

DE LA RECHERCHE À L'INDUSTRIE

cea



LARSIM

DSM/IRFU

Étienne Klein

Saclay, le 14 janvier 2015

LARSIM ~ Research Laboratory *on* Matter Sciences

- Created in January 2007, LARSIM has four permanent members (including one emeritus researcher) and had two PhD students until 2014. But its efficiency comes from the fact that it activates and animates working groups including researchers from other fields in the CEA and has collaborations with other institutions in France and abroad.
- The main specificity of LARSIM is that its researchers have all completed dual academic training, as physicists on the one hand, as philosophers of physics on the other hand.
- The idea at the origin of LARSIM was not to make a fusion of physics and philosophy, nor to colonize physics by philosophy or philosophy by physics, but to examine some points where they have close contacts.

The missions of LARSIM (1)

LARSIM's mission is triple :

- 1) *To do some work in the field of foundations of physics, which was not very much covered in France before 2006.*

LARSIM was the coordinator of an ANR project called **FoundPhys** (2008-2011). This project aims to address the founding principles of physics. It helped to create a group of researchers working on this field, contributed to organize 8 conferences, 50 seminars and 16 visits to France by top-level researchers (University of Vienna, University of Maryland, University of Sydney, Imperial College in London, and see web site).

FoundPhys workshops focused on the following topics :

- *operational approaches of quantum theory, quantum information*
- *philosophy of statistical mechanics*
- *issue of time in physics (causality, arrow of time...)*
- *conceptual implications of the discovery of the Higgs boson.*

Highlight 1 in Foundations of physics

- **LARSIM has organized jointly with LTCI (CNRS-Telecom) an international workshop, “Physics and Information-2013”, at Institut Poincaré in Paris, from April 8th to 10th, 2013.**

Understanding physics from the point of view of information led to the emergence of many new fields over the last years. These fields correspond to different approaches to the notion of information, from the perspective of mathematics, computer science and philosophy. By encoding information onto quantum systems the purely quantum correlations given by non-locality have been shown to be useful for many tasks where classical correlations would fail, for example in communication complexity, device independent security, multiparty computation and random number generation. Indeed influence now goes both ways as quantum information has become a powerful method for investigating the foundations of quantum mechanics, allowing us to understand quantum features in a meaningful and tangible way.

Following the workshop, LARSIM will foster new collaboration with University College London (Jonathan Oppenheim) and the University of Vienna (Caslav Brukner, **Fabio Costa**).

Highlight 2 in Foundations of physics

Renormalized entropy of entanglement in relativistic field theory

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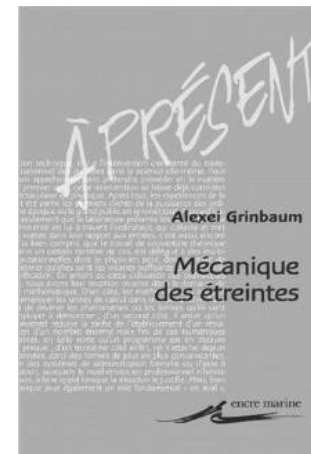
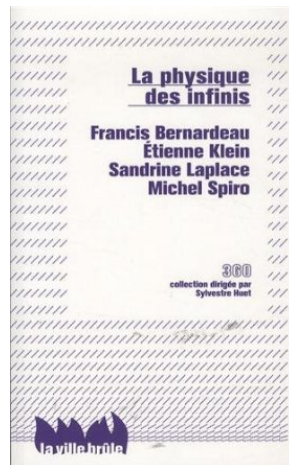
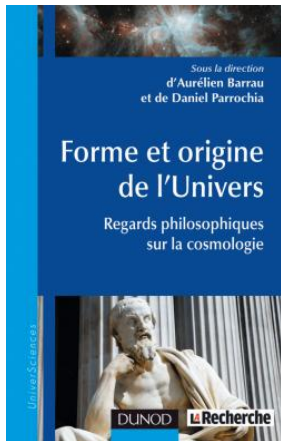
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Entanglement is defined between subsystems of a quantum system, and at fixed time two regions of space can be viewed as two subsystems of a relativistic quantum field. The entropy of entanglement between such subsystems is ill-defined unless an ultraviolet cutoff is introduced, but it still diverges in the continuum limit. This behavior is generic for arbitrary finite-energy states, hence a conceptual tension with the finite entanglement entropy typical of nonrelativistic quantum systems. We introduce a novel approach to explain the transition from infinite to finite entanglement, based on coarse graining the spatial resolution of the detectors measuring the field state. We show that states with a finite number of particles become localized, allowing an identification between a region of space and the nonrelativistic degrees of freedom of the particles therein contained, and that the renormalized entropy of finite-energy states reduces to the entanglement entropy of nonrelativistic quantum mechanics.

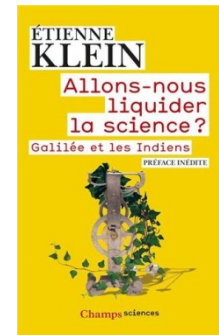
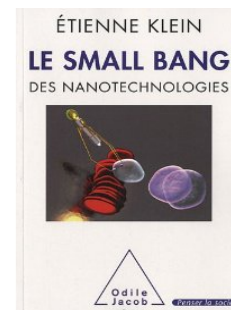
Some books of LARSIM around the foundations of physics

FoundPhys publications include academic research articles in top-ranked-peer-reviewed journals (two discussions in Nature) but also popularization articles and several books to reach out the general public.



The missions of LARSIM (2)

- *2) To achieve a better understanding of the issues raised by the DSM's research activities, especially in cases when they lead to misunderstanding or public anxiety (a good example is nanosciences).*
- We try to analyze the intellectual arguments that are used in the debates and controversies about new technologies, specially about nanotechnologies. This led the LARSIM to be the French coordinator of a European project, called “Observatory-nanos”, which aims to deal with the ethical questions raised by the development of nanotechnologies. We published several specialized “toolkits” for researchers and books for the general public.



- In the wake field of this activity, LARSIM was recently listed as a partner of the French National Forum for Synthetic Biology. It has developed a lasting collaboration on these questions with the group ETHOS of the University of Lausanne.

Highlight 1

- *Recherche et innovation : vers une éthique de la responsabilité*, Université de Lausanne, 4 et 5 octobre 2012.



The poster features a central image of a tightrope walker balancing on a thin wire against a white background. The text is arranged in a structured layout with a purple vertical bar on the left side.

[Recherche et innovation]
 vers une éthique de la responsabilité

Un événement ETHOS (Unil) / LARSIM (CEA) / ENSTA ParisTech

LE JEUDI 24 JANVIER 2013
 de 14h30 à 18h
 À L'ENSTA PARISTECH

CONFÉRENCES de
 > Etienne KLEIN
 physicien au CEA
 > Dominique BOURG
 philosophe à l'Unil

TABLE RONDE
 avec les membres du Collège « ETHOS/LARSIM »,
 animée par les élèves de AGROPARISTECH, CENTRALE PARIS,
 ÉCOLE POLYTECHNIQUE, ENSTA PARISTECH.

ENSTA PARISTECH
 828, boulevard des Maréchaux / 91120 Palaiseau
 inscription obligatoire / Contact : 01 87 19 03 / evenement@ensta-paristech.fr

Logos for ENSTA, Unil, and cea are located at the bottom left of the poster.

Highlight 3 : innovation

Innovation is on the agenda of every research policy. To take but one example, the European Commission set the objective in 2010 of developing an “Innovation Union” by 2020. This “Europe 2020” strategy follows the “Lisbon strategy” promoted in 2000 with the aim of making the European Union the “leading knowledge-based economy”. The word “innovation”, as omnipresent as it may be in that document (there are more than 300 occurrences of the word on less than 50 pages), is not defined anywhere. Its meaning is taken for granted and evident.

It is this obvious fact that we wished to question: what does the word innovation stand for ?

**WHAT DOES INNOVATION STAND FOR? REVIEW OF A
WATCHWORD IN RESEARCH POLICIES**

Vincent Bontems

**De Boeck Supérieur | *Journal of Innovation Economics &
Management***

2014/3 - n°15

pages 39 à 57

The missions of LARSIM (3)

- **3) *Didactics of science***
- We wish to install on the Saclay campus a much stronger activity between the hard sciences and other sciences, specially by collaborating with the engineering schools that are already present on the Plateau (Polytechnique, ENSTA) and also with the ones that will soon arrive (Centrale, ENS-Cachan).
- We already participate to different Masters programs, notably the Master LOPHISS of Paris 7, and in several “Grandes Ecoles”. We have also initiated a permanent education program (five days in residence) at the INSTN, called “questions de Sciences”, that has already trained 320 CEA staff.
- More widely, we write books, articles, and give many conferences to various audiences in order to reach the general public.
- Projects of MOOCs, whose aim is to explain to non-scientists the contents and the implications of the physical revolutions that occurred during the XX^e century.