

Visitor, Associates and Students' Programme (VASP)
presents Webinar Series on
Statistical Mechanics



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TITLE

Leonardo da Vinci, Andrei Kolmogorov and Giorgio Parisi.
The energy decay of turbulence from Leonardo to multifractal theory

ABSTRACT

Leonardo da Vinci had a strong interest in hydrodynamics. Around 1505 he got interested in "turbulence" (he was the first to use this name). Examining the "turbulences" (eddies) in the river Arno of Florence, he found that the amplitude of the turbulence was decreasing very slowly in time, until it would come to rest (within the surrounding river). In spite of Leonardo's strong interest in mathematics, at that time, it consisted basically of geometry and simple polynomial equations. There were no tools available to describe the very slow temporal relaxation of turbulence. This topic would remain dormant for about 430 years, until in 1938 Karman, triggered by Taylor, established that the mean energy of the turbulence should decrease very slowly, indeed like an inverse power of the time elapsed. Three years later, Kolmogorov himself found another inverse power ($10/7$) of the time elapsed. This, likewise was wrong, because he was assuming a certain invariance property (Loitsiansky, proved later wrong by Proudman and Reid). The main change in the last few decades is that fully developed turbulence is definitely not self-similar, not only is it fractal, but it can have infinitely many fractal scalings (multifractality), as proposed by Parisi and Frisch in the eighties. Furthermore, multifractality can manifest itself either at small scales or at large scales. The latter might change the law of energy decay. Not enough is understood for the 3D Euler equations, but large-scale multifractality for the Burgers is an interesting possibility, which is being explored by Frisch, Khanin, Pandit and Roy. A brief exploration of what happens to the energy decay-law will be presented.

SPEAKER

Prof. Uriel Frisch, The French National Centre for Scientific Research

Prof. Uriel Frisch is a theoretical physicist working as a directeur de recherche emeritus of CNRS at the Observatoire de la Côte d'Azur, Nice, France. Prof. Frisch is best known for his pioneering contributions to the area of fluid dynamics and turbulence. His research interest spans across a wide range of fields from cosmology and statistical physics to history of science. Over his illustrious career, Prof. Frisch has been honored with many prestigious prizes including EUROMECH, awarded by the European Mechanics Society, the Lewis Fry Richardson Medal of the European Geosciences Union, the Bazin Prize of the French Academy of Sciences and Peccot Prize of the Collège de France. He is an Officier of the Ordre national du Mérite and a member of the French Academy of Sciences. His book 'Turbulence' is a standard text for most advanced courses on the subject all over the world.

