Rudolf L. Mössbauer

(1929–2011)

A physicist who revitalized German science by creating a new type of spectroscopy.

When Rudolf Mössbauer found in 1957 that γ-rays emitted by iridium-191 could be absorbed by a target of the same isotope without any loss of energy, it was soon obvious that he had discovered a new basis for spectroscopy. Just four years later, at the age of 32, he was awarded the Nobel Prize in Physics.

Now named after him, Mössbauer spectroscopy is applied in fields ranging from chemistry to conservation. It is ideal for very fine-resolution work, such as determining the shift of spectral lines in Earth's gravitational field. It has even been used beyond Earth — to analyse the composition of rocks on Mars.

Born in 1929 in Munich, Germany, Mössbauer was a talented piano player but decided to study physics at the Technical Institute of Munich (now the Technical University of Munich). His prizewinning discovery emerged from his PhD work investigating γ-ray absorption, done between 1955 and 1958 under Heinz Maier-Leibnitz at the Max Planck Institute for Medical Research in Heidelberg. In 1960, he moved to the California Institute of Technology (Caltech) in Pasadena, and received the Nobel prize a year later.

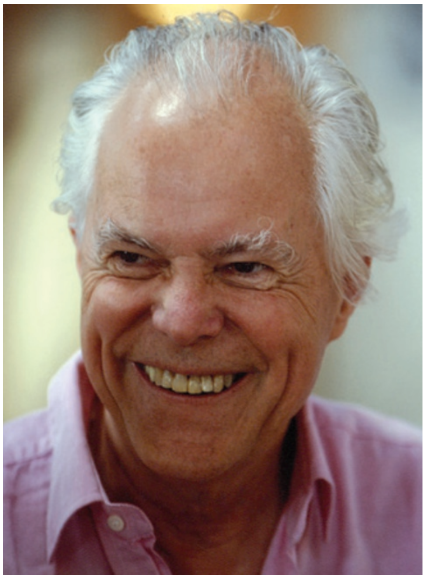
But he didn't stay in America for long, moving back to the Technical Institute of Munich in 1964. The Bavarian government was willing to pay a high price for his return — a new physics building and ten professorships. But the gain for physics in Germany was tremendous. Mössbauer's new department brought a blast of fresh air to Munich and enhanced the scientific climate nationwide. Several German scientists who worked in the United States came back to Germany in what was called the 'second Mössbauer effect'.

"Ultimately, Mössbauer saw science as the language connecting all the people of the world."

Mössbauer remained in Munich until his retirement in 1997. Between 1972 and 1975, he took leave to serve as director of the Laue–Langevin Institute in Grenoble, France.

The power of Mössbauer spectroscopy stems from two facts. Nuclei bound in a solid (a crystal, glass or viscous liquid) are unaffected (with some probability) by recoil when they emit or absorb γ-radiation, and so do not gain or lose energy. Moreover, the frequency range of these γ-rays — the natural width — is determined by the nuclear lifetime and is not broadened by the Doppler effect. The spread of energies absorbed or emitted by a particular isotope is extremely narrow, giving the technique its high energy resolution.

Mössbauer realized that γ-rays emitted by a nucleus could be reabsorbed by nuclei of the same isotope in another sample. Any difference between the environment of the two nuclei causes an energy shift. Such shifts yield information about the state of the electrons of the isotope, and hence the nature of the solid containing it. Properties such as magnetism and flexibility (of protein molecules, for example) can be derived.



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Applying his discovery across many fields, Mössbauer and his colleagues produced an explosion of papers in nuclear physics, solid-state physics, chemistry and biophysics — especially when the Mössbauer effect on iron-57 was found. Other Mössbauer isotopes were detected, such as tantalum-181, which has an extraordinarily narrow natural linewidth and thus fine energy resolution. Measurements on iron and tin compounds led to breakthroughs on their valence and electronic configurations.

Once such experiments became 'routine', Mössbauer's interest shifted. He studied neutrinos through his involvement in the GALLEX experiments at the Gran Sasso National Laboratory in Italy. And he turned his spectroscopic method to exotic applications, such as the structure and dynamics of proteins, and reflections and anomalous transmissions in perfect single crystals.

But ultimately, Mössbauer saw science as the language connecting all the people of the world. He set up many international collaborations during his career. Strong links with Russia began when, during his time at Caltech, scientists at the USSR Academy of Sciences invited American physicists to Moscow to discuss possible cooperation. Because the cold war was still going on, no prominent American scientist wanted to go — so Mössbauer did. That visit was the starting point of long-running exchanges with Vitalii Goldanskii at the academy's Institute of Chemical Physics and with Yuri Kagan at the Kurchatov Institute in Moscow. Mössbauer became a foreign member of the USSR Academy of Sciences in 1982.

THE TRAIN FROM TEHRAN

After Mössbauer returned to Munich, he and Goldanskii exchanged students and scientists. They organized the first common seminar in Moscow in 1975, out of which grew a series held alternately in the Soviet Union and Germany. In 1977, one was to be held in Yerevan, Armenia. When he was invited to visit Iran during the week before the seminar, Mössbauer looked at the map and decided to go by train from Tehran to Yerevan, not realizing that the train would stop in the desert between the two cities. His delegation waited in Yerevan for two days for their lost chief. Mössbauer also maintained excellent contacts with many other countries, especially the United States.

Mössbauer placed great value on teaching. He gave brilliant lectures, and never went to conferences during the school term. He gave his students — including me — freedom, but he helped when problems arose.

When the University of Münster offered me a professorship in 1982, Mössbauer decided that my research field should go with me. He generously arranged for me to take all of my equipment, so that I could make the best start. Always collaborative, he did not wish to compete with a former student and colleague. ■

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