

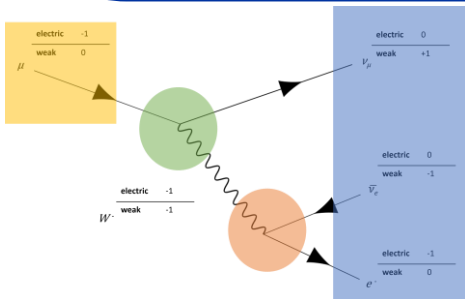
Research-based instruction design for Feynman diagrams

Motivation and Context

- Feynman diagrams (FD) as one of the most popular **forms of representation in particle physics**
- Long lasting **debate about its usage in physics education** (Passon et al., 2018)
- **Research-based instruction design** for a component as a MOOC on particle physics (currently under development at CERN)

Theoretical Background

- FD example for **representation dilemma** (Rau, 2017)
- **Social Semiotics** (cf. Airey & Lindner, 2017): disciplinary vs. pedagogical affordance
- Representations with high disciplinary affordance need „**unpacking**“ (Fredlund et al., 2014)
- **Eye Tracking** as tool to inform instruction design (Jarodzka et al., 2017)
- **Model of educational reconstruction** (Duit et al., 2012): educational use vs. possible challenges



An example for an “unpacked” FD

Expert Interviews

FF1) Which opportunities for physics education on high school level is connected to Feynman diagrams according to experts?

FF2) Which challenges are connected to teaching Feynman diagrams to high school students?

First results Expert Interviews

Opportunities

- Motivation of interaction particles
- Motivation of conservation laws
- Motivation of quantum mechanical concepts
- Motivation of computation tools

Challenges

- Real particle exchange
- Space-time embedding
- Superficial view on particle physics
- Takes away lesson time from quantum mechanics

Students

Eye Tracking Study

FF1) How is the visual attention of students distribute when reading Feynman diagrams to learn about conservation laws and interaction particles?

FF2) Which elements make a Feynman diagram more accessible for students?

Expert Eye Tracking Study

FF1) How is the visual attention of experts examine Feynman diagrams compared to novices?

FF2) Which visual chunks do experts deconstruct Feynman diagrams in mentally?

Research-based Assessment-Instrument for Particle Physics

- Evaluation of the MOOC
- Based on expert interviews: concepts in particle physics which are connected to teaching of FD

Research-based Instruction Design

- Based on model of educational reconstruction
- Informed by interviews and eye tracking studies
- Test of effectiveness with high school students at CERN

What do you think about instruction design for Feynman diagrams?

10/20

04/21

09/21

01/22

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12/22