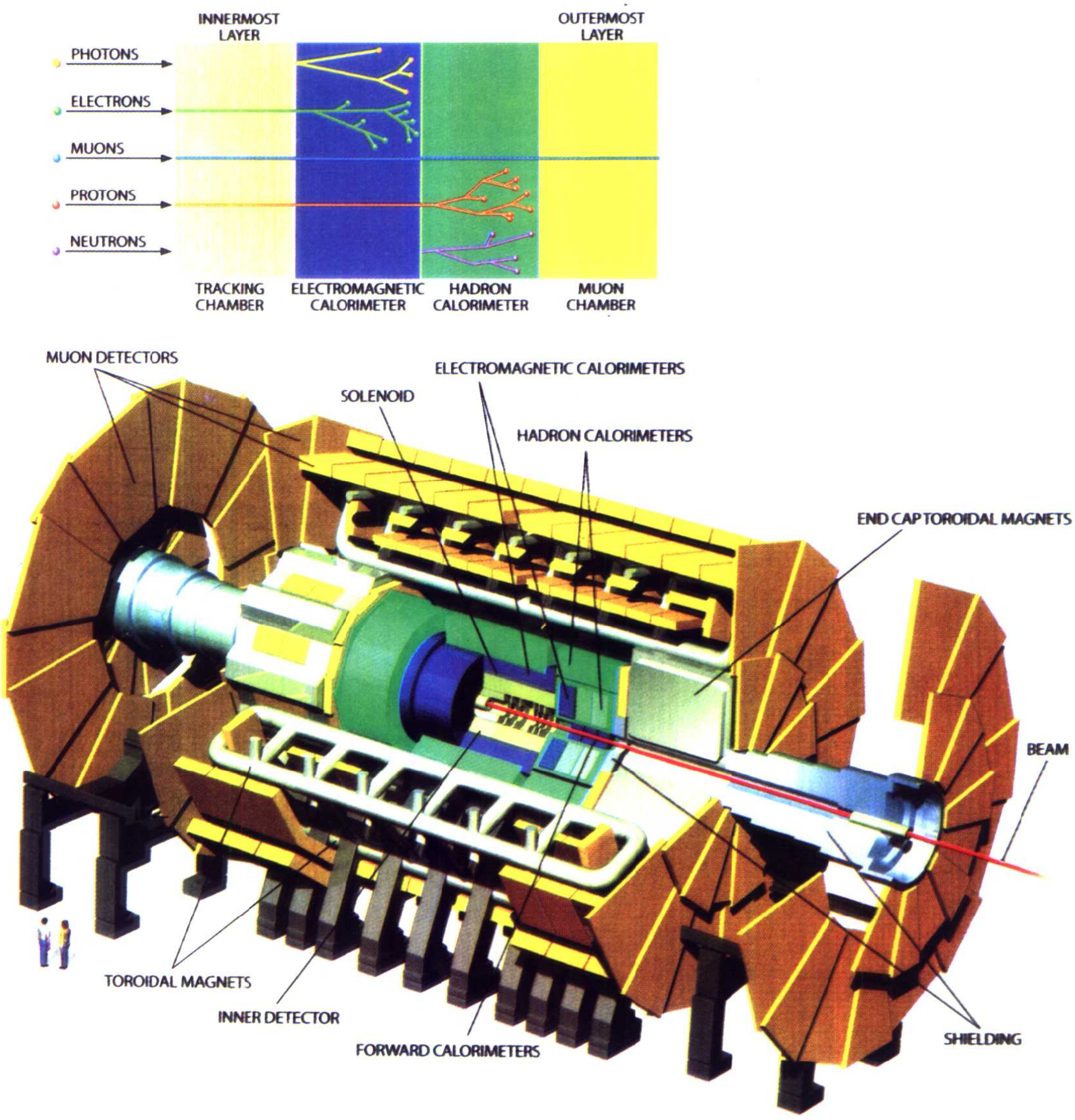

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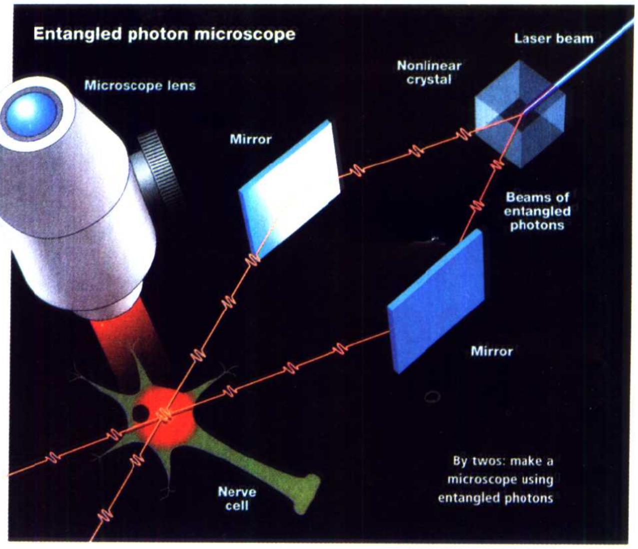

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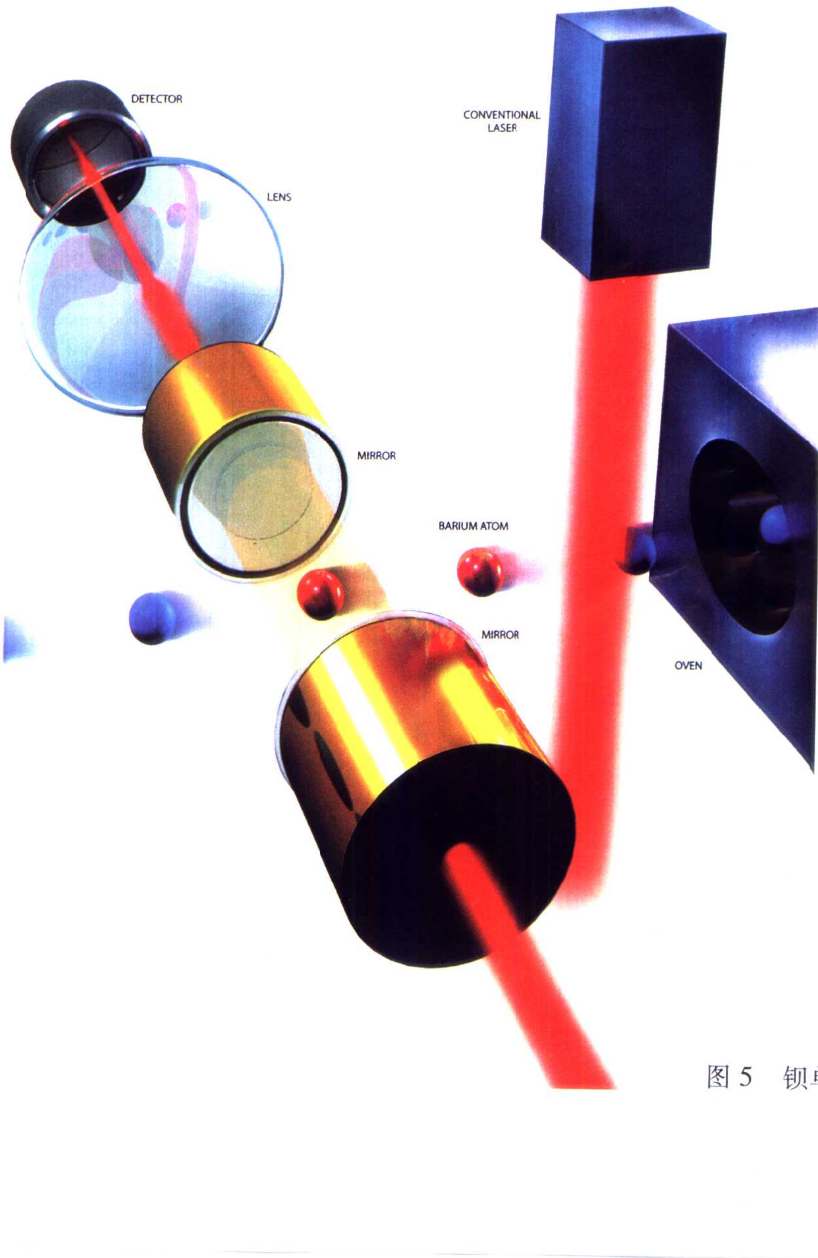

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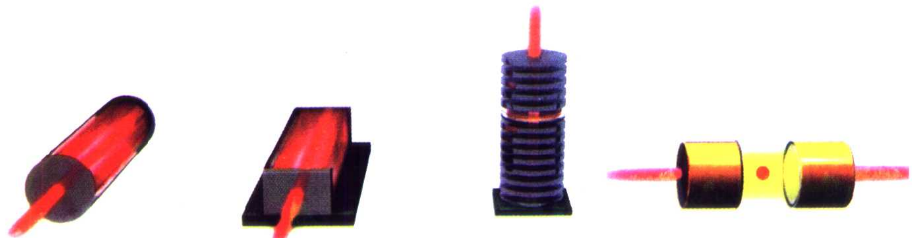

	HELIUM-NEON	NEODYMIUM-YAG	MICROCAVITY SEMICONDUCTOR	SINGLE-ATOM
DISTANCE BETWEEN MIRRORS	20 TO 100 CENTIMETERS	5 TO 15 CENTIMETERS	2 TO 5 MICRONS	1 MILLIMETER
NUMBER OF ATOMS	10^{16} NEON ATOMS	10^{19} NEODYMIUM IONS	10^{6} ELECTRON-HOLE PAIRS	1 BARIUM ATOM
POWER (WATTS)	0.001	1.0	0.0001	0.000000000001

MARK GERBER

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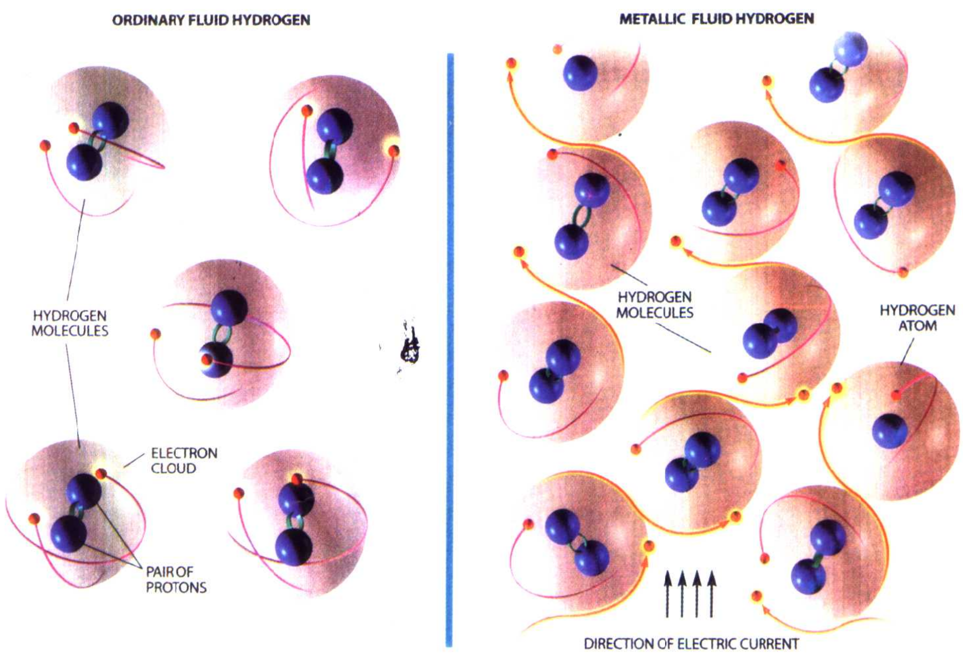

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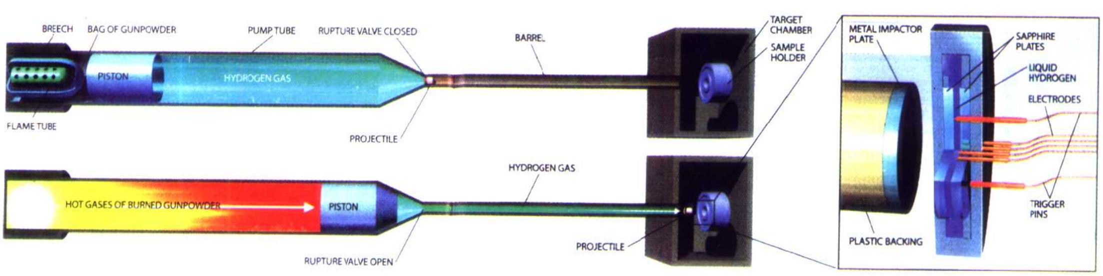

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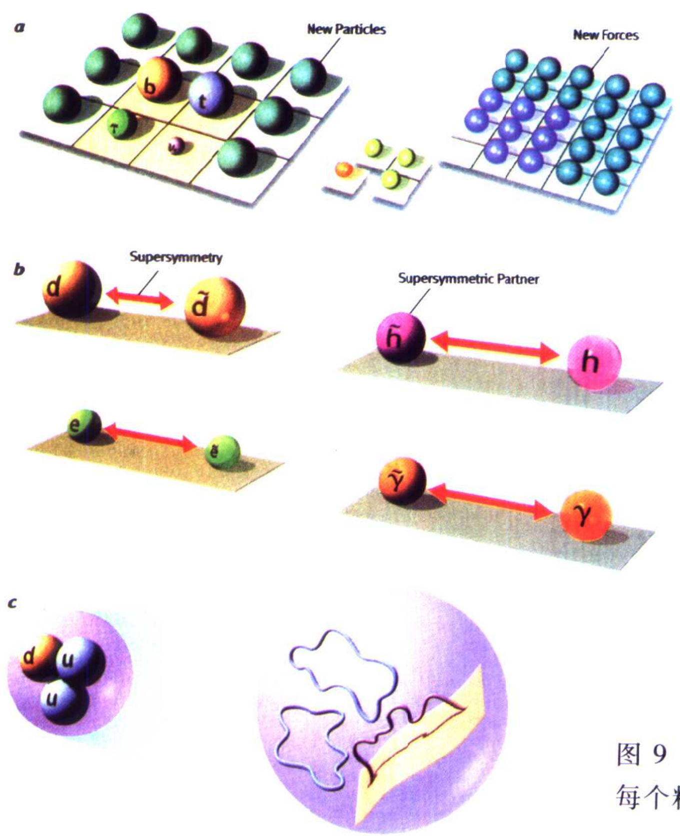

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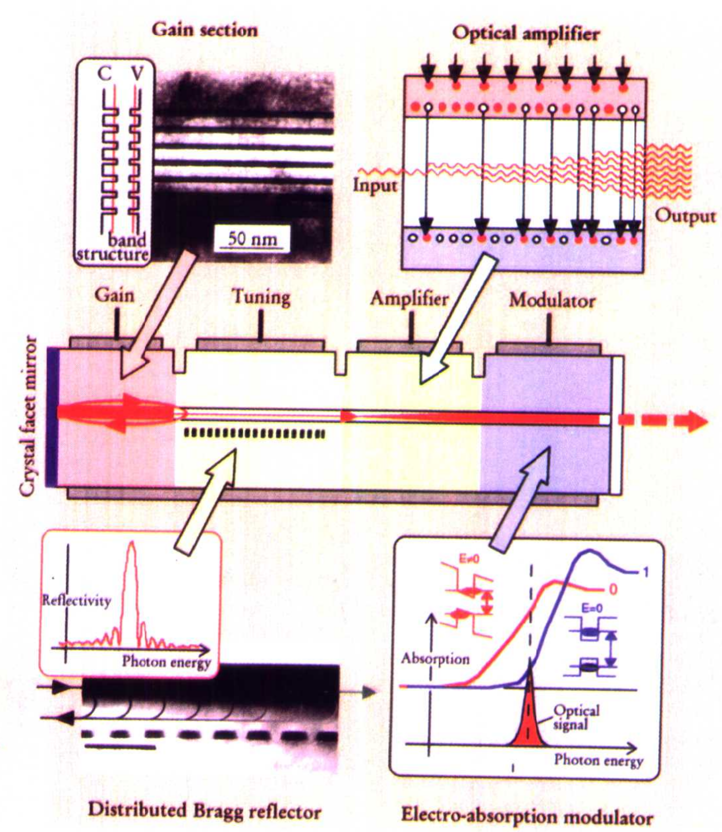

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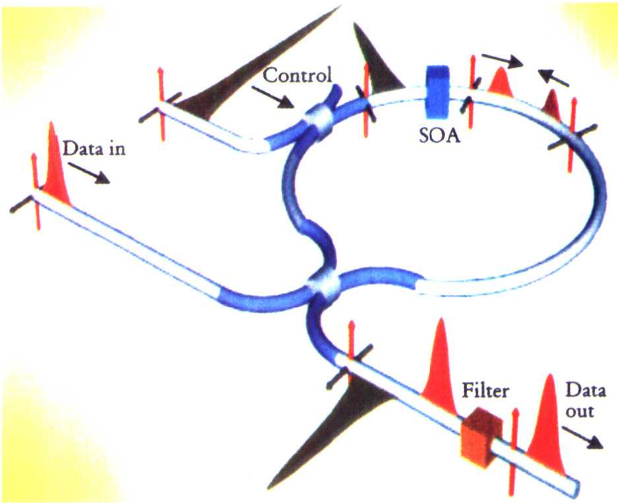

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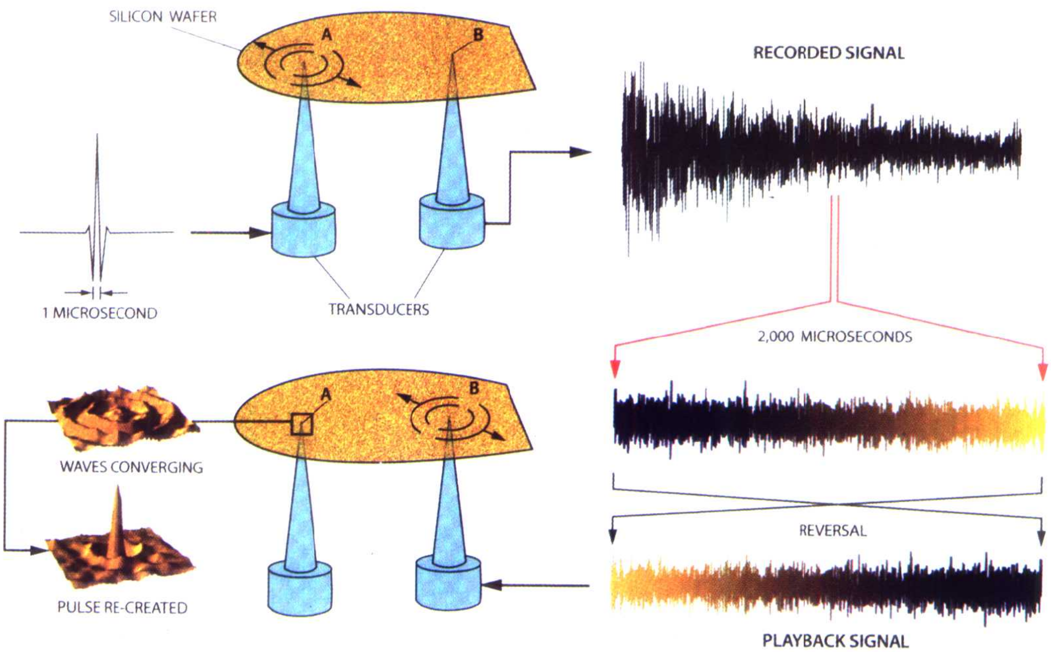

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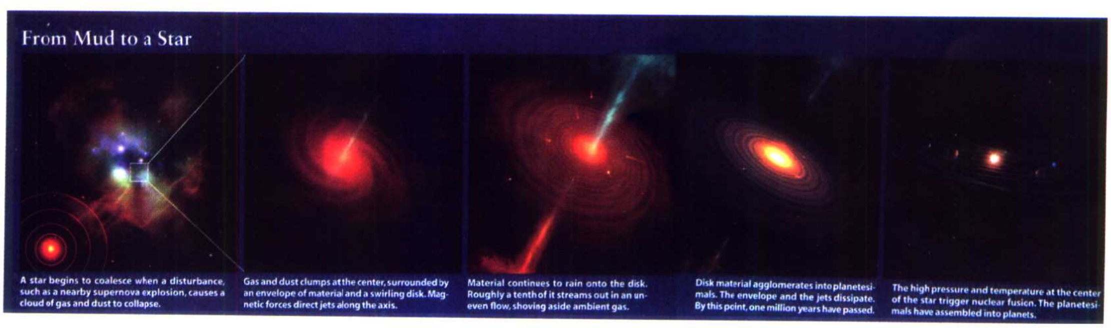

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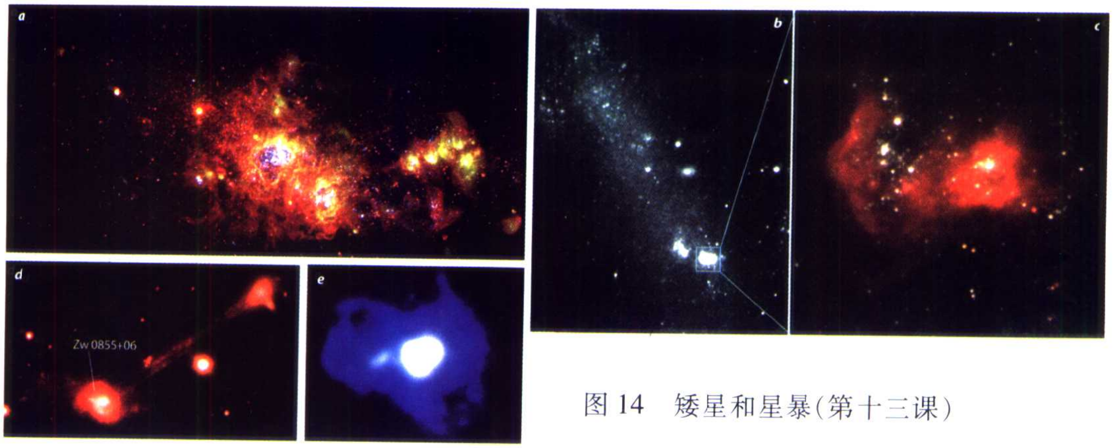

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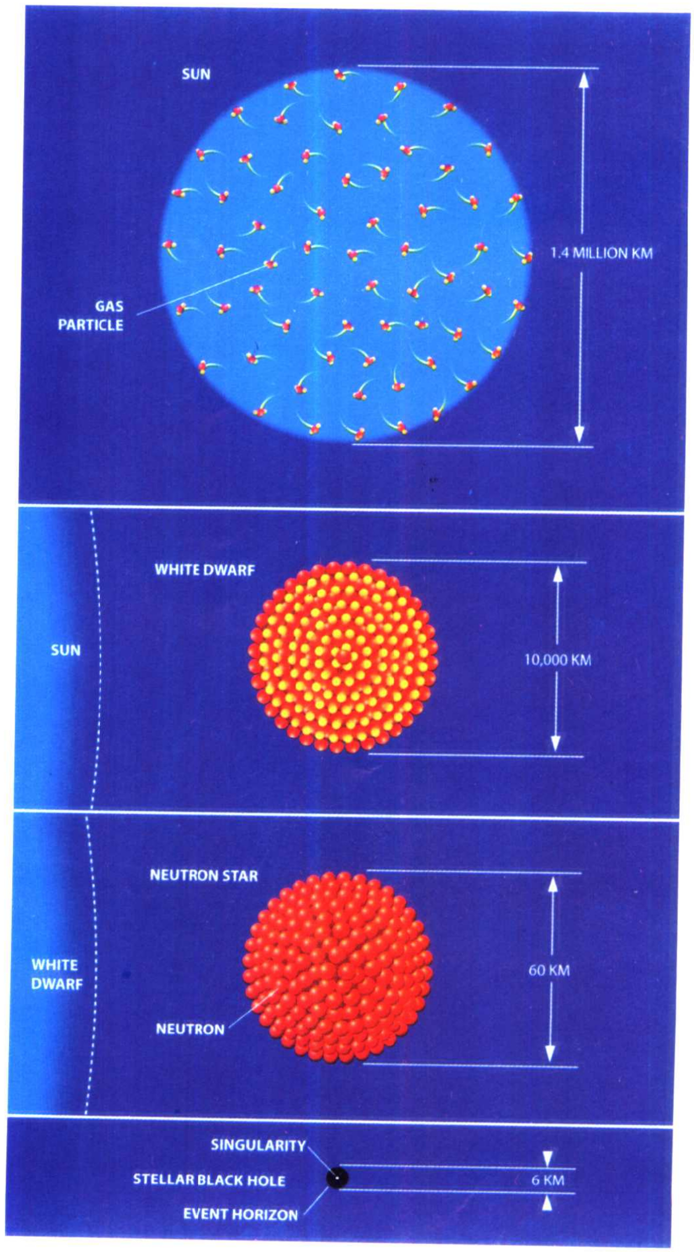

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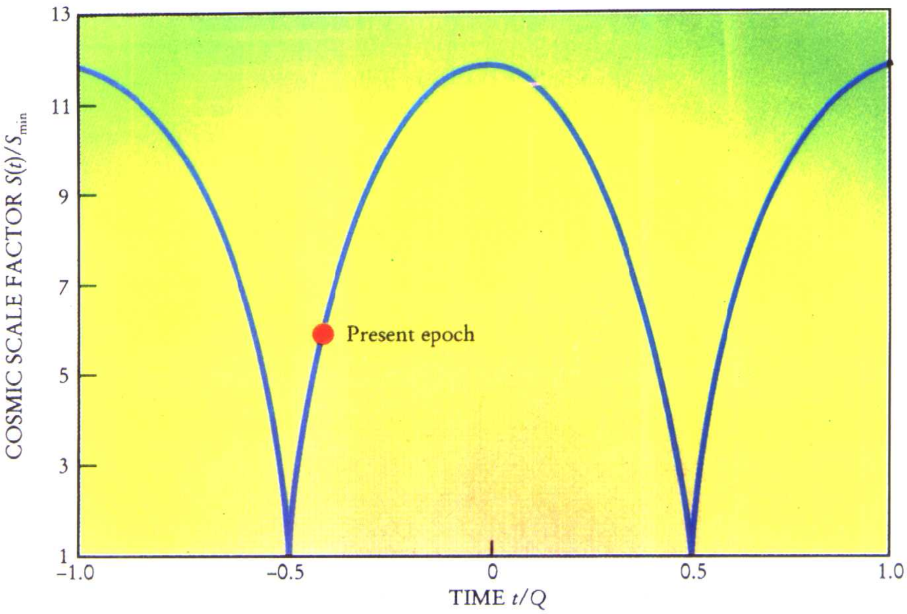

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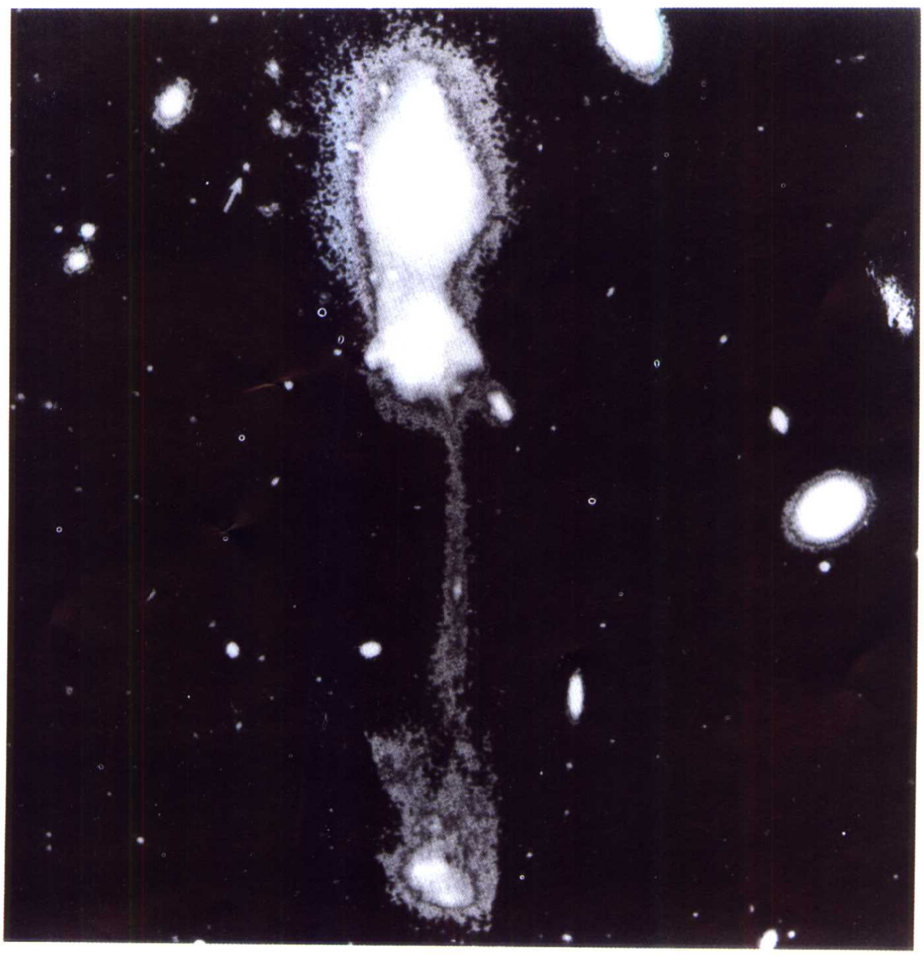

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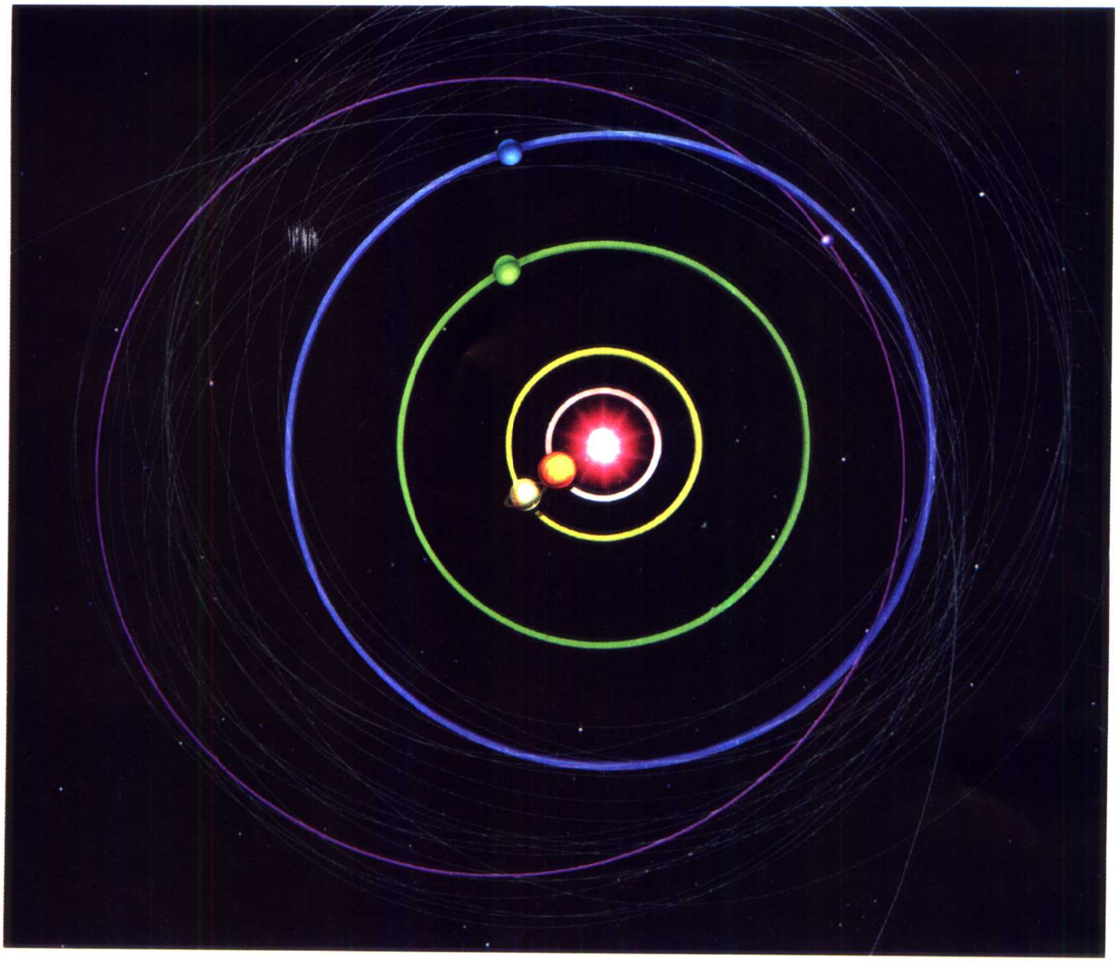

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前　言

本书是最新科技英语教程序列的物理和天文学卷。它是继1999年以来以电子科学与工程为主的《最新科技英语教程》,以气象、地质、地理和环境为主的《最新科技英语教程(地球科学卷)》和以化学和生命科学为主的《最新科技英语教程(化学与生命科学卷)》出版以后,我校四位理、文科学者所编写的又一本以物理及天文学为主的科技英语新书。

我们四人都相继留学国外,长则十多年,短的也有两三年。现在分别在南京大学物理系、外语部、天文系和电子系任教。文、理学者在一起编著一本书,在我校已经尝试多次,证明是一种颇为奏效的合作模式。实践表明,光靠文科学者,科技英语选材的新颖、深度和广度难以得到保证,反之,光靠理科学者,科技英语的严谨和文采,翻译技巧和其中的恰到好处,也是难以得到保证的。

和前三本书一样,我们对《最新科技英语教程(物理及天文学卷)》选题的宗旨是:紧跟当前最新的科技发展。因而本书编录了美国和英国 *Physics Today*, *Scientific American* 和 *New Scientist* 等著名杂志近年来,特别是2000年以来发表的一些最新的科技文章。全书共有十九课,几乎涉及到当今物理学(高能物理、量子物理、材料物理、激光、超导和声学)及天文学(宇宙起源、行星、外星及黑洞)最新的科技方向和科研成果。本书中有一课收录了美国一位教授写的关于宇宙起源的诗。最后作为附录,本教材还收集了 *IEEE Professional Communication Society* 有关科技工作者如何书写科技论文以及如何口头演讲科技论文的文章。本书无疑是一本适合理科和工科相关系科的高年级及研究生使用的科技英语教材。

本书每课都有中文的提要、英文课文、中文注释、作者简介和简要的口头练习。课文的各段落都按顺序编了号。各段中较难懂或复杂的句子前均依次打上 *、* *、* * * 等符号,在课文后的注释中以相应的段落编号和符号 * 为序一一翻译成汉语,供读者学习参考之用。对于比较专业化的生词、不常用或难懂的词组和单词,我们也尽量收列在注释中。

最后,借此机会向所有支持和鼓励我们编写和出版本书的师长、同事、家人和朋友们表示衷心的感谢。我们还要特别向支持我们出版本书的南京大学出版社表示深切的谢意。没有他们的大力支持、鼓励和指导,是不可能有这四本最新科技英语教程的。物理系陈廷扬教授和孙景李教授对本书有关内容进行认真审核。在本书出版之际,谨向他们表示衷心的感谢。

由于时间紧迫,加上我们的水平有限,书中的错误在所难免,敬请读者不吝指正。

编　著　者

2001年1月于南京大学

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第一课

物理学与信息革命

阅读本课，你将会知道：

——计算机技术和物理学之间的关系。

——什么是莫尔定理；什么是莫尔第二定理。

——什么是未来的计算机；什么是量子态开关。

——什么是纳米尺度器件；它的困难何在。

——如何实现高故障容限的计算器。

Unit 1

Physics and the Information Revolution

[课文]

1. * In the fourth century BC, a young man named Pythias was condemned to death by Dionysius, the tyrant of Syracuse for plotting against him, but Pythias was granted three days' leave to go home to settle his family's affairs after his friend Damon agreed to take his place and be executed should Pythias not return. Pythias encountered many problems but managed to return just in time to save Damon. Dionysius was so struck by this remarkable and honorable friendship that he released them both.

2. * The decades-old friendship between computer technology and physics has also been remarkable and honorable one, and it, too, has produced salutary results. ** Present-day experimental and theoretical physicists depend on computing, and have incurred a debt that they have repaid many times over by making fundamental contributions to advances in hardware, software, and systems technologies.

3. In this article, we discuss the physical and economic limits to the geometrical scaling of semiconductor devices that has been the basis of much of the computer industry's progress over the last 50 years. We then look at some of the options that may be available when we come up against fundamental physics barriers sometime after 2010.

Disruptive Technology

4. The first stored-program electronic computer, ENIAC (the Electronic Numerical Integrator and Computer), was built in 1946. A major triumph for vacuum-tube technology, ENIAC could add 5,000 numbers in one second. At that rate, it could calculate the trajectory of an artillery shell in only 30 seconds, whereas an expert human with a mechanical calculator would have needed some 40 hours to complete the task. The machine was large and expensive. ENIAC:

◆ Contained 17,468 vacuum tubes

◆ Weighed 60,000 pounds

◆ Occupied 16,200 cubic feet

◆ Consumed 174 kilowatts (233 horsepower).

5. * The amount of energy ENIAC expended to compute a single shell trajectory was comparable to that of the explosive discharge required to actually fire the shell. ENIAC was still the fastest computer on Earth nine years later, when it was turned off because the US Army could no longer justify the expense of operating and maintaining it.

6. Even in the early days of ENIAC, though, technologists dreamed of smaller, faster, and far-more-reliable computers. An article by a panel experts in the March 1949 issue of *Popular Mechanics* confidently predicted that someday a computer as powerful as ENIAC would contain only 1,500 vacuum tubes, weigh only 3,000 pounds, and require a mere 10 kilowatts of power to operate. Such a machine would be about the size and weight of an automobile, said the experts, with power consumption to match. What was intended to be a bold projection seems quaintly conservative to us now. These days, a palmtop computer is thousands of times more powerful than ENIAC was.

7. The reason for the experts' now-laughable error is that their prediction was based on the wrong foundation—reasonable extrapolation of the in-place vacuum-tube technology. The transistor, which had already been invented and represented a disruptive technology—that is, a technology that could totally displace vacuum tubes in computers, as electronic calculators later replaced slide rules—was completely ignored.

8. By 1949, after 40 years of development, vacuum-tube technology was mature, and

the associated manufacturing infrastructure was enormous. In 1938 the vacuum tube had still been a decade away from its ultimate accomplishment. But already there was a significant search for something that would be better: a solid-state switch. The development of that switch required a great deal of basic research, both in material purification and in device concepts.

9. Even though transistors as discrete devices had significant advantages over vacuum tubes and progress on transistors was steady during the 1950s, the directors of many large electronics companies believed that the vacuum tube held an unassailable competitive position.

10. * Their companies were eventually eclipsed by the ones that invested heavily in transistor technology R&D and that were poised to exploit new advances. ** As we shall see, there are eerie parallels with the situation today.

Moore's Law

11. Gordon Moore of Intel Corp was the first to quantify the steady improvement in gate density when he noticed that the number of transistors that could be built on a chip increased exponentially with time. * Over the past 28 years, that exponential growth rate has corresponded to a factor-of-four increase in the number of bits that can be stored on a memory chip in every device generation of about 3.4 years—an increase of 64,000 times.

12. * This exponential growth in chip functionality is closely tied to the exponential growth of the chip market, which has been approximately doubling every five years. ** At the present time, there are two recognized factors that could bring Moore's law scaling to an end. The first, according to Moore himself, is economic. *** The cost of building fabrication facilities to manufacture chips has also increasing exponentially, by about a factor of two of every chip generation. This is sometimes known as Moore's second law.

13. Thus, the cost of manufacturing chips is increasing to significantly faster than the market is expanding. * At some point, a saturation effect should slow the exponential growth to yield a classic s-curve for expanding populations.

14. In 1995, to build a single fabrication facility, or "fab", took about $ 1 billion, or about 1% of the entire annual chip market. By the year 2010, a fab could cost $ 30 billion to $ 50 billion—or about 10% of the total annual market at that time—if Moore's second law continues to hold.

15. * The second factor threatening Moore's first law is that the engine that has brought the industry to this point, the complementary metal oxide semiconductor field-effect transistor (CMOS), can only take the technology part of the way to where it needs to go. The Semiconductor Industry Association has established a National