Royal Society Series on
Advances in Science - Vol.1

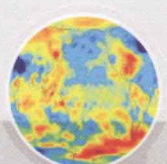
英国皇家学会前沿科技丛书——卷1

天文学前沿
——从大爆炸到太阳系

Advances in Astronomy
From the Big Bang to the Solar System

剑桥大学　J.M.T. 汤普森　主编

英文版



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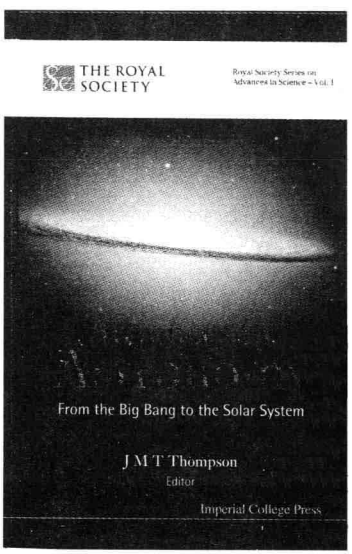
主　编　J. M. T. 汤普森（剑桥大学）



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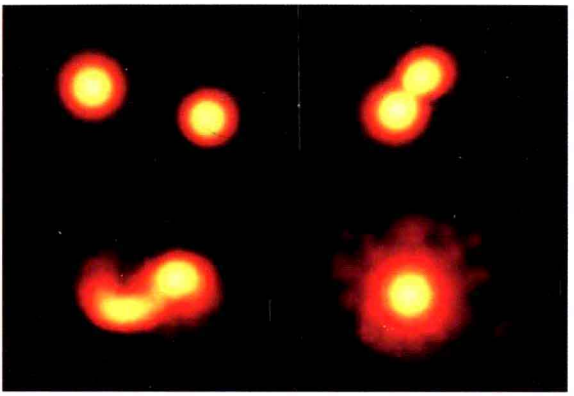
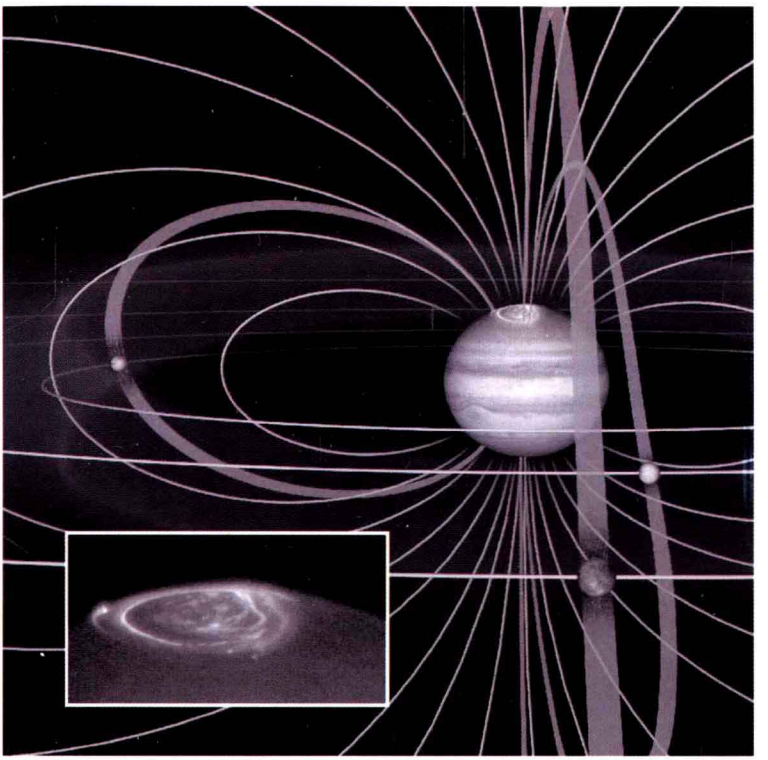
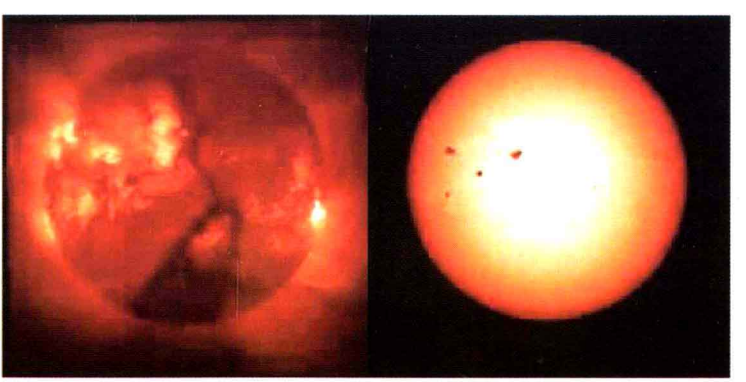


A figure showing four snapshots of a collision between two main–sequence stars (top–left to bottom–right). The density of the gas in the plane of the collision is shown here (white is for the highest densities, black for the lowest densities). For this collision, the original stellar masses are 0.8 $M_{\odot}$ and 0.6 $M_{\odot}$ and the cores of the two stars passed within one quarter of the sum of the stellar radii. As a result of the collision, the two stars merge to form a single object.

Auroral emissions, as seen from the ground (Photo courtesy of Jouni Jussila).



Jupiter's space environment, with moons Io, Europa and Ganymede (insert: Jupiter's aurora, as seen in the UV). (Illustration courtesy of John Clarke.)



The left-hand figure shows a full Sun image in white light, and the right-hand figure shows an X-ray image of the Sun both taken on the same day. The darkest spots on the white-light image show the source of the most intense magnetic field. This corresponds to the brightest regions of X-ray emission. Courtesy of S. Matthews and the Yohkoh team.

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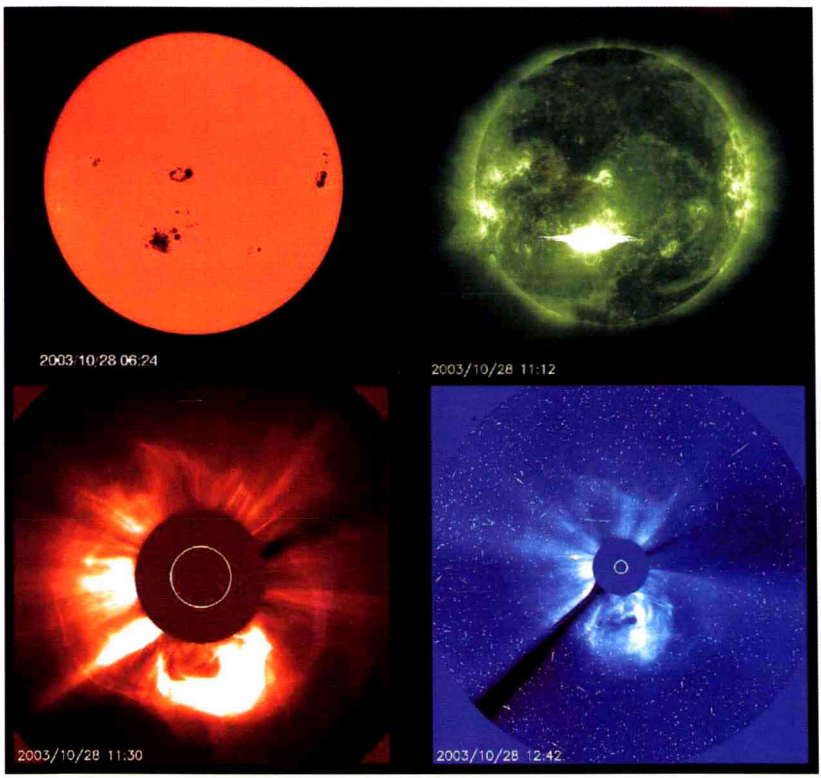
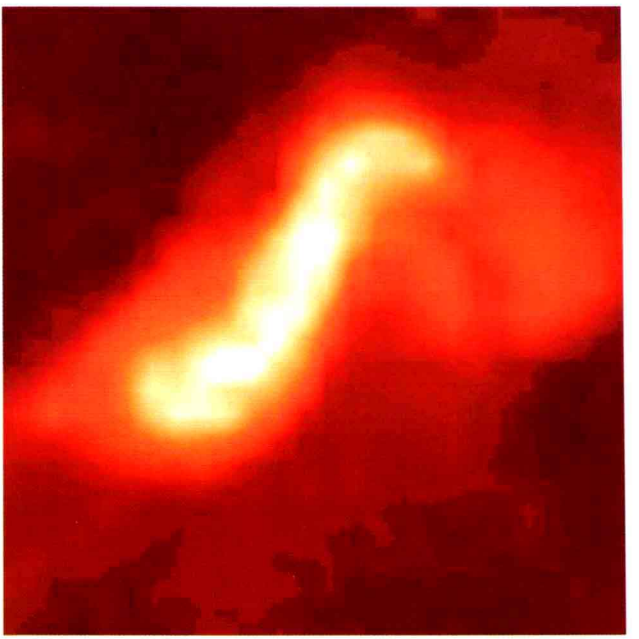
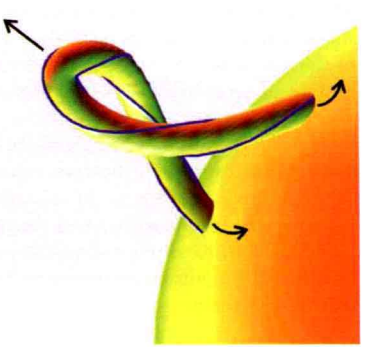


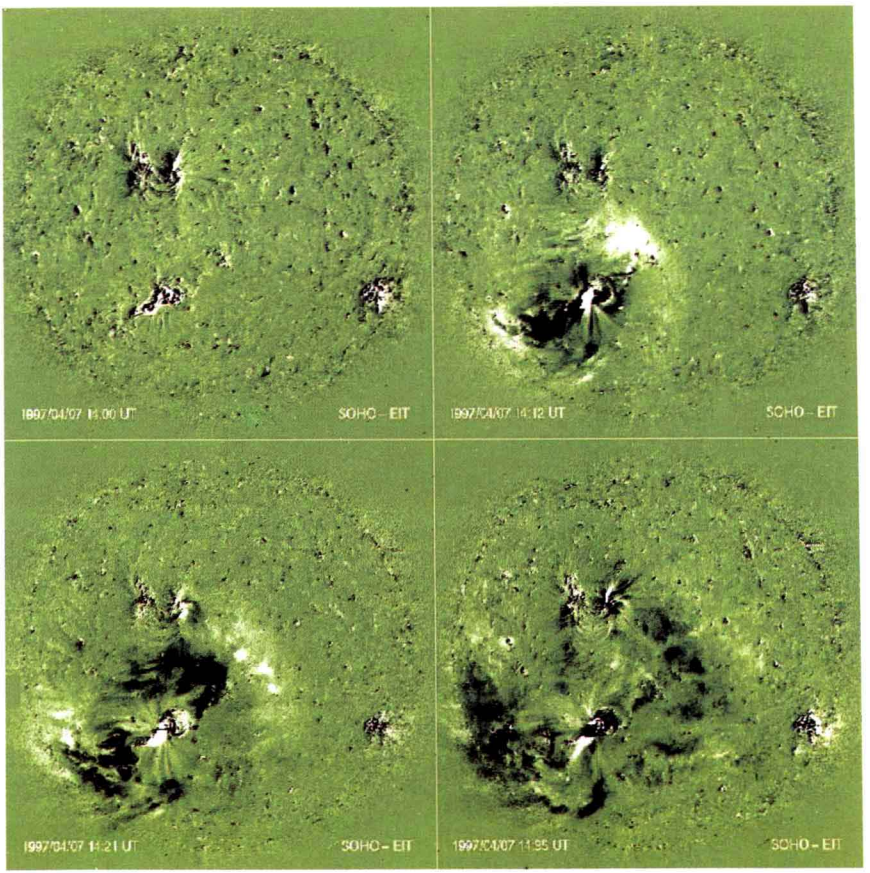
Active region 10486, which had grown to one of the largest sunspot seen by SOHO, unleashed a spectacular eruption on 28 October 2003. The second largest flare observed by SOHO hurled out a fast-moving Coronal Mass Ejection. The top left figure shows the magnetic field of the active region - seen as the darkest region on the disk. The top right figure shows the flare as seen in EUV - it shows as intense brightness which even saturates the detector. The bottom left figure shows the coronal mass ejection appear in the coronagraph (LASCO) and is heading towards Earth. This coronagraph, LASCO-C2 observes out to 6 solar radii. The bottom right figure shows the ejection hurled further away from the Sun, reaching out to 30 solar radii. By the time it appears in this coronagraph, high energy particles have reached the detectors causing the 'snow' effect seen in this image. The solid white circle shows the size of the Sun's disk in the bottom images.As a result of this storm, aurora were seen as far south as Dublin, Ireland!. Courtesy of the ESA/NASA SOHO team.



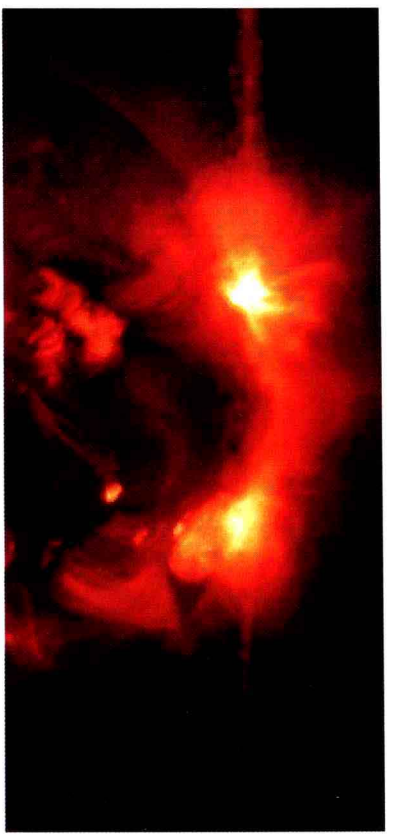
A soft X-ray image of a coronal loop just before a coronal mass ejection lifted off. The structure shows an 'S-shaped' structure that illustrates twisted and sheared magnetic field. This particular event was studied intensively by Sterling and Hudson, and an 'S-shaped' structure is now used as a proxy for a region that is likely to produce a coronal mass ejection.



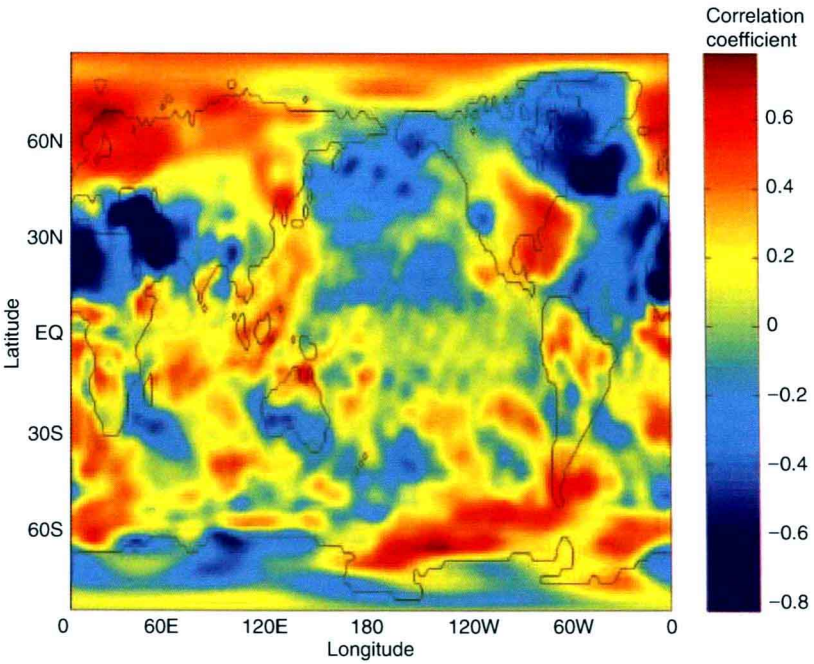
An example of how twist and writhe can be achieved in a magnetic flux tube (Démoulin and Berger)



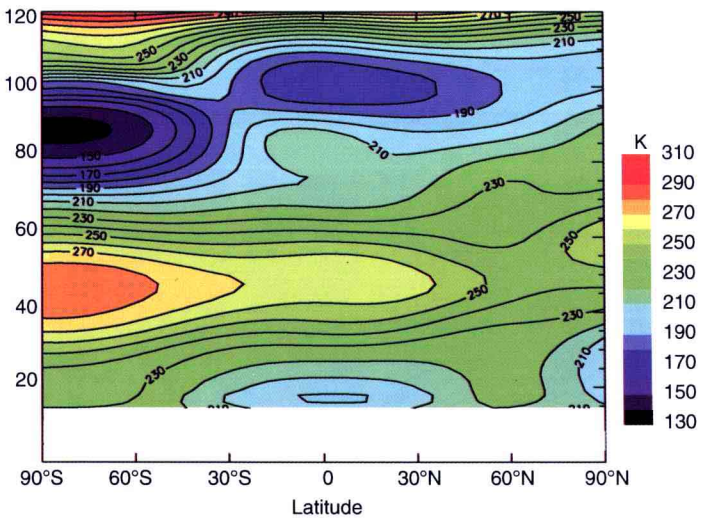
An example of a coronal wave. This is a time series of difference images from the EUV Imaging Telescope on board SOHO. There is a bright front which propgates across the disk in less than an hour. A strong region of coronal dimming lags the front.



The Sun at the west limb in soft X-rays. There are two bright active regions at the limb that are connected by a larger magnetic loop.



Global pattern of statistical significance of solar forcing versus temperature at 500 mb for the eastern phase of the equatorial Quasi Biennial Oscillation during the Northern Hemisphere winter showing clear influence in the North Atlantic storm track region. The data was obtained from the National Center for Environmental Prediction 40 year global climate reanalysis project. (Courtesy of Wesley Ebisuzaki and Chris Calvey).



limatology of seasonally averaged zonal mean temperatures for the Northern e winter for the middle atmosphere and lower thermosphere. The stratosphere on between the temperature minimum around 15 km and the maximum at 50 the mesosphere is the region of decreasing temperatures above that. (Taken ISIS-90E climate reference model Hedin A. E. 1991 *J. Geophys. Res.* **96** 1159.)

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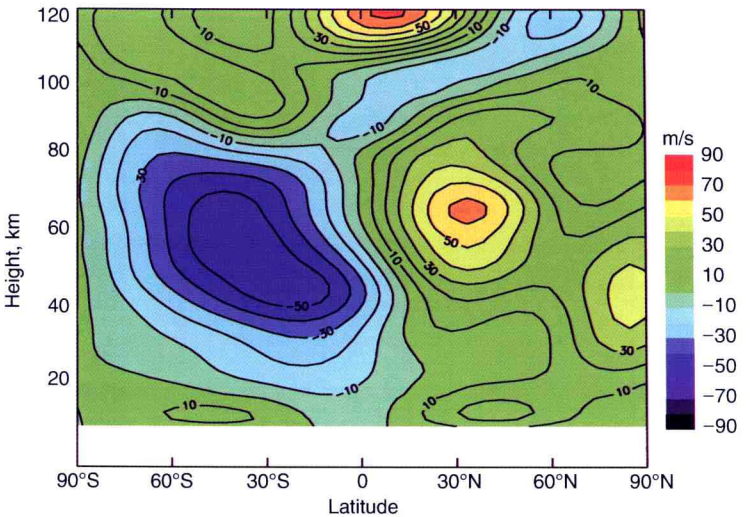
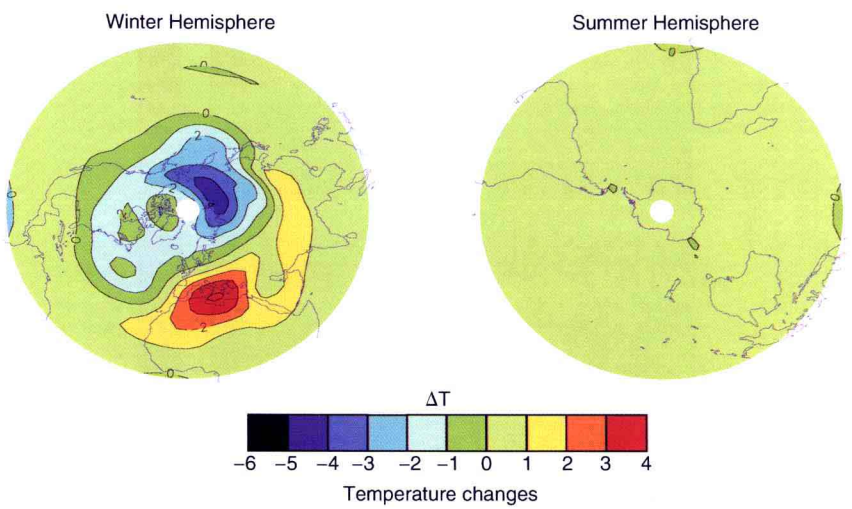
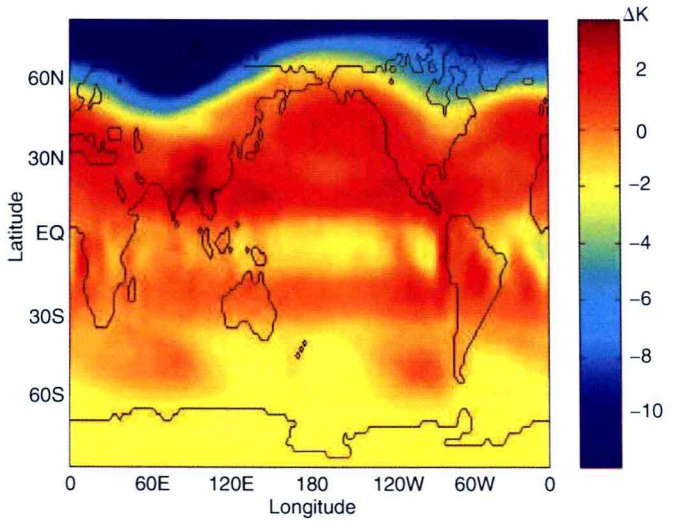


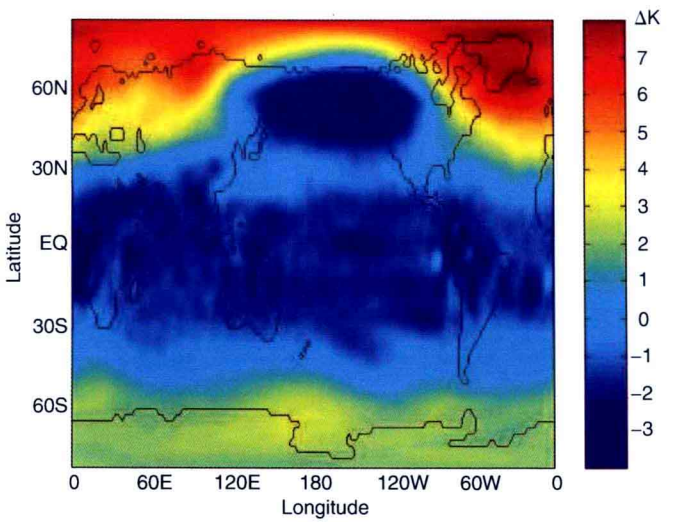
Climatology of seasonally averaged zonal winds for the Northern Hemisphere winter. (Taken from the Empirical Wind Model Hedin A. E., E. L. Fleming, A. H. Manson, F. J. Schmidlin, S. K. Avery and S. J. Franke 1993 *NASA Tech. Memo. 104581.*)



8 Model simulation of temperature difference between (a) solar maximum and (b) solar minimum conditions in the Northern Hemisphere stratospheric winter. The plot is a cross-section of the stratosphere at *ca.* 40 km altitude. The polar vortex has cooled by up to 6 K, as mixing due to planetary wave activity has been suppressed.

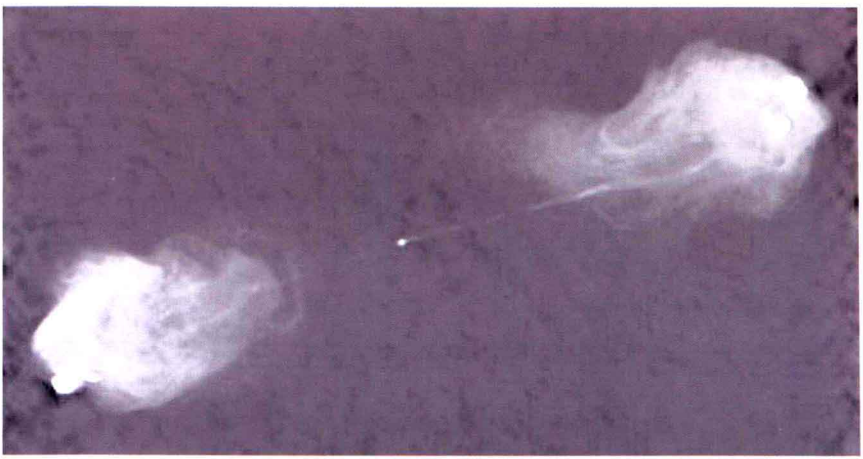


(a)

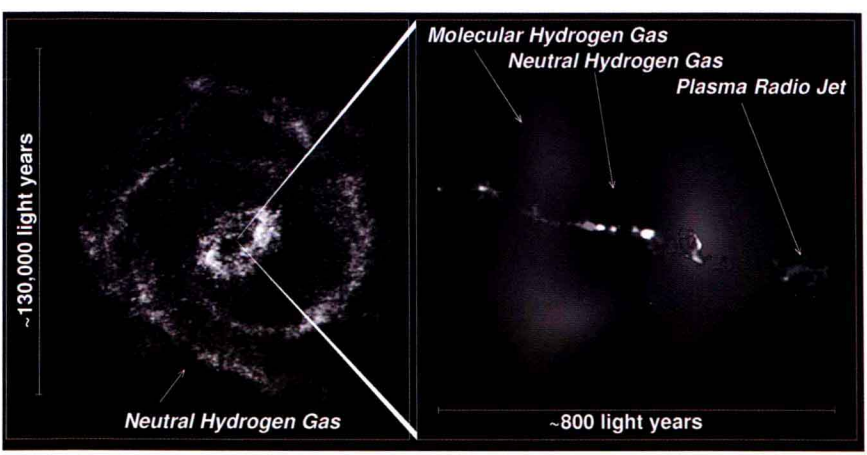


(b)

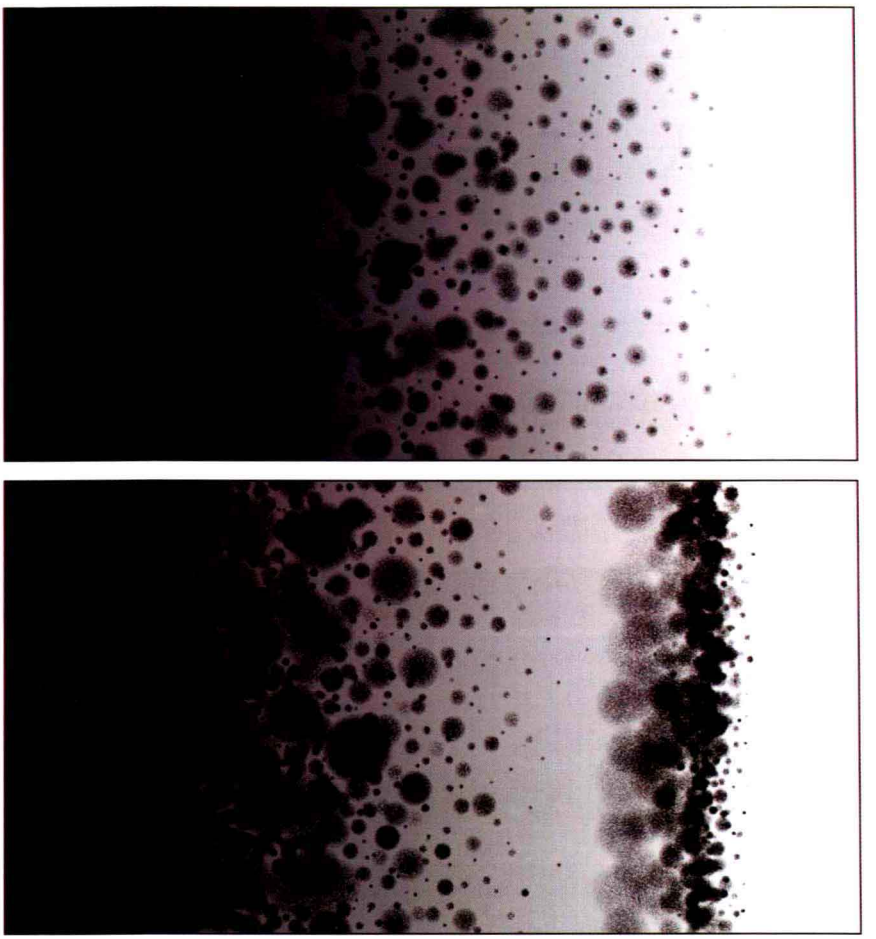
NCEP climate reanalysis air temperature anomalies at 25 km from 40 year mean. (a) 1991 a year with western phase QBO and solar maximum (b) 1974 a year with western phase QBO and solar minimum.



6-cm radio image of the classic radio galaxy Cygnus A (courtesy Chris Carilli).



Left: Radio image of neutral hydrogen gas in the spiral Seyfert host galaxy NGC 4151[22]; Right: composite image of the central regions of NGC 4151 showing a 1.4-GHz radio image of the well-collimated plasma jet surrounded by an obscuring torus of molecular hydrogen imaged at 2.2μm[23] and an inner ring of neutral hydrogen inferred from absorption measurements.[24]



This schematic figure illustrates how the universe may have evolved (time running right to left) from a largely neutral state (white in this representation) at early times to being completely ionized between the galaxies at the present day (coded black here). UV photons from the first stars and to some extent the first quasars, probably were responsible for the reionization, and therefore the process is thought to have proceeded through the gradual merging of growing regions of ionized gas surrounding nascent galaxies. However, the details are still murky, due to the extreme difficulty of observing these early objects. For instance, it has been suggested[12] that the process may in fact have taken place in two relatively rapid stages (lower panel) rather than a single, drawn-out phase (upper panel). Potentially GRBs may provide the search lights which allow us to see into this region of the universe for the first time.

关于《英国皇家学会前沿科技丛书》的一点说明

这套《英国皇家学会前沿科技丛书》（Royal Society Series on Advances in Science）共三卷，主编是英国剑桥大学教授、英国皇家学会会员 J. M. T. 汤普森（J. M. T. Thompson）。三卷依次为：

卷 1：《天文学前沿——从大爆炸到太阳系》；
卷 2：《地球科学前沿——从地震到全球变暖》；
卷 3：《纳米科技前沿——电子学、材料和组装》。

这套丛书的内容基本上是针对这三个学科当前的进展情况而写的，无论是从内容还是从出版时间来看都是相当新的，属于这三个学科的前沿。

这三卷是由多名作者合写而成的，每人就其所从事的研究领域各写自己的专题。因此，内容不仅丰富、真实可靠，而且极具权威性，不是什么“二手货”。可以说，书的专业学术分量充足，“含金量足够”。每章的内容基本上都是从问题的提出开始，对历史沿革和发展经过、目前研究的主要内容、可能的技术应用以及未来的发展动向都有所涉及、描述和讨论，对于从事相关领域的研究人员了解该领域的现状和发展动向很有帮助。对于初入门或正想进入这些研究领域的青年学者来说，这套书不仅可以丰富他们的专业知识、扩展他们的视野，更可以为他们选择适合于自己兴趣的研究方向提供帮助。而对于大学生和那些对这些领域的知识和发展方向有兴趣的一般读者来说，阅读这些书，既可以增进他们的科学知识，也可以助其了解这些领域的发展方向。所以说，为我国读者引进这些书，无疑大有裨益。

这三卷中各章的作者基本上是英国从事一线研究的青年科学家。对这些青年科学家，由主编汤普森教授在丛书卷1的前言中作了简单说明：青年科学家是指那些博士后研究经历不超过十年，外加在英国大学中有研究员身份，从事过三年本学科研究的研究人员。这些青年科学家虽然没有老科学家那么经验丰富，但是更加朝气蓬勃，在学术发展上更具雄心，在探引新的发展方向上或许更为敏锐，因而写出的书更具有特色。

关于这套丛书的写法，虽然在其前言中说到，作者们注意了语言的通俗性，也没有使用大量的数学推导和公式，附图也比较多，但基本上是通用学术论文的写法，且差不多每篇末尾都列出了相当多的参考文献。这对于想更多、更深地了解该课题（领域）的人来说，无疑大有帮助。由于每卷都是由多个作者分章写成，因此，并没有像单个作者那样，构思时着重全书前后贯通，写作时注意一气呵成，多少会感到有些分散。

这套丛书涉及的每个学科领域的内容都很广泛，特别是像纳米科技，要想在一本书中都囊括到，是很难的。这一点在《纳米科技前沿——电子学、材料和组装》的前言中特别作了说明。但是，纳米材料可能的毒性以及纳米科技所带来的社会伦理问题非常重要，不可避之，而书中并未专题涉及，当是美中不足之处。

张邦维

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