

 faculty of science and engineering van swinderen institute for particle physics and gravity

"Follow the money"

WHAT ON EARTH AM I DOING IN HERE ON THIS BEAUTIFUL DAY?" THIS IS THE ONLY LIFE IVE GOT!"

Rob Timmermans

UG Summer School @ Ameland

June 17, 2019



Imagine Isaac Newton having to compete for funding



"THE ROYAL ALADEMY OF SCIENCE IS WILLING TO PAY YOU FOR THIS APPLE TREE, IF YOU'LL SHARE WITH US ANY IDEAS YOU GET FROM IT."



- ✓ But this is 2019, not 1665..., funding is finite and in the small hands of...
 - Ultimately, it is taxpayers money!

International Journal of Modern Physics A, Vol. 16, No. 17 (2001) 2895–2908 © World Scientific Publishing Company

CAN THERE BE PHYSICS WITHOUT EXPERIMENTS? CHALLENGES AND PITFALLS*

GERARD 'T HOOFT

Institute for Theoretical Physics, University of Utrecht, Princetonplein 5, 3584 CC Utrecht, The Netherlands

and

Spinoza Institute, Postbox 80.195, 3508 TD Utrecht, The Netherlands E-mail: g.thooft@phys.uu.nl http://www.phys.uu.nl/~thooft/

Received 14 June 2001

Summary

Physicists investigating space, time and matter at the Planck scale will probably have to work with much less guidance from experimental input than has ever happened before in the history of physics. This may imply that we should insist on much higher demands of logical and mathematical rigor than before. Working with long chains of arguments linking theories to experiment, we must be able to rely on logical precision when and where experimental checks cannot be provided.

Assignment: Spend M€ 250

- ✓ Groups of 6 students are asked to
 - Evaluate the discovery potential of "proposed" experiments
 - Rank the proposals
 - Draw the line at a budget total of M€ 250
- ✓ Motivate the ranking!
 - EFT motivation gives your brownie points
 - Creativity is encouraged (but not science fiction)









Some guidelines for defending/criticizing proposals

- ✓ What is the *scientific goal* of the proposal?
- ✓ How does it help to uncover the "new Standard Model" ?
- ✓ What is the *experimental concept* of the proposal?
- ✓ What are its *weak* and *strong* aspects?
- ✓ What makes the project *unique* & worth the *effort/*€?
- ✓ Can the same result be obtained by *other* projects?
- \checkmark Has the chosen technology proven to be *sound* ?
- ✓ What prevents a *clean* interpretation of the data?
- ✓ *Etc...*
- ✓ Which question would YOU like to see answered?



Original research

- ✓ Beyond "lamppost reasoning" (the streetlight/drunkard's search)
- ✓ Hypothesis-driven vs. "fishing expedition"
- ✓ No "old wine in new bottles"…



Detecting the ghost particle

- ✓ Wolfgang Pauli (1900–1958) postulated the neutrino in 1930
 - To save energy & angular-momentum conservation in beta decay
 - "I have done a terrible thing, I have postulated a particle that cannot be detected"



- ✓ 1951: A proposal to detect neutrinos from a nuclear explosion was approved, but ultimately not executed...
- ✓ The neutrino was detected in 1956 at the Savannah River reactor site

"I have the best people"





Following

For all of the money we are spending, NASA should NOT be talking about going to the Moon - We did that 50 years ago. They should be focused on the much bigger things we are doing, including Mars (of which the Moon is a part), Defense and Science!

7:38 PM - 7 Jun 2019

Some options AEGIS







1	LHC upgrade	M€ 200	http://home.cern
2	SNO+	M€ 150	http://snoplus.phy.queensu.ca
3	ALPHA	M€ 100	http://alpha.web.cern.ch
4	GERDA upgrade	M€ 100	http://www.mpi-hd.mpg.de/ge76
5	DUNE	M€ 75	http://www.dunescience.org
6	Muon g-2	M€ 75	http://muon-g-2.fnal.gov
7	AEGIS	M€ 50	http://aegis.web.cern.ch/aegis
8	KATRIN	M€ 50	https://www.katrin.kit.edu
9	Mu2e	M€ 25	http://mu2e.fnal.gov
10	Neutron EDM	M€ 25	https://www.psi.ch/nedm
11	nnbar@ESS	M€ 25	https://europeanspallationsource.se
12	Theory Institute	M€ 25	<i>Example:</i> http://www.ect.it

DUNE SNQ









€ @ Ameland

μ...

MU2e

e

The dream teams

Team 1 Parul Aggarwal Anne Cournol Paul Hofland Lukas Spiesz Ayaki Sunaga Anno Touwen

Team 2

Alexander Boeschoten

Malika Denis

Polina Feldmann

Pi Haase

Lukas Pasteka

Team 3 Marit Fiechter

Noah Fitch

Yongliang Hao

Mina Morshed

Tim Wolz

Yanning Yin

Team 4

Nikoleta Boziou

James Chow

Matthew Lawson

Ginny Marshall

Maarten Mooij

Maximilian Zawierucha

Team 5 Laura Blackburn

Julien Frank

Thomas Meijknecht

Wander van der Meer

Trevor Wright

Pauline Yzombard

For a bonus point: "Contact"

✓ Two civilizations communicate via unpolarized electromagnetic waves



✓ Can they agree on

- 1. the sign of electric charge, and
- 2. the definition of a right-handed screw?
- ✓ If yes, how? If no, why not?

On Friday

- ✓ Prepare a short presentation
 - 15 min. maximum
 - Give explicit ranking
 - And explicit instructions to aliens
 - Give motivation
 - Teamwork is important



✓ Get active: Where would YOU put your money for the next breakthrough?

