







ECFA Midterm Report The Netherlands

Sijbrand de Jong

Thanks to those who helped to prepare this report

Frank Linde, Nicolo de Groot, Marcel Merk, Gijs Nelemans, Arjen van Rijn, Jeff Templon, Jo van den Brand

Europe

-  International Boundary
-  River
-  National Capital
-  City or Town

0 250 500 KM
0 250 500 Miles

© 2007 Geology.com



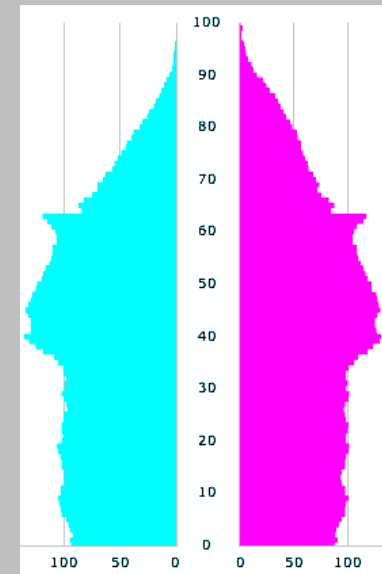
Netherlands

- International boundary
- - - Province boundary
- ★ National capital
- ⊙ Province capital
- +— Railroad
- Expressway
- Road

0 10 20 30 Kilometers
0 10 20 30 Miles



- July 2009:
16,716,000 inhabitants
- Life expectancy at birth: 80 years

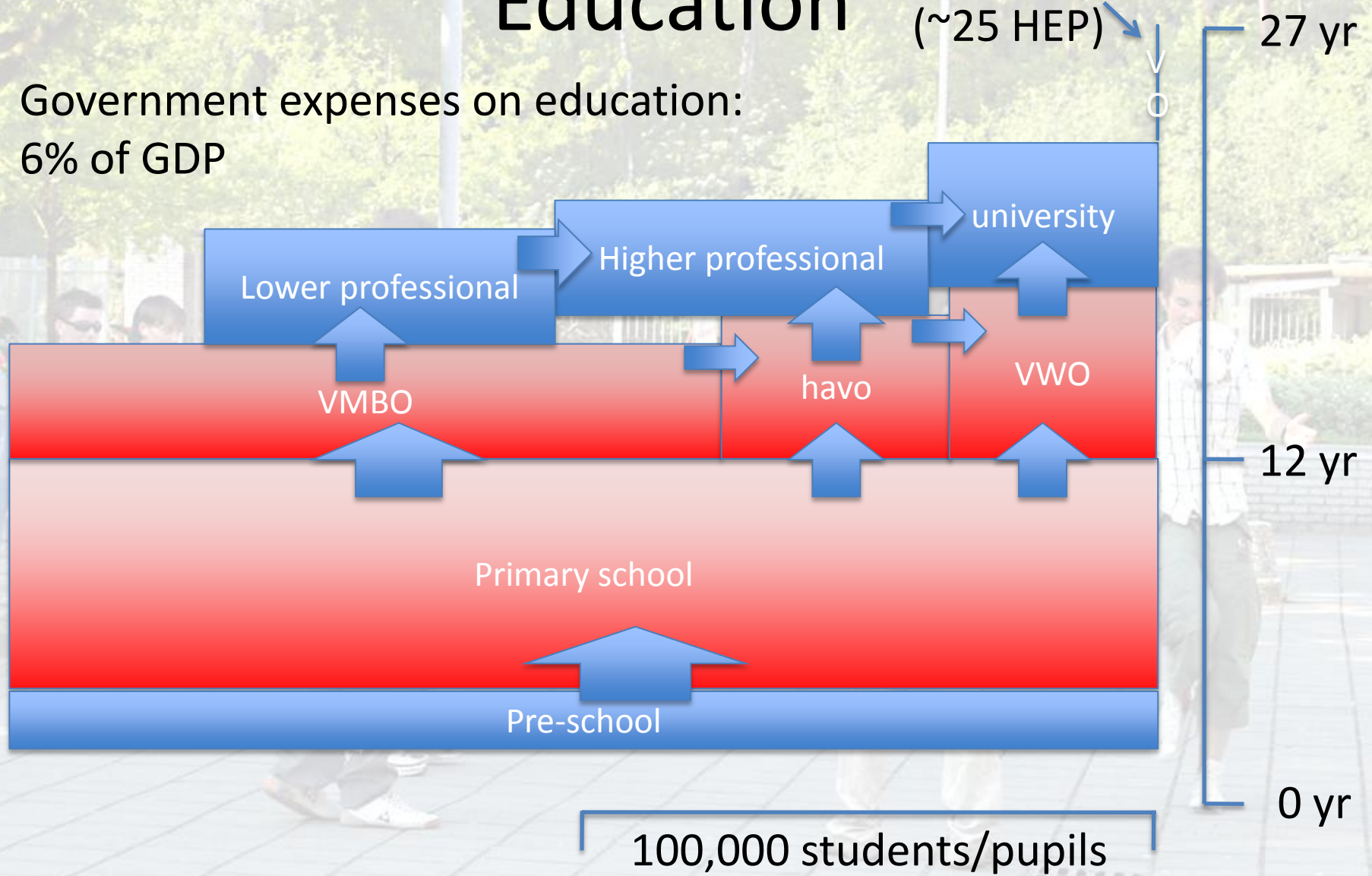


- GDP/capita: 39.2 k\$
(24% industry,
74% services)
- 6% unemployment

Education

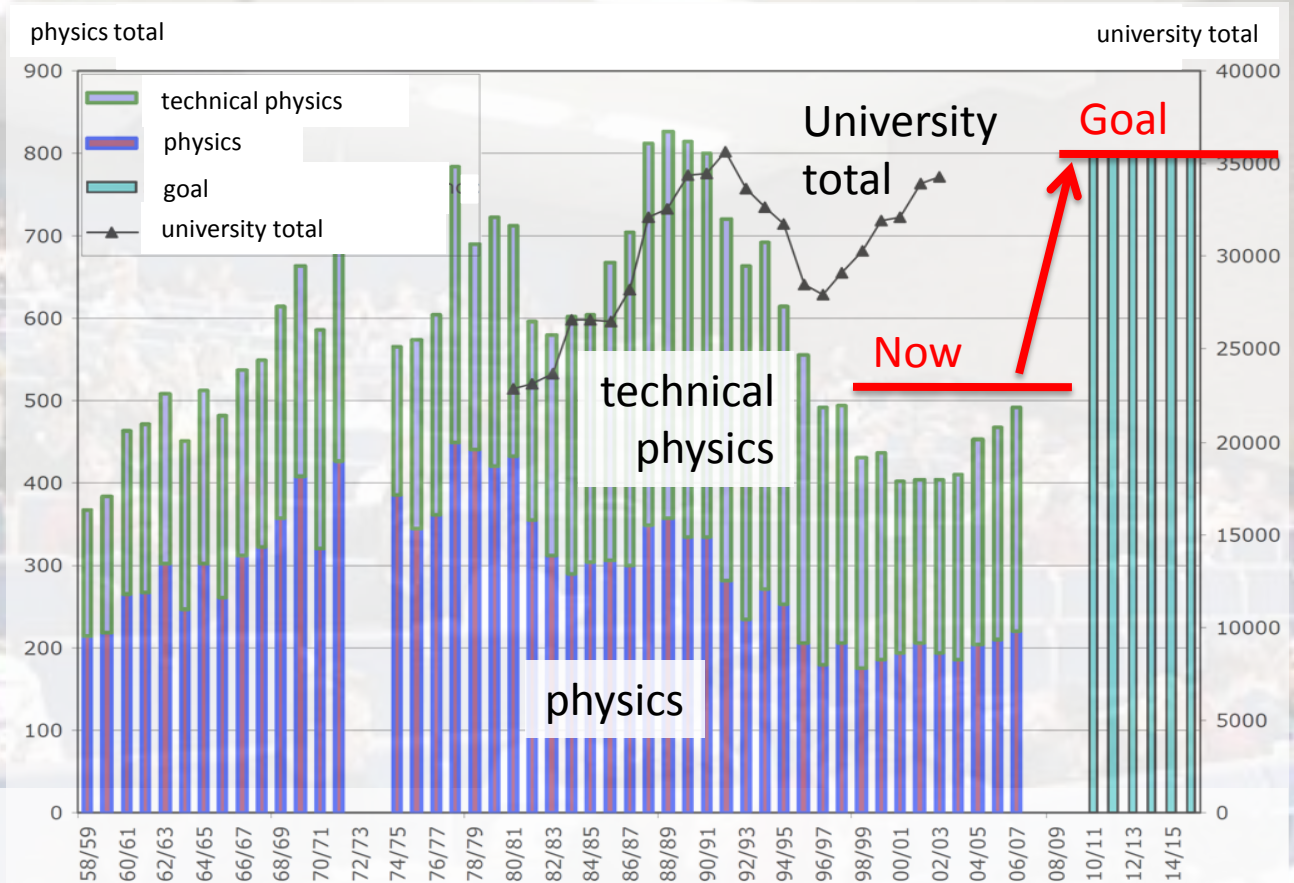
Government expenses on education:
6% of GDP

2800 PhD/yr
(~25 HEP)



(33% of working population has higher professional or higher education)

University Physics Education



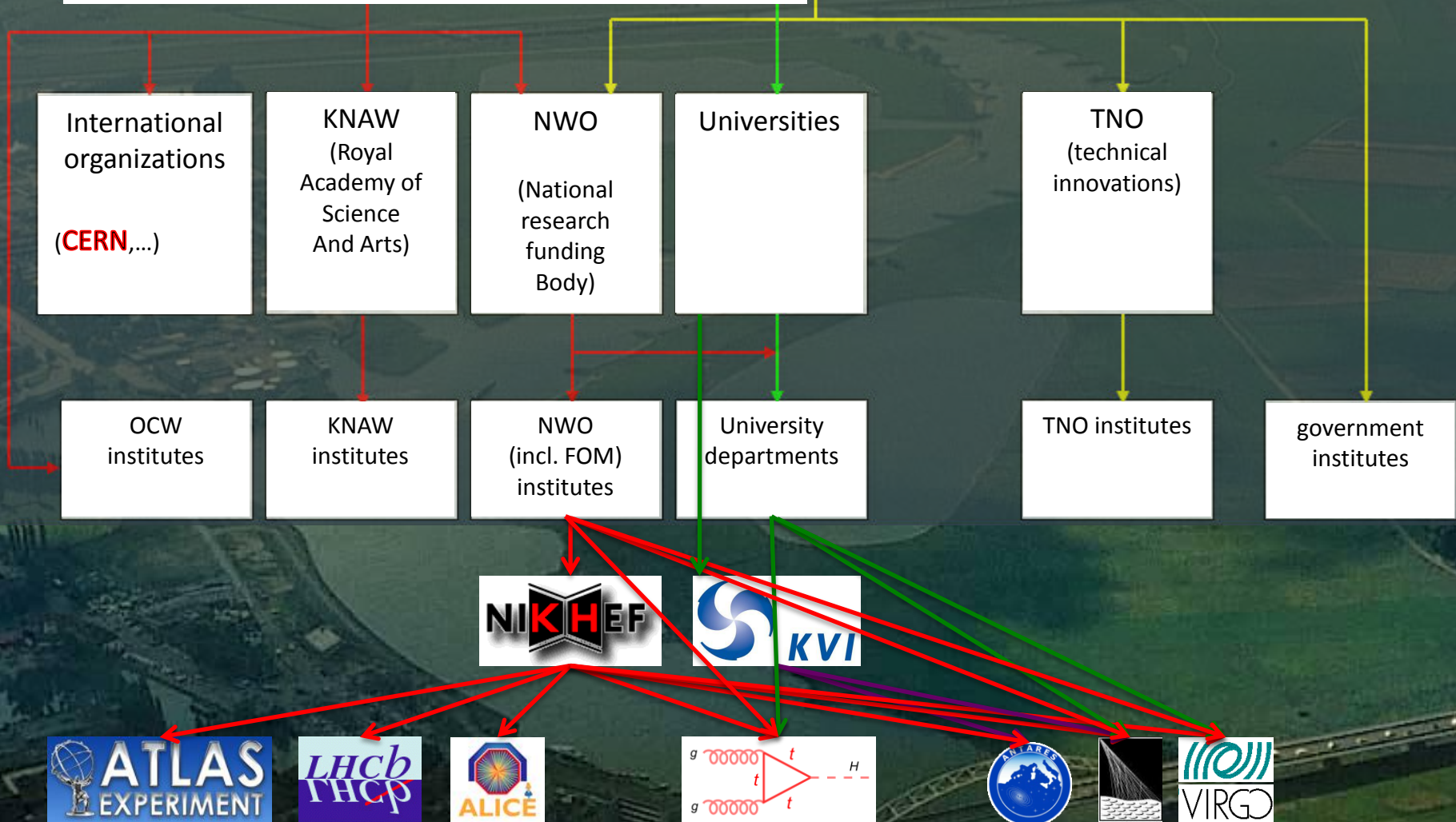
HEP community
focus on:

- increase # physics students: sectorplan physics and chemistry +10 M€/yr for university physics
- Limiting time for PhD to 4 years: 2002: 5.4yr --> 2004: 4.6yr

Dutch funding landscape

Ministry of Education, Culture and Science

Ministries of health, well-being and sport,
Agriculture, environment and fishing,
Economic affairs



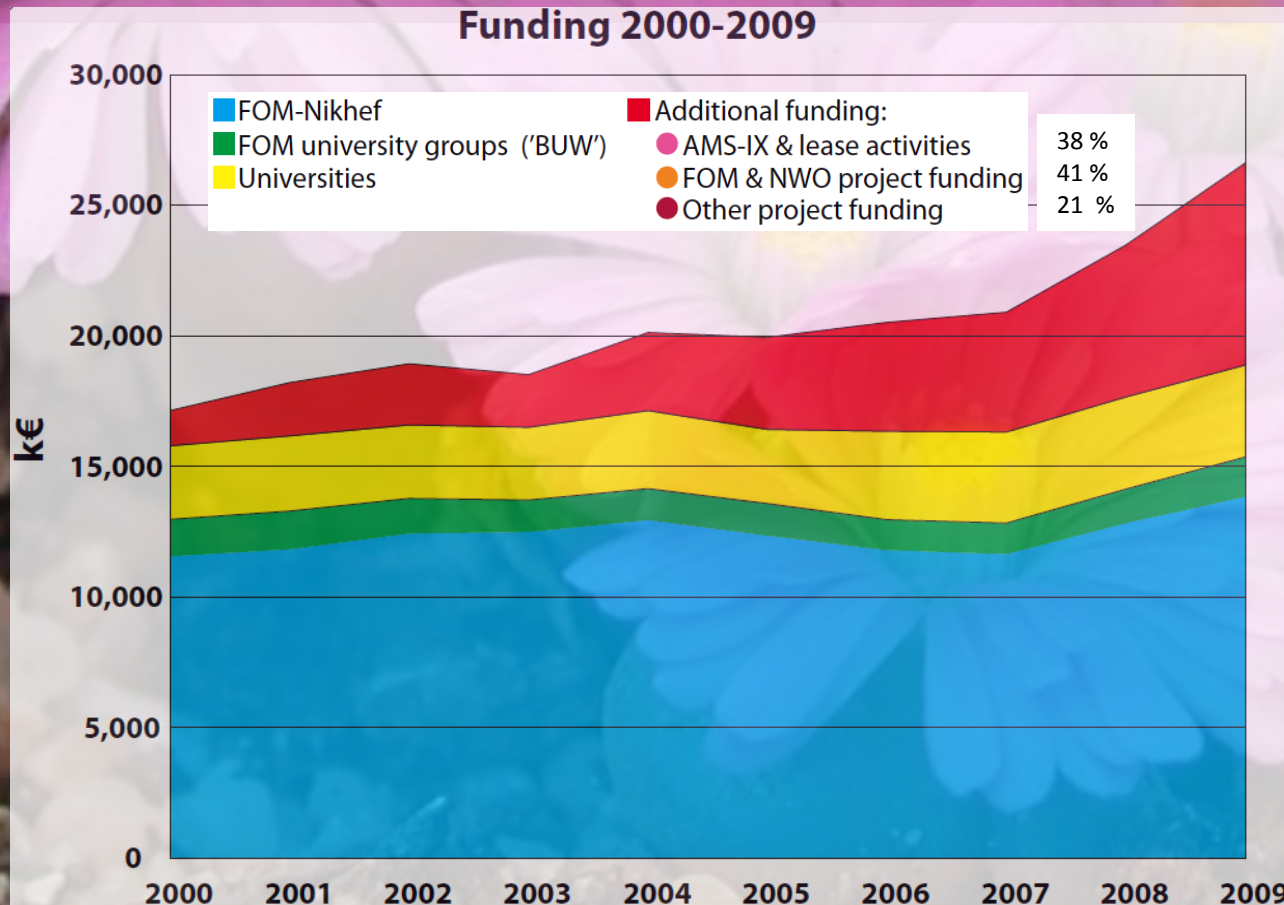
HEP funding

Competition based government research funding, NWO 2010: M€ 600

Competition based physics funding, FOM 2009: M€ 91

Particle Physics funding, Nikhef 2009: M€ 26.6

(CERN contribution 2009: M€ 34.7)



R&D investment

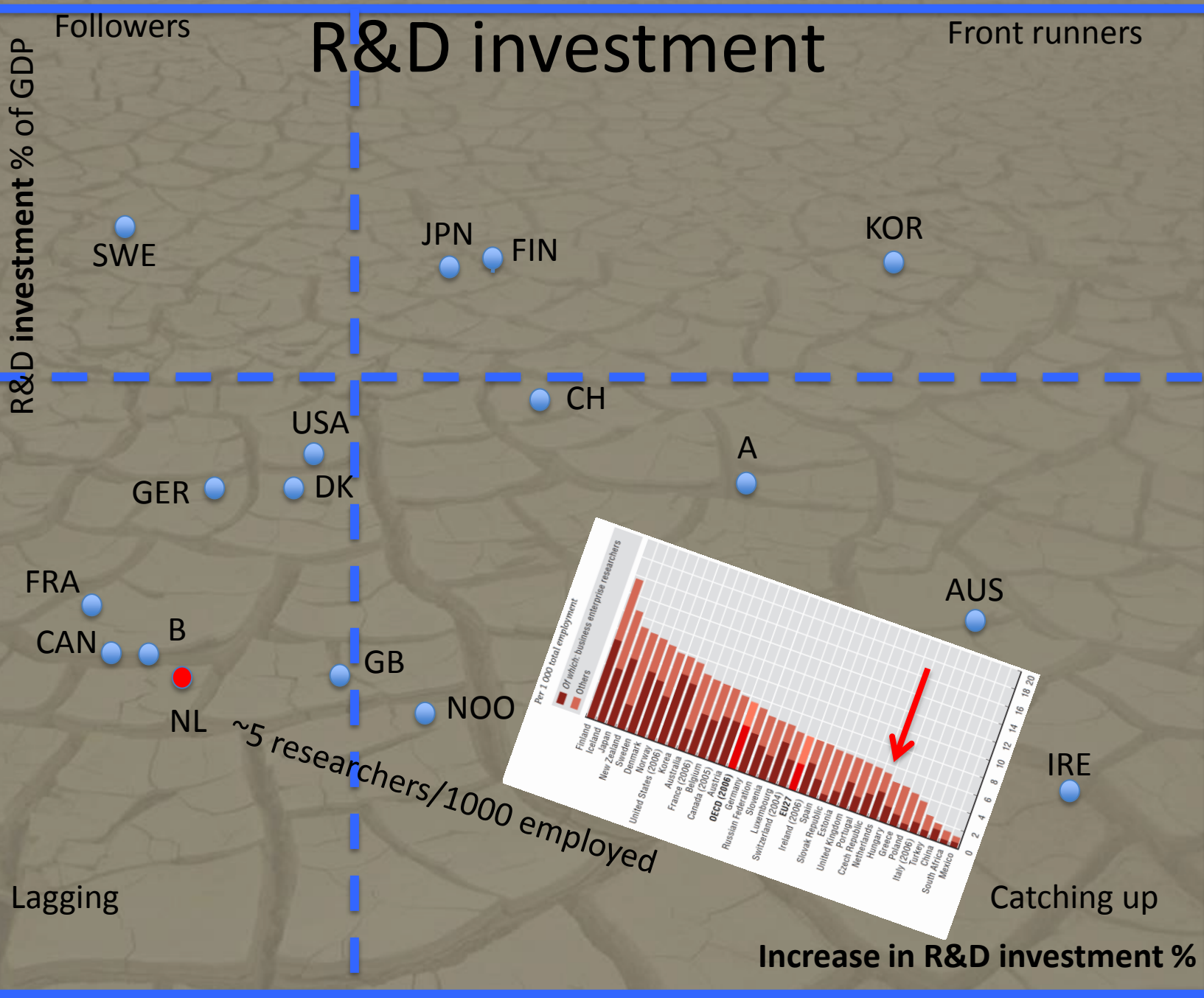
Followers

Front runners

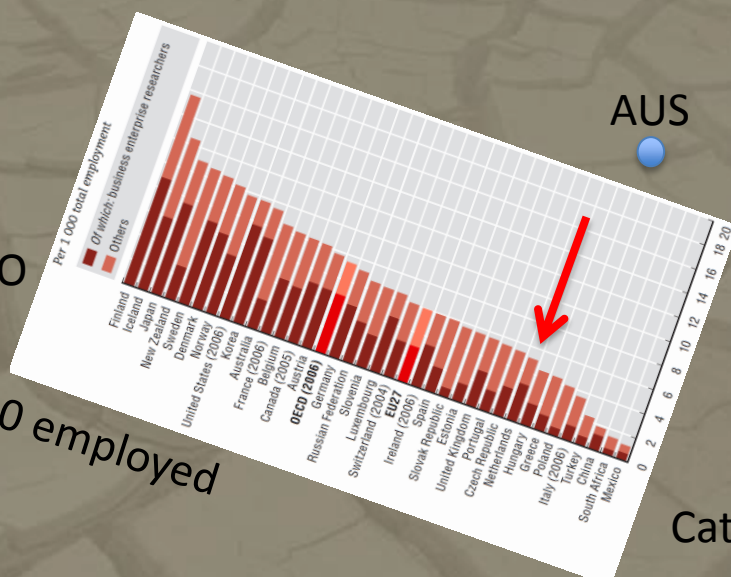
R&D investment % of GDP

Lagging

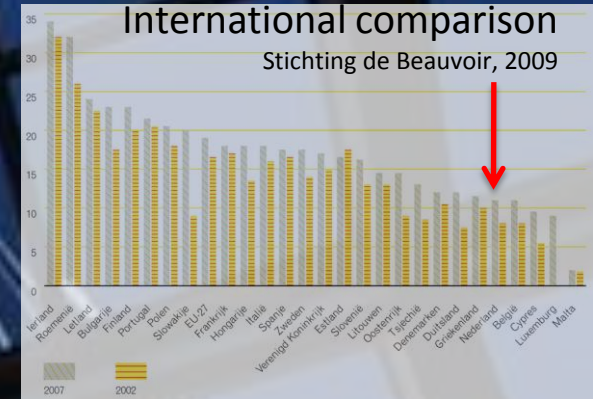
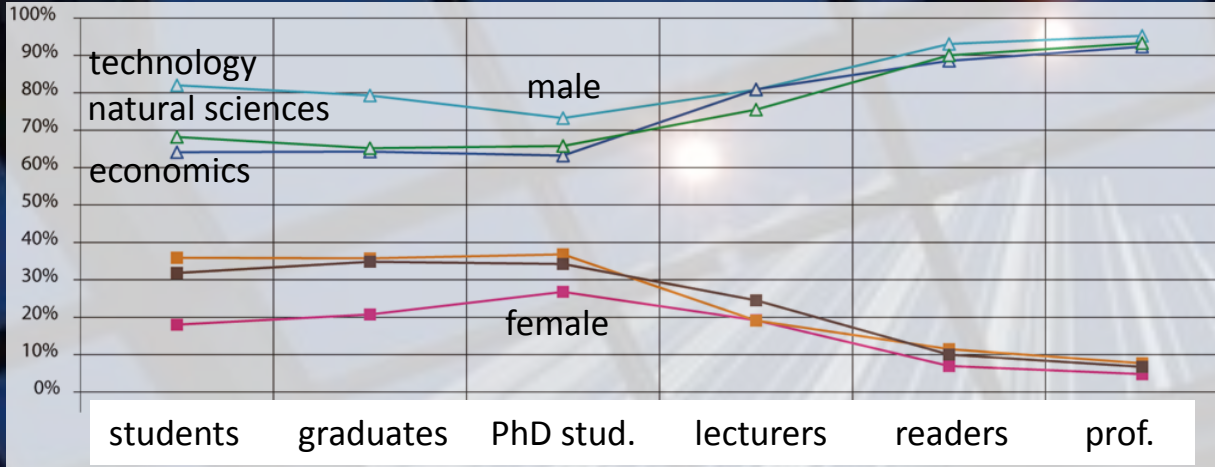
Increase in R&D investment %



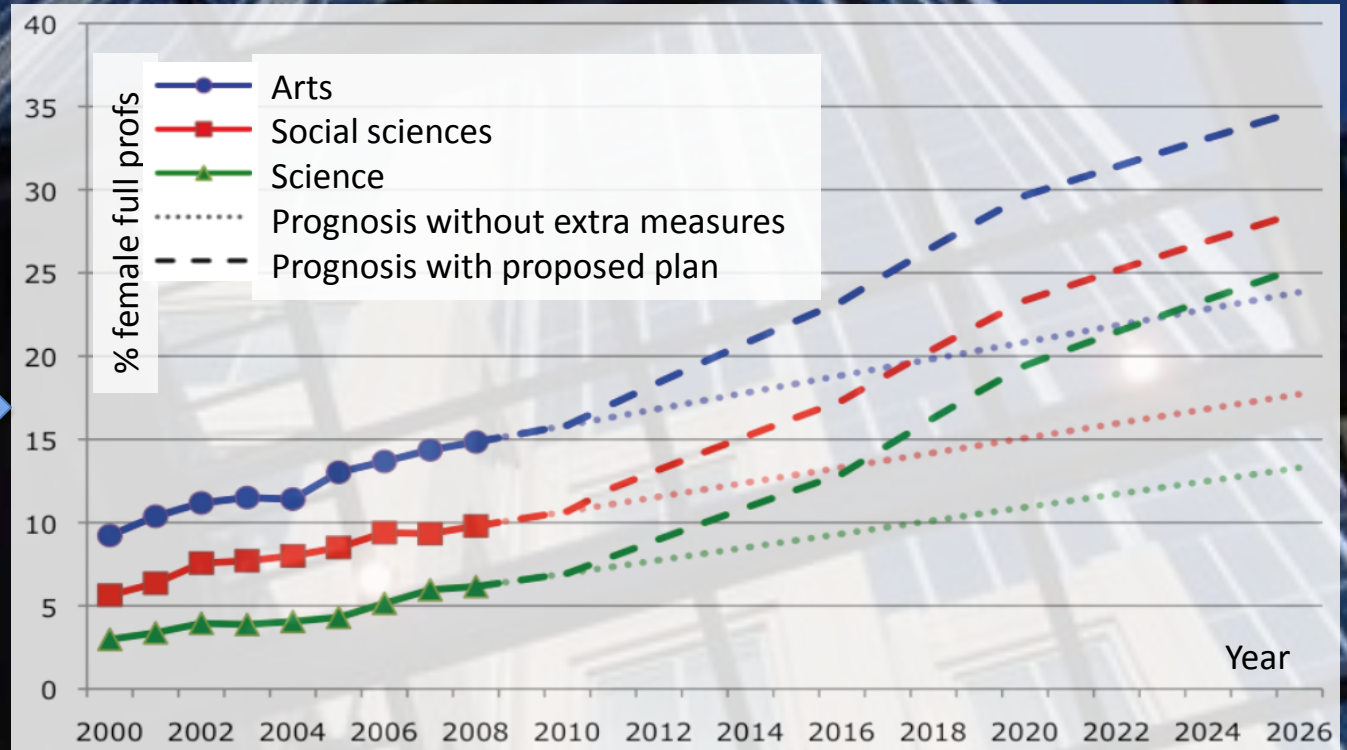
~5 researchers/1000 employed



Gender inequality



Working towards 20% women faculty in 2020

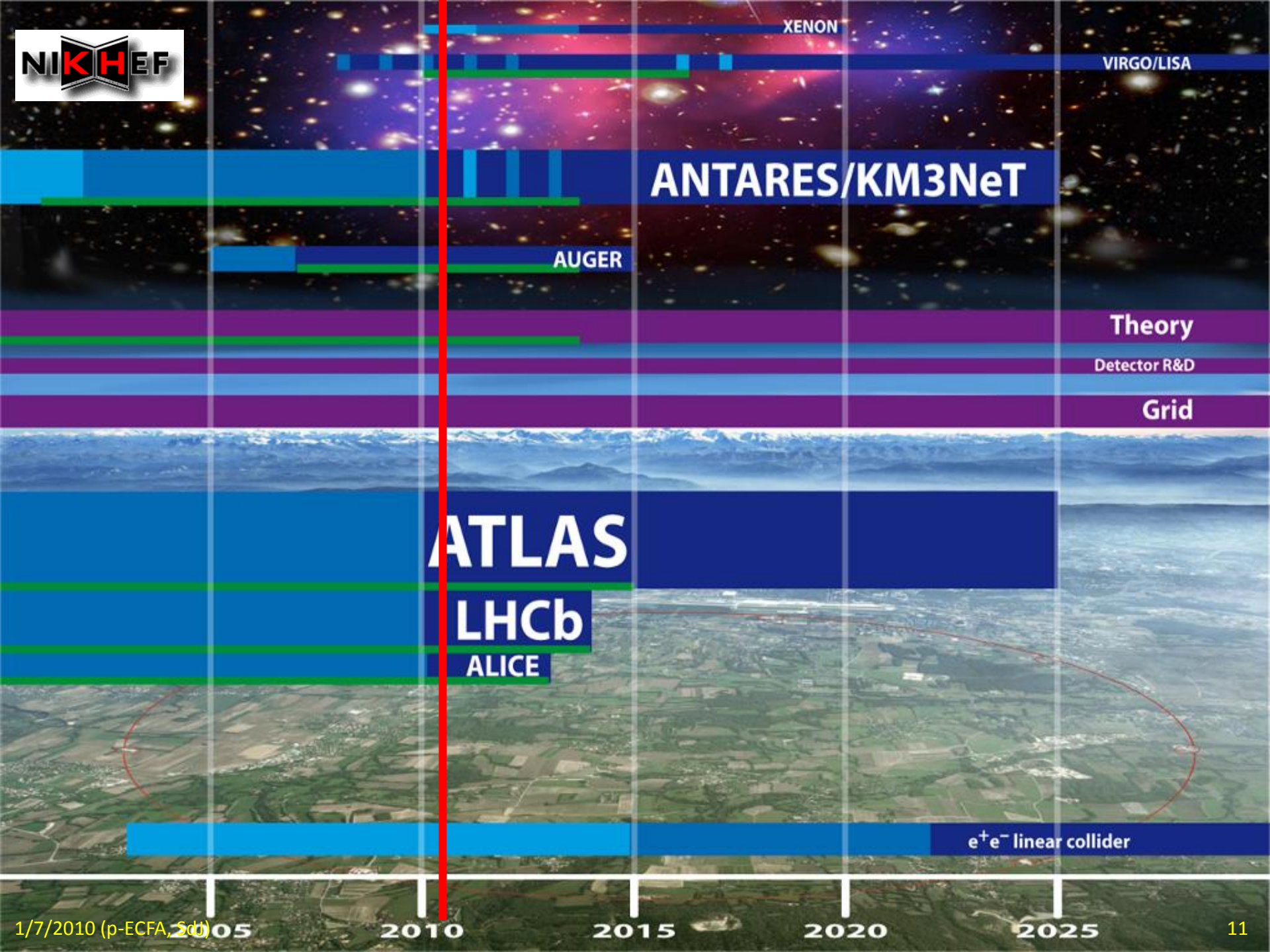




= FOM research institute
+ 4 university groups

Scientific Staff:	67 (5)	} 181
Post-docs:	34 (5)	
PhD students:	80(13)	
MSc students:	47	
Guests:	24	
Support staff:	102	





Discovery Potential

	Accelerator-based particle physics			Astroparticle physics			
	ATLAS DØ	LHCb BaBar	ALICE STAR	ANTARES KM3NeT	AUGER	VIRGO LISA	Xenon
Origin of mass?	•••	•					
Antimatter?	•	•••					
Quark-gluon plasma?			•••				
Supersymmetry?	•••	••		•	•		
Dark matter?	•	•		••	••		•••
Dark energy?	•						
Nature of neutrinos?				•			
Extra dimensions?	••	•					
Gravitational waves?						•••	
Magnetic monopoles?	•			••			
Origin of cosmic rays?				••	•••	•	
Early Universe?	•	•	••			••	
Unexpected phenomena!	•••	••	•	•••	••	•	

National Co-operation



FOM

RU

UU

UvA

VU

ATLAS
LHCb
ALICE
ANTARES
AUGER
VIRGO
Theoretical Physics
Detector R&D
Grid computing

••••
••••
•••
•••
••
••
••••
•••
••

•••
••
••
•
••
•
••
•

•••
•••
•••
•••
•••

•••
••
••
••
••
••
•••
•

••
••
••
••
••
••

•
••
••
••
••

•

Preparing for LHC and doing world class physics

publications

DZero	232
BaBar	468
STAR	92

personnel peak

5 staff, 1 PD, 5 PhD
2 staff, 1 PD, 2 PhD
4 staff, 5 PhD

personnel now

2 staff, 1 PhD
1 staff, 1 PhD
2 staff, 1 PhD



ATLAS



Funding 1997–2015: 48.1 M€ (material+manpower)

Material (FOM&UvA&RU): $(14.3\text{MCHF} / 535\text{ MCHF}) = 2.7\%$

Manpower: ~17 staff, ~ 8 postdocs, ~24 PhD students

Physics goals:

- Top quark related physics
- Higgs search and study
- SUSY searches

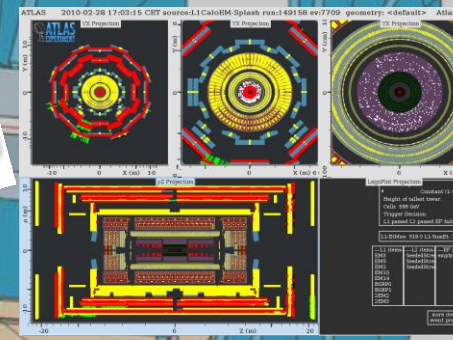
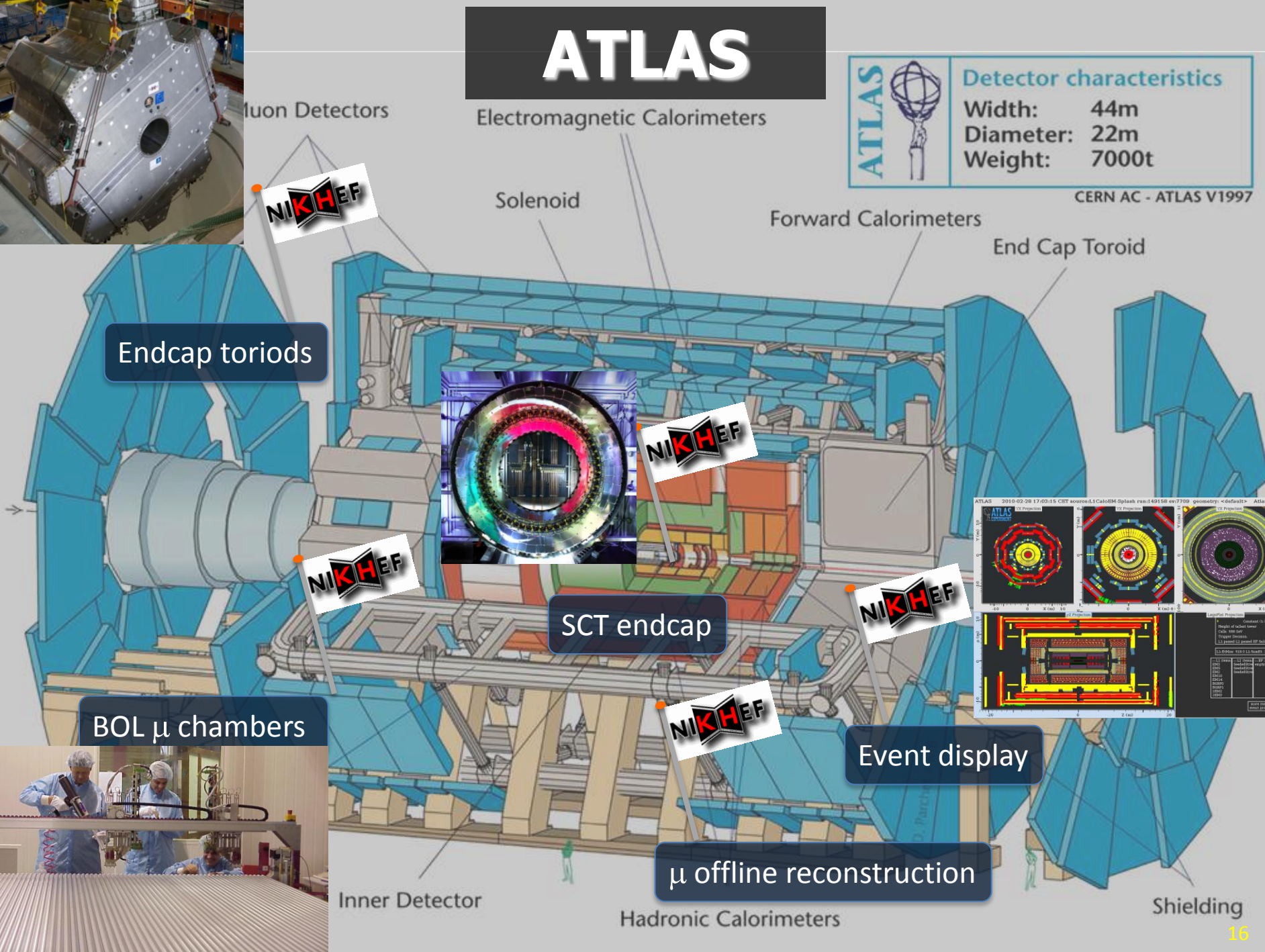
ATLAS



Detector characteristics

Width: 44m
Diameter: 22m
Weight: 7000t

CERN AC - ATLAS V1997



LHCb

Funding 1999–2014: 30.9 M€ (material+manpower)

Material (FOM&VU): $(6.7 \text{ MCHF} / 75 \text{ MCHF}) = 8.9\%$

Manpower: ~10 staff, ~ 3 postdocs, ~10 PhD students

Physics goals: B-Physics with charged particle final states

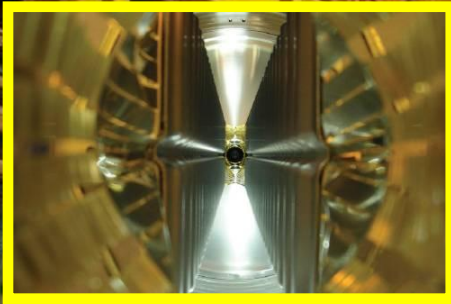
CP Violation: The B_s mixing phase with $B_s \rightarrow J/\psi \phi$

The angle γ with $B_s \rightarrow D_s K$

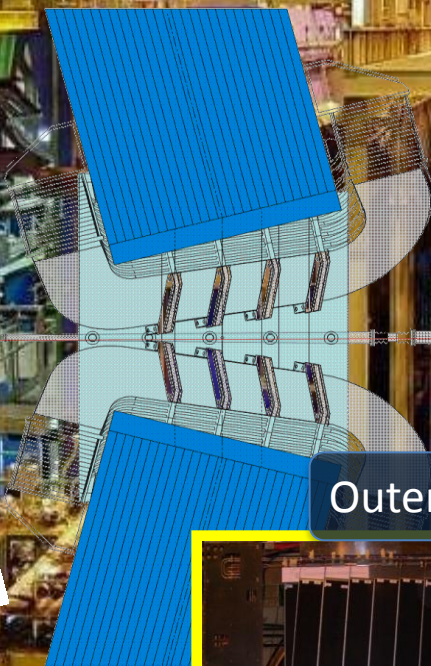
Rare decays: Branching ratio $B_s \rightarrow \mu^+ \mu^-$

F-B Asymmetry $B_s \rightarrow K^* \mu^+ \mu^-$

LHCb



VELO



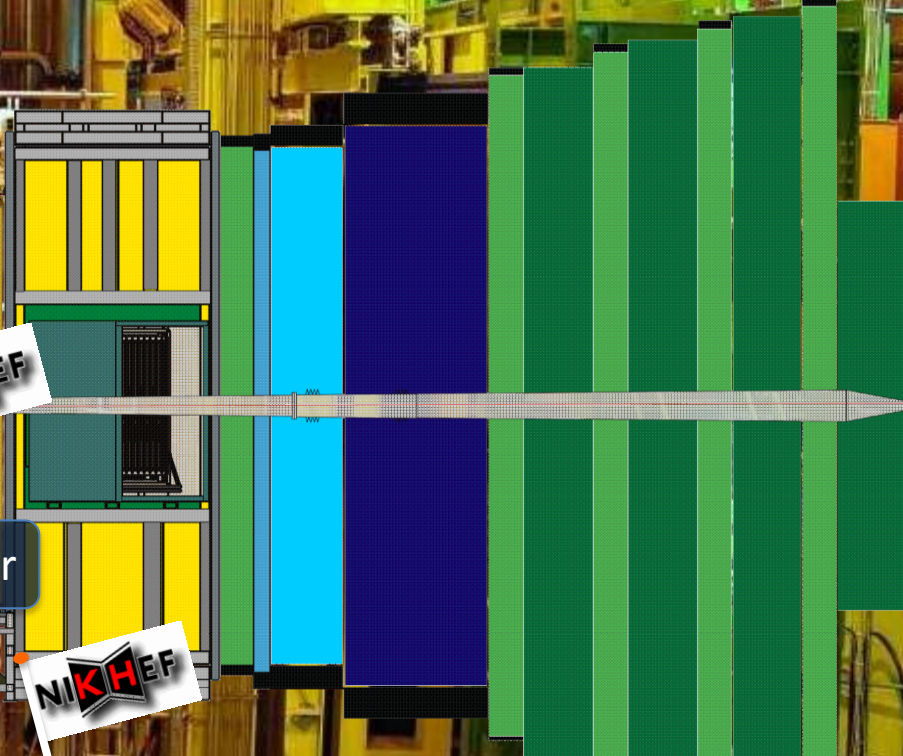
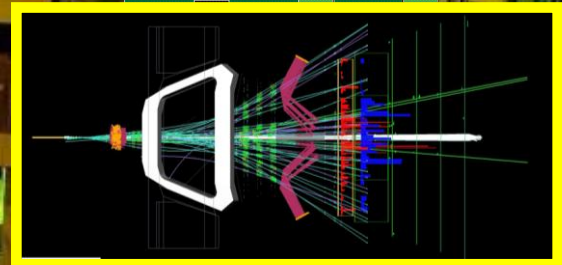
Outer Tracker



Pile-up trigger



Track reconstruction



ALICE

Funding 1998–2013: 13.5 M€ (material+manpower)

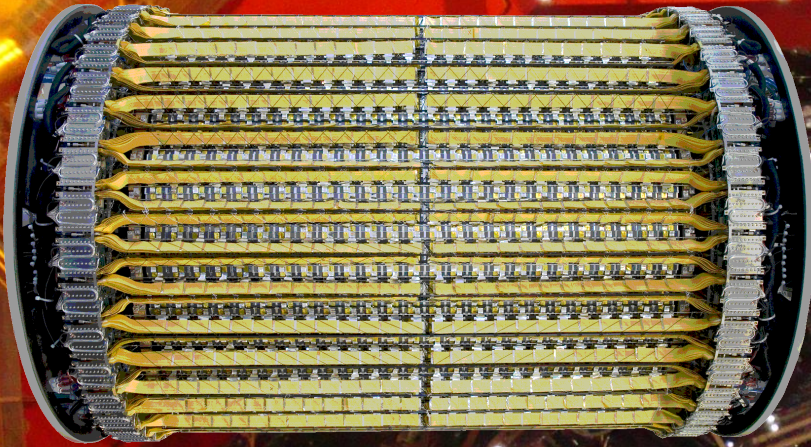
Material (FOM&UU): $(2.5 \text{ MCHF} / 144 \text{ MCHF}) = 1.7 \%$

Manpower: ~7 staff, ~ 3 postdocs, ~8 PhD students

Physics goals:

- elliptic flow
- particle spectra (high p_T /jets)
- heavy flavour (charm/bottom)
- simulation detector upgrade
- small x physics

ALICE

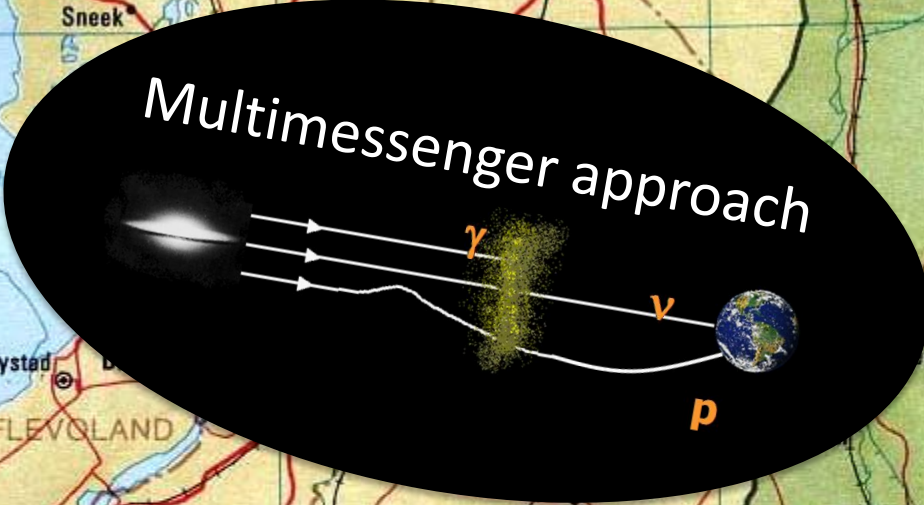


Silicon Strip Detector



Astroparticle Physics

ANTARES/KM3NeT
Pierre Auger
Virgo/LISA
Xenon



including astronomers

ANTARES/KM3NeT

Material funding (FOM): 3.3/10 M€

Manpower: ~6 staff, ~ 5 postdocs, ~7 PhD students

Physics goals: find and study extra-terrestrial neutrinos

ANTARES technical contributions:

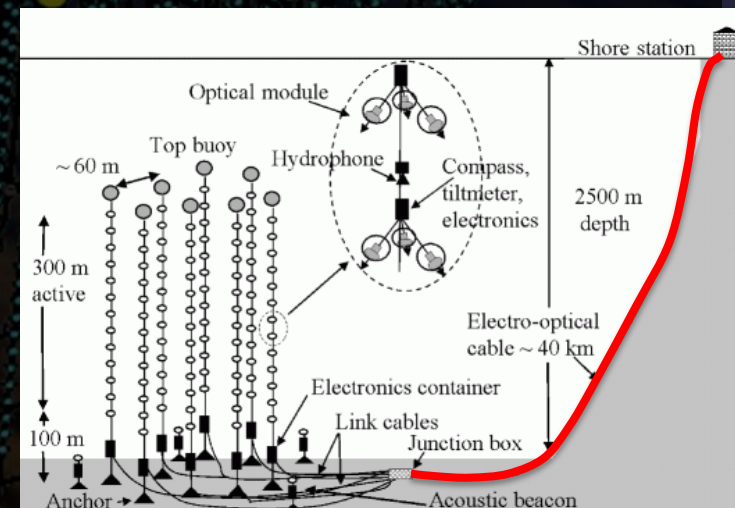
- DAQ (all data to shore)

- Reconstruction software

KM3NeT technical contributions:

- DAQ

- design/build detector elements



Pierre Auger Observatory

Material funding (FOM+universities+ERC AdG): 1.5 M€

Manpower: ~6 staff, ~ 2 postdocs, ~8 PhD students

Physics goals: CR composition
source identification

PAO technical contributions:
Radio detection of CRs



Virgo/Lisa

Material funding (FOM): 2 M€

Manpower: ~4 staff, ~ 1 postdoc, ~5 PhD students



Physics goals: find and study gravitational waves

Virgo+ technical contributions: suspension system

modeling/data analysis

GW + EM combination



Lisa technical contributions: GW from white dwarfs studies

Xenon

Material funding (FOM): 0.5 M€

Manpower: ~2 staf, 1 postdoc, 1 PhD student (ramping up)

Physics goals: find dark matter particle

Technical contributions to: acquisition of part of the Xe
cryostat design
electronics PMT/QUPID readout

Precision Physics

**β -decay
Deviation V-A**

^{21}Na

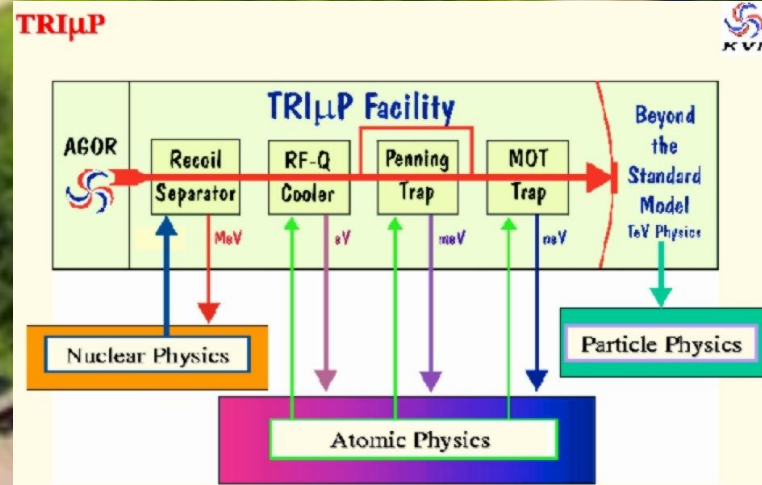
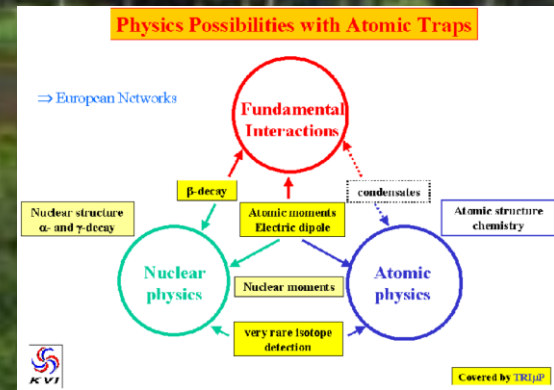
**Electric Dipole Moment
Time reversal violation**

Ra / d

**Atomic Parity Violation
Weak charge**

Ra⁺

Searches for violations of Discrete Symmetries provide a window to look out for Physics beyond the Standard Model



Theory

Riding on the wave of a great tradition

Manpower: ~38 staff, ~30 postdocs, ~49 PhD students

Physics goals:

- String/M theory
- SM & Higgs phenomenology
- Cosmology and inflation
- Non-commutative geometry

Tools:

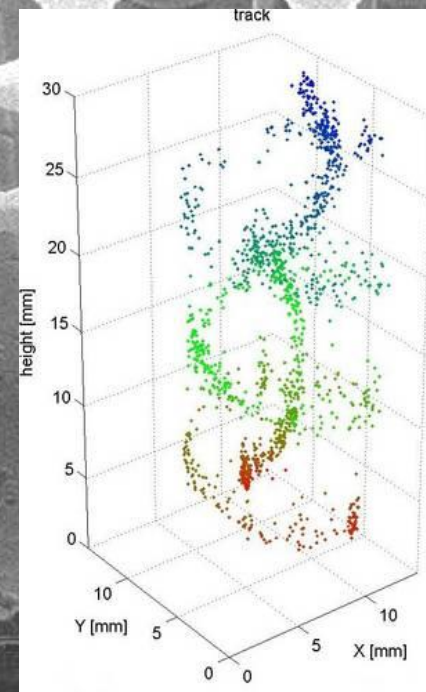
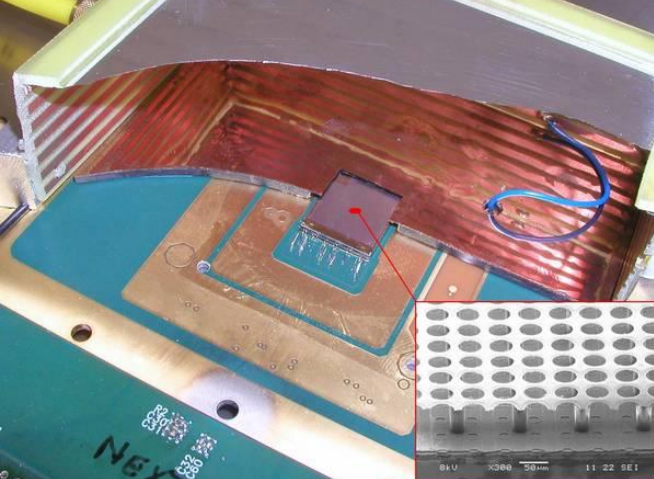
- FORM (computer algebra)
- Monte Carlo simulation

Generic detector R&D

Funding from Nikhef mission budget
Manpower: ~7 staff, ~ 3 postdocs,
~7 PhD students

Goals:

- Rad hard pixel detector
- TPC read-out (CLiC/ILC)
- Alignment system



8kV

X300

50 μ m

11 22 SEI

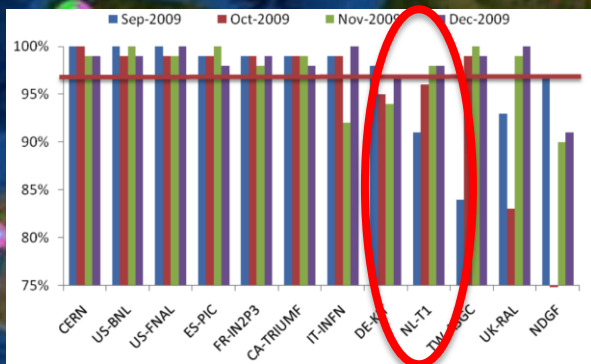


Funding: 28.8 M€ (until 2011)

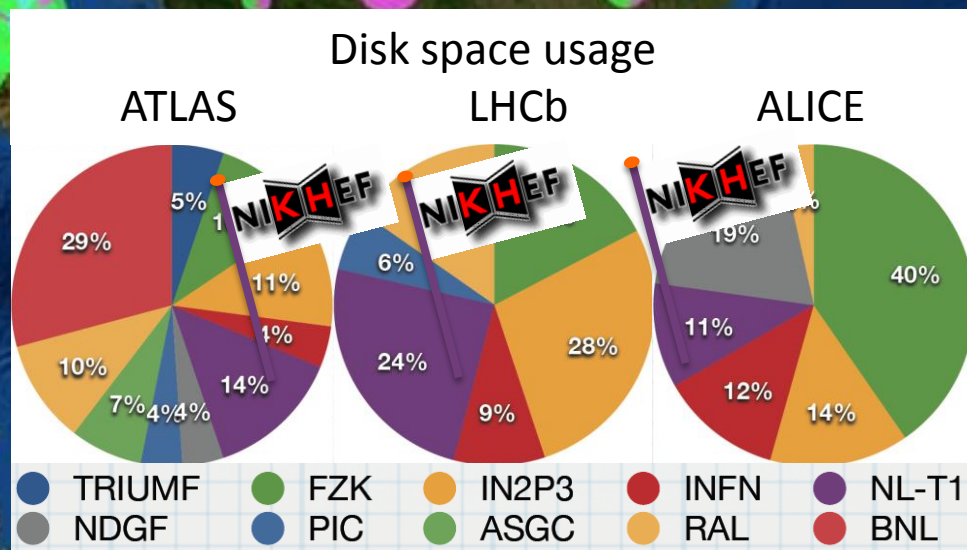
NL-T1: SARA & Nikhef ($2/3$ used by LHC)

Manpower: ~12 staff+tech, ~ 3 postdocs,
~1 PhD student

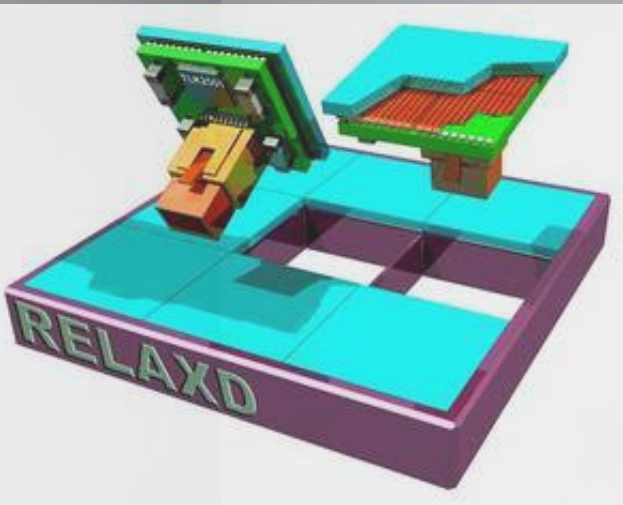
EGL.eu housed
near Nikhef




NL-T1 had slow start,
but caught up now



Links to industry




- Medipix: PANalytical
- HPD: Photonis-DEP BV
- RasClic alignment: first Nikhef patent
- RELAXD: PANalytical, Canberra Olen, IMEC
- Hidralon edgeless Ca-ZN-Te X-ray detector: Philips Healthcare
- Data transfer chip/pixel detector design with Bruco personnel
- Holland@CERN sponsored by ministry of economic affairs



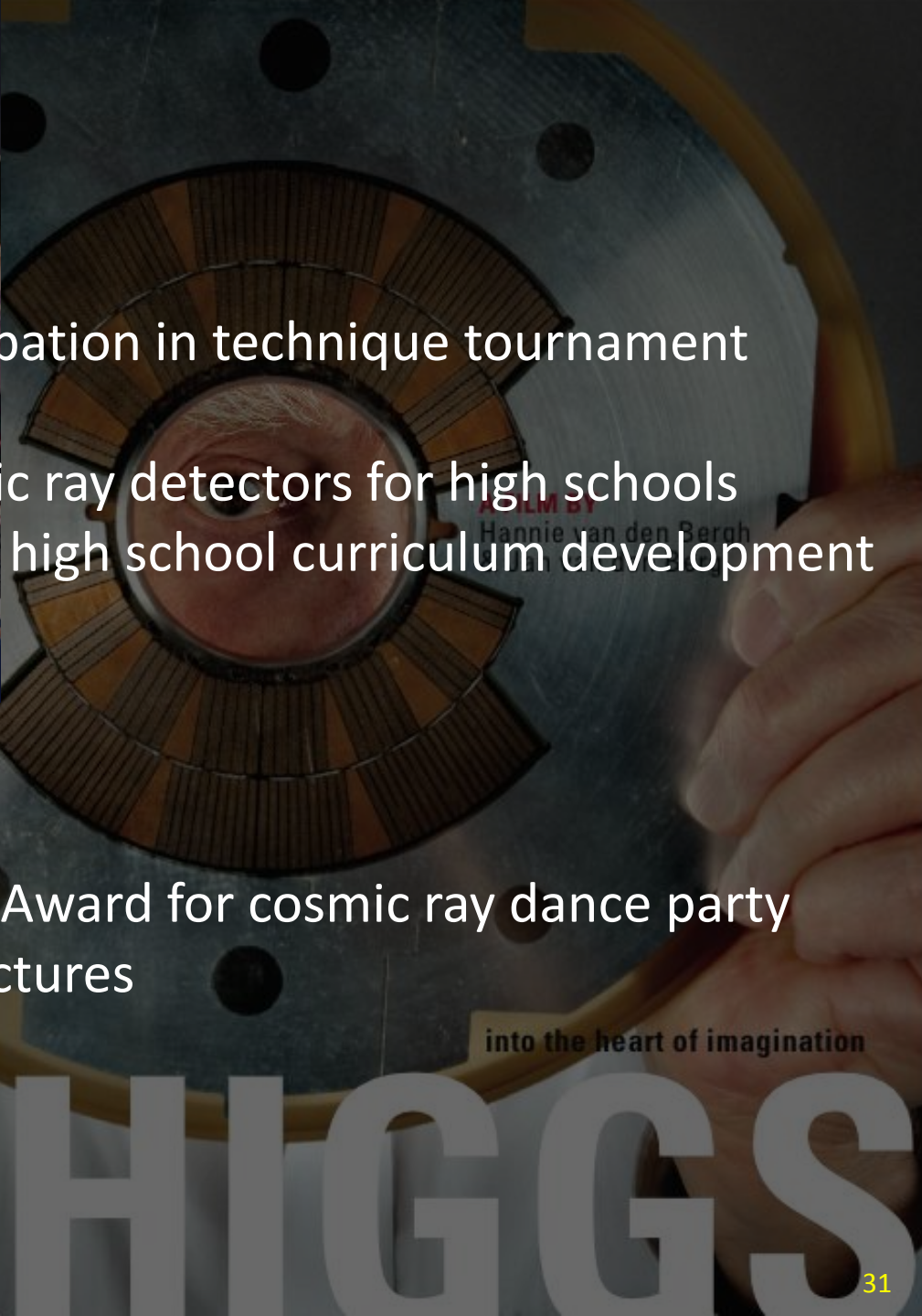
Outreach:

Primary school: Leading participation in technique tournament

Secondary school: HiSPARC, cosmic ray detectors for high schools
Participating in high school curriculum development
Master classes
CERN visits



General public: Higgs movie
Academic Year Award for cosmic ray dance party
Many public lectures
CERN visits
Open days



Conclusion

- Research funding in the Netherlands raises concern
- HEP is doing relatively well and is able to maintain highest international standards
- Move to APP with significant additional funding
 - without decreasing accelerator based HEP research
- Focus to attain critical mass on all supported projects
 - Most particle physics key questions covered, except
 - No significant accelerator physics effort any more
 - No (accelerator) neutrino research
- Consolidating large, nationally recognized, outreach effort
- Consolidate co-operation with industry
- Would have liked to start in earnest on O(1 TeV) e^+e^- collider