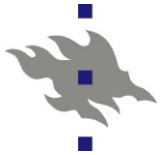
MID-TERM REPORT FINLAND

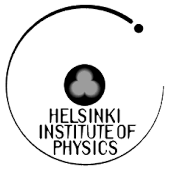
Plenary ECFA

DESY 25 July 2014

Overview

- Organisation, statistics
- Research
- Technology, education, outreach
- Performance indicators
- From last RECFA visit to Finland 2010
- Recent developments





Organisation, statistics

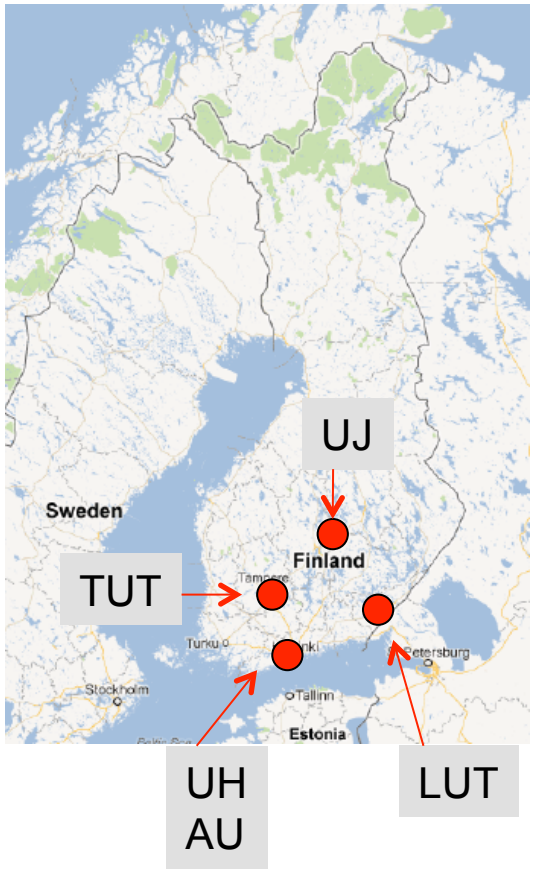
Helsinki Institute of Physics HIP 1996-

- Finland joined CERN 1991
- 1996 three Helsinki-based institutes: SEFT, TFT (Univ. of Helsinki) and HTI (Helsinki Univ. of Technology) were merged to HIP
- HIP was founded by a law, passed by the Finnish Parliament in summer 1996
- HIP started on September 1, 1996
- Mandate: to carry out and facilitate research in
  - basic and applied physics and
  - research and technology development

  at international accelerator laboratories
- CERN from 1996, FAIR from 2010

HIP organisation and strategy

- National research institute operated by
  - Helsinki and Aalto* Universities (1997)
  - University of Jyväskylä (2002)
  - Lappeenranta Univ of Technology (2007)
  - Tampere Univ of Technology (2008)
- Administratively an independent institute under the Rector of the University of Helsinki
- National CERN Strategy from 2003:
  - Forefront particle and nuclear physics
  - Applied research in accelerators, instrumentation and computation
  - Research training
  - Enhance technology know-how of Finnish companies
  - Science education and public awareness



*Formerly Helsinki Univ. of Technology (+ Helsinki School of Economics & School of Art and Design)

Profiles and staff of the universities

- University of Helsinki
  - Particle physics – experiment: 2 co-funded profs (HIP+UH), 1 lecturer
  - Particle physics – theory: 3 profs, 2 lecturers, 2 res. fellows (AoF*)
  - Cosmology – theory: 1 prof, 2 lecturers,1 res. fellow (AoF*)
- University of Jyväskylä
  - Particle physics – experiment: 1 prof – NEW (in Alice), 1 lecturer
  - Particle physics and cosmology – theory: 3 profs, 2 res. fellows (AoF*)
  - Nuclear physics – experiment: 4 profs, 3 lecturers, 6 univ. res, 2 res.fellows (AoF*)
  - Nuclear physics – theory: 1 prof, 1 research prof**, 1 res. fellow (AoF*)
- Aalto University
  - Applied fields: materials science, information technology, engineering
  - Materials science – theory
- Tampere University of Technology
  - Applied fields: instrumentation and accelerator technology, IT, robotics
- Lappeenranta University of Technology
  - Applied fields: instrumentation and electronics

*Academy of Finland: 5 year fully-funded research fellow

** 5 year research professor funded by AoF

Helsinki Institute of Physics 2014

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CMS Upgrade
Jaakko Härkönen

Tier-2 Operations
Tomas Lindén

TOTEM
Heimo Saarikko

Nuclear Matter

Ari Jokinen

ALICE
Jan Rak

ISOLDE
Paul Greenlees

FAIR
Ari Jokinen

Technology

Saku Mäkinen

Accelator Technology
Kenneth Österberg

Green Big Data
Tapio Niemi

Biomedical Imaging
Ulla Ruotsalainen

Forward Physics

Risto Orava

PLANCK-EUCLID

Hannu Kurki-Suonio

CLOUD Experiment

Markku Kulmala

Detector Laboratory

Eija Tuominen

HIP personnel: about 83 FTE/y including scholarships (64 FTE regular).
Project oriented: no permanent research staff.

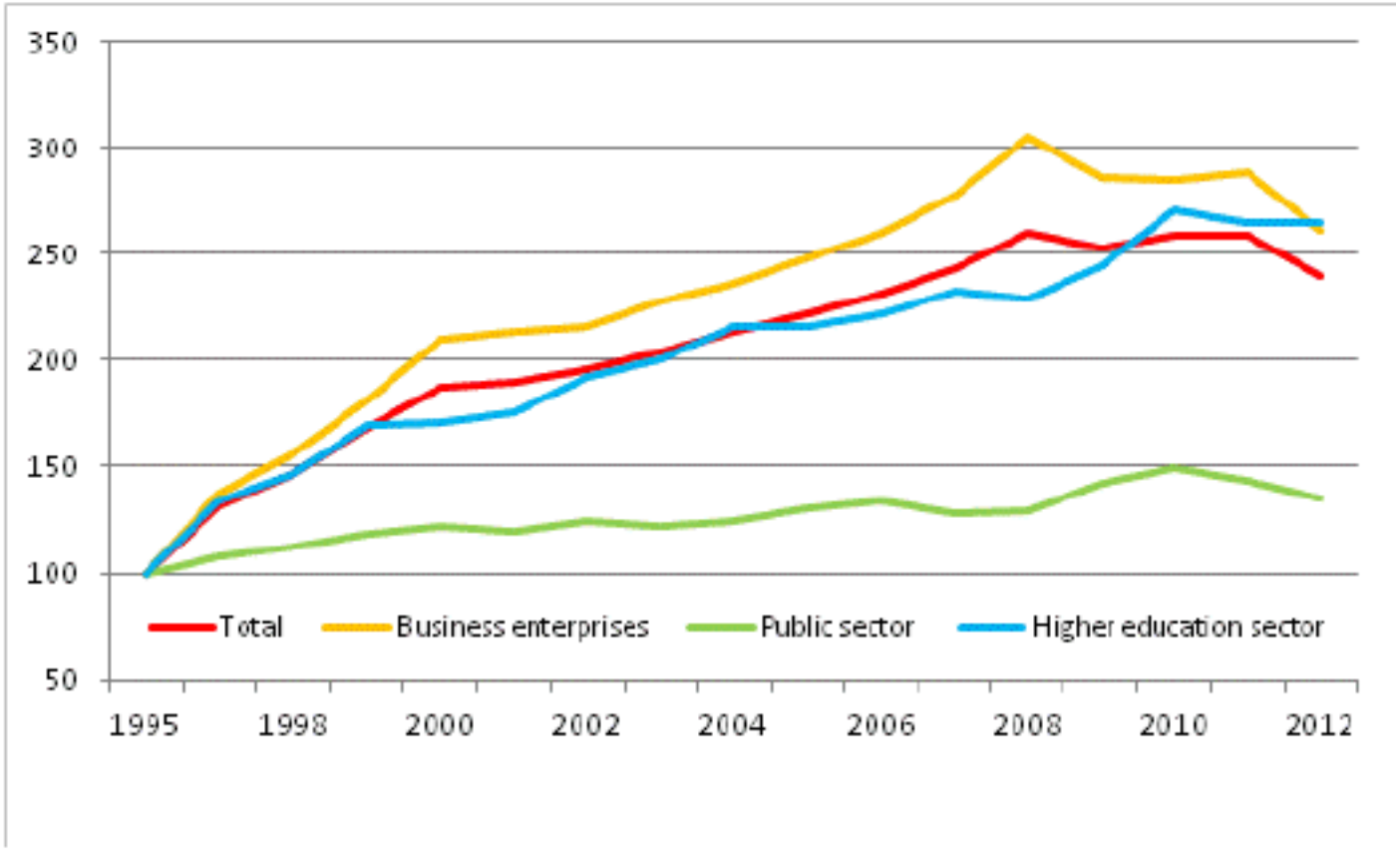
Annual Report 2013
http://www.hip.fi/wp-content/uploads/2013/09/HIP-Annual-Report-2013.pdf

HIP budget

[k€]	2012	2013	2014
Ministry of Education and Culture	3200	3500	3590
UH: host contrib and result based	1140	908	857
Other universities, result based	340	335	335
SUM	4680	4743	4782
EXTERNAL	1085	974	open

HELSINKI INSTITUTE OF PHYSICS

Development of real R&D expenditure by sector in 1995 to 2012 (1995=100)



Deflated by the GDP price index

Research ~3.5% of GDP in 2013

Research

Contributions to LHC experiments

- **CMS research programme – HIP, UH and LUT groups**
  - CMS experiment – physics analysis, operations, open data
  - CMS upgrade – phase 1 pixel upgrade (funding secured), phase 2 tracker
  - CMS Tier-2 operations: part of W-LCG, close collaboration between HIP, CSC and NDGF (future funding open)
  - TOTEM – physics, T2 tracker stations, upgrade (funding applied). Since 2014 under CMS programme.
- **ALICE – UJ, HIP, UH groups**
  - Physics analysis, detector operations – UJ
  - TPC GEM upgrade (funding secured) – HIP, UH
  - New forward physics project – UH, HIP

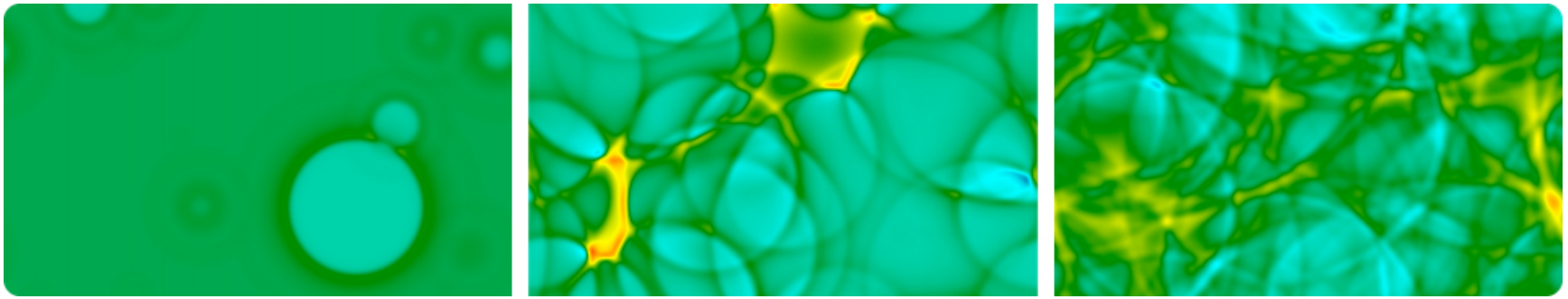
Other experimental projects

- **Nuclear matter – UJ, HIP groups**
  - ISOLDE – UJ
  - FAIR – UJ, HIP
- **CLOUD – UH, UEF (Univ. of Eastern Finland), FMI, HIP**
  - FI atmospheric scientists: measure nucleation; data-analysis and modelling/theory
- **Cosmology**
  - Planck – UH, Aalto: data analysis, LF instrument
  - Euclid – UH, UJ, Turku: data centre, physics case+simulations
- **Underground Physics**
  - EMMA – UJ, UO (University of Oulu)
  - LAGUNA-LBNO (Design Study) – UH, UJ, UO

Theory programme

Current projects 2014-2016:

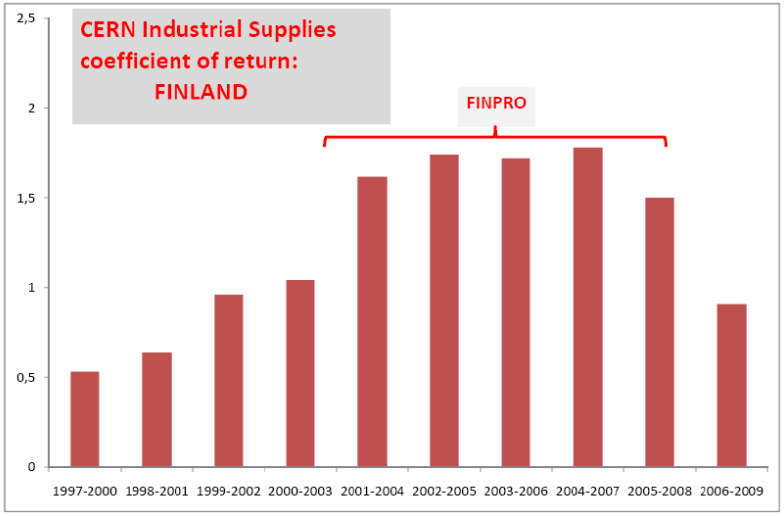
- Nuclear Structure for Weak and Astrophysical Processes – UJ, HIP
- QCD and Strongly Interacting Gauge Theory – UJ, UH, HIP
- Domain Wall Dynamics – Aalto, HIP
- Cosmology of the Early and Late Universe – UH, UJ, HIP
- High Energy Phenomenology in the LHC Era – UH, HIP



Technology, education, outreach

Technology

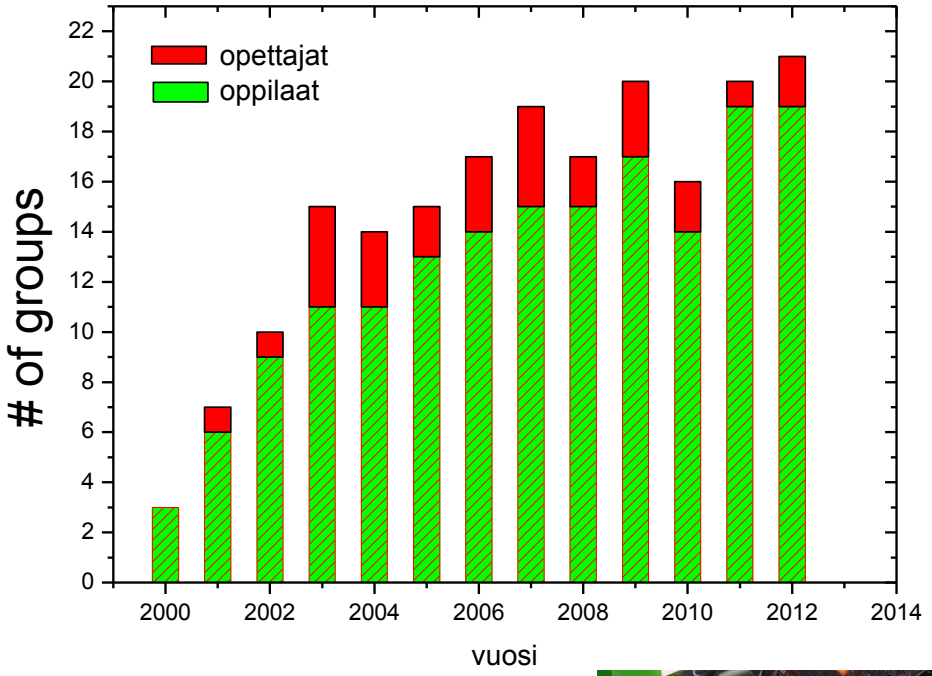
- Technology transfer: TEKES → FINPRO → Big Science Activation Team (outsourced by TEKES): TERMINATED MARCH 2014!
- Industrial return has diminished considerably since top years
- NEW (about to start): HIP – CERN Business Incubation Centre (BIC) pilot
  - connect businesses and entrepreneurs with innovative CERN technologies

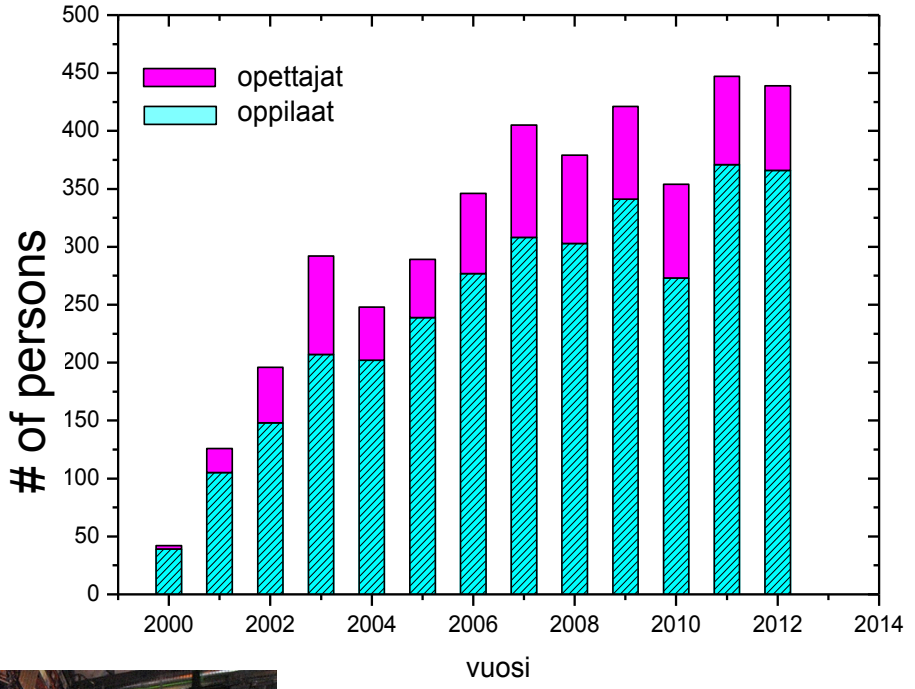


- CLIC – R&D of RF structures: HIP, UH, Aalto
  - MeChanICs Marie Curie linking industry to CERN 2010-2014 – 5 companies, HIP (coordinator) and CERN - manufacturing and assembly of RF structures
  - Test module assembly. Development of measurement devices.
  - Multi-scale modelling of surface defects and breakdown
- Green Big Data – HIP, Aalto, foreign partners
- Biomedical imaging – TUT: AxPET → AvanTomography

CERN-HIP high school visits 2000-2012

3179 pupils, 912 teachers





HIP Summer student programme

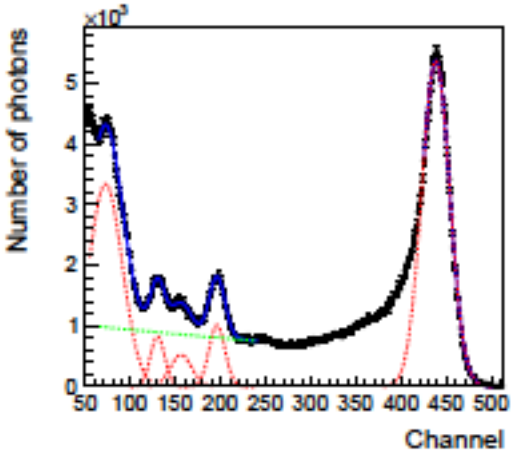
- ~16 master-level students during summer months from HIP member universities (mostly)
- Supervision by Finnish scientists at CERN (mostly)
- Projects:
  - Experimental particle physics
  - Instrumentation
  - Nuclear physics
  - Mechanics and engineering
  - Computing, information technology
  - Technology transfer

Graduate student education

- **Graduate schools reorganised in Finland. Previously few national schools, now every university have their own.**
  - **+ overall better organised**
  - **- national coordination and part of funding lost**
- **HIP works together with partner univ. graduate schools.**

Nordic detector course in the detector laboratory

Single wire proportional chambers constructed by the students

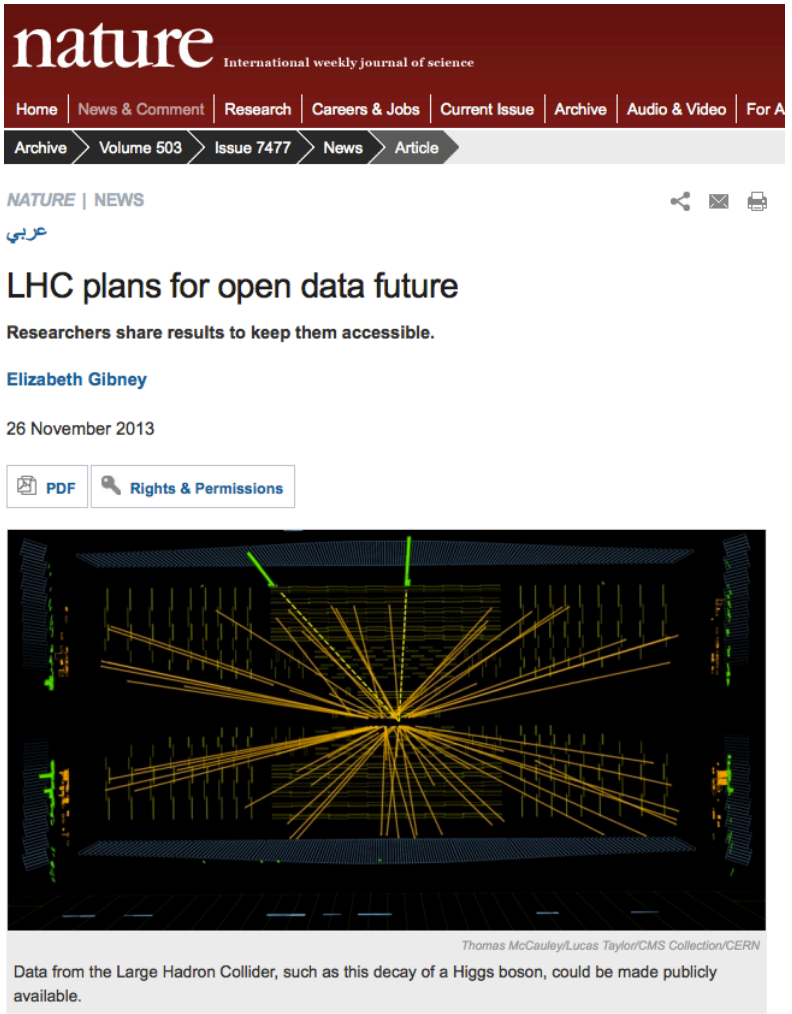


Am-241 energy spectrum measured by one beer can radiation detector constructed at the course

Open data

- CMS Data Preservation and Open Access project
  - coordinator from HIP
- Spin-off: use of CMS data at physics classes at high schools
  - HIP, CSC*, CERN, Imperial College, FNAL
  - Pedagogical foundation and teacher survey: MSc thesis S. Suoniemi 2014
  - Interface: Rovaniemi IT polytechnics, in progress

*Finnish Centre for Scientific computing



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NATURE | NEWS

عربي

LHC plans for open data future

Researchers share results to keep them accessible.

Elizabeth Gibney

26 November 2013

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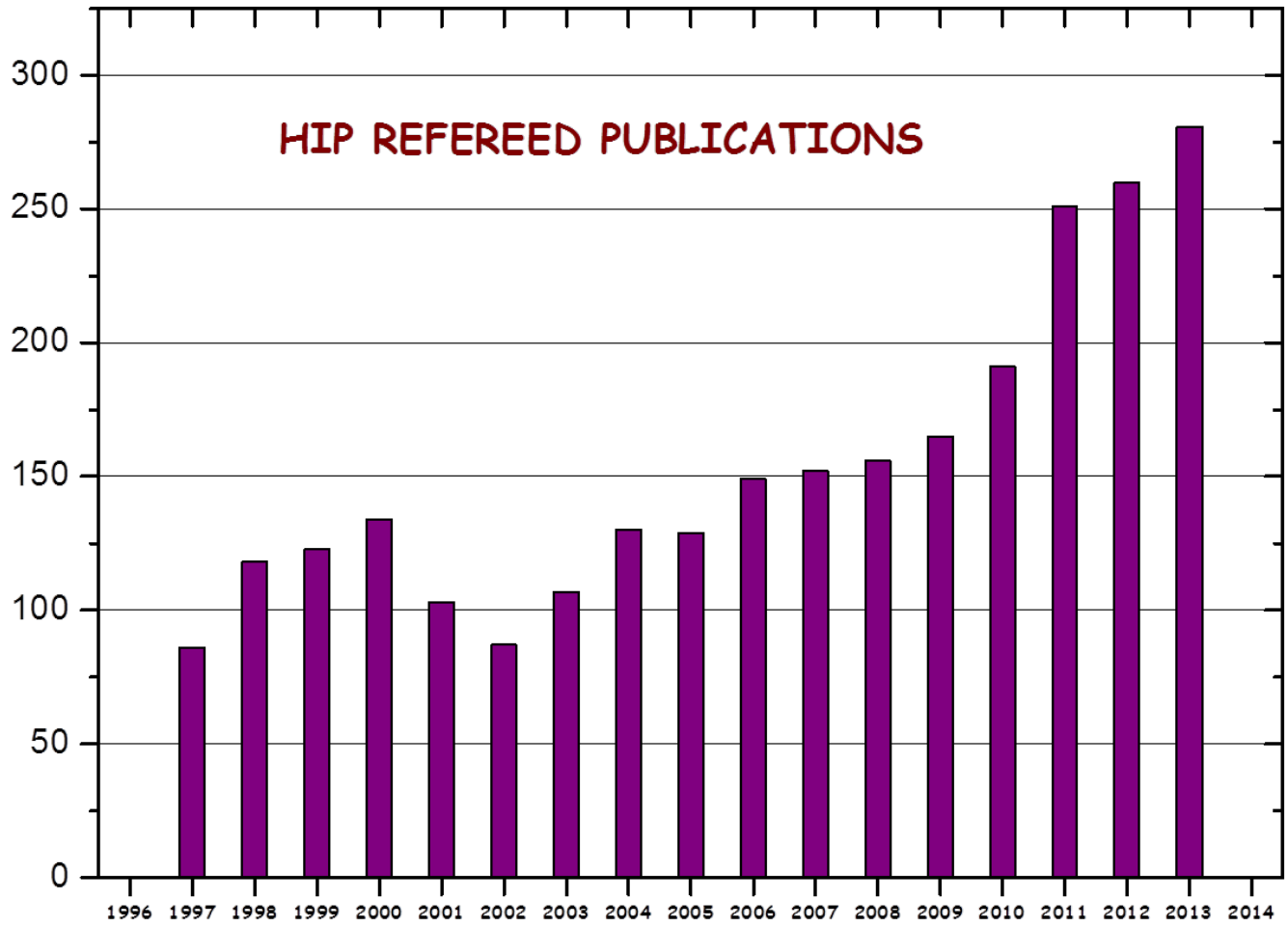
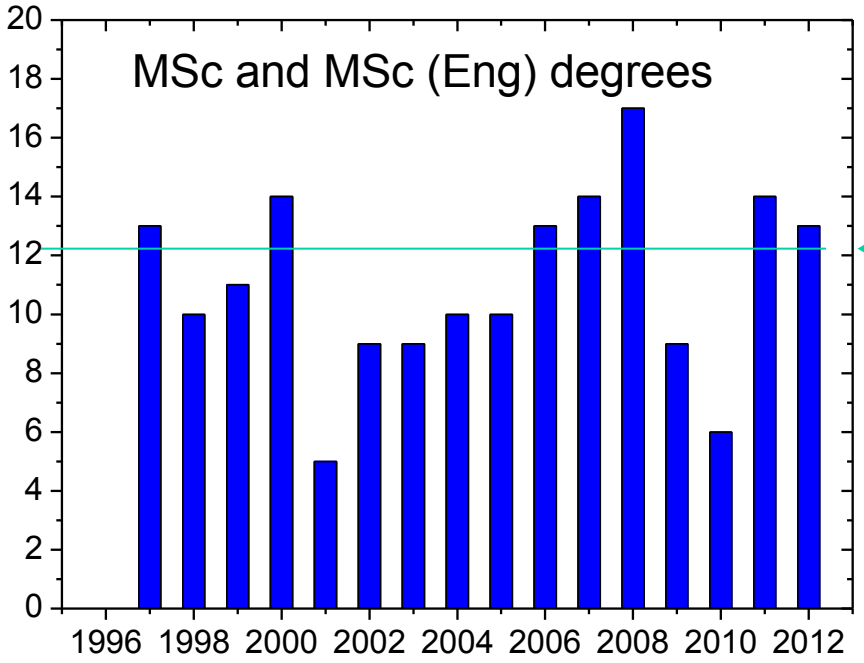
Thomas McCauley/Lucas Taylor/CMS Collection/CERN

Data from the Large Hadron Collider, such as this decay of a Higgs boson, could be made publicly available.

http://www.nature.com/news/lhc-plans-for-open-data-future-1.14244

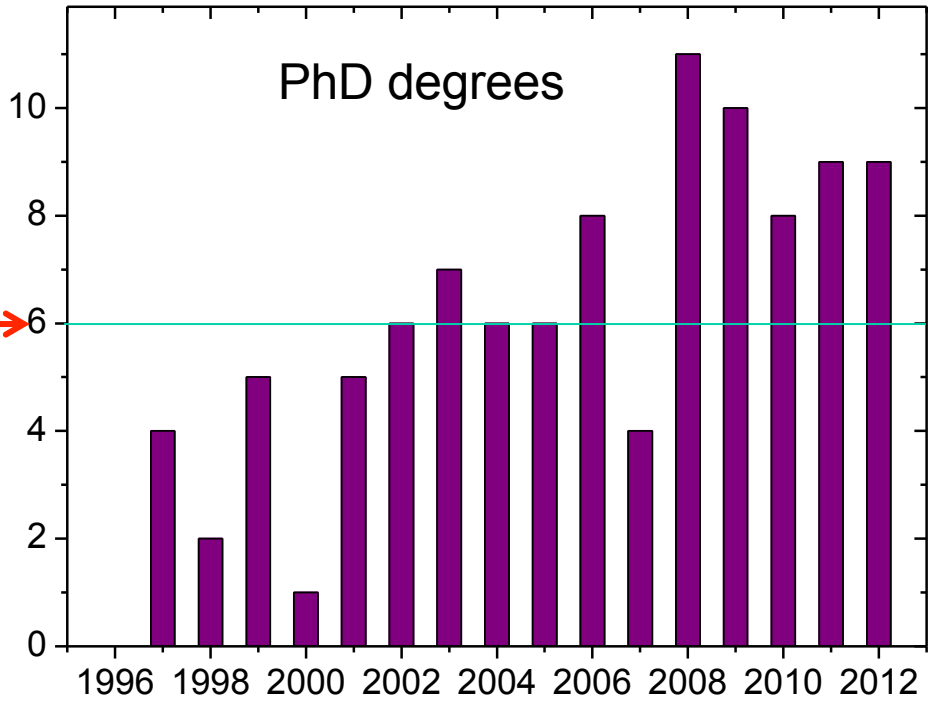
Performance indicators


HIP REFEREED PUBLICATIONS
300
250
200
150
100
50
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


MSc and MSc (Eng) degrees
20
18
16
14
12
10
8
6
4
2
0
1996 1998 2000 2002 2004 2006 2008 2010 2012

Goal

Goal


PhD degrees
10
8
6
4
2
0
1996 1998 2000 2002 2004 2006 2008 2010 2012

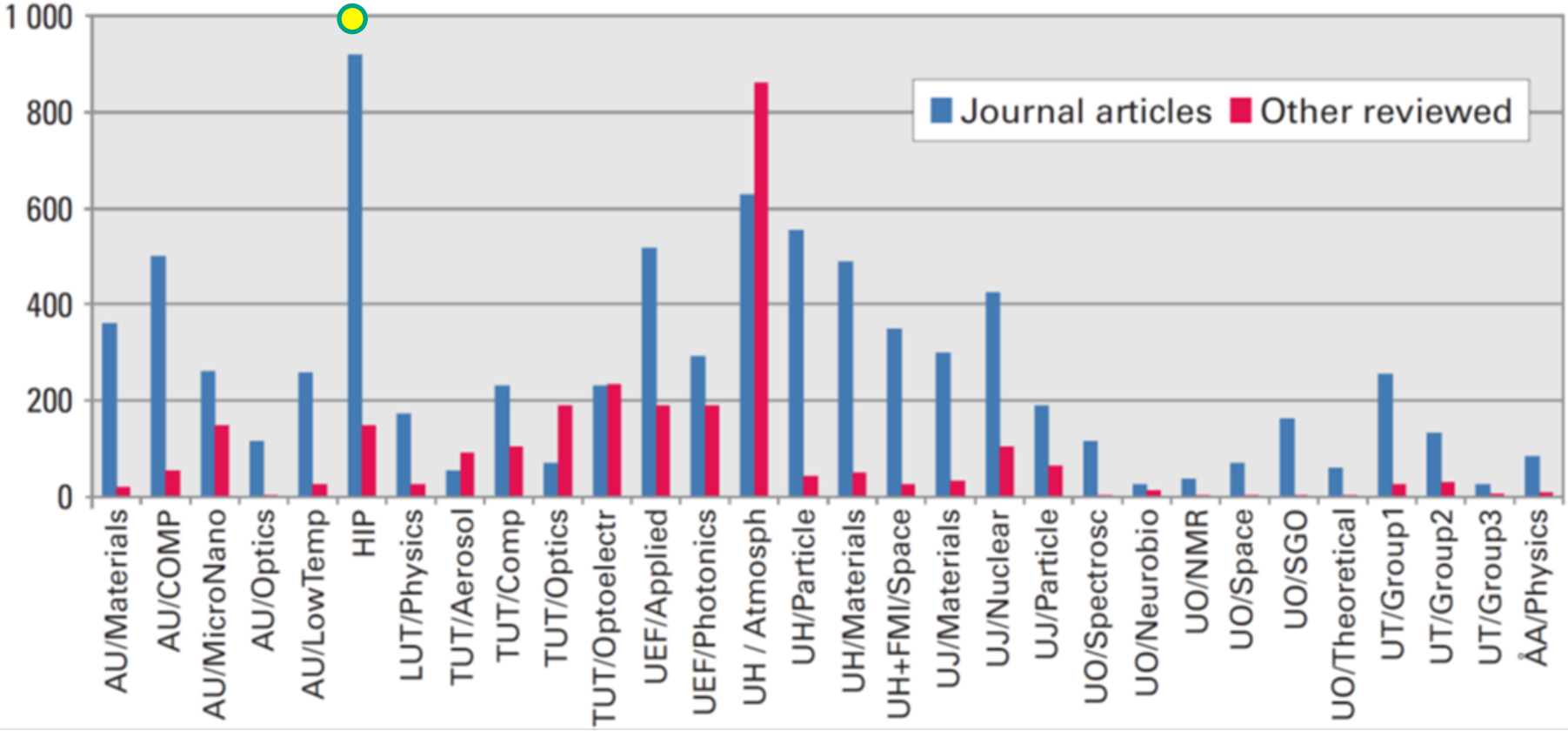
”HIP” extracts…

The big overlap in activities and personnel between a university physics division and research institute is an unusual constellation on the international scene. It creates a very diverse and creative atmosphere that provides the best possible environment for education and research.

Raising the financial contribution to international infrastructures such as CERN and FAIR could certainly enhance the visibility and role of groups involved in such experiments.

In the present situation, the unit has adequate administrative help. With all the time-consuming interactions with international organisations and foreign groups, this support is important for the functioning of the unit. Today, such help seems to be uncommon in Finland. Here, it

Physics Research in Finland 2007–2011. Evaluation Report



HIP 1997-2014 PROFESSORS

TH	TAPIO ALA-NISSILÄ	HELSINKI UNIV TECHNOLOGY
TH	MATTI ALATALO	LAPPEENRANTA UNIV TECHNOL
EXP	MARCO BATTAGLIA	UNIV CALIFORNIA BERKELEY
TH	BRUNO CARNEIRO	UNIVERSIDADE FEDERAL PERNAMBUCO
EXP	PAULA EEROLA	HELSINKI UNIVERSITY
TH	KARI ENQVIST	HELSINKI UNIVERSITY
TECH	ARI-PEKKA HAMERI	UNIVERSITÉ DE LAUSANNE
TH	FAWAD HASSAN	STOCKHOLM UNIVERSITY
TH	KATRI HUITU	HELSINKI UNIVERSITY
TH	NORBERT LÜTKENHAUS	UNIVERSITY OF WATERLOO
TH	JAYDEEP MAJUMDER	NAT IONAL INSTITUTE OF SCIENCE EDUCATION AND RESEARCH BHUBANESWAR
TH	ANTTI NIEMI	UPPSALA UNIVERSITET
EXP	RISTO ORAVA	HELSINKI UNIVERSITY
TH	DIMITRI POLYAKOV	AMERICAN UNIVERSITY BEIRUT
TH	KALLE-ANTTI SUOMINEN	TURKU UNIVERSITY
EXP	STEPHAN TAPPROGGE	J. GUTENBERG UNIVERSITÄT MAINZ
TH	PÄIVI TÖRMÄ	HELSINKI UNIVERSITY OF TECHNOLOGY
TH	ILPO VATTULAINEN	TAMPERE UNIVERSITY OF TECHNOLOGY
TH	KARI J. ESKOLA	JYVÄSKYLÄ UNIVERSITY
EXP	NICK VAN REMORTEL	UNIVERSITEIT ANTWERPEN
TH	MICHAEL STRICKLAND	GETTYSBURG COLLEGE
TH	K. P. YOGENDRAN	INDIAN INST SCIENCE EDU. AND RESEARCH
EXP	ARI JOKINEN	JYVÄSKYLÄ UNIVERSITY
TH	KIMMO KAINULAINEN	JYVÄSKYLÄ UNIVERSITY
EXP	PAUL GREENLEES	JYVÄSKYLÄ UNIVERSITY
EXP	JAN RAK	JYVÄSKYLÄ UNIVERSITY

TH SOUROV ROY IACS

TH ANINDYA DATTA CALCU

From last RECFA visit to Finland 2010

HIP director D.-O. Riska at RECFA-Finland 2010:

THE NEXT FIVE YEARS:

- -FULL EXPLOITATION OF CMS & ALICE RUNS 2011-2015 ✔
- -SECURE FUNDING FOR FINNISH CONTRIBUTION FOR CMS & ALICE UPGRADE FOR HIGHER LUMINOSITY RUNS ✔
- -SECURE RESOURCES FOR CONTINUATION OF NORDIC Tier-1 and FINNISH Tier-2 COMPUTING FACILITIES ✔ ✖
- -REALIZE PLAN FOR FINNISH FAIR/NUSTAR & SFRS CONTRIBUTION ✔
- -DISENGAGE SMOOTHLY FROM CDF COLLABORATION AT FERMILAB ✔
- -CONSIDER/DECIDE/FUND COMMUNITY REQUESTS FOR HIE-ISOLDE AND TOTEM DIFFRACTIVE PHYSICS CONTRIBUTION ✔
- -REVIEW FINNISH ISOLDE CONTRIBUTION IN 2011 ✔

RECFA letter to minister Virkkunen 22 Nov 2010

Role of HIP
-now: performing better than ever. Future status nevertheless uncertain.

conducts outreach and training activities. The Committee congratulates the Finnish authorities and the Finnish community for establishing such an effective organization that puts Finland at the forefront of the field.

physics community, as well as by the support provided by the government. The Helsinki Institute of Physics is a success story which Finland can proud of. With the conscious effort by the Finnish HEP

Lack of faculty positions
-now: situation is largely the same. One new exp. professor in Jyväskylä.

participating scientists including Master and PhD students is sizable, a very small number of permanent posts are available for senior researchers at the universities. The problems created by the relative lack of permanent posts noted by the Committee during its previous visit, therefore, remain. The Committee thinks that a solution needs to be found, for example by introducing a tenure-track-professorship scheme. Such a scheme would also give a clear career path to the young researchers.

Investments
-now: Research Infrastructure committee created in Academy of Finland 2012, more stable situation. Upgrade funding obtained for CMS+ALICE Phase 1.

projects, provides both stability and flexibility in the research programme. However, there exists a considerable uncertainty in the future prospect, since there is no base program for investment in large experiments and infrastructures, and funding for these activities has been obtained directly from the Ministry of Education and Culture or from ad-hoc programmes implemented by the Academy of

Technology transfer
-now: decline in industrial return, Big Science industry activation (TEKES) terminated. HIP-CERN BIC about to start.

Finland has been extremely successful in obtaining a high return coefficient from CERN. This is certainly due to the high technological level of Finnish industry. However, the sustained effort by the Finnish HEP community to promote technology transfer and to maintain the information flow between CERN and Finnish industry has also been instrumental. The Committee applauds their success and wishes this effort to continue.

Recent developments

Structural development of University of Helsinki

- **HIP NOW: Administratively an independent research institute under the Rector of the University of Helsinki**
- **UH: 18 independent institutes. Only 4 have several partners:**
  - **HIP – the only national research institute, with 5 universities**
  - **Other 3 very different**
    - **HIIT (IT) – UH+Aalto, administratively hosted by Aalto**
    - **FIMM (molecular medicine) – UH and 2 state research institutes**
    - **UniSport – UH+Aalto, student sports facilities**
- **New rector Jukka Kola (2013-2017), memorandum 2.4.2014:**
  - **UH strategy: "…improve the quality, impact and international competitiveness." → UH actions based on strategy: "…continue to develop the structures of UH. In particular consider independent institutes vs. faculties."**

What happens and when?

- A working group set 04/2014 to investigate different possibilities for HIP organisation. Deadline 8.10.2014.
- Options: a) part of Faculty, b) part of Physics Department, c) no change.
- Rector "states that his will is that HIP would operate under the Faculty of Science".
- Rector discusses with faculties in Nov 2014.
- UH Board accepts rectors proposals in Dec 2014.

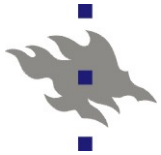
Pros and cons for keeping HIP in current format

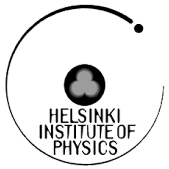
- **Pros**
  - HIP performs superbly, change is a big risk.
  - Efficient and result-oriented organization, flexibility.
  - Administration is used to international matters (people based at CERN, incoming international researchers and students).
  - Short decision paths. Own Board and high-level Scientific Advisory Board.
  - Long-term base funding secured directly from the Ministry of Education and Culture (MEC). Essential for projects with long time span. Within a Faculty the Dean decides about funding.
  - As a part of a Faculty the national character could be lost. Other universities' involvement and interest in HIP would be jeopardized.
  - Without HIP subatomic physics would fragment into separate activities by separate university departments, national coherence lost.

- **Pros cont'd**
  - **Investment funding: who would be responsible for investments if there is no national coordination?**
  - **Direct connection between MEC and CERN + FAIR via the HIP director: he has the mandate to act on behalf of the funding agency at LHC and FAIR RRBs. Also scientific delegate at CERN and FAIR Councils.**
  - **Interdisciplinarity, industry contacts and technology R&D, outreach + education at the national level.**
- **Cons**
  - **Within a Faculty there would be a stronger role for influencing permanent positions, other faculty funds and faculty infrastructure inside UH.**
  - **There might be some further synergy effects concerning teaching and student supervision inside UH.**

Concluding remarks

- High energy physics in Finland: HIP is an effective and excellently performing concept.
- All indicators at the top.
- From RECFA 2010:
  - Research targets met.
  - Situation with permanent faculty: not much progress.
  - Reverse progress in technology transfer. New initiative: HIP-CERN BIC about to start.
- HIP reorganisation: a potential threat.





Backup slides

HIP personnel

Programme	2013 [FTE]	Regular contracts at UH	External grants, adjoint
Theory	23,7		
High-energy physics (finished)	13,0		
CMS	18,5		
Technology	6,2		
Nuclear matter	5,9		
Separate projects	4,2		
Support and practise	11,6		
Total	83,1	63,8	19,3

Construction: 2011-2018

International facility for heavy ion and antiproton research

Near Darmstadt

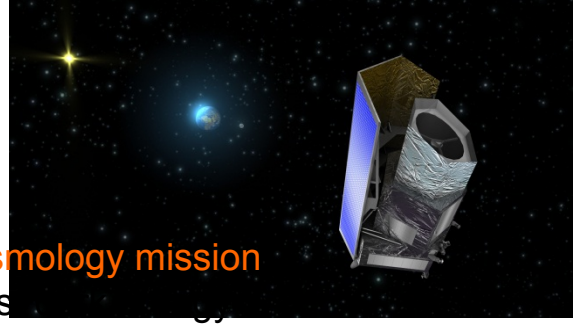
Germany 75 %
Russia 17 %
Others 8 %

Finland-Sweden ~ 1 %

FAIR CONVENTION
2010

Accelerator in-kind 3.4 M€
NUSTAR Collaboration
Future: APPA collaboration
CBM Collaboration

Planck and Euclid cosmology space missions



- Planck
  - HIP Planck project /data analysis
    - sky maps for the 3 lowest frequencies
    - calibration, simulations
    - cosmological parameters for models with isocurvature perturbations
    - ...
  - Data from first 15 months released in March 2013, together with 28 publications
    - 4-7 HIP authors in each
    - *Planck 2013 results. XVI. Cosmological parameters*, has over 500 citations in less than 5 months
  - Total 81 HIP publications so far (since 2009)
  - Next data release planned for 2014 and a final one in 2015
    - Two of the Planck 2014 papers will have HIP coordinators
    - Planck has now collected 4 years of data
    - Planck will cease operation in October 2013

- Euclid
  - Next major cosmology mission
    - main focus
    - complements Planck ideally in improving understanding of the Universe
  - Launch 2020
  - HIP Planck group will shift to Euclid work over the next 2-3 years
  - Now 16 Finnish members (+ students) in Euclid collaboration
    - Univ. Helsinki, Jyväskylä, Turku
  - Kurki-Suonio is the Finnish representative in the Euclid board
    - responsible for the Finnish participation
  - Finnish responsibilities in Euclid data analysis(based on Planck experience)
    - One of the 8+ Euclid Science Data Centers (in collaboration with CSC);
    - Data Quality Control Tools work package
    - software development for simulation of Euclid data
  - Participation in several Euclid science working groups (cosmological/gravity theory, cosmological simulations, correlation with CMB, ...

UHEL participation in CLOUD 2012-2013

- Main responsibility in CLOUD for measuring ions and smallest particles with state-of-the-art instrumens
- 10 persons working at CERN during intensive campaigns, 24/7
- CLOUD6 campaign in June-July 2012
  - Preparation for ice nucleation studies (for CLOUD8)

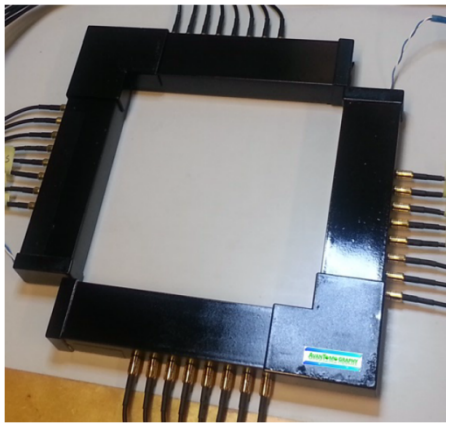
- CLOUD7, October-December 2012
  - Effect of different oxidation products of organics on nucleation and early growth of particles

- CLOUD8, October–December 2013
  - Nucleation experiments
  - Study formation of liquid and ice clouds
  - Analyzing data from previous campaigns

- 3 manuscripts under review for publication in Nature, Science, PNAS; 10+ manuscripts in preparation, submitted or published

By Ulla Ruotsalainen

AvanTomography



- Exploiting the gained knowledge from AX-PET project to build avant-garde solutions in medical imaging.
- Bringing new ways of examinations to the field of nuclear medicine imaging with flexible and modular scanner structure
- The prototype is built with TEKES TUTLI funding and with international and national collaborators.
- The first clinical experiments are planned to be in Spring 2014.

AVANTOMOGRAPHY