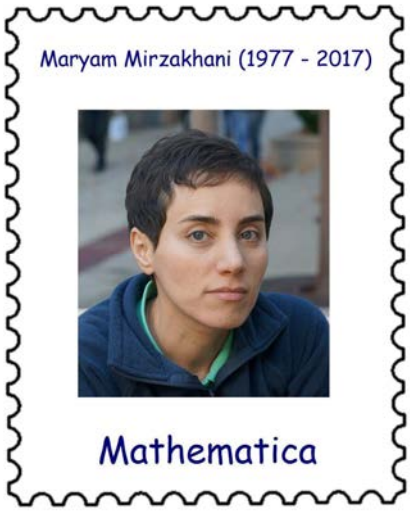
MARYAM MIRZAKHANI (May 12, 1977 –July 14, 2017)

by HEINZ KLAUS STRICK, Germany



(photo by courtesy of Stanford University)

The International Medal for Outstanding Discoveries in Mathematics, known as the FIELDS Medal after its founder JOHN CHARLES FIELDS (1864-1932), has been awarded to a total of 59 people since 1936. FIELDS wanted the prize to be a recognition of work already done and as *an encouragement for further achievement*. It is only awarded to mathematicians who are younger than 40 years of age.

Four prizes were awarded at the *ICM Congress 2014* in Seoul (South Korea). For the first time, one of the prizewinners was a woman: the Iranian mathematician MARYAM MIRZAKHANI, professor at *Stanford University*.

As a child, MARYAM MIRZAKHANI grew up in the capital Tehran together with two siblings during a time of privation during the Iraq-Iranian war (1980–1988). Her father AHMAD worked as an electrical engineer.

MARYAM passed the entrance examination of *Farzanegan Middle School for Girls*, a school sponsored by the *National Organisation for the Promotion of Exceptional Talent*. However, her first maths teacher at this school hardly knew how to interest her in his subject; in fact, he made her understand that she had no particular talent for maths.

This changed – fortunately – in the second year after a change of teacher.

In the first few days at the new school, MARYAM met a girl with whom she would do many things together in the years to come. Both were interested in literature and spent all their pocket money on books. They dreamt of becoming writers or famous women like MARIE CURIE or HELEN KELLER.

After MARYAM and her friend ROYA BEHESHTI moved on to the upper school (Secondary school), the two discovered an exercise sheet with six tasks from the *Mathematics Olympiad*, and MARYAM succeeded in solving three of them at once. Encouraged by this, they asked their headmistress whether she could also set up a mathematics problem-solving group at her school – as was usual at the parallel boys' school.

Success was not long in coming: both girls qualified for participation in the 1994 *International Mathematical Olympiad* in Hong Kong – it was the first time that girls had been part of the Iranian Olympic team.

MARYAM MIRZAKHANI won a gold medal (she achieved 41 out of 42 possible points), and her friend ROYA BEHESHTI a silver medal. The following year, at the Olympics in Toronto (Canada), MARYAM MIRZAKHANI even achieved a full score.

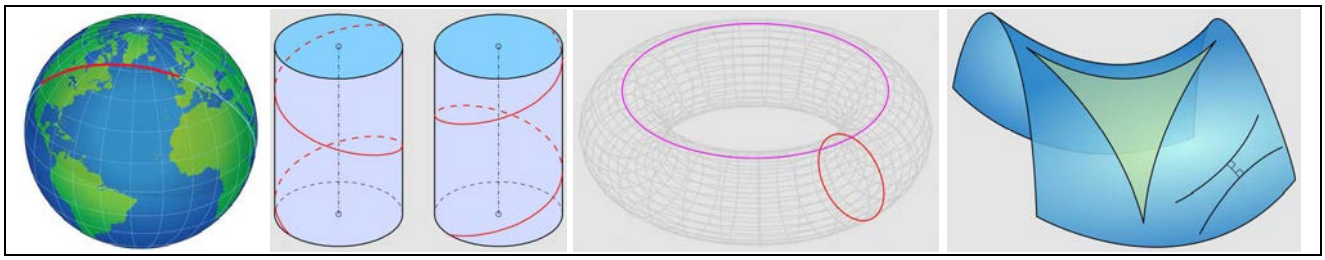
In 1995, she began studying mathematics at Iran's most renowned technical and scientific university, the *Sharif University of Technology* (founded on the model of the *Massasuchetts Institute of Technology*, MIT). During her first years of study she had already published three articles.

In February 1998 she and other top students took part in a competition in Ahwaz (in the south of Iran), about 900 km away. On the way back the bus crashed and fell into a gorge - seven students and two bus drivers died but the 21-year-old MIRZAKHANI survived.

After completing her Bachelor's degree, she moved to *Harvard University* in Massachusetts on a scholarship. Her advisor (and later doctoral supervisor) was CURTIS MCMULLEN, who had just been awarded the FIELDS medal at the 1998 ICM conference in Berlin.

She dealt with the number of closed geodesic lines on hyperbolic surfaces.

Geodesic lines are the shortest connecting paths lying in a surface between two points. For example, the geodesic lines connecting two points of a sphere lie on great circles; in the case of cylinders, they are left- or right-turning helical lines, provided that the two points do not lie on the same circle or on a surface line (perpendicular or parallel to the axis). With a torus (the third figure below) the matter becomes even more complicated: the number of closed geodesic lines can only be estimated. *Hyperbolic surfaces* have a constant negative curvature; the figure on the right shows a hyperbolic triangle.



(graphics from Wikipedia)

In her 130-page doctoral thesis of 2004 on *Simple Geodesics on Hyperbolic Surfaces and Volume of the Moduli Space of Curves*, MARYAM MIRZAKHANI gave a very precise estimate of how many of the closed geodesic lines of a given length on any hyperbolic surfaces do not intersect themselves.

These research results have been compared with the prime number theorem of number theory. In 2009, it received special recognition with the presentation of the *Blumenthal Award for the Advancement of Research in Pure Mathematics*.

After completing her doctorate, MIRZAKHANI declined the offer of a junior fellowship at *Harvard University*; instead, she accepted an assistant professorship (*Clay Research Fellowship*) at *Princeton University* in New Jersey, which gave her greater freedom for research. With the support of this fellowship, she created further groundbreaking work on geodesic lines.

In 2008, she moved to *Stanford University* in California to become a professor of mathematics. There she married JAN VONDRÁK, a computer scientist from the Czech Republic. He had studied computer science in Prague and then completed his doctorate in applied mathematics at MIT – the two had met in Princeton.

Their daughter ANAHITA was born in 2011.

When asked about her mother's activities when she was three years old, ANAHITA described it as painting – in fact, MARYAM MIRZAKHANI tried to visualise the highly abstract objects she examined through drawings (*doodles*). This effort to convey the abstract topics of mathematical research to the general public in an understandable way earned her the title of one of *Popular Science*'s "Brilliant 10" in 2006.

During all these years she had been in contact with her friend ROYA BEHESHTI, who after completing her doctorate at MIT and various postdoctoral activities (including in Bonn) took up a professorship at *Washington University* in St Louis.

MIRZAKHANI 's research also focused on dynamic systems: Starting from the seemingly simple question of what paths an (unbraked rolling) billiard ball travels on an (irregular) polygonal billiard table with rational angular sizes, and whether these paths cover the surface without gaps (i.e. every point on the surface is traversed by the ball), she developed models for the propagation of gases. In 2011 she published a paper on this subject – in collaboration with ALEX ESKIN from the *University of Chicago* – for which she received numerous other international awards.

Even before the FIELDS medal was awarded in 2014, she was diagnosed with breast cancer. Despite immediate treatment, the cancer spread and also attacked her liver and bone marrow. At the peak of her career, she died at the age of just 40.

In his obituary the president of Stanford University wrote:

> "*Maryam is gone far too soon, but her impact will live on for the thousands of women she inspired to pursue math and science. Maryam was a brilliant mathematical theorist, and also a humble person who accepted honors only with the hope that it might encourage others to follow her path. Her contributions as both a scholar and a role model are significant and enduring, and she will be dearly missed here at Stanford and around the world*."

In 2018 in Rio de Janeiro the delegates of an international congress of women mathematicians decided to introduce 12 May, the birthday of MARYAM MIRZAKHANI, as an annual worldwide day for women in mathematics.

First published 2020 by Spektrum der Wissenschaft Verlagsgesellschaft Heidelberg

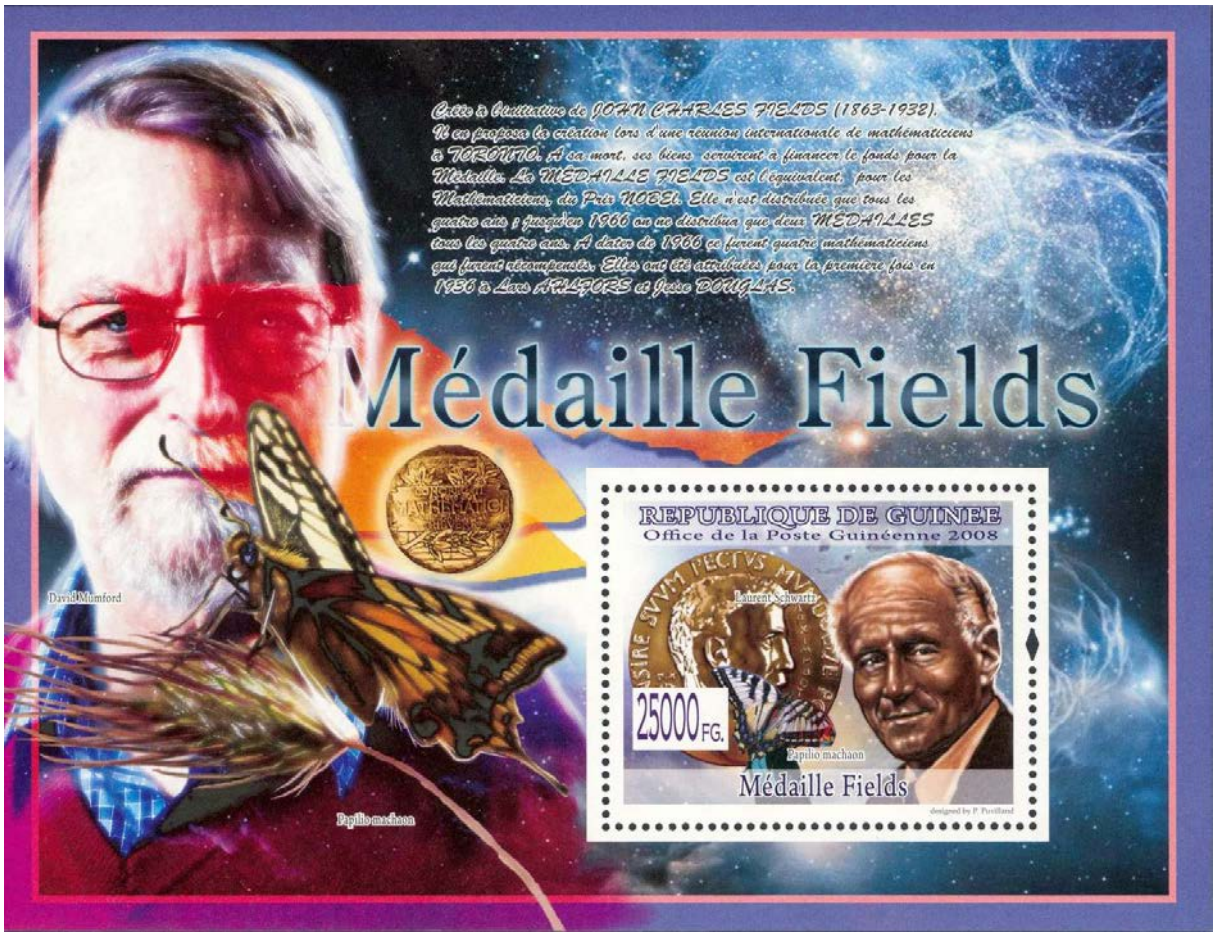
https://www.spektrum.de/wissen/maryam-mirzakhani-1977-2017-vorbild-vieler-mathematikerinnen/1771125

Translated 2020 by John O'Connor, University of St Andrews

Here an important hint for philatelists who also like individual (not officially issued) stamps. Enquiries at europablocks@web.de with the note: "Mathstamps".


FIELDS-MEDAILLEN
L.V. Ahlfors
J. Douglas
OSLO 1936
FIELDS-MEDAILLEN
L. Schwartz
A. Selberg
CAMBRIDGE (USA) 1950
FIELDS-MEDAILLEN
K. Kodaira
J.-P. Serre
AMSTERDAM 1954
FIELDS-MEDAILLEN
K.F. Roth
R. Thom
EDINBURGH 1958
FIELDS-MEDAILLEN
L. Hörmander
J.W. Milnor
STOCKHOLM 1962
FIELDS-MEDAILLEN
M.F. Atiyah
P.J. Cohen
A. Grothendieck
S. Smale
MOSKAU 1966
FIELDS-MEDAILLEN
A. Baker
H. Hironaka
J.G. Thompson
S. Novikow
NIZZA 1970
FIELDS-MEDAILLEN
E. Bombieri
D.B. Mumford
VANCOUVER 1974
FIELDS-MEDAILLEN
P.R. Deligne
C.L. Fefferman
G.A. Margulis
D.G. Quillen
HELSINKI 1978
FIELDS-MEDAILLEN
A. Connes
W.P. Thurston
S.-T. Yau
WARSCHAU 1983
FIELDS-MEDAILLEN
G. Faltings
S.K. Donaldson
M.H. Freedman
BERKELEY 1986
FIELDS-MEDAILLEN
V.G. Drinfeld
V.F.R. Jones
S. Mori
E. Witten
KYOTO 1990
FIELDS-MEDAILLEN
J. Bourgain
P.-L. Lions
J.-C. Yoccoz
E. Zelmanov
ZURICH 1994
FIELDS-MEDAILLEN
W.T. Gowers
R.E. Borcherds
M. Konzewitsch
C. McMullen
BERLIN 1998
FIELDS-MEDAILLEN
L. Lafforgue
W. Wojewodski
PEKING 2002
FIELDS-MEDAILLEN
A. Okunkow
G. Perelman
T. Tao
W. Werner
MADRID 2006
FIELDS-MEDAILLEN
N.B. Châu
E. Lindenstrauss
S. Smirnow
C. Villani
HYDERABAD 2010
FIELDS-MEDAILLEN
A. Ávila
M. Bhargava
M. Hairer
M. Mirzakhani
SEOUL 2014
MARKE INDIVIDUELL
Deutsche Post
45


Efim Zelmanov
Médaille Fields
REPUBLIQUE DE GUINEE
Office de la Poste Guinéenne 2008
André Weil
Alain Connes
5000 FG.
Médaille Fields
Trinity College (Cambridge)
Alan Baker
5000 FG.
Médaille Fields
John Charles Fields
5000 FG.
Médaille Fields
Université de Chicago
Vladimir Drinfeld
5000 FG.
Médaille Fields
Instanton
Simon Donaldson
5000 FG.
Médaille Fields
Variété de Calabi-Yau
Andrei Okounkov
5000 FG.
Médaille Fields
Manish Jartina
Pierre Deligne


Cette dénomination de JOHN CHARLES FIELDS (1863-1932).
Il en propose la création lors d'une réunion internationale de mathématiciens
à TORONTO. A sa mort, ses biens servirent à financer le fonds pour la
Médaille. La MEDAILLE FIELDS est l'équivalent, pour les
Mathématiciens, du Prix NOBEL. Elle n'est distribuée que tous les
quatre ans ; jusqu'en 1966 on ne distribua que deux MEDAILLES
tous les quatre ans. A dater de 1966 ce furent quatre mathématiciens
qui furent récompensés. Elles ont été attribuées pour la première fois en
1936 à Lars AHLFORS et Jesse DOUGLAS.
Médaille Fields
David Mumford
Papilio machaon
REPUBLIQUE DE GUINEE
Office de la Poste Guinéenne 2008
Laurent Schwartz
25000 FG.
Papilio machaon
Médaille Fields