

# Physicists' conceptions about the nature of theoretical physics

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**Abstract.** Scientists' conceptions of their discipline give interesting insights in authentic scientific practice. The existing studies about scientists' view of nature of science are rare. Schwartz & Ledermann (2008) were not able to identify clear differences between the conceptions from scientists from several disciplines. Only the ones from theoretical physicists differ from the ones from other scientists. The aim of the current study is the reconstruction of conceptions from researchers in the field of physics about the nature of physics. Here the comparison between experimentally and theoretically working physicists is particularly interesting.

## 1 University lecturers' conceptions about the nature of physics

In contrast to studies that examine conceptions about the nature of science (NOS) of students or teachers at school there is a lack of investigation that focuses on conceptions of scientists and university lecturers. Their beliefs are important as well, because also within the courses at university the lecturer can influence his or her students' conceptions.

Often scientist have only a naïve or informed but rarely a sophisticated understanding about the NOS [1]. Most of the scientists emphasize the empirical base of scientific knowledge and ignore the possibility to gain findings just with theoretical-mathematical methods. It is nearly impossible to see any clear differences between the disciplines (e.g. biology, chemistry, physics) and corresponding research approach (e.g. experimental, theoretical). Only the theoretical physicists differ from the other scientists [2].

In the context of teacher education at university it seemed to be fruitful to analyse the views of involved lecturers and to look for differences between the scientists in detail and focus more on domain specific characteristics – in this case the distinction between experimental and theoretical work in physics. Several authors claim to consider the differences among the scientific disciplines more and explore views about nature of physics/biology/chemistry [3,4].

## 2 Research questions

The research aim is the reconstruction of conceptions of researchers in the field of physics about the nature of theoretical physics. In the end these conceptions are compared with the ones from students at university and will be evaluated. The main research questions are:

- a. What conceptions do university lecturer in physics and physics education have about theoretical physics?
- b. Which differences between experimental physicists, theoretical physicists and physics education researchers can be identified?

In this contribution I want to focus on two aspects: the methods of theoretical physicists (e.g. role of models and simplification) and views on the interplay between experiment and theory.

## 3 Methods

For answering these research questions, an explorative-qualitative study was conducted. An open questionnaire was presented to three different groups of university lecturers: experimental physicists, theoretical physicists and physics education experts (N=17). The respondents had to write a guided essay about the question: "What is theoretical physics?" and they should, for

example, consider aspects like the interplay between theory and experiment, the mode of working and thinking in theoretical physics or the role of mathematics. For the analysis of the data the qualitative content analysis was used.

## 4 Results

In this abstract we only present a selected example of the different aspects addressed in the essay and focus on the way how theoretical physicists work and think. It was possible to distinguish in which way the respondent describes the role of simplification (idealization and approximation) and which aspects were mentioned about the mode of working and thinking. All respondents were located in the following attribute space.

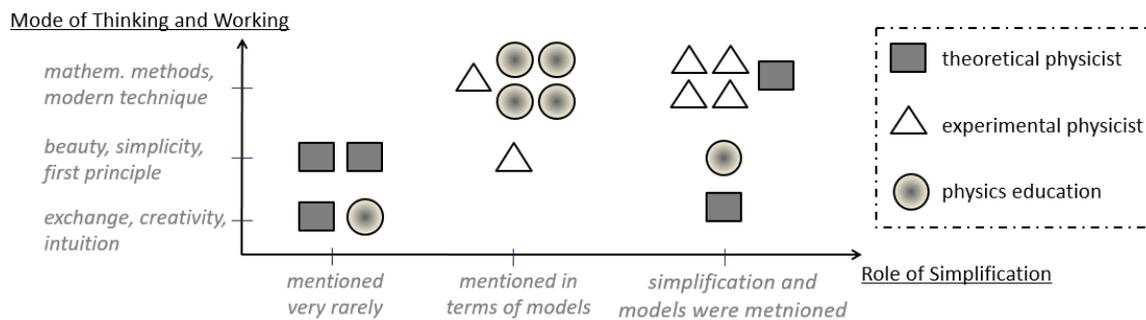


Fig. 1 Attribute space for the mode of thinking and working and the role of simplification

In Fig. 1 it can be seen, that experimental physicists and physics education experts emphasize mainly the work with mathematical methods. Theoretical physicists underline also aspects like elegance and beauty of theories or the role of creativity and intuition.

The conceptions about the interplay between experiment and theory differ also a lot between the three different groups. These results will be presented in the talk.

## 5 Discussion and Implications

From the essay it can be inferred that scientists' conceptions about the nature of theoretical physics are shaped by their daily work, main research fields and differentiate between experimental physicists, theoretical physicists and physics education experts. For students at university it could be very interesting to read the essays and get an insight in the conceptions of physicists about their own work. This authentic insight into physics research would be very important because many students whose conceptions were also investigated criticize that they do not know a lot about the theoretical-mathematical work in physics although it plays a central role in physics teacher education in Germany.

## References

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