Special seminar of the

RESEARCH CENTER FOR THEORY AND HISTORY OF SCIENCE

with

Paolo Bussotti & Raffaele Pisano

26th November 2012
Sedláčkova 19, 306 14 Pilsen
Room RJ-209

Full schedule

13:30 PAOLO BUSSOTTI:
The Method of the Infinite Descent
and its Applications in Number Theory

14:30 RAFFAELE PISANO:
On Electromagnetic Theory. Faraday and Maxwell
between Physics and Physics Mathematics

Výzkumné centrum pro teorii a dějiny vědy – CZ.1.07/2.3.00/20.0138

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OP Vzdělávání pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

THE METHOD OF THE INFINITE DESCENT AND ITS APPLICATIONS IN NUMBER THEORY

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The method of the infinite descent is used in number theory. This method has a long history because it was used – likely for the first time – by Euclid to prove that every composite number has a prime number as a divisor (*Elements*, VII, 31). Nevertheless, as a matter of fact, Fermat was the first who fully understood the potential of the infinite descent, he applied the method to difficult problems in number theory, so that he can be considered the inventor, or at least, a second discoverer of the infinite descent.

The descent is a method based on the *reduction ad absurdum*. It works like this: if we consider an integer *n*, there are only *n*-1 integers between *n* and 0. Suppose we have to prove the theorem **T**, and let us pose – *ad absurdum* hypothesis – that ¬**T** is true, but, if through a series of reasoning we are able to prove that ¬**T** implies that an infinite quantity of integers (an infinite descent), should exist between 0 and *n*-1, this is absurd, hence ¬**T** is false and therefore **T** is true.

Fermat applied this method to the problems of binary quadratic forms (the first theorem of this kind is that every prime of the form 4*n*+1 is the sum of two squares). Fermat left almost no demonstrations. Euler and Lagrange reconstructed Fermat's method and proved many of the theorems Fermat claimed he proved by descent. Obviously they made the field of number theory wider. After these great mathematicians, Gauss used the method, as well. It is used nowadays, too.

In my conference, I will expose the logical bases of this method and of its numerous variants. As to the historical-mathematical point of view, I will deal with the theorems of the "heroic age" of number theory demonstrated by descent, hence I will concentrate on Fermat, Euler, Lagrange, Gauss. I also will deal a logical comparison between indefinite descent and mathematical induction

ON ELECTROMAGNETIC THEORY. FARADAY AND MAXWELL BETWEEN PHYSICS AND PHYSICS MATHEMATICS

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Historical epistemology of science is one of the possible approaches to understanding the history of the foundations of science combining historical/epistemological aspects (primary sources, historical hypothesis, shared knowledge, epistemological interpretations) using logical and mathematical inquire. By following this historical–methodological standpoint, *what are physics and mathematical objects in a theory?* Generally speaking focusing on *mathematical and physical quantities* within experiments, modeling, properties, existences, and structures one can see some theories where physics and mathematics work in a unique discipline: *physics mathematics* (or *mathematics physics*). It is not a mathematical application of physics or vice–versa, but rather it a *new* way to work with science. New methodological approach to solve physical (in origin) problems where the quantities may be physical and mathematical at the same time (first novelty), measurements are not a priority or a prerogative (second novelty) to make a coherent physical science. It is a structured discipline on *relationships of thought* among *mathematical quantities* and *physical structures* (including logic and language) in order to "[...] reducing [experimental electric and magnetic] phenomena into scientific form [...]" (Maxwell 1865, p. 459). It has its own hypotheses, methods of proofs, internal coherent logic, where a change of mathematics produce a change in both significant physical processes and interpretations of *physical quantities.* Some theories became mechanical/rational/analytical, where principles *ne présuppose aucune loi* [object] *physique* and experimental studies were not in attendance. E.g.: *Traité de Mécanique céleste* (1805) by Laplace, analytical approach without considering nature of heat/experiments (1807; 1822) by Fourier, Ampère showed that a mathematical approach (1820; 1828) basing on previous Ørsted's experiments (1820) where new and not mathematical interaction, outside of mechanical foundations, can be observed. Nevertheless, the lacks of *mathematical objects* in Sadi Carnot's theory (1824) and in Faraday's *Experimental Researches in Electricity* (1839–1855) were emblematical expectations. Faraday without formulas introduced the basis for the concepts of field and vectors in electromagnetic induction theory. Differently, in late (electrothermal and) electromagnetic theory an advanced use of mathematics was presented (1864–1873) by Maxwell and mechanically (*vortex*) explain Faraday's phenomena.

In my talk, by following Maxwell's physics mathematics, reflections concerning physical and mathematical objects differently used by Faraday and Maxwell in their theories would be discussed.

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