

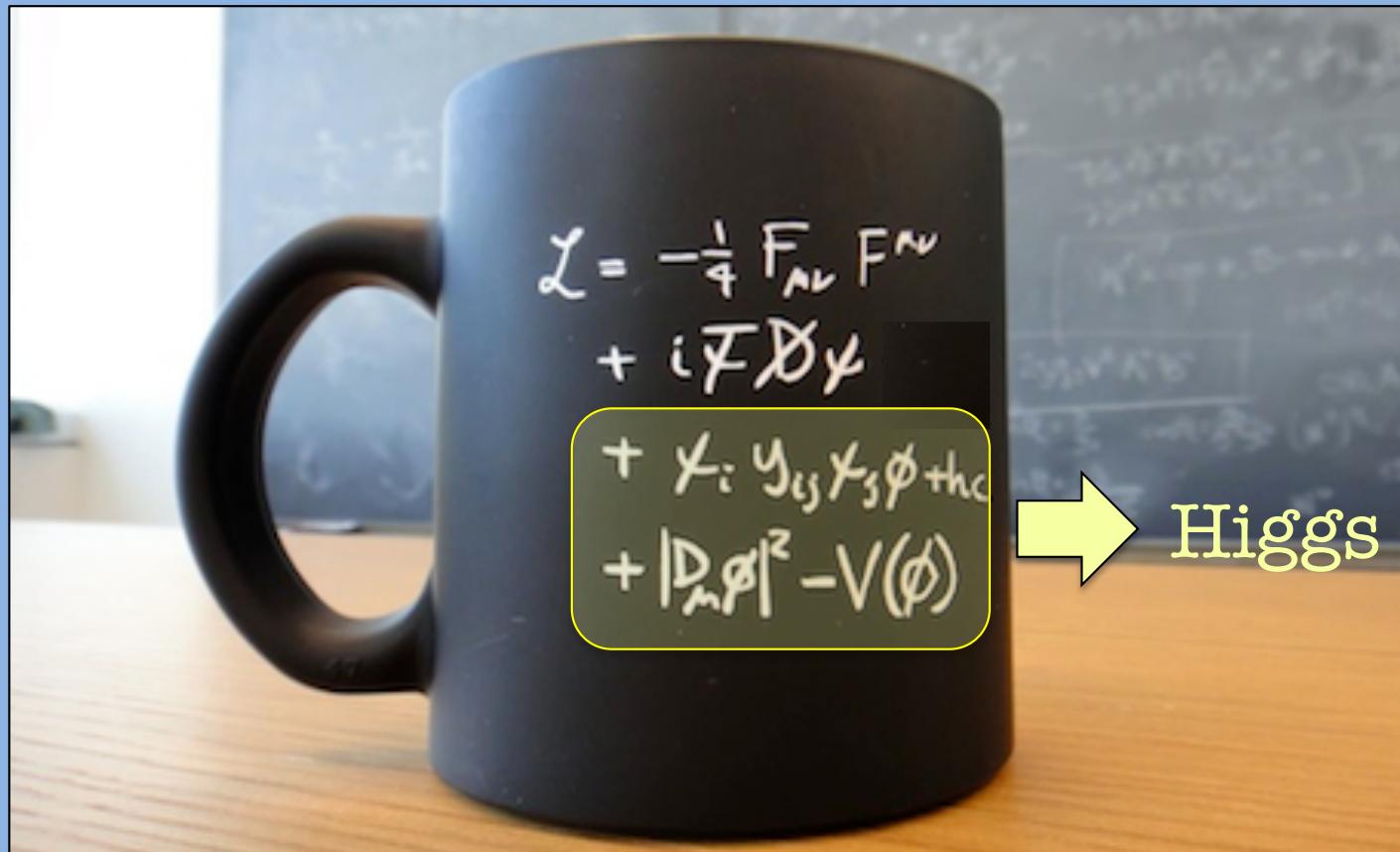


# Topical lectures on Higgs physics

Nikhef, 17-19 June 2020

Stan Bentvelsen, Wouter Verkerke & Ivo van Vulpen

# Standard Model



For the gravitational waves community:

No Higgs → no neutron stars / BH's → no gravitational waves 😊

## Links to new physics

- portal to dark matter
- multiple Higgs bosons (SUSY)
- couplings (structure)

## Massive gauge bosons

- short range weak force
- mixing  $U(1)_Y \times SU(2)_L$   
photon remains massless  
and couples to  $Q = I_3 + \frac{1}{2}Y$

## Higgs boson

### Massive fermions

- massive fermions
- mixing mass and EW eigenstates  $\rightarrow V_{CKM}$
- *Neutrino masses*
- *Mass hierarchy itself*
- *Matter anti-matter asymm.*  
*EW phase transition?*

### Experimental

- Detailed experimental program
- Interpretation framework (EFT)
  - *2<sup>nd</sup> generation*
  - *Higgs potential (self-coupling)*
  - *Future accelerators*

### Problems

- *hierarchy problem*
- *vacuum energy contribution*



Solange Schrijnder  
van Velzen

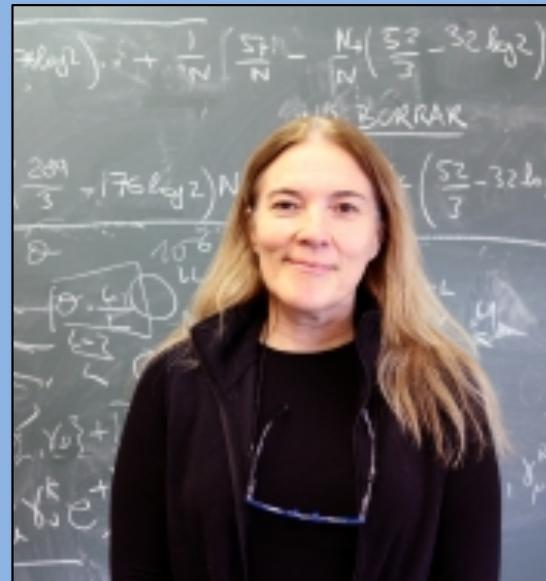


Frank Filthaut

Melissa van Beekveld

# Topical lectures on Higgs physics

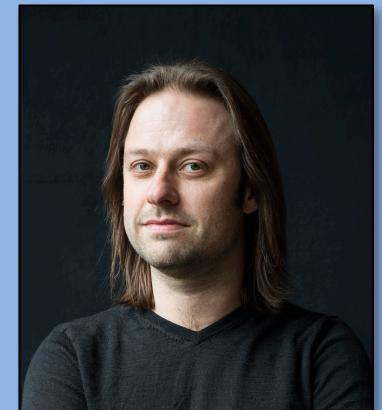
<https://indico.nikhef.nl/event/2143/>



Pilar Hernández



Avanish Basdew-Sharma



Tristan du Pree



Wouter Verkerke

## Topical Lectures "Higgs Physics"

from Wednesday, 17 June 2020 at **09:30** to Friday, 19 June 2020 at **18:00** (Europe/Amsterdam)  
at Nikhef ( Online )

Manage ▾

Go to day ▾

### Wednesday, 17 June 2020

- 10:00 - 10:30 Short introduction to SM Higgs  
Conveners: Ivo van Vulpen, Stan Bentvelsen
- 10:30 - 11:00 Break
- 11:00 - 12:30 Theory students helping other students - basics concepts of SM Higgs  
Conveners: Solange Schrijnder van Velzen, Mr. Avanish Basdew-Sharma (Nikhef)
- 12:30 - 14:00 Break
- 14:00 - 15:00 Higgs - experimental status overview  
Convener: Frank Filthaut
- 15:00 - 16:00 Student projects - kickoff
- 16:00 - 16:30 Question time in Zoom 30'
- 16:30 - 17:00 Student projects 30'

project

### Thursday, 18 June 2020

- 09:30 - 10:15 Invited Lecture of 'Higgs in Perspective'  
Convener: Pilar Hernandez
- 10:15 - 10:30 Break
- 10:30 - 11:15 Future Higgs measurement frameworks ('EFTs')  
Convener: Wouter Verkerke (Nikhef)
- 11:15 - 11:30 Break
- 11:30 - 12:15 Future accelerators - with focus on Higgs physics  
Convener: Tristan du Pree
- 12:15 - 14:00 Break
- 14:00 - 16:00 Student projects
- 16:00 - 16:30 Question time in Zoom 30'
- 16:30 - 17:00 Student projects 30'

project

### Friday, 19 June 2020

- 09:30 - 10:15 Invited Lecture of 'Higgs in Perspective'  
Convener: Pilar Hernandez
- 10:15 - 10:30 Break
- 10:30 - 11:15 Invited Lecture of 'Higgs in Perspective'  
Convener: Pilar Hernandez
- 11:15 - 11:30 Break
- 11:30 - 12:15 Lecture on fine tuning  
Convener: Melissa van Beekveld
- 12:15 - 14:00 Break
- 14:00 - 15:30 Student project presentations
- 15:30 - 16:30 Evaluation and closeout

project

Basic theory introduction  
*Solange & Avanish*

Experimental status overview  
*Frank Filthaut*

Pilar lecture (I) – SM  
*Pilar Hernández*

Higgs meas. frameworks (EFT)  
*Wouter Verkerke*

Future accelerators  
*Tristan du Pree*

Pilar lecture (II and III) - BSM  
*Pilar Hernández*

Higgs & fine-tuning  
*Melissa van Beekveld*

# Student projects

- Investigate in more detail a future accelerator (technology) and study potential for a specific Higgs measurement
- 2 x 2 hours per group on Wed & Thu
- Each group makes a short (10 min) presentation on Friday. Facility, theory and few plots/numbers

*Document with projects be circulated today*

project group 1	
1	Puecher, Anna
2	Aggarwal, Anamika
3	Moser, Brian
4	Eeden, Thijs van
5	Butter, Jordy
6	Snoch, Aleksandra

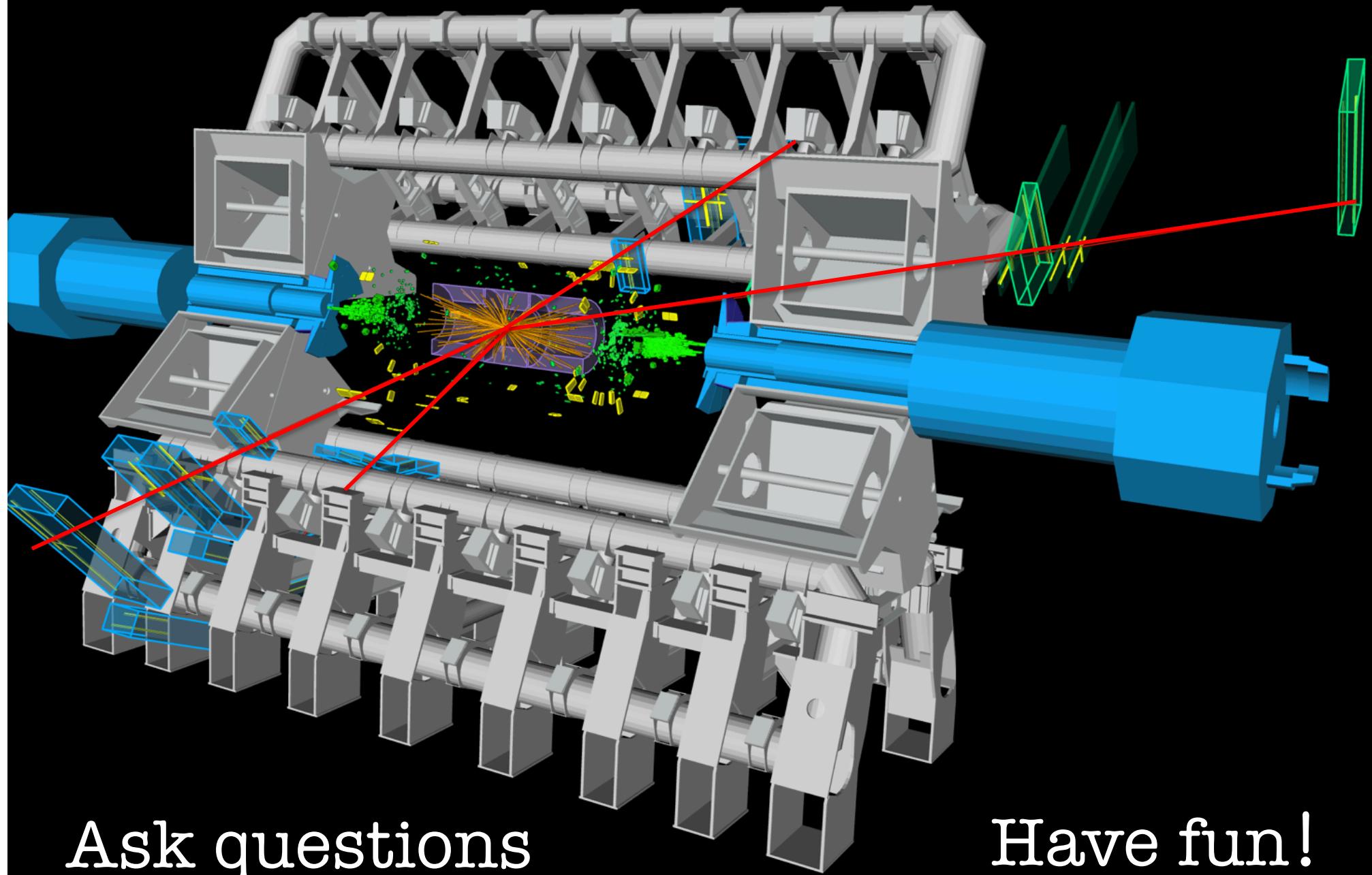
project group 2	
1	Walet, Rob
2	Alfonsi, Alice
3	Moskvitina, Polina
4	Jung, Bouke
5	Doremalen, Lennart van
6	

project group 3	
1	Muller, Rasa
2	Balasubramanian, Rahul
3	Federica Pasquali
4	Féo, Mauricio
5	Geertsema, Robbert
6	Stylianidis, Christos

project group 4	
1	Brían Ó Fearraigh
2	Degens, Jordy
3	Pizzini, Alessio
4	Ferrerres, Sylvia
5	Veen, Michiel
6	

project group 5	
1	Gaemers, Peter
2	Kortman, Bryan
3	Seneca, Jordan
4	Greeven, Lex
5	Qiu, Shi
6	

project group 6	
1	Lukashenko, Valeriia
2	McDougall, Ashley
3	Pothast, Mart
4	Vermunt, Luuk
5	Stamenkovic, Marko
6	



Ask questions

Have fun!