

# Path Integration in Complex Dynamical Systems

6 Feb 2017 - 10 Feb 2017 @Oort

• A concise version of the **description and aims** of the workshop, including what were the most important scientific questions motivating the workshop (about 5 lines).

The aim of this workshop was to bring together theorists and phenomenologists who actively use path-integral methods in their research, and via carefully selected lectures stimulate exchange of opinions and dissemination of new ideas and state-of-the-art applications. The workshop covered modern topics in which path integrals play an indispensable or decisive role. A structural backbone of the workshop was given by four benchmark topics: a) Econophysics and heavy-tailed systems, b) Hard and soft condensed matter theory and biophysics, c) Quantum gravity, d) Foundational issues in natural and mathematical sciences

• Is a **tangible outcome** of the workshop expected? If so, please mention – even if it is, as yet, at the level of intention.

We expect that in the coming years, a number of papers will be published which will owe significantly to the workshop. Apart these prospective papers, the workshop organizers together with key-note speakers plan to write a report paper (probably in Annals of Physics) on the present state-of-the-art applications of path integrals.

• Were there any developments which could, already, be termed a (beginning) **scientific breakthrough**? If yes, please tell about it shortly.

So far, it is perhaps too early to speak about scientific breakthroughs. One might modestly state that the workshop invoked and provoked a number of interdisciplinary questions among participants. This could be clearly seen during discussion breaks every day. We could also observe that new collaborations have been established.

• Did you, or to your knowledge any of the participants, experience notable **"Aha" moments** (for instance, separate scientific communities realizing that they have significantly more in common than they had thought)?

Yes, cross-fertilization among separate scientific communities could be clearly seen. As already mentioned, the discussion breaks were quite instrumental in finding a unifying language and in experiencing "Aha" moments among participant with different specializations. Personally, we have experienced a number of "Aha" moments, for instance; a) when Prof G. Junker was able to show that the "local-time" path integral used by Dr V. Zatloukal can be understand as "path-integral power-law duality" in disguise, b) when Prof J. Klauder proposed to Dr. L. Smaldone a new way of looking on canonical transformations in phase-space path integrals via complex canonical transformations in cohere-state path integrals c) when Dr. P. Ribeiro in the discussion session discussed his current research difficulties involving operator ordering issues within the path integral formulation and Prof. J. Klauder could shed new light on the issue and Prof. A. Abanov could show that the ambiguity does not make a difference.

**Organization/Format part of the report:**

· How did you experience the **format of the workshop** (the structure of the program, lectures vs discussion time etc.)? Did you try something new (different kind of discussions for instance)? If so, how did it work out? Would you do it again or advise it to others?

We did not experiment much with the workshop format. We adhered rather strictly to the proposed program. We have found that 5 longer lectures (45 to 60 minutes) per day furnished with two-hour discussion per day represented a very stimulating scientific milieu. Most likely, we would follow a similar format during possible future LC workshop.

· **Other comments**, suggestions and/or criticism for the Lorentz Center, the scientific advisory boards and/or future organizers.

Right from the start when we submitted our proposal to LC we felt enjoyed the professional and collegial atmosphere of the Lorentz Center. Finally, it was an absolute pleasure to spend the conference week at LC. The workshop coordinator, Ms. Aimée Reinards, made all the participants feel looked after and she worked closely with us (the scientific organizers) to make the workshop a success.

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