2012 年邵逸夫数学奖得主康采维奇

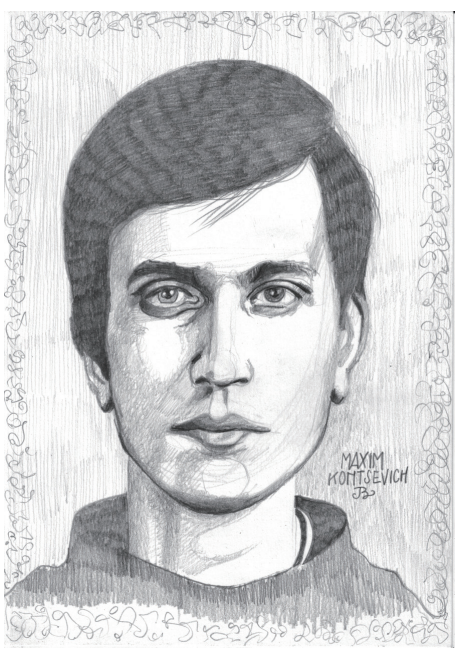
Maxim Kontsevich Laureate in Mathematical Science

Maxim Kontsevich/ 文　谢敏仪 / 译

编者按：2012 年邵逸夫数学科学奖得主是马克西姆 • 康采维奇（Maxim Kontsevich），以表彰他在代数、几何和数学物理，特别是形变量子化、Motivic 积分和镜像对称等方面的开创性工作。本文是他在香港领奖后的获奖感言。

近年来物理学的某些观念激发了代数和几何的深刻进展，康采维奇是这些进展的领路人。海森堡引入量子力学以来，量子化的数学过程，即从古典力学到量子力学的过程已经成为一个中心研究课题，其中关于泊松流形的形变量子化（某些特殊情形除外）是一个非常困难的问题，康采维奇使用量子场论的思想完美地解决了这一问题。他发明了一个令人惊奇的全新概念和工具——Motivic 积分，并和其他数学家使用这一工具解决了代数几何中一些过去无法下手的问题（多变数的多项式方程组的解的研究）。弦理论学家发现“镜像对称”以后导致了一系列出人意料的数学预见，它断言关联到古典力学的辛几何和代数几何这两种明显不同的几何在弦理论中是互为“镜像”的。经过数学家们的努力，这些断言逐渐得以证实。现代的镜像对称是基于一些重要的洞察和进展表述的，其中大多数归功于康采维奇，从 1994 年最初提出同调镜像对称猜想开始，他不但重新回顾了最初的构想，而且对“什么是镜像对称”这一数学问题给出了更清晰的概念性的回答。

康采维奇 1964 年生于俄罗斯希姆基，1999 年成为法国公民，现为法国高等科学研究所教授。他 1992 年获德国波恩大学博士学位，1990 至 1993 年分别在德国马克斯普朗克研究所、美国哈佛大学及普林斯顿高等研究院等机构做访问学者，1993 至 1995 年为美国加州大学伯克利分校教授。他曾获得 1997 年庞加莱奖、1998 年菲尔兹奖、2008 年克拉福德（Crafoord）奖等奖项。



I was born in 1964 in a suburb of Moscow, close to a big forest. My father is a well-known specialist in Korean language and history, my mother was an engineer (she is retired now), and my elder brother is a specialist in computer vision. The apartment where I grew up was very small and full of books – about half of them in Korean or Chinese.

I became interested in mathematics at age 10-11, mainly because of the influence of my brother. Several books at popular level were very inspiring. Also, my brother was subscribed to the famous monthly “Kvant” magazine containing many wonderful articles on mathematics and physics addressed to high-school kids, sometimes explaining even new results or unresolved problems. Also, I used to take part in Olympiads at various levels and was very successful.

In the Soviet Union, some schools had special classes for gifted children, with an additional four hours per week devoted to extra-curricular education (usually in mathematics or physics) taught by university students who had passed through the same system themselves. At age of 13-15 I

马克西姆•康采维奇（Maxim Kontsevich）

我 1964 年出生于莫斯科市郊，周边是一大片森林。我父亲是位著名的韩国语文及历史专家，母亲是位工程师，现在已经退休，哥哥是电脑视觉专家。我幼年时候一家人住在狭小的公寓里，家里放满了书，其中有一半是韩文或中文书籍。

我 10 到 11 岁开始对数学产生兴趣，主要是受到哥哥的影响。那时候，我看了几本对我启发很大的畅销书，也喜欢翻阅哥哥订阅的《量子》(Kvant) 月刊，当中有很多适合高中生阅读的数学和物理文章，有时会刊登最新的研究成果和有待解决的科学问题，内容非常精彩。另外，我参加过不同程度的国际数学奥林匹克竞赛，而且取得不错的成绩。

在前苏联，一些学校会为资优儿童提供增益课程，每星期花上四小时课外时间进行特别课（通常是数学和物理科），由曾经接受过一样的资优教育的大学生授课。我 13 岁到 15 岁时在莫斯科就读的学校就是这一类型的学校。1980 年至 1985 年，我在莫斯科国立大学读书，主修数学，其实大部分课堂的内容在高中时已经学过，所以我从来不上大学的正规课程，而是去参加一些面向研究生和研究人员的讲座，从中可以学到许多东西。我的指导老师是盖尔范德（Israel Gelfand），他是二十世纪最伟大的数学家之一。逢星期一他都会主持讲座，由来自苏联当地和海外的杰出数学家主讲，内容层出不穷，涵盖众多数学领域。我在如此浓厚的学术氛围

was attending such a school in Moscow, and from 1980 till 1985 was studying mathematics at Moscow State University. Because of my previous training in High School, I never attended regular courses, but instead went to several graduate and research-level seminars where I learned a huge amount of material. My tutor was Israel Gelfand, one of the greatest mathematicians of the 20th century. His weekly seminar, on Mondays, was completely unpredictable, and covered the whole spectrum of mathematics. Outstanding mathematicians, both Soviet and visitors from abroad, gave lectures. In a sense, I grew up in these seminars, and also had the great luck to witness the birth of conformal field theory and string theory in the mid-80s. The interaction with theoretical physics remains vitally important for me even now. After graduating from university, I became a researcher at the Institute for Information Transmission Problems. Simultaneously, I began to learn to play the cello and for several years enjoyed the good company of my musician friends with whom I played some obscure pieces of baroque and renaissance music.

In 1988, I went abroad for the first time, to Poland and France. Also in 1988, I wrote a short article concerning two different approaches to string theory, and maybe because of this result, was invited to visit the Max Planck Institute for Mathematics in Bonn for three months in 1990. At the end of my stay there was an annual informal meeting of mostly European mathematicians, called Arbeitstatgung, where the latest hot results were presented. The opening lecture by Michael Atiyah was about a new surprising conjecture of Witten concerning matrix models and the topology of moduli spaces of algebraic curves. In two days I came up with an idea of how to relate moduli spaces but with a completely new type of matrix model, and explained it to Atiyah. People at MPIM were very impressed and invited me to come back the following year. During the next 3-4 years I was visiting mostly Bonn, and also IAS in Princeton and Harvard. My then future wife Ekaterina, whom I met in Moscow, accompanied me, and in 1993 we were married. In Bonn I finished several works which became very well-known: one on Vassiliev invariants, and another on quantum cohomology (with Yu Manin, whose seminar I had attended back in Moscow). Scientifically,

康采维奇 在 2012 年邵逸夫奖领奖台上

下学习，更有幸见证八十年代中期共形场论（conformal field theory）和弦理论（string theory）的诞生，这些理论与理论物理学的发展息息相关，有着划时代的重大意义。大学毕业后，我在俄罗斯信息传输研究所担任研究员。那时候，我刚开始学大提琴，我非常享受跟我的音乐家朋友们一起演奏巴洛克及文艺复兴时期的乐章，就这样渡过了几年的快乐时光。

我同时在罗格斯大学（Rutgers University）及普林斯顿高等研究院访问过好几年（我的老师盖尔范德在苏联社会经济改革之后赴美，并任教于罗格斯大学），而最近六年，我定期到迈阿密大学访问。

研究方面，我会不时转变研究主题，从费恩曼图（Feynman graphs）到抽象代数，一直到微分几何、动力系统、有限域等，不过主要研究方向还是涉及镜像对称。数学与理论物理学相辅相成，在过去二十年取得惊人的发展，不断创新突破。我有幸能够参与其中，不只是透过弦理论汲取数学的精髓，更重要的是能够回馈学术界，正如我跟长期合作研究伙伴索贝尔曼（Yan Soibelman）一同研究得出的“穿墙”（wall-crossing）公式，已经成为物理学家手中的重要工具，同时解答了有关超对称粒子的问题以及解决以渐近法解小参数方程的经典问题。

康采维奇（右一）

a very important moment for me was Spring 1993 when I came to the idea of homological mirror symmetry, which was an opening of a grand new perspective. In 1994, I accepted an offer from Berkeley, but one year later I moved to IHES in France, where I continue to work. In 1999 my wife and I were granted French citizenship (keeping our Russian citizenship as well), and in 2001 our son was born.

For a few years I visited simultaneously Rutgers University, where my teacher Gelfand moved to after the perestroika, and IAS in Princeton. During the last six years I have regularly visited the University of Miami.

In my work I often change subjects, moving from Feynman graphs to abstract algebra, differential geometry, dynamical systems, finite fields. Still mirror symmetry remains the major line. The interaction during the last two decades between mathematics and theoretical physics has been an amazing chain of breakthroughs. I am very happy to be a participant in this dialogue, not only absorbing mathematical ideas from string theory, but also giving something back, like a recent wall-crossing formula which I discovered with my long-term collaborator Yan Soibelman, and which became a very important tool in the hands of physicists, simultaneously answering questions concerning supersymmetric particles, and solving the classical problem about asymptotics for equations depending on small parameter.