# 致远人刊 新版启航

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## 数学快递

### 2014 年菲尔兹奖揭晓

2014 年的菲尔兹奖被授予以下四位杰出的数学家：

阿图尔 • 阿维拉（Artur Avila）

阿图尔 • 阿维拉，1979 年出生于里约热内卢，现任职于巴黎狄德罗大学和巴西国立纯数学与应用数学研究所。阿图尔因为在动力系统和分析等方面的杰出贡献被授予菲尔兹奖。他将重正化作为一种统一原则的想法改变了整个动力系统领域的面貌。

曼纽尔 • 巴尔加瓦（Manjul Bhargava）

曼纽尔 • 巴尔加瓦，1974 年出生于安大略，现任职于普林斯顿大学。曼纽尔因为在几何数论领域引入一些强有力的新方法，计算了小秩环并界定了椭圆曲线的平均秩而被授予菲尔兹奖。

马丁 • 海尔（Martin Hairer）

马丁 • 海尔，奥地利人，现居英国，任职于华威大学。由于马丁在随机偏微分方程理论方面的杰出贡献，尤其是为这些方程建立了一套正则性结构理论，而被授予菲尔兹奖。

玛利亚姆 • 米尔扎哈尼（Maryam Mirzakhani）

玛利亚姆 • 米尔扎哈尼，1977 年出生，伊朗人，现居美国，任职于斯坦福大学。玛利亚姆因为对黎曼曲面及其模空间的动力学和几何学的突出研究而被授予菲尔兹奖，成为有史以来第一位荣获此奖项的女性。

来源：果壳网 http://www.guokr.com/article/438982/

### 经济学Study: Workplace diversity can help the bottom line.

MIT economist scrutinizes firm data suggesting diverse offices function more effectively.

Peter Dizikes | MIT News Office

**October 7, 2014**

Gender diversity in the workplace helps firms be more productive, according to a new study co-authored by an MIT researcher — but it may also reduce satisfaction among employees.

“Having a more diverse set of employees means you have a more diverse set of skills,” says Sara Ellison, an MIT economist, which “could result in an office that functions better.”

At the same time, individual employees may prefer less diverse settings. The study, analyzing a large white-collar U.S. firm, examined how much “social capital” offices build up in the form of things like cooperation, trust, and enjoyment of the workplace.

“The more homogeneous offices have higher levels of social capital,” Ellison observes. “But the interesting twist is that … higher levels of social capital are not important enough to cause those offices to perform better. The employees might be happier, they might be more comfortable, and these might be cooperative places, but they seem to perform less well.”

More diversity, more revenue?

The paper summarizing the study’s results, “Diversity, Social Goods Provision, and Performance in the Firm,” was recently published in the Journal of Economics and Management Strategy. The authors are Ellison, a senior lecturer in MIT’s Department of Economics, and Wallace P. Mullin, an economist at George Washington University.

The study used eight years of revenue data and survey results, covering 1995 to 2002, from a professional-services firm with more than 60 offices in the United States and abroad. The data included some all-male and all-female offices — both of which are unusual, the researchers note — in addition to mixed-gender offices. The survey data allowed Ellison and Mullin to study the employees’ ratings of office satisfaction, cooperation, and morale, not just one generalized measure of workplace happiness.

Among other results, the economists found that shifting from an all-male or all-female office to one split evenly along gender lines could increase revenue by roughly 41 percent. To see how this could happen, Ellison suggests an analogy with a baseball team.

“A baseball team entirely composed of catchers could have high esprit de corps,” Ellison says, noting that a band of catchers could share experiences, equipment, or tips for handling knuckleballs. “But it would not perform very well on the field.”

Similarly, greater social diversity implies a greater spread of experience, which could add to the collective knowledge of a group of office workers and make the unit perform more effectively.

Another wrinkle Ellison and Mullin found is that just the perception that firms are diverse was sufficient to produce satisfaction among employees — but this perception did not necessarily occur in the places where more extensive gender diversity accompanied better bottom-line results.

“In offices where people thought the firm was accepting of diversity, they were happier and more cooperative,” Ellison says. “But that didn’t translate into any effect on office performance. People may like the idea of a diverse workplace more than they like actual diversity in the workplace.”

Ellison acknowledges that in focusing on a single firm that was willing to provide data, the study was necessarily limited in scope, and says she would welcome further research. Management studies on social capital, she says, do not necessarily link the matter to objective financial results; economics studies of social capital have generally focused on issues such as public finance or even soldier behavior, and not job issues.

“There have been a number of studies looking at things like diversity and performance, but they don’t always use the [bottom-line] measures of performance that economists might prefer,” Ellison says. At the same time, she adds, “Highlighting the workplace setting, as a place for economists to study social capital, is also useful.”

The work was funded in part by the National Science Foundation.

来源：

MITHttp://newsoffice.mit.edu/2014/workplace-diversity-can-help-bottom-line-1007

### 纠错码 New frontier in error-correcting codes

Coding scheme for interactive communication is the

first to near optimality on three classical measures.

Larry Hardesty | MIT News Office

October 2, 2014

Error-correcting codes are one of the glories of the information age: They’re what guarantee the flawless transmission of digital information over the airwaves or through copper wire, even in the presence of the corrupting influences that engineers call “noise.”

But classical error-correcting codes work best with large chunks of data: The bigger the chunk, the higher the rate at which it can be transmitted error-free. In the Internet age, however, distributed computing is becoming more and more common, with devices repeatedly exchanging small chunks of data over long periods of time.

So for the last 20 years, researchers have been investigating interactive-coding schemes, which address the problem of long sequences of short exchanges. Like classical error-correcting codes, interactive codes are evaluated according to three criteria: How much noise can they tolerate? What’s the maximum transmission rate they afford? And how time-consuming are the encoding and decoding processes?

At the IEEE Symposium on Foundations of Computer Science this month, MIT graduate students past and present will describe the first interactive coding scheme to approach the optimum on all three measures.

“Previous to this work, it was known how to get two out of three of these things to be optimal,” says Mohsen Ghaffari, a graduate student in electrical engineering and computer science and one of the paper’s two co-authors. “This paper achieves all three of them.”

Vicious noise

Moreover, where Claude Shannon’s groundbreaking 1948 analysis of error-correcting codes considered the case of random noise, in which every bit of transmitted data has the same chance of being corrupted, Ghaffari and his collaborator — Bernhard Haeupler, who did his graduate work at MIT and is now an assistant professor at Carnegie Mellon University — consider the more stringent case of “adversarial noise,” in which an antagonist is trying to interfere with transmission in the most disruptive way possible.

“We don’t know what type of random noise will be the one that actually captures reality,” Ghaffari explains. “If we knew the best one, we would just use that. But generally, we don’t know. So you try to generate a coding that is as general as possible.” A coding scheme that could thwart an active adversary would also thwart any type of random noise.

Error-correcting codes — both classical and interactive — work by adding some extra information to the message to be transmitted. They might, for instance, tack on some bits that describe arithmetic relationships between the message bits. Both the message bits and the extra bits are liable to corruption, so decoding a message — extracting the true sequence of message bits from the sequence that arrives at the receiver — is usually a process of iterating back and forth between the message bits and the extra bits, trying to iron out discrepancies.

In interactive communication, the maximum tolerable error rate is one-fourth: If the adversary can corrupt more than a quarter of the bits sent, perfectly reliable communication is impossible. Some prior interactive-coding schemes, Ghaffari explains, could handle that error rate without requiring too many extra bits. But the decoding process was prohibitively complex.

Making a list

To keep the complexity down, Ghaffari and Haeupler adopted a technique called list decoding. Rather than iterating back and forth between message bits and extra bits until the single most probable interpretation emerges, their algorithm iterates just long enough to create a list of likely candidates. At the end of their mutual computation, each of the interacting devices may have a list with hundreds of entries.

But each device, while it has only imperfect knowledge of the messages sent by the other, has perfect knowledge of the messages it sent. So if, at the computation’s end, the devices simply exchange lists, each has enough additional information to zero in on the optimal decoding.

The maximum tolerable error rate for an interactive-coding scheme — one-fourth — is a theoretical result. The minimum length of an encoded message and the minimum decoding complexity, on the other hand, are surmises based on observation.

But Ghaffari and Haeupler’s decoding algorithm is nearly linear, meaning that its execution time is roughly proportional to the length of the messages exchanged.

“It is optimal in the sense that it is linear,” says Mark Braverman, an assistant professor of computer science at Princeton University who has also worked on interactive coding. “That’s an important benchmark.” But linear relationships are still defined by constants: y = x is a linear relationship, but so is y = 1,000,000,000x. A linear algorithm that takes an extra second of computation for each additional bit of data it considers isn’t as good as a linear algorithm that takes an extra microsecond.

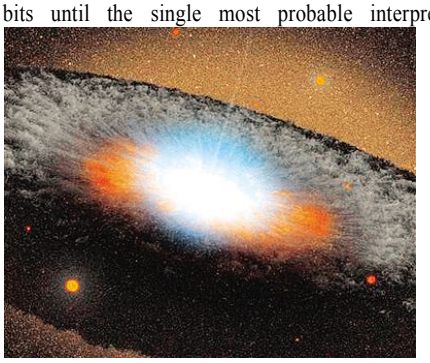
“We still need to worry a little bit about constants,” Braverman says. “But before you can worry about constants, you have to know that there is a constant-rate scheme. This is very nice progress and a prerequisite to asking those next questions.”

来源：

MITthttp://newsoffice.mit.edu/2014/interactive-error-correcting-code-1002

# 物理世界

## 研究称黑洞根本就不存在



这幅由艺术家绘制的图像描绘了一个位于星系中心的超大质量黑洞。图中蓝色区域是物质进入黑洞时所产生的辐射。围绕黑洞的灰色结构被称为环面，由气体和尘埃组成。

作为宇宙中最黑暗质量最密集的物质，黑洞点燃了不少人的想像力，为众多科幻小说和电影提供了精彩的素材和设定。但来自美国科学家的一项新研究可能要让这些人失望了：这名理论物理学家经

过数学计算得出结论——黑洞根本就不存在。相关论文分别发表在著名的预印本网站ArXiv 和《物理快报B》杂志上。

“得出这个结论后，即便我本人都感到十分震撼。”提出这一理论的美国北卡罗来纳大学教堂山分校理论物理学教授劳拉·梅尔西尼—霍顿这样描述自己的感受。她说：“科学家们研究这个问题已经超过了50 年，而这个解决方案给了我们许多新的思考。”

经典理论认为，黑洞是宇宙中存在的一种超高密度天体，由一个质量足够大的恒星在能量耗尽后因引力坍缩形成。其中心是一个密度无限大、时空曲率无限高、体积无限小的奇点。围绕在奇点四周的是一片空空如也的区域，这便是黑洞视界。一个恒星形成黑洞的过程就像是把一个地球大小的天体压缩成一个花生大的小球。根据爱因斯坦的相对论，黑洞会吞噬邻近宇宙区域的所有光线和任何物质，只要进入黑洞视界就有去无回。

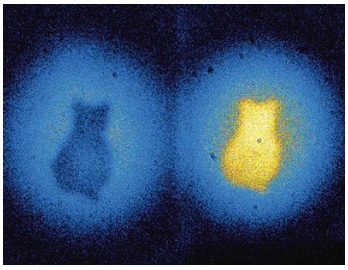
但这种解释与另一种基本理论产生了冲突：量子力学认为，任何物理演化过程都应满足因果律，即信息是守恒的，没有信息能从宇宙中永远消失。不少科学家试图使用数学的方法来让两种理论形成统一，但都无功而返。自此，关于黑洞中的信息是否丢失的问题就成了一个谜。

1974 年，霍金通过量子力学的方法得出结论：黑洞不仅能够吸收黑洞外的物质，同样也能以热辐射的方式向外“吐出”物质。而这种量子力学现象，就被称为霍金辐射。

物理学家组织网9 月25 日（北京时间）报道称，新研究中梅尔西尼—霍顿描述了一种全新的方案。她和霍金都同意，当恒星因自身的引力发生坍塌时会产生霍金辐射。但梅尔西尼—霍顿认为，发出这种辐射后，恒星的质量也会不断地发生损失。正因为如此，当这些恒星坍缩时就不可能达到形成黑洞所必须的质量密度。她认为，垂死的恒星在发生最后一次膨胀后，就会爆炸，然后消亡，奇点永远不会形成，黑洞视界也不会出现。根本就不会存在像黑洞这样的东西。

其实早在今年年初，霍金就曾通过论文指出在经典理论中黑洞是不存在的，他承认自己最初有关视界的认识是有缺陷的，并提出了新的“灰洞”理论。该理论认为，物质和能量在被黑洞困住一段时间以后，又会被重新释放到宇宙中。（来源：《物理快报B》）

## 纠缠光子拍出“薛定谔猫”悖论照片



最近，奥地利物理学家设计出一种新奇方法，无需光与拍摄目标相互作用，利用量子效应也能拍出照片。这听起来似乎颠覆了传统物理的成像原理，他们用一个镂空的猫图案进行了实验，虽不是一张同时“要死要活”的猫照片，却是粒子能同时处于两种状态的证明。相关论文发表在8 月28 日的《自然》杂志上。

据自然网站8 月27 日报道，量子成像要用成对光子，也就是纠缠的“孪生光子”，其中一个光子的量子态会与另一个连在一起。一个光子以某种概率可能地通过拍摄目标，另一个则进入探测仪。但进入探测仪的光子却“知道”它孪生兄弟的命运，研究人员就是根据它“知道”的情况构建出图像来。

通常人们要收集从物体上反射来的光子才能拍照，该研究负责人、奥地利科学院物理学家安东·泽林杰说：“现在，你第一次不用这么做了。”这种技术的一个优点就是，两个光子的能量不一定要相同，这意味着接触目标的光与检测信息用的光可以有颜色差异。比如，一个量子成像仪可以发射低能光子通过微量生物样本，而用可见光波段的光子和传统照相机来拍照。

泽林杰和同事在1991 年提出了这项技术的理论，实验系统包含把每个光子转变为一对纠缠光子的晶体，让每个光子有两条飞行路径，但只有一条路径通过拍摄目标。

论文合著者、奥地利科学院的伽布里拉·莱默斯说，按照量子力学法则，如果不对光子通过了哪条路进行检测，它实际上相当于通过了两条路，在每条路上同时产生一个光子对。在第一条路径上，光子对中的一个光子通过了拍摄目标，而另一个没有。那个通过目标的光子会与另一个“概率自己”——也就是可能选择了第二条路径而没有通过目标的光子——重新结合，然后继续飞开；其余从第二条路径通过的光子也会与它第一条路径上的自己重新结合，然后直接进入摄像机，摄像机就利用这些光子来构建图像，虽然这些光子从未与拍摄目标相互作用过。

研究人员拍了一张几毫米宽的镂空猫图样，还有几张蚀刻在硅片上的其他图样。他们用摄像机无法检测到的光波长来探测到了图形。“这一点非常重要，这是量子成像确实起作用的证据。”泽林杰说。

泽林杰解释说，选择猫形是为了纪念薛定谔1935 年提出的著名思想实验。他假设了一只猫在盒子里同时处于死活两种状态，因为没人知道盒子里的毒药是否释放。同样，在新实验中，没人知道光子选择了哪条路径，由此产生了光子对中那个走两条路而不通过目标的光子。（来源：《科技日报》）

## 低温电子让电子设备更节能

据物理学家组织网近日报道，美国德克萨斯大学阿灵顿分校的研究小组找到了一种不借助外部降温设备并能在室温下将电子温度降至-228℃的方法。借助这种方法，可以使电子设备在使用很少能量的情况下正常工作。该相关研究发表在近日的《自然—通讯》上。

传统的电子冷却技术需要将装置浸入极低温的冷却池中，十分不便，而无需外部冷却装置的这项成果前景将十分广阔。“我们率先实现了室温下的低温电子技术，这项技术将实现极大的效益。”研究的领导者、该校材料科学与工程系副教授高成金（音译）表示，“电子的物理性质使其本身即使在室温下也很容易被激发，但如果电子的激发态能够被抑制，那么电子的温度就能在没有外部设备的情况下被很好地控制。例如，可以不再使用麻烦的液氦和液氮来给电子降温。”

该小组构建了一种纳米结构，此结构按照源极、量子阱、隧道势垒、量子点、另一个隧道势垒和一个漏极的顺序排列组成，通过抑制电子激发态的方式为电子降温。该小组表示正在尝试利用这项技术制造全新的节能晶体管。

资助这项研究的美国国家科学基金会主管乌沙·瓦施利表示，这项成果将带来巨大的综合效益，“使用这项技术的晶体管，其能耗可能只有现在晶体管的十分之一。未来常用的智能手机、平板电脑等个人电子设备将会有更长的续航能力”。

除了潜在的商业价值外，这项技术可应用于军事领域，为军用设备电池大幅减重，减少士兵负重，从而提高士兵的作战能力。还可应用于遥感设备、远程操作的无人机以及高功率计算设备。（来源：《科技日报》）

## 天文学家在一系外行星上发现水蒸气

美国马里兰大学的天文学家在一个太阳系外的行星大气中发现水蒸气和氢气，该行星比地球大4倍，位于天鹅座，离地球约124 光年、几乎729 万亿英里。对于了解太阳系外行星而言，这一发现标志着科学家已经能够确定最小行星大气中的一些化学

成分。该研究成果刊登在9 月25 日的《自然》杂志上。

据物理学家组织网9 月24 日报道，研究人员利用当一颗行星经过其恒星前面时发生的急转光发现了水蒸气。该行星大气层里的物质吸收了一些恒星的光线，使得这颗行星看起来更大，类似于我们的太阳在日落的余晖中显得更大一样。通过绘制系外行星大小的变化，将其与该望远镜观察到的电磁辐射波长关联，天文学家得到一个曲线图，显示这颗行星的大气吸收了多少恒星的辐射。该图的形状称为透射光谱，可以揭示在大气中存在哪些化学物质。

行星越大，在经过其恒星的过程中大小的变化越明显。天文学家已经用这种独特的方法描述过几个巨大行星的大气，以及太阳系中木星的大小。在这项研究中，该团队要分析较小行星的大气成分。

该团队选择的行星HAT P-11b，是由匈牙利制造的自动望远镜（HAT）发现的。它约是地球半径的4倍，地球质量的26 倍。相比于太阳系的行星，这颗星的大小最接近海王星。但它在距离上更接近其恒星，因此热得多，约有878 开氏度（1120 华氏度）。它可能有一个岩石芯，被包裹在约90％厚的氢气膜中。其高空的大气层晴朗无云，但该研究团队发现，它含有水蒸气的信号。

因为水是生命存在的前提，天文学家们热衷于在系外行星上寻找水。水分子广泛存在于宇宙之中。只要有氢气和氧气，即会自然形成，甚至有些太阳黑点冷却后也含有水蒸气，当然它在阳光下对于生命来说过于炎热。

但水在太阳系巨大行星的大气之外结冰，很难将其观测到。更近且更小的行星、火星、金星和地球，在其早期演化时有了水，虽然只有地球在表面保持液态水。天文学家认为，行星越小，像水蒸气这样较重的分子越有可能随着氢气而丰富。

研究人员解释道，他们要测试的基本问题是小型行星在水蒸气里的氧是否丰富。在HAT P-11b 上发现水蒸气和氢气是拼图中的关键一块，符合天文学家关于行星形成的主要观点。（来源：《科技日报》）

### 日本开发出世界最高速相机

东京大学和庆应大学联合研究小组在10 日出版的《自然—光子学》杂志网络版上发表了有关世界最高速相机的研究成果。这台相机能以万亿分之一秒的极短间隔进行连拍，性能是传统高速相机的千倍以上，可以清晰拍下过去难以捕捉到的等离子现象及化学反应。

按照光速1 秒钟能绕地球7 圈半来计算，万亿分之一秒相当于光只前进了0.3 毫米。这台相机能将每秒闪烁1 万亿次以上的频闪光按波长进一步细分，依次照射被摄体后获得连拍图像。研究人员用激光照射金属化合物的结晶，世界上首次成功对热传导进行了连拍，并据此确认热是以秒速5 万千米的类似波的形式进行传导的。（来源：《人民日报》）

## 化学视角

### Sweet Fluorinating Agent From Saccharin?

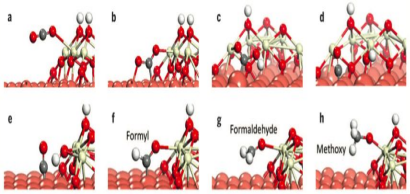



**Fig. 4. DFT studies.** Reaction path for methanol synthesis (MS) by $CO_2$ hydrogenation on the $CeO_x/Cu(111)$ system. Step colors are as follows: local minima states (blue), transition states (TS) (red), and energies including the entropy contribution (gray). The calculated energy for the whole methanol synthesis reaction is indicated on the right side of the graph. The main transition states are pointed out by vertical red arrows, and the respective energy values are also shown under the arrows. The other energy barriers are indicated above the respective transition-state step. The whole reaction has been divided into two parts: The first one constitutes the RWGS (indicated by a green arrow on the top of the graph), and the second one consists of the steps leading to the methanol synthesis (MS) (red arrow on the top of the graph). The optimized structures for the main intermediates are included in the bottom part of the figure. Carboxylate species observed in the IRRAS experiments correspond to the structure shown in b. Colors: O (red), C (gray), H (white), cerium (light-beige), $Cu$ (dark pink).

The trifluoromethylthio group, SCF3, is one of the most lipophilic functional groups known and as such has attracted the attention of chemists who develop pharmaceuticals and pesticides. Chunfa Xu, Bingqing Ma, and Qilong Shen of Shanghai Institute of Organic Chemistry have now developed a trifluoromethylthiolating reagent that should make life easier for those researchers (Angew. Chem. Int. Ed. 2014, DOI: 10.1002/anie.201403983). Chemists currently use CF3SCl as a direct trifluoromethylthiolating reagent, but it is a toxic gas. Other strategies such as adding sulfur and CF3 to a compound tend to require multiple steps and have limited synthetic applications. An alternative that is meeting with some success is creating N-substituted SCF3 reagents (Chem. Eur. J. 2014, DOI: 10.1002/chem.201403409). Building on the latter approach, the Shanghai team used the inexpensive artificial sweetener saccharin and AgSCF3 to create the new reagent. It works well for adding SCF3 to a variety of organic compounds under mild conditions to prepare OSCF3, NHSCF3, SSCF3, and SCF3 derivatives. Shen and coworkers have applied for Chinese patents on the saccharin reagent and are working with a Chinese company to produce it for industrial and research use.

Source:C&E News via Stephen K. Ritter

### 新催化剂实现将二氧化碳转化为甲醇

美国能源部布鲁克海文国家实验室（BNL）的研究人员发明了一种新的翠花系统，可以将二氧化碳转化为甲醇。该系统的催化效率比原有的技术得到了极大的提高，相关研究结果发表于2014 年8 月1 日的《Science》杂志上。

布鲁克海文国家实验室化学家Jose Rodriguez 谈到：“开发有效的催化剂，可以更有效的利用二氧化碳这一廉价的化学原料。”可以想象，在未来的应用中，该催化系统可以帮助减少温室气体的累积，通过捕捉燃料排放物中的二氧化碳，就可以合成新的燃料。

然而，二氧化碳在一般条件下属于惰性物质，很难被催化反应。在实验中，一种由铜和二氧化铈的纳米颗粒构成的催化系统引起了研究人员的兴趣。在以往的研究中，研究人员已经发现这类金属氧化物纳米颗粒对很多反应都可以进行高效的催化。然而，单独的催化剂金属组分不能完成催化制备甲醇的所有步骤。研究最终发现，催化效率最高的活性部位位于铜与纳米二氧化铈的交界处，该位置对二氧化碳的吸附和活化能力最强。此外，该催化系统中也需要掺杂一些二氧化钛。

通过借助最新的实时监测和化学指纹图谱分析技术，研究人员可以随时监控催化剂的动态变化。此外，研究人员还借助计算机更加精准地模拟了甲醇合成的机理。

结果显示，铜/铈催化系统的效率比单质铜颗粒高出10000 倍，并且催化速度至少比目前工业应用的铜/氧化锌催化剂高出90 倍以上。

来源：《新发现》2014 年10 月刊 房冰

Graciani, Jesús, et al. "Highly active copper-ceria and copper-ceria-titania catalysts for methanol synthesis from CO2." Science 345.6196 (2014): 546-550.

文章链接：

http://www.sciencemag.org/content/345/6196/546.abstract

### 机器人化学家，合成一切有机分子？

2014 年8 月7 日，《Nature》杂志“NEWS FEATURE”一栏讨论了关于“可以合成一切有机分子的机器人化学家”的想法。

众所周知，有机合成化学家有着一套专属的工作模式：首先，他们在纸上勾画、分析分子的结构、计划合成路线；然后，通过一步一步不同的化学反应，结合波谱分析与分离纯化方法实现对目标分子的合成。合成复杂分子需要大量的时间与精力，如果有一个机器人可以完成反应与纯化，得到目标分子，就能大大提高科研效率。

机器人能做到这些吗？到现在为止，人类已经获得了有限的成功：多肽、DNA 的合成已经可以由机器人来完成，但所用的起始原料和所涉及的反应非常有限。任意目标分子的合成路线设计可以通过将逆合成分析（The Nobel Prize in Chemistry 1990, Elias James Corey, "for his development of the theory and methodology of organic synthesis”）程序化来实现。话虽如此，但由于数据库中信息的不足和机器对反应模式尤其是多键生成的反应模式分析的不成熟，逆合成分析软件鲜有成功的。对于反应过程，传统的一步一步反应需要不断分离提纯、确定产物，效率较低，所以现在不少科学家都在研发连续反应方法，以提高效率。

无论制造有机合成机器人的终极梦想能不能达成，这项研究都势必会改变化学界的文化：它将推进科学家们记录所有成功、失败的实验结果、建立一个共享的数据库、研发新的反应方式。

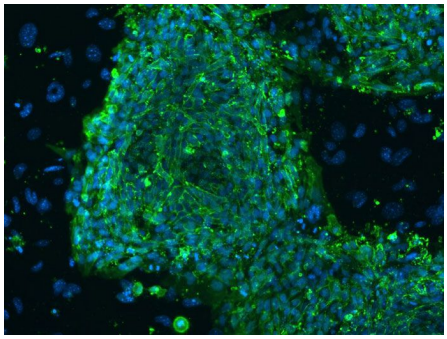
Peplow, Mark. "Organic synthesis: The robo-chemist." Nature 512.7512 (2014): 20.

文章链接：

http://www.nature.com/news/organic-synthesis-the-robo-chemist-1.15661

# 生科发现

## 远古残余病毒DNA 竟担大责任



2014-04-21 www.bio360.net 来源:生物360 作者:koo 9270

日前，来自新加坡基因组研究所和加拿大麦吉尔大学等机构的研究人员发现，人体 DNA 中的远古病毒 DNA 残余与人类干细胞多能性密切相关。研究小组在《自然-结构与分子生物学》Nature Structural & Molecular Biology）杂志上发表的论文称，使干细胞样本中的病毒残余失能，可阻止干细胞成长为除一种人体细胞外的任何其他细胞类型。

人体中的所有细胞都开始于干细胞，干细胞的这种能力也被称为多能性。科学家们目前仍未真正掌握个体干细胞如何知道要成长为哪种类型的细胞，此领域的研究成果或将导致出现治疗肢体再生和许多疾病的新方法。

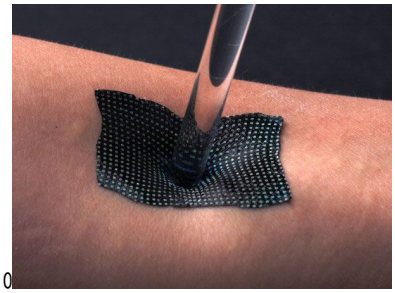
作为数百万年前逆转录病毒感染的结果，病毒 DNA 存在于人类 DNA 中。逆转录病毒通过将自身 DNA 导入宿主 DNA 而繁殖，如果它进入精子或卵子细胞中，病毒 DNA 就终结在宿主 DNA 中。科学家们一直认为，残余病毒 DNA 只不过是“垃圾” DNA ，亦即它是无用的。但新研究表明，至少一种类型的残余病毒 DNA （例如 HERV-H ）实际上对多能性起着非常重要的作用。

研究人员利用少量旨在抑制 HERV-H 的 RNA 对某些人体干细胞进行处理。他们发现，干细胞失去了发展成任何人体细胞的能力，而只能成长为与结缔组织中常见的成纤维细胞类似的细胞。深入观察发现，抑制 HERV-H 也抑制了多能性所必需的蛋白质的生产。因此，至少在人体中，残余病毒 DNA 似乎是正常人体发育所必需的，没有它，人类生命就不可能存在。

基于 HERV-H 在多能性中扮演的角色，研究人员接下来将着重对其他残余病毒 DNA 进行测试，以了解其仅是遗留垃圾还是对人体发育有着重要作用。

## 用皮肤补丁监控心脏健康

2014-09-30 www.bio360.net 来源:生物360 作者:koo 2140



用皮肤补丁监控心脏健康

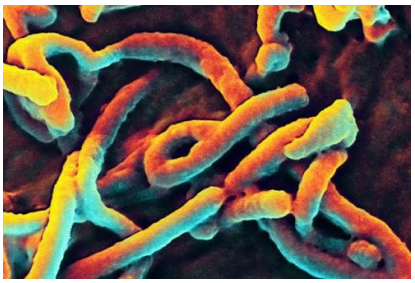
随着智能手表和健康监测器的流行，可穿戴技术革命才刚刚开始。下一步可能是用“类似皮肤”的诊断器监测心脏健康。

近日，研究人员在《自然-通讯》期刊上报道称，他们制作出一种5 平方厘米大小的超薄柔韧补丁，当被放置于皮肤上时，它能够监控皮肤下的血流，从而揭示心脏健康方面的变化。

这块补丁包含由3600 个微小“热变色”液态晶体设备组成的阵列，这些设备会随着温度的变化而改变颜色。然后，成像传感器和计算机程序能将颜色模式翻译成温度曲线和健康报告。另外，这些补丁还能为处于危险境地的患者提供连续不断的健康

## JIDC：早期筛查是避免大型埃博拉疫情爆发的关键

来源：生物谷 2014-09-30 09:04



2014 年9 月30 日 讯 /生物谷BIOON/ --近日，研究发现提高诊断严重发烧症状的方法对于抵抗埃博拉病毒是非常有必要的，这项研究发表在《Journal of Infection in Developing Countries》上。

美国宾夕法尼亚州梅西大学和哈弗学院的研究人员使用灵敏-暴露-感染-移除（SEIR）的方法较对和分析了1995 年在刚果民主共和国kikwit 爆发的埃博拉病毒疫情。

Thomas Pfeiffer 教授说在卫生资源缺乏的非洲，疫情的爆发有时持续几周甚至几个月才得知。

类似埃博拉病毒的拉沙热病毒和马尔堡病毒，这些病毒疫情的爆发相对来说比较罕见，除非这种病毒疫情正在持续进行中，否则它们不会被考虑在因发烧所诊断的疾病中。比如，在疟疾流行区域发烧通常被首诊为疟疾，除非在抗疟疗法失败后发烧才有可能被诊断为其他疾病。这样一来，由于诊断的延误而导致了该病毒疫情的爆发。

通过在电脑上模拟流行病的方法，我们测试了一种诊断步骤，这种步骤可以快速检测到疫情的爆发情况。我们的模拟实验表明实现这种步骤，比如隔离对抗疟和抗菌疗法均无疗效的病人，用这种步骤对这种未知原因的案例进行检验是非常有效的。用这种步骤应对面临风险的健康工作者的早期疫情检测也是非常有效的。

Thomas Pfeiffer 教授说实验室诊断和诊断步骤的使用会减少危险病毒性发烧像埃博拉病毒传播的可能性，还将提高诊断鉴别普通发烧的原因并提高现代非洲的卫生保健水平。

目前西非国家埃博拉病毒爆发的严重性和传播广泛性

看起来非常严重，但是在未来提高诊断辅助资源的水平，加强诊断辅助资源的利用可以有助于避免这样的灾难性事件。（生物谷Bioon.com）

原文链接：

http://news.bioon.com/article/6659555.html

### BMS-986094 备忘录：警惕丙肝药物的心脏毒性

2014-09-30 11:53 来源：丁香园作者：王鹏

药物 BMS-986094（百时美施贵宝公司开发）是一种具有慢性丙型肝炎（HCV）治疗作用的核苷酸聚合酶抑制剂，但是 BMS-986094 的开发研究工作由于一些其心脏毒性不得不于 2012 年 8 月份被叫停。

近期，Hepatology 杂志发布了一篇回顾性分析，进一步探讨了与 BMS-986094 相关的心脏毒性。此研究发现或有助于我们更好的认识该药，并应用于其他尚处于研究试验阶段的药物。Medscape 对此进行了详细报道。

一、来龙去脉

暂停 BMS-986094 的导火索是由于在 BMS-986094 试验过程中，一位 25 岁患者服药后出现呼吸急促、左室射血分数降低（LVEF＜10%），并快速进展为心衰，最终死亡。研究者进一步针对 34 例服用 BMS-986094 的患者进行了回顾性研究分析。

研究者发现共有 14 例患者心功能不全与 BMS-986094 相关，其中停药后 6 个月内，6 例重度心功能不全（LVEF＜30%），8 例中度心功能不全（LVEF 在 30% 至 50%）。

这无疑是药物开放商的滑铁卢事件，因为在这之前类似的直接抗病毒药物取得了高额利润，且 HCV 领域前景良好，而心脏毒性终止了 BMS-986094 开发。另一方面，百时美施贵宝公司在调查过程中的积极配合得到了 FDA 的认可及赞赏。

二、心肾毒性

研究者表示中高剂量（200mg 与 100mg）BMS-986094 治疗与患者心收缩功能不全相关，而 50mg 组患者未出现心收缩功能不全。心功能不全的患者服用 BMS-986094 时间较长，而早期试验 BMS-986094 药物滞留时间为 1 至 6 周。

研究者表示很多患者并未明显症状，但是超声显示心功能不全相当严重。另一方面，肌钙蛋白及 BNP 并没有太多异常。除了上述异常，研究者还指出患者存在 ECG 异常，但是这些异常多在患者 LVEF 降低后才出现。

BMS-986094 存在的肾毒性亦不容忽视——研究者发现服药后，患者血肌酐水平升高，而且停药后恢复正常。三、反思及探索

该研究第一作者 Tariq Ahmad 博士表示，罹患高血压或糖尿病的患者服用 BMS-986094 后出现心功能不全的风险更高，而临床试验为入组这些患者，但是许多 HCV 患者存在这些疾病背景。

同时 Tariq Ahmad 博士指出，回顾性研究揭示了 BMS-986094 的心脏毒性，而且 HCV 临床研究规模较小，我们应该警惕并关注其他核苷酸聚合酶抑制剂（如其他 HCV 直接抗病毒药物）是否存在心脏负面作用。

有研究者检查了服药后死亡患者的心脏，发现心室细胞伸长、纤薄造成了患者心功能不足，而并非伴发的局限性坏死及不充分心肌炎。但是至今为止，我们尚不清楚 BMS-986094 造成心功能不全的机制。

来源地址：

http://www.medscape.com/viewarticle/832251

## 化学视角

### U.S. May Be Falling Behind in Researching Tech's Next Big Thing

**October 3, 2014**

A paper from the Computing Community Consortium (CCC) published in 2008 said the U.S. National Science Foundation should be spending $75 million a year to fund research into cyber-physical systems (CPS), the hybrids of automation, sensors, and communication capabilities that will typify the Internet of Things. The paper said overall the federal government should be spending $375 million a year on CPS, and as much as $500 million when including private investment.

However, this year NSF spent just $40 million on CPS research, and only about $200 million in the last five years.

Although it is not easy to ascertain what government-wide spending on CPS research currently amounts to, University of Virginia professor John Stankovic, co-author of the CCC paper, says, "anecdotally, I would say they are not spending enough."

By contrast, the European Union is currently investing almost $350 million a year of public and private funds into developing CPS technologies.

The reduced level of spending comes during a period of weak increases in the federal research and development budget and the increasing likelihood the U.S. will be eclipsed by China in terms of government funding for basic research as early as 2022.

Stankovic says it is important to increase public investment in such research or the U.S. will lose out to other nations.

From Computerworld

(http://cacm.acm.org/news/179075-us-may-be-falling-behind-in-researching-techs-next-big-thing/fulltext)

### Computer Science and Engineering Researchers Win Best Paper Award

**October 2, 2014**

Texas A&M University researchers Harshvardhan, Adam Fidel, Lawrence Rauchwerger, and Nancy Amato won the Best Paper Award at the recent 2014 Parallel Architectures and Compilation Techniques (PACT) conference in Alberta, Canada.

The researchers said they took a new approach to parallelizing graph algorithms.

The panel of judges at the high-performance computing and parallel processing conference focused on originality, significance, impact, and interest.

The paper, "KLA: A New Algorithmic Paradigm for Parallel Graph Computations," unifies and extends the existing level-synchronous and asynchronous approaches. The researchers say their approach offers an order of magnitude improvement in performance of parallel graph algorithms, and scalability beyond 98,000 cores on a Cray XE6 supercomputer.

Harshvardhan and Fidel are Ph.D. students in the Parasol Lab in the Department of Computer Science and Engineering. Harshvardhan also received the first-place medal in the ACM Student Research Competition. Rauchwerger and Amato are co-directors of the Parasol Lab.

From Texas A&M Engineering News

(http://cacm.acm.org/news/179040-computer-science-and-engineering-researchers-win-best-paper-award/fulltext)

### The Unpatchable Malware That Infects USBs Is now on the Loose

**October 2, 2014**

It's been just two months since researcher Karste Nohl demonstrated an attack he called BadUSB to a standing-room-only crowd at the Black Hat security conference in Las Vegas, showing that it's possible to corrupt any USB device with insidious, undetectable malware. Given the severity of that security problem—and the lack of any easy patch—Nohl has held back on releasing the code he used to pull off the attack. But at least two of Nohl's fellow researchers aren't waiting any longer.

In a talk at the Derbycon hacker conference in Louisville, Kentucky last week, researchers Adam Caudill and Brandon Wilson showed that they've reverse engineered the same USB firmware as Nohl's SR Labs, reproducing some of Nohl's BadUSB tricks. And unlike Nohl, the hacker pair has also published the code for those attacks on Github, raising the stakes for USB makers to either fix the problem or leave hundreds of millions of users vulnerable.

"The belief we have is that all of this should be public. It shouldn't be held back. So we're releasing everything we've got," Caudill told the Derbycon audience on Friday. "This was largely inspired by the fact that [SR Labs] didn't release their material. If you're going to prove that there's a flaw, you need to release the material so people can defend against it."

The two independent security researchers, who declined to name their employer, say that publicly releasing the USB attack code will allow penetration testers to use the technique, all the better to prove to their clients that USBs are nearly impossible to secure in their current form. And they also argue that making a working exploit available is the only way to pressure USB makers to change the tiny devices' fundamentally broken security scheme.

"If this is going to get fixed, it needs to be more than just a talk at Black Hat," Caudill told WIRED in a followup interview. He argues that the USB trick was likely already available to highly resourced government intelligence agencies like the NSA, who may already be using it in secret. "If the only people who can do this are those with significant budgets, the manufacturers will never do anything about it," he says. "You have to prove to the world that it's practical, that anyone can do it...That puts pressure on the manufactures to fix the real issue."

Like Nohl, Caudill and Wilson reverse engineered the firmware of USB microcontrollers sold by the Taiwanese firm Phison, one of the world's top USB makers. Then they reprogrammed that firmware to perform disturbing attacks: In one case, they showed that the infected USB can impersonate a keyboard to type any keystrokes the attacker chooses on the victim's machine. Because it affects the firmware of the USB's microcontroller, that attack program would be stored in the rewritable code that controls the USB's basic functions, not in its flash memory—even deleting the entire contents of its storage wouldn't catch the malware. Other firmware tricks demonstrated by Caudill and Wilson would hide files in that invisible portion of the code, or silently disable a USB's security feature that password-protects a certain portion of its memory.

"People look at these things and see them as nothing more than storage devices," says Caudill. "They don't realize there's a reprogrammable computer in their hands."

In an earlier interview with WIRED ahead of his Black Hat talk, Berlin-based Nohl had said that he wouldn't release the exploit code he'd developed because he considered the BadUSB vulnerability practically unpatchable. (He did, however,offer a proof-of-concept for Android devices.) To prevent USB devices' firmware from being rewritten, their security architecture would need to be fundamentally redesigned, he argued, so that no code could be changed on the device without the unforgeable signature of the manufacturer. But he warned that even if that code-signing measure were put in place today, it could take 10 years or more to iron out the USB standard's bugs and pull existing vulnerable devices out of circulation. "It's unfixable for the most part," Nohl said at the time. "But before even starting this arms race, USB sticks have to attempt security."

Caudill says that by publishing their code, he and Wilson are hoping to start that security process. But even they hesitate to release every possible attack against USB devices. They're working on another exploit that would invisibly inject malware into files as they are copied from a USB device to a computer. By hiding another USB-infecting function in that malware, Caudill says it would be possible to quickly spread the malicious code from any USB stick that's connected to a PC and back to any new USB plugged into the infected computer. That two-way infection trick could potentially enable a USB-carried malware epidemic. Caudill considers that attack so dangerous that even he and Wilson are still debating whether to release it.

"There's a tough balance between proving that it's possible and making it easy for people to actually do it," he says. "There's an ethical dilemma there. We want to make sure we're on the right side of it."

BY ANDY GREENBERG

(http://www.wired.com/2014/10/code-published-for-unfixable-usb-attack/)

# 校内通讯

## 《基础学科拔尖创新人才培养的"致远"模式的探索与实践》荣获2014年国家级教学成果奖一等奖

日前，教育部公布了第七届国家级教学成果奖(2009—2014年)获奖成果名单，上海交通大学共有12项成果获奖。其中，《基础学科拔尖创新人才培养的"致远"模式的探索与实践》获得一等奖。

成果特点

该成果以"体制改革"为依托、"机制激励"为抓手、"环境营造"为根本，形成了具有显著特色的"致远"模式。成立致远学院作为试验基地，成立由海内外教授组成的教学指导委员会作为学院人才培养的决策机构，各方向聘请相关学科的杰出教授

担任项目主任，落实“三位一体”育人理念；实施突出能力建设和交叉的创新人才培养方案，开展“主修+辅修”的模块式的教学，加强了导论课，主修和辅修同堂学习，课上主要讨论重点和难点，课后独立完成讨论中形成的课题；以科学激情和创新潜力为标准，创新教师聘用与学生选拔机制，保障师生质量；营造国际化、开放式的育人环境和创新氛围。通过营造“转身遇到大师”的国际化学术环境和“随处可见讨论”的开放式学习氛围，促进学生个性化发展，突出培养了学生的批判性思维、知识整合和沟通协作能力，有效提高了学生的综合素质。

成果创新点

在体制创新方面，打破院系学科壁垒、整合优质资源的基础学科人才培养模式。通过“学院+书院”的学习平台和“学院+研究院”的学术平台，形成了言传身教的育人环境；在机制创新方面，致远学院创新性地采用了师资双聘激励机制和滚动进出遴选学生的机制，形成了正反馈循环效应；在文化创新方面，致远学院和自然科学研究院每年有一百多位国际学者前来授课与研究，营造了国际化学术氛围，同时也塑造了学生志向的高远。致远学院到处都可以看到白板，营造了开放式的学习氛围，有效的提高了学生的综合素质。

成果优势

通过引进“千人计划”和“青年千人计划”，一大批从海外回来的杰出教授投入到了基础学科的学生培养中。致远系列教材建设已经展现了辐射作用，John Hopcroft 为大数据编写的第一本数学方面的教材已经出版，对大数据的基础教育产生了重要影响；“致远”模式带动了全校的人才培养改革，以前大教授不愿意上课的问题在致远学院得到了解决。现在“致远”模式以“荣誉计划”的方式正在逐步覆盖全校各专业的拔尖学生。

国家级教学成果奖是国务院确定的国家级奖励，每四年评选一次，代表着我国高等教育教学工作的最高水平，是与国家自然科学奖、国家技术发明奖、国家科技进步奖并列的国家级奖项。

来源：致远学院官网

## 李保界老师实验室简介

【导师介绍】

个人简历

李保界，1966 年9 月生；北京师范大学学士，1997 获美国纽约Albert Einstein College of Medicine 细胞生物学博士；于1997-2001 在哥伦比亚大学Howard Hughes Medical Institute(HHMI)作博士后，师从美国科学院院士Steve Goff 教授，并获美国HHMI 和Cancer Research Institute 博士后基金。2001 至2006 任新加坡国立分子与细胞生物研究院实验室主任，助理教授。2007 年后为资深实验室主任和副教授。于2009 年起，任上海交通大学特聘教授。现为上海交通大学Bio-X 研究院副院长，骨骼干细胞信号转导研究组组长。

个人荣誉

曾获美国骨矿研究协会“事业提升奖”(ASBMR: Career Enhancement Award， USA)。2009 年获教育部“长江学者奖励计划”特聘教授，2011 年入选“上海市千人计划”。科技部973 重大科学研究计划首席科学家。主持了1 项863 项目和1 项973 项目。

现为国际杂志BMC Developmental Biology 副主编和Current Enzyme Inhibition 等其他三种杂志的编委。共在Nature Genetics、Nature Cell、Nature Communications、Genes and Development、PNAS、Journal Cell Biology、Human Molecular Genetics 等杂志发表62 篇学术论文，在国际上被引用次数>1500 次。

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【实验室介绍】

上海交通大学Bio-X 研究院李保界研究组现有导师、博士后、博士、硕士共20 余人。Bio-X 研究院享有优良的学术氛围、良好的科研条件和多学科交叉的优势，并与多个国内外学术机构有紧密的合作和联系。

主要研究方向：

1 、 Mesenchymal stem cells in bone development/remodeling and disease.

2、Gentoxic/oxidative stress response, aging and tumorigenesis.

实验室特色：

1. 网罗细胞生物学、生物化学、分子生物学、发育生物学及其他生命科学专业人才

2. 国内研究信号转导通路及神经的航母

3. 科研团队人员对科研富有激情、创新精神和独立思考能力，团队协作精神积极，科研氛围浓厚。

4. 实验室与国际接轨，资金条件丰富。

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