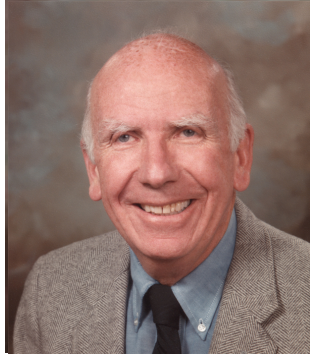


## Leon Knopoff, 1925 - 2011



Leon Knopoff, an internationally renowned scientist who advanced the fields of physics, seismology and music, died at home on Jan. 20 surrounded by his wife and three children.

He earned his Ph.D. in physics and mathematics from the California Institute of Technology in 1949 and joined the UCLA faculty the following year. He became a research musicologist in the UCLA Institute of Ethnomusicology shortly after its creation in 1960.

His numerous honors included election as a member or fellow of the National Academy of Sciences (1963), the American Association for the Advancement of Science (1964), the American Academy of Arts and Sciences (1965), the Guggenheim Foundation (1976) and the American Philosophical Society (1992). He earned the Gold Medal of the Royal Astronomical Society (U.K., 1979), the H. F. Reid Medal of the Seismological Society of America (1990), the Emil Wiechert medal of the German Geophysical Society (1978), and a Docteur Honoris Causa from Université Louis Pasteur, Strasbourg (2004). Knopoff visited China in the 1970s, returning often to collaborate. He was named the first honorary professor of the Institute of Geophysics of the China Earthquake Administration (2004).

He supervised 39 Ph.D. students and 40 postdoctoral scholars from 17 countries. Known for his exceptional clarity in teaching, he presented the complex simply with an infectious enthusiasm and a caring empathy for his students. They have been recognized for their rigorous training in fundamentals and have gone on to successful academic and industrial careers. Four outstanding teaching awards earned from UCLA's Physics Department were among his treasures.

His exemplary career was replete with outstanding contributions to fundamental geophysics, and by applying ideas from mathematical physics to seismology he contributed to both fields. Knopoff was extremely creative, unusually prolific and elegant in his choice of research topics. The hallmarks of his research were extreme rigor and thorough consideration of alternate interpretations.

Knopoff's theoretical advances cover nearly everything seismological, including diffraction, attenuation, creep, equations of state, scattering, cracked media, and dynamic crack propagation. He was one of the first to recognize that modern developments in nonlinear science such as chaos, strange attractors, fractality, and self-organized criticality also applied to earthquakes.

In 1956, Knopoff published the basis for the "double couple" earthquake source model, so-named in a 1960 article he wrote with Freeman Gilbert. Knopoff showed that discontinuous displacement across a fault results in seismic waves identical, in the far field, to those from two pairs of opposing body forces. This development enabled rapid computation and later evolved into the moment tensor representation of seismic sources. He showed how motion on a boundary, such as a seismic fault, is linked to displacements in a medium, such as the Earth's crust, and demonstrated that such displacements are proportional to the slip velocity across a fault plane. In the 1960s, Knopoff and his colleagues developed computational approaches for fault plane dynamics and the propagation of seismic waves. These developments underpinned methods to invert seismic waves so that focal mechanisms and velocity along the ray path could be inferred. Another milestone, recognized as a first principle in seismology, is the 1964 representation theorem by Robert Burridge and Knopoff. Their continued collaboration included the highly cited 1967 model of interacting springs and blocks: a basis for simulating self-organization and chaos in the earthquake dynamical system. It predated by two decades such developments in physics.

Knopoff pioneered the installation of temporary long-period seismograph stations throughout the European Alps. In 1966, he and colleagues Stephan Mueller and Walter Pilant were the first to process long-period seismograms digitally. He also helped to develop ultra-long period seismometers for the South Pole. Always a pioneer, he was first in measuring solid Earth polar tides and vibrational modes there, important because they are unaffected by Earth's rotation and elliptical shape. He used global seismographic data to define the main structures of tectonic plates and showed that the oceanic lithosphere thins at mid-ocean ridges and lies above a decoupling zone between plates and the mantle below. In 1972, Knopoff demonstrated first that as stable continental shields plough through the mantle, they are slowed by their deep roots or 'keels.'

With Yan Kagan, Knopoff developed the stochastic branching model of faulting that displays the clustering properties of earthquake catalogs, including foreshocks, aftershocks, and weak clustering of mainshocks. This model anticipated by years the popular Epidemic Type Aftershock Model (ETAS).

Knopoff had a talent for setting large-scale projects into motion. In 1963 he became the first Chair of a

National Academy of Sciences Committee to coordinate US participation in the International Upper Mantle Project. The Project was proposed by the International Union of Geodesy and Geophysics and adopted by the International Council of Scientific Unions as a complement to the International Geophysical Year. The US Committee organized the first transcontinental geophysical survey of North America, started a project of scientific deep-earth drilling, and produced crucial data supporting the then-controversial hypothesis of global plate tectonics. Knopoff was an ardent supporter of UCLA's Institute of Geophysics and Planetary Physics, serving as its Director from 1972 to 1986. In 1991 he joined a small group including Lynn Sykes, Rob Wesson, and Kei-iti Aki who successfully pursued the creation of the still-vigorous Southern California Earthquake Center.

His creative contributions far surpassed seismology. With UCLA's George Kennedy he developed thermoluminescence dating, a method now practiced by archaeologists and art historians. It works because rocks and pottery contain traces of radioactive elements whose decay products become trapped in a sample. Its age can then be inferred from the amount of light emitted when the sample is heated. But the light which music gives also interested him. Knopoff applied pattern recognition and time-series analysis to quantify the information content of music and writing, asking what makes them distinctive and pleasant. In all fields he took delight in the marriage of discovery and rigor.

Leon Knopoff was a warm-hearted and adventurous man with an endearing humor evident in his elegant writing. He was very much at home climbing glaciers, hiking in the Sierras, advancing theoretical physics, and delighting in his family. A remarkable polymath, he effectively spanned the "two cultures," leaving an extraordinarily rich record of achievement. His cadre of students and colleagues will continue his work as they miss him.

**David D. Jackson and Paul M. Davis**

## Meetings Calendar

A calendar of scientific meetings relevant to the interests of IASPEI scientists is maintained at:

<http://www.iaspei.org/meetings/forthcoming.html>

where more details can be found. We report below just the titles, dates, places and websites of the forthcoming meetings.

### 2011

#### European Geosciences Union General Assembly 2011

April 03 – 08, 2011, Vienna, Austria

Website: <http://meetings.copernicus.org/egu2011/>

#### Sixth International Conference on Seismology and Earthquake Engineering (SEE6)

May 16-18, 2011, Tehran, Iran

Papers due: January 31, 2011

Pre-registration: February 28, 2011

Website: [www.see6.ir](http://www.see6.ir)

#### 7<sup>th</sup> International Workshop in Statistical Seismology

May 25-27, 2011, Thera Is. (Santorini), Greece

Contact person: Dr Gerassimos A. Papadopoulos,  
[statsei7@gein.noa.gr](mailto:statsei7@gein.noa.gr).

Web site:

<http://www.gein.noa.gr/statsei7/back/index.html>.

#### CTBT: Science and Technology 2011 (S&T2011) scientific conference

June 8-10 June, 2011, Hofburg Palace, Vienna, Austria.

Website: <http://www.ctbto.org/specials/ctbt-science-and-technology-2011-10-june-2011-vienna-austria/>

#### XXV IUGG2011 GENERAL ASSEMBLY "Earth on the Edge: Science for a Sustainable Planet"

June 27 – July 8, 2011, Melbourne, Australia

Website: <http://www.iugg2011.com>

#### International Symposium on Geophysical Imaging with Localized Waves

July 24-28, 2011, Sanya, Hainan Island, China.

Contact person: Wu Ru-Shan ([wrs@pmc.ucsc.edu](mailto:wrs@pmc.ucsc.edu))

#### 12th International Workshop on Modeling of Mantle Convection and Lithosphere Dynamics

August 20-25, 2011, Hotel Döllnsee-Schorfheide, Germany (about 80 km from Berlin)

Contact person: Bernhard Steinberger, [bstein@gfz-potsdam.de](mailto:bstein@gfz-potsdam.de)

Website: [http://www.gfz-](http://www.gfz-potsdam.de/events/2011/Mantle_Lithospheric_Dynamics_Workshop)

[potsdam.de/events/2011/Mantle Lithospheric Dynamics Workshop](http://www.gfz-potsdam.de/events/2011/Mantle_Lithospheric_Dynamics_Workshop)

#### 4th IASPEI International Symposium: Effects of Surface Geology on Seismic Motion

August 23-26, 2011, University of California, Santa Barbara, USA

Contact persons: Ralph Archuleta

[ralph@crustal.ucsb.edu](mailto:ralph@crustal.ucsb.edu)

or Jamie Steidl, [steidl@crustal.ucsb.edu](mailto:steidl@crustal.ucsb.edu)

Website: <http://esg.eri.ucsb.edu/>

#### INTERNATIONAL CONFERENCE "EARTHQUAKE FORECASTING-2011"

September 12-15, 2011, Çanakkale, Turkey

Website: [www.efc2011.org](http://www.efc2011.org).

#### UGI2011 – Regional Geographic Conference

November 14-18, 2011, Santiago, Chile

Contact: [kbecker@fisa.cl](mailto:kbecker@fisa.cl)

Website: [www.ugi2011.cl](http://www.ugi2011.cl)