Wolfgang Pauli Institut & „Inst. CNRS Pauli“, IRL2842 du CNRS
Fakultät f. Mathematik, Universität Wien
Fakultät f. Physik, Universität Wien
Forschungsplattform MMM „Mathematics-Magnetism-Materials“
Fakultät f. Geowissenschaften, Geographie und Astronomie

23. PAULI COLLOQUIUM, jointly with

KOLLOQUIUM der Fakultät für MATHEMATIK

The **Fakultät für Mathematik** jointly with the **Fakultät für Physik,**
the **research platform MMM „Mathematics-Magnetism-Materials”**
and the **Fakultät für Geowissenschaften, Geographie und Astronomie,**
together with the **Wolfgang Pauli Institut** & the **“Inst. CNRS Pauli”,**

kindly invite you to the talk of **Uriel FRISCH** (CNRS)

Time: Wednesday, 7. June 2023, 15:15 – 16:15

Place: Skylounge, 12th floor, Oskar-Morgenstern-Platz 1, 1090 Wien

1) 14h55 – 15h15 : **Coffee & Cake**

2) 15h15 – 15h20 : **Introduction :** Norbert J **Mauser** (U.Wien & WPI & CNRS)

3) 15.20 – 16.15 Uhr :

Uriel Frisch (Lab. J.L. Lagrange,
Observatoire de la Côte d'Azur, CNRS, Nice)

“Fusion: past and future of an energy source"

4) 16h15 – 17h00 : **Vinum cum pane**

Radu Bot	***Robin Golser***	***Rainer Abart***	***Norbert J Mauser***
(Dean Math)	(Dean Physics)	(Dean Geo/Astro)	(director WPI & Inst CNRS Pauli speaker research platform MMM)

Abstract:
In December 2018, Patrick Diamond, Uriel Frisch and Yves Pomeau published in "European Physical Journal (History)" a history of plasma physics in the 20th century of more than 300 pages. The articles were written by key players in plasma physics. Since the bulk of the plasma studies were born after 1950, most of the players are still alive and contributed eagerly. Nevertheless, the aformentioned editors had the feeling that the "prehistory of plasma physics" in the first half of the 20th century was certainly worth commenting on. In Section 3 "The birth of nuclear fusion", [1] they concluded "*Sustained energy production by plasma fusion seems significantly more complex but, given enough international brain-power, time and money (in that order), it will be achieved, hopefully."*

This week at the Wolfgang Pauli Institute we are running a workshop where we try to assess how much a recent breakthrough in laser fusion at the Lawrence Livermore Laboratory in California [2] bring us to sustained energy production.

Curiously, fusion did not at all start in the early fifties. In the 19th century William Prout and Charles Darwin made key observations. In the early 20th century, Paul Langevin and Jean Perrin observed that Einstein's equivalence between mass and energy has important consequences for fusion energy.

This was before Arthur Edington well-known observations on the Solar energy *"If indeed, the sub-atomic energy in the stars is being freely used to maintain their great furnaces, it seems to bring a little nearer to fulfilment our dream of controlling this latent power of the well-being of the human race - of for its suicide."*

[1] P. Diamond, U. Frisch, Y. Pomeau, Editorial introduction to the special issue “Plasma physics in the 20th century as told by players”, The European Physical Journal H, 43 (4-5) (2018) 337-353 sec 3
[2] *"National Ignition Facility achieves fusion ignition"*. *Lawrence Livermore National Lab. Retrieved 2022-12-13.*
[3] W. Prout, 1815. On the relation between the specific gravities of bodies in their gaseous state and the weights of their atoms", Ann. Philos. 6: 321-330 (at first, published anonymously).
[4] C. Darwin, 1859. On the Origin of Species, John Murray
[5] P. Langevin, 1913. L'inertie de l'énergie et ses conséquences", J. Phys. Theor. Appl. 3: 553-591.
[6] J. Perrin, J., 1919. Matière et lumière. Essai de synthèse de la mécanique chimique", Ann.Phys. 9: 5-108.
[7] A.S. Eddington, 1926. The internal constitution of the stars. Cambridge University Press

Short Biography:

Uriel Frisch (born 19 December 1940 in Agen, France) is a French physicist of fluid mechanics, of cosmology and of applied mathematics, specialist on turbulence. Frisch was a student at the École Normale Supérieure and earned a Ph.D. in 1967 from the University of Paris. He published over 200 papers and a well-known book on the work of Kolmogorov.

Key discoveries :

Intermittency and complex singularities. Experimental data on turbulence show evidence that high-order derivatives present intermittent puffs. Frisch and Morf proved that such puffs are associated to complex singularities.

Multifractality. Turbulence data show that, at scales where forcing and dissipation are negligible, the moments of velocity increments, scale as powers of the separation. Parisi and Frisch showed that the exponents have non-trivial dependence on the order. This effect, which connects with the foundation of the entropy in statistical physics is called multifractality (presence of infinitely many fractal dimensions). This is one of the topics for which Giorgio Parisi earned the Physics Nobel Prize in 2021.

Lattice Hydrodynamics. Frisch, Hasslacher and Pomeau showed that there exist cellular automata on suitable lattices that simulate the Navier-Stokes dynamics. Variants, using the same lattices, but with the Boltzmann approximation, are now frequently used for simulating flows around vehicles and airplanes.

Key prizes: Peccot Prize of the Collège de France for his doctoral thesis in 1967.
Elected as Correspondant of the French Academy of Science (1994), Full Member in 2008.
Lewis Fry Richardson Prize of the European Geoscience Union (2003). Applied Mechanics Prize Modesto Panetti e Carlo Ferrari of the Turin Academy of science (2010). EUROMECH Prize (fluid mechanics) 2020.