ECFA Midterm Report for AUSTRIA

Presented by
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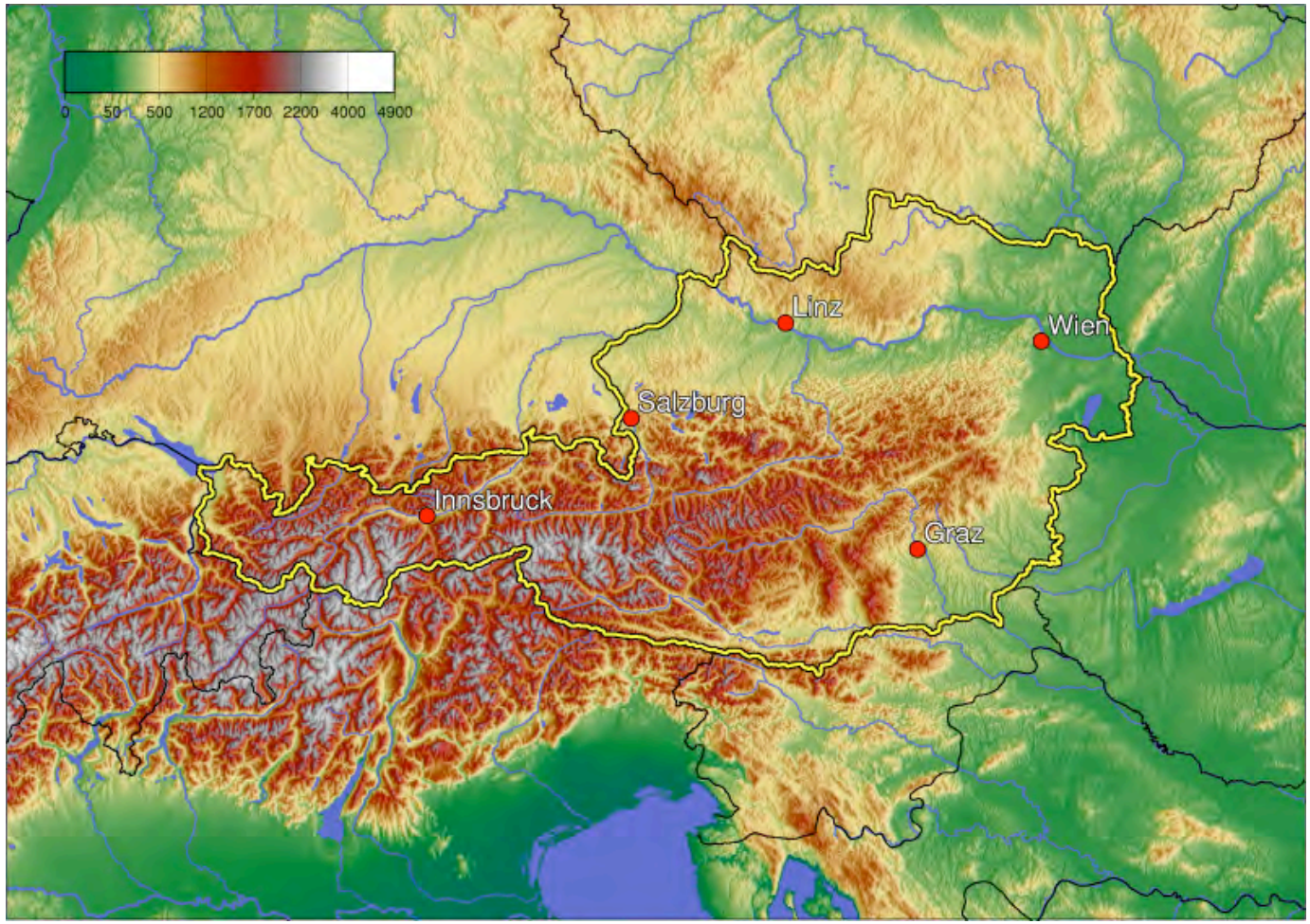
ECFA Meeting, CERN, 28 Nov. 2008

BASIC INFORMATION ABOUT AUSTRIA

Population: 8.2 million
GDP per capita: 36200 US$ (OECD average 30900 US$)
Total expenditure for R&D in % of GDP: 2.42%



RESEARCH PROJECTS IN HEP

Accelerator-based physics

CERN: Active: ATLAS (4 FTE), CMS (23 FTE), nTOF (2 FTE), ASACUSA (FTE's included in FAIR)
Finishing: NA48, ALEPH, DELPHI, nTOF (pre-2005)

KEK/JAEA: BELLE (4 FTE), J-PARC E15 & E17 (FTE's included in FAIR)

FAIR: FLAIR, PANDA, AIC (16 FTE in total)

DAFNE: Siddharta (FTE's included in FAIR)

Non-accelerator-based physics

LNGS: VIP (FTE's included in FAIR)

Astroparticle physics (4 FTE)

FERMI (formerly GLAST)

HESS

Cosmic Ray Observatory Innsbruck

Detector R&D (FTE counted under items above except for ILC)

RD42, SLHC, ILC (1 FTE), Detectors for astro- and particle physics

Accelerator R&D

medAUSTRON (8 FTE + 2 FTE consultants)

Particle physics theory and phenomenology (75 FTE)

SUSY, QCD, QFT, chiral perturbation theory, neutrino physics, quantum mechanics, gravitational physics

RESEARCH GROUPS IN HEP

- Institute for High Energy Physics Vienna (HEPHY Vienna)
  - experimental physics, theory/phenomenology
- Institute for Astro- and Particle Physics of the University of Innsbruck
  - experimental physics, theory/phenomenology
- Stefan Meyer Institute for Subatomic Physics Vienna (SMI)
  - experimental physics
- University of Vienna
  - theory/phenomenology
- Vienna University of Technology
  - theory/phenomenology
- Atomic Institute of the Austrian Universities, Vienna
  - experimental physics, theory/phenomenology
- University of Graz
  - theory/phenomenology

Institute for High Energy Physics Vienna

http://www.hephy.at

Running experiments:

CMS: Trigger, Tracker, Physics Analysis
BELLE: Electronics, Physics Analysis

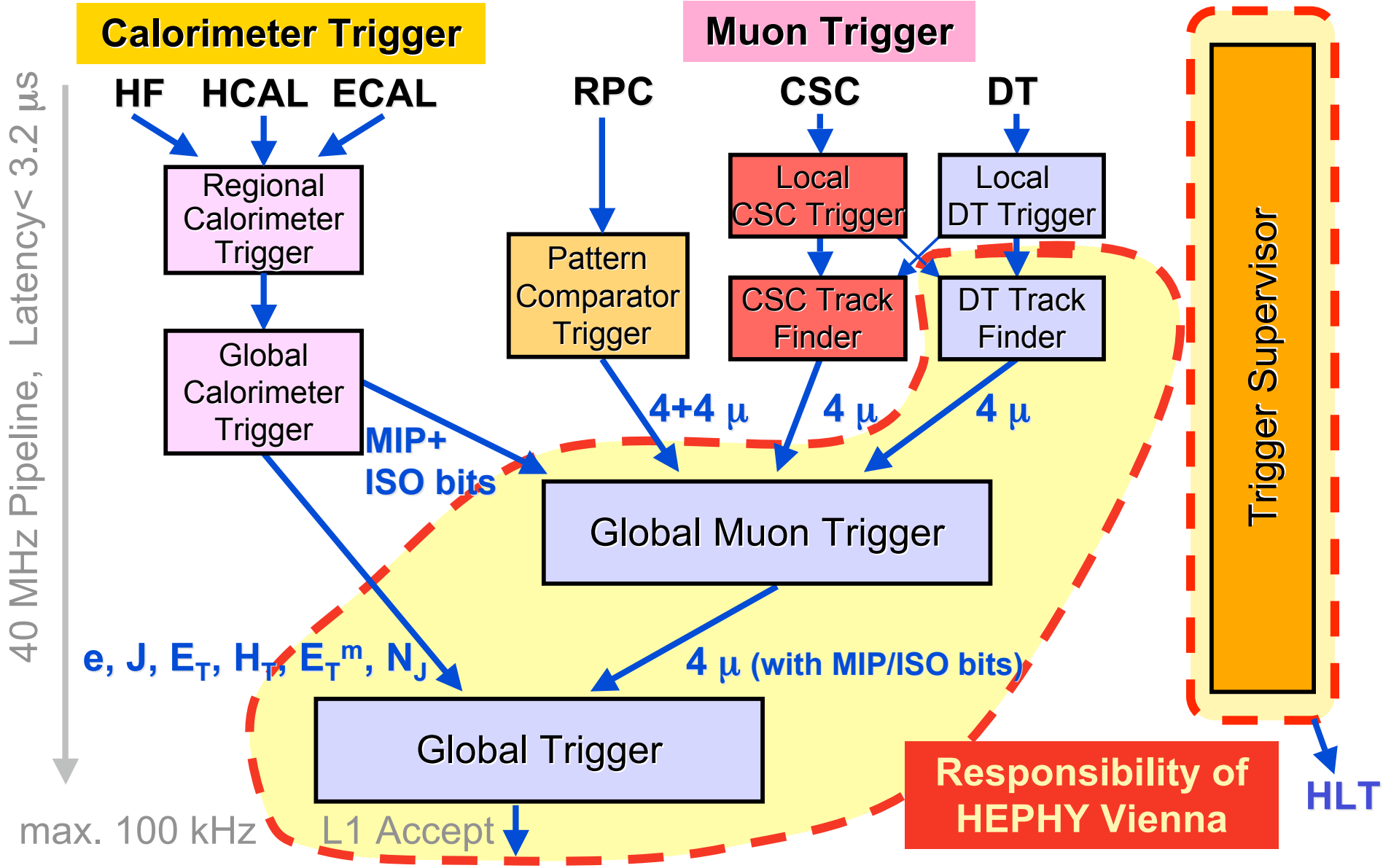
Theory:

SUSY
QCD

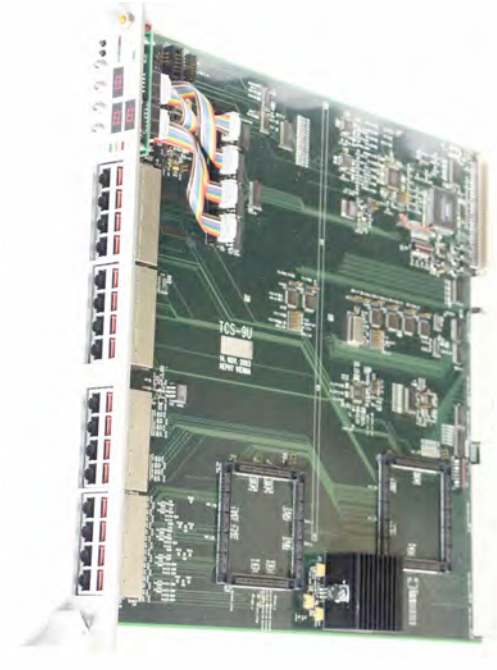
Future projects:

ILC
SLHC

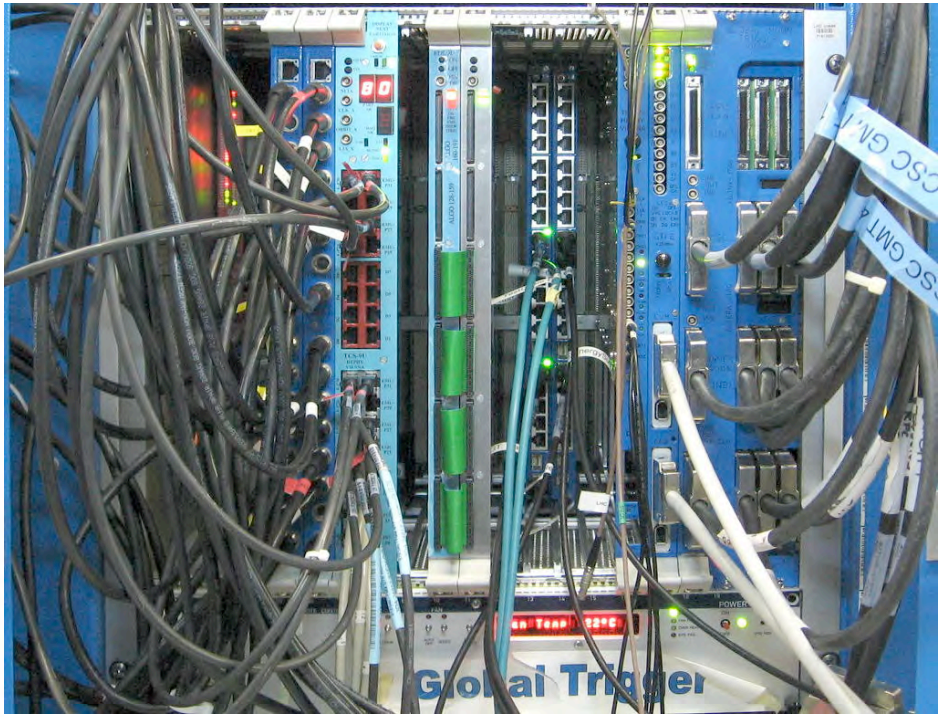
CMS Level-1 Trigger Contributions

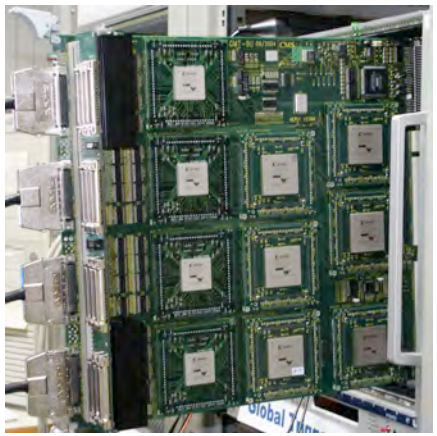


CMS Global Trigger and Trigger Control System

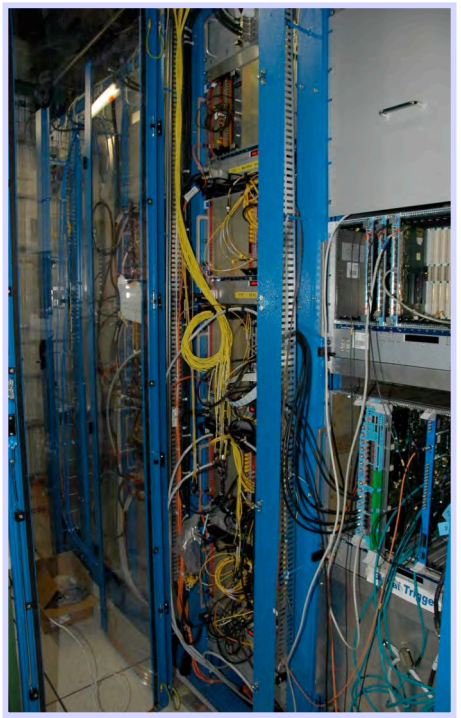


TCS module



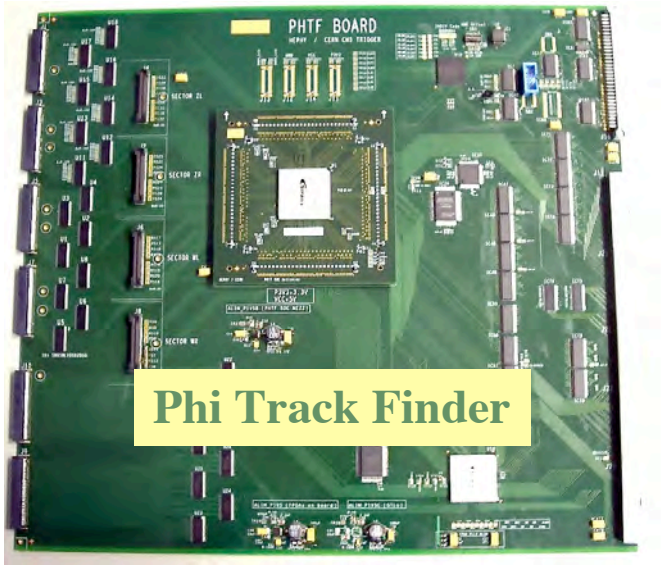


Global Muon Trigger

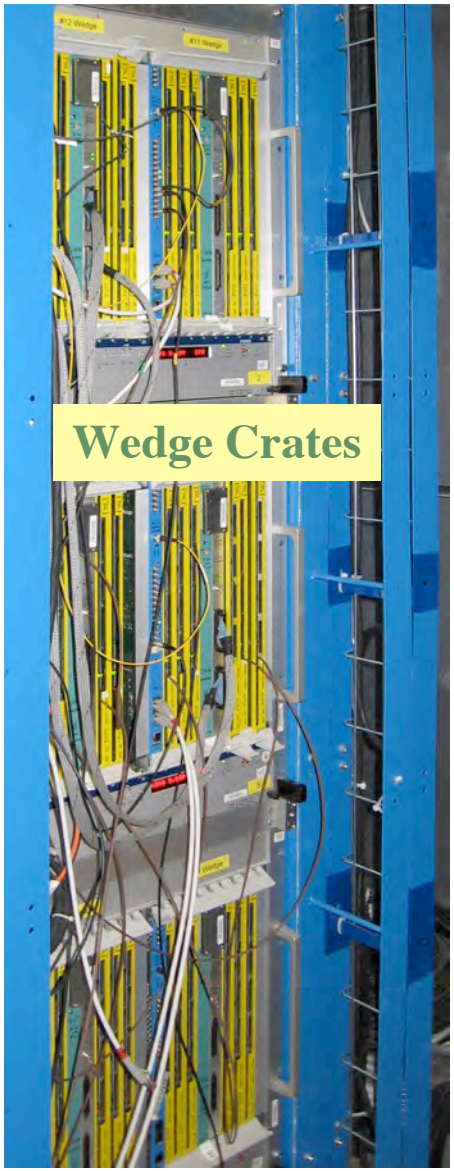


CMS Muon Trigger Contributions


Central Crate



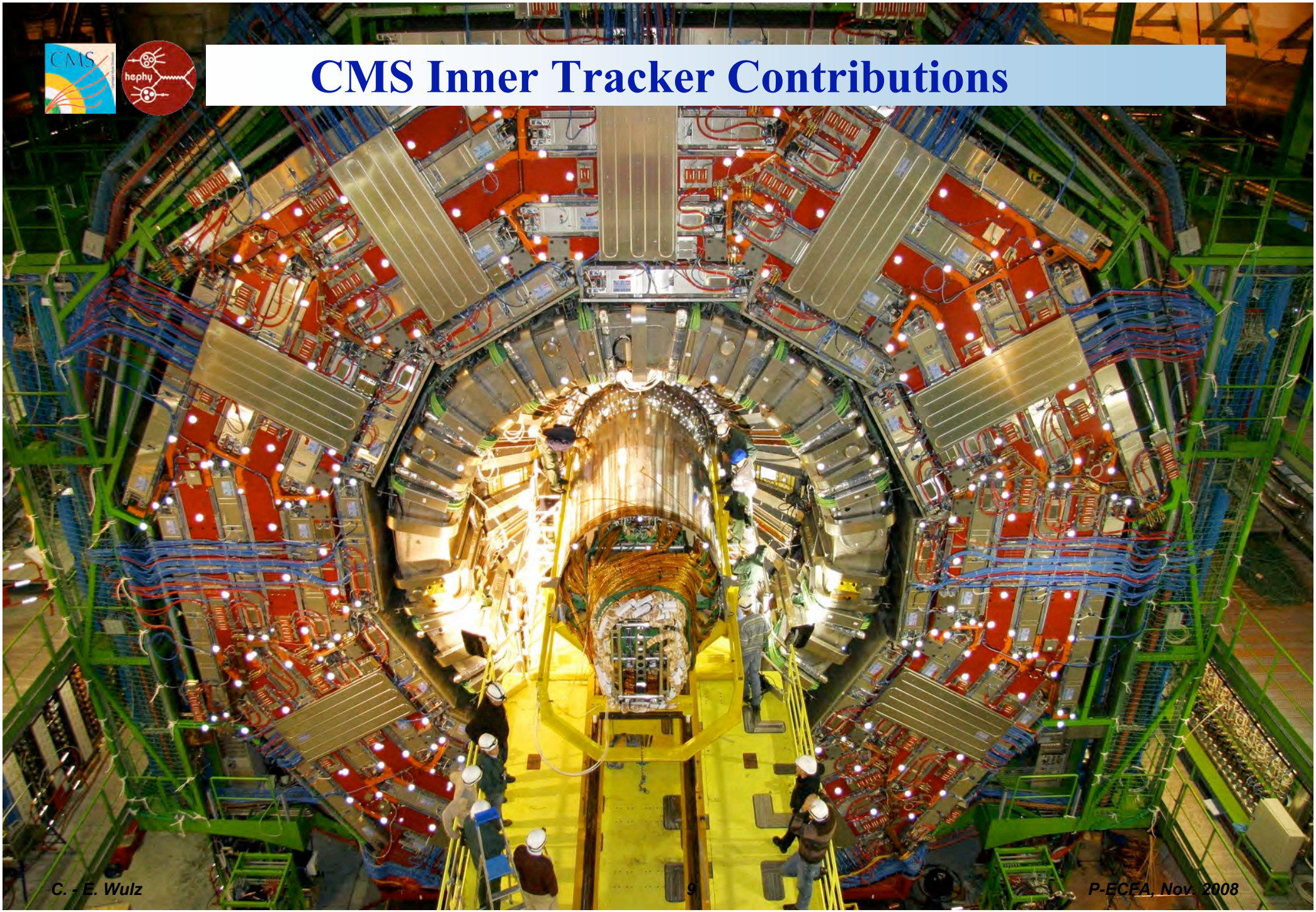
Phi Track Finder


Wedge Crates


Cabled Wedge Crates

Eta Track Finder

CMS Inner Tracker Contributions



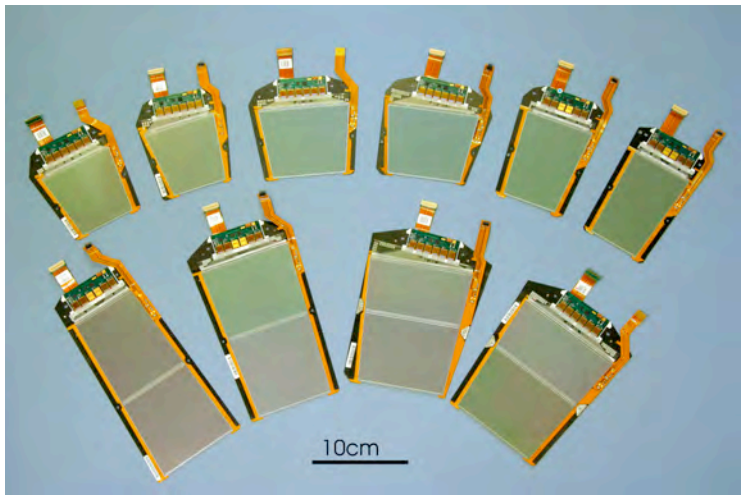
CMS Silicon Strip Tracker Contributions

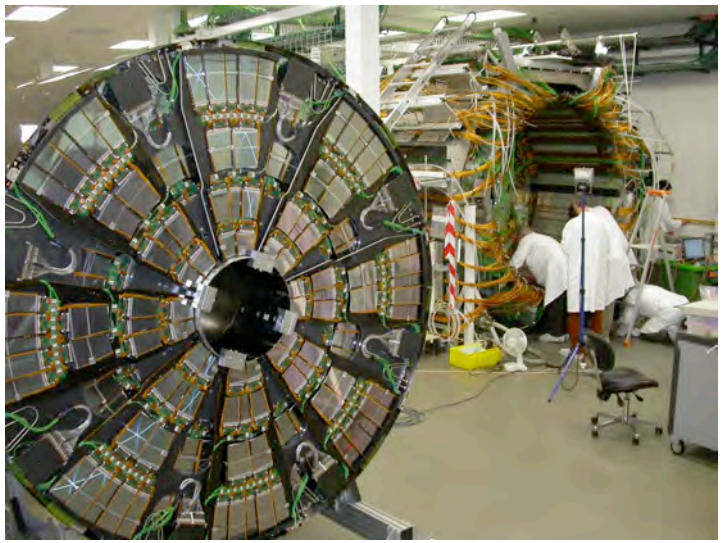
Construction of the Silicon Strip Tracker:

Coordination and test centre for quality control of the silicon sensors
Coordination of the module production for the tracker endcaps (TEC)
Production and test of two TEC rings (bonding, assembly)

Tracker electronics:

Design and quality control of 14000 analog optohybrids, produced at Kapsch in Austria.
Tests of readout chips in testbeams at PSI and DESY.

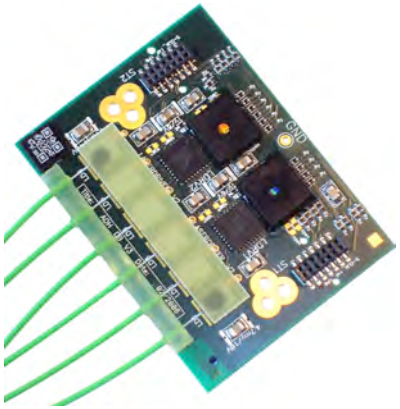




CMS Pixel Detector Contributions

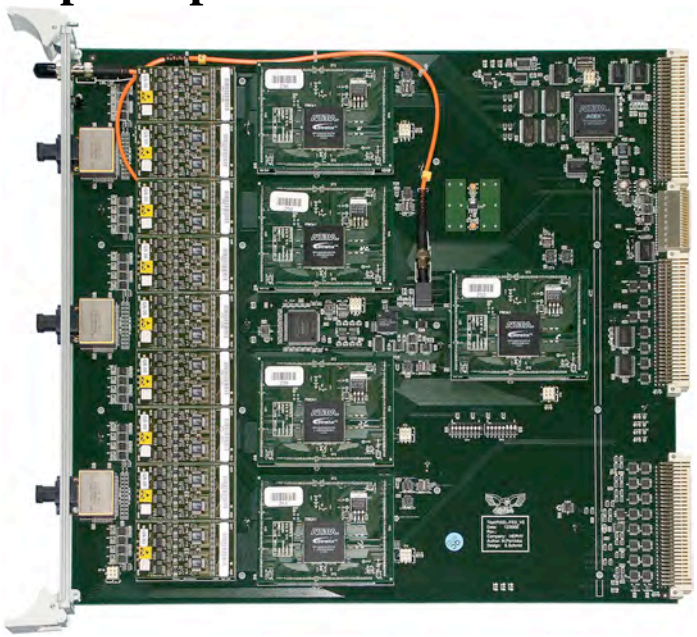
Pixel optohybrids:

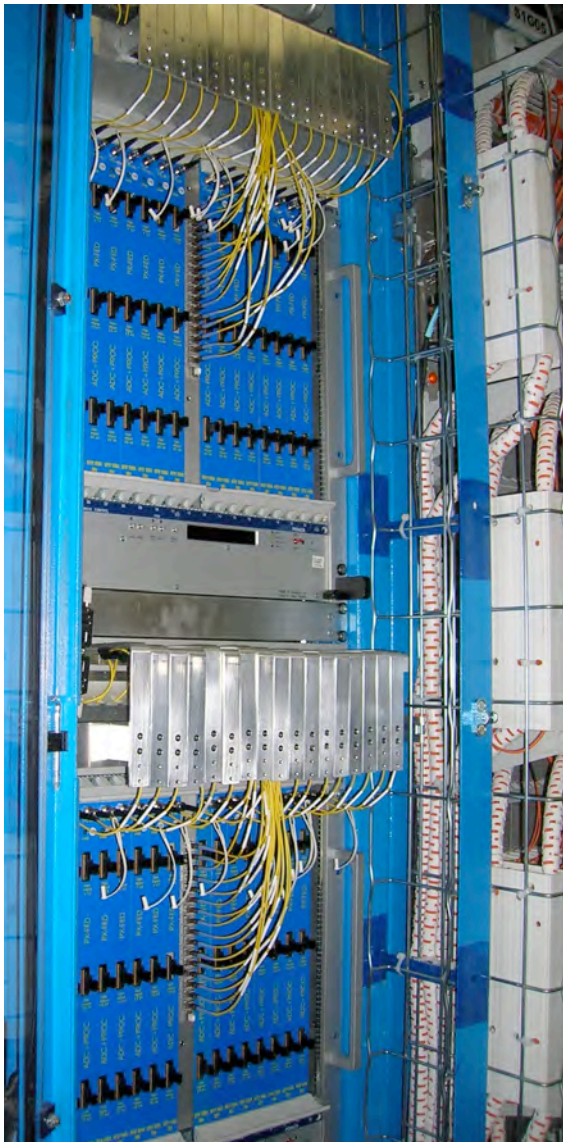
Technical responsibility



Pixel electronics:

Design and production of Frontend Drivers -
1.6 million pixels per module

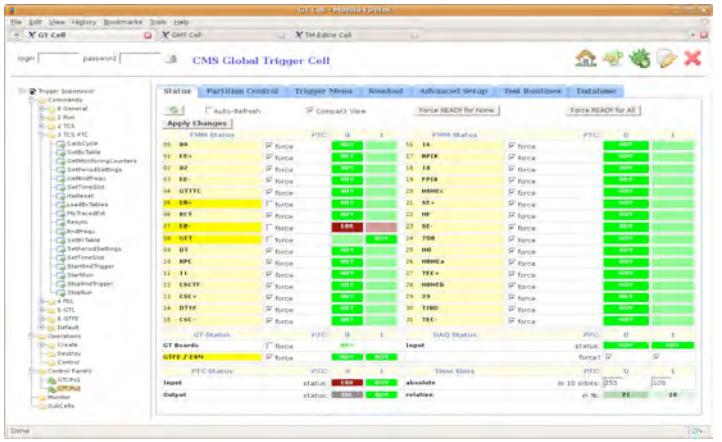




Software and Analysis Contributions to CMS

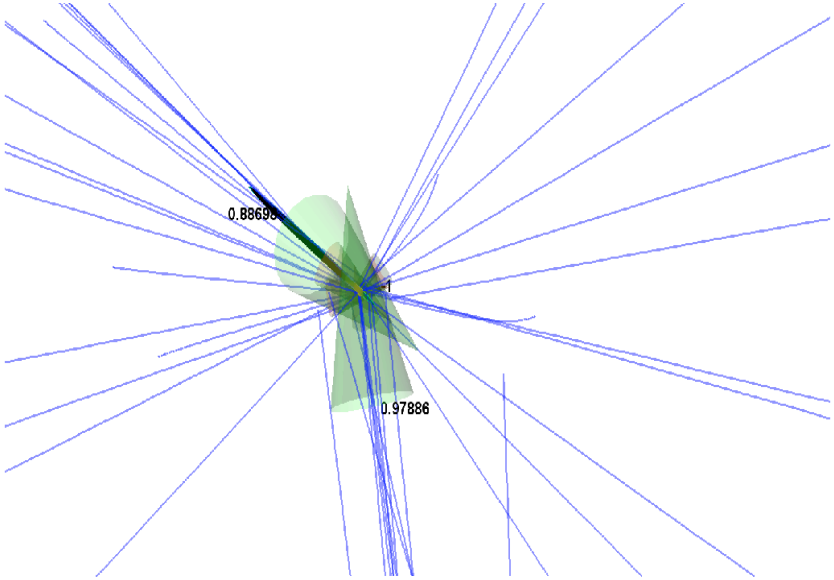
Trigger software:

Level-1 Trigger offline- and online software
Monitoring software



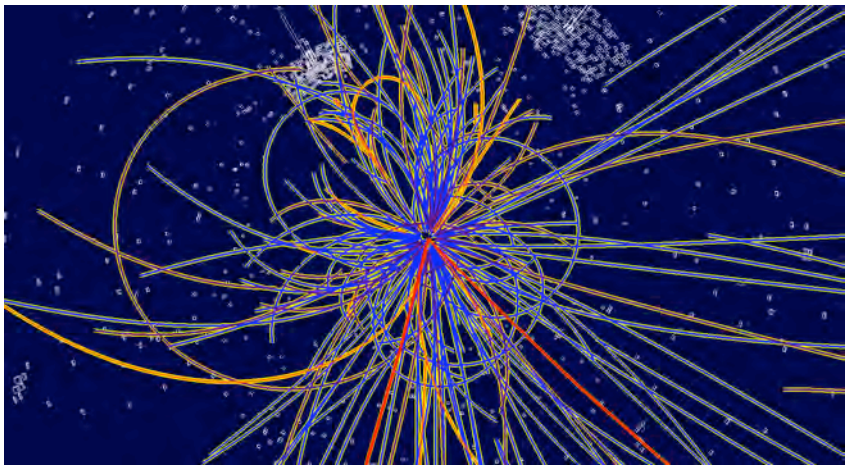
Tracker software:

Track- and vertex reconstruction algorithms
B-tagging algorithms
Alignment



Preparations for physics analysis:

Top studies
Supersymmetry



BELLE

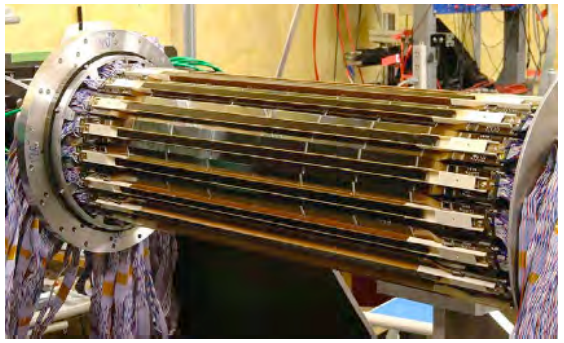
Belle at KEK (Japan) studies the flavour sector of the Standard Model, mainly through measuring the CP violation in B mesons. HEPHY Vienna is a member of the Belle collaboration since 2001. The main contributions were the readout system of the vertex detector and the participation in the physics analysis.

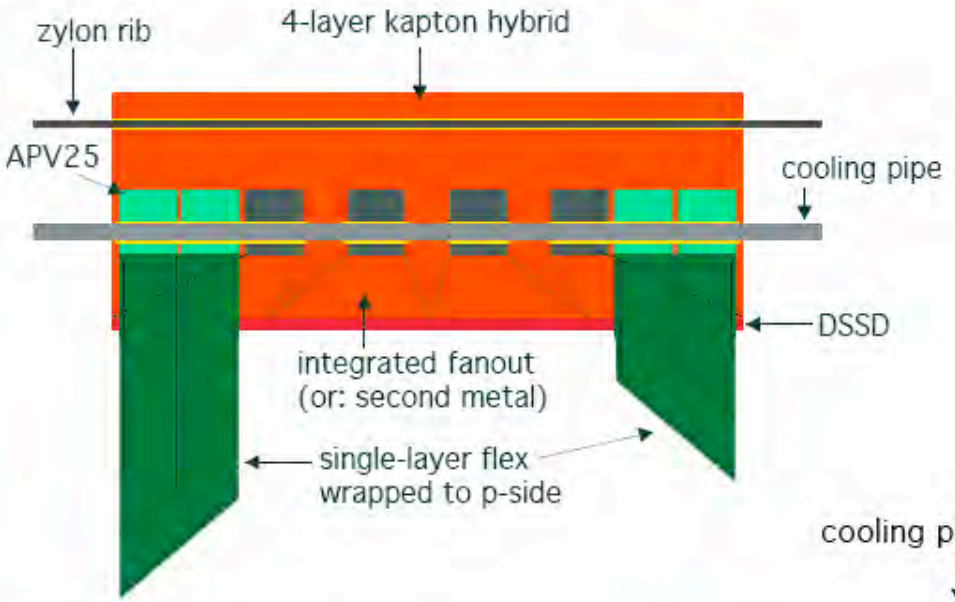
Main physics topics, with 5 BELLE papers with first authors from HEPHY: semileptonic B-decays ($|V_{ub}|$, $|V_{cb}|$) and charm decays

- First observation of $B^+ \rightarrow \omega l^+ \nu$
- $|V_{cb}|$ inclusive
- $B^0 \rightarrow D^{*-} l^+ \nu$ ($|V_{cb}|$ exclusive and form factors)
- $D^0 \rightarrow K^- l^+ \nu$ or $\pi^- l^+ \nu$
- $D_s^0 \rightarrow \mu^+ \nu$

BELLE Silicon Vertex Detector Upgrade

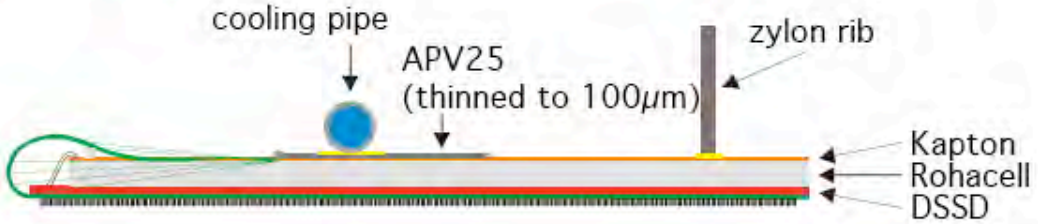
Present Silicon Vertex Detector 2 was installed in 2003. HEPHY Vienna built the readout electronics (FADCs). For the upgrade, a new readout chip is under development.





Vienna Origami concept

Side View
(below)



ILC, SLHC

ILC:

Coordination of the R&D contributions to the design of a detector for a future e^+e^- linear collider.
HEPHY has signed the Expression of Interest of the International Large Detector (ILD) Collaboration.

Letter of Intent is in preparation for 2009.

No financial commitments so far.

SLHC:

For the Super-LHC luminosity upgrade, HEPHY investigates new technologies for trigger design and optical links.

Theory at HEPHY Vienna

Supersymmetry

- SUSY Higgs decays
- SUSY phenomenology at LHC and ILC
- Radiative corrections to processes with SUSY particles
- CP violation in SUSY
- R-parity violation
- Spin correlations (in chargino/neutralino production and decay)
- Lepton flavour violation (LFV)

QCD

- Study and description of bound states - primarily but not exclusively of quarks - by relativistic equations of motion.

ATLAS, ALEPH, HESS, FERMI - Innsbruck

Creation of a new Institute for Astro- and Particle Physics at the Leopold-Franzens University Innsbruck in 2004

High Energy Group (Prof. D.Kuhn) and *Astrophysics* (Prof. S. Schindler) merged
http://astro.uibk.ac.at/

Particle Physics fields of work (4 FTE):

- ATLAS-Detector: B-Physics (flavour tagging algorithms, Δm_s (B-Oscillations))
- ALEPH- Data: QCD, Gluon jet fragmentation and model calculations

Astroparticle Physics fields of work (4 FTE):
(starting April 2009 with Prof. O. Reimer, successor of D. Kuhn)

- HESS (http://www.mpi-hd.mpg.de/hfm/HESS/)
- FERMI (formerly known as GLAST, http://fermi.gsfc.nasa.gov/)
- development of astroparticle detectors

Accelerator-based research

- CERN Antiproton Decelerator: ASACUSA collaboration (Atomic Spectroscopy And Collisions Using Slow Antiprotons)
  - pbar-He [CPT, three-body QED, antihydrogen (CPT, matter-antimatter asymmetry]
- LNF DAFNE: SIDDHARTA collaboration (Silicon Drift Detectors for Hadronic Atom Research by Timing Application)
  - Kaonic atoms, strong interaction in kaonic atoms, search for di- and tribaryons with strangeness -1 (AMADEUS, Antikaonic Matter at DAFNE)
- J-PARC: E15 & E17
  - Kaonic atoms, strong interaction in kaonic atoms, search for dibaryons with strangeness -1
- FAIR: FLAIR (spokesperson E.Widmann), PANDA, AIC (antiproton-ion collider)
  - Austria contributes to construction & operation of FAIR

Non-accelerator-based research

- VIP experiment

Experiment on the Pauli Exclusion Principle (PEP) Violation – worldwide best limit on PEP violation

Detector R&D

- GEM based detectors: PANDA, AMADEUS
  SiPM detectors: scintillating fiber detectors
- Cherenkov detectors: PANDA, FOPI, AMADEUS
- SDDs for exotic atom research (SIDDHARTA)

University of Vienna

http://www.thp.univie.ac.at/english/research/particle/part-home.htm

Flavor physics and quantum field theory

- The Standard Model at Low Energies
- Phenomenology of Supersymmetry
- Models for neutrino masses and mixing
- Tests of quantum mechanics in particle physics
- Quark bound states in QCD
- Complex stochastic systems, quantization of gauge theories

Atomic Institute Vienna

http://www.ati.ac.at/

Two HEP working groups:

Group A - experimental and theoretical physics:

Neutron cross-section measurements at nTOF facility at CERN (until 2005, restart in 2009)
2 staff members, 2 PhD students

Group B - theoretical physics:

Hadron physics and field theory
2 staff members, 2 postdocs, 1 PhD student

Vienna University of Technology

Institute for Theoretical Physics
http://www.itp.tuwien.ac.at

RESEARCH TOPICS

String theory

Classification of compactification manifolds

Quantum field theory

Supersymmetric gauge dynamics, supersymmetric solitons
Non-commutative field theory
Low-dimensional quantum gravity

Theory of the quark-gluon plasma

Thermal field theory
Novel strong coupling methods (AdS/CFT)

Gravity

Karl Franzens University of Graz

Institute for Physics, Theory Department: Theoretical Elementary Particle Physics, in particular QCD (60% of department)
http://physik.uni-graz.at/itp

RESEARCH GROUPS

Strong interactions in continuum quantum field theory

QCD Green functions, QCD thermodynamics, hadron structure and hadronic reactions, strong-field QED (particle creation and transport), low-dimensional quantum field theories

Lattice QCD (http://physik.uni-graz.at/lattice)

Lattice approach to QCD, chirally improved lattice Dirac operators in QCD, topology and spectral properties of lattice Dirac operators,

Karl Franzens University of Graz

Few-body physics

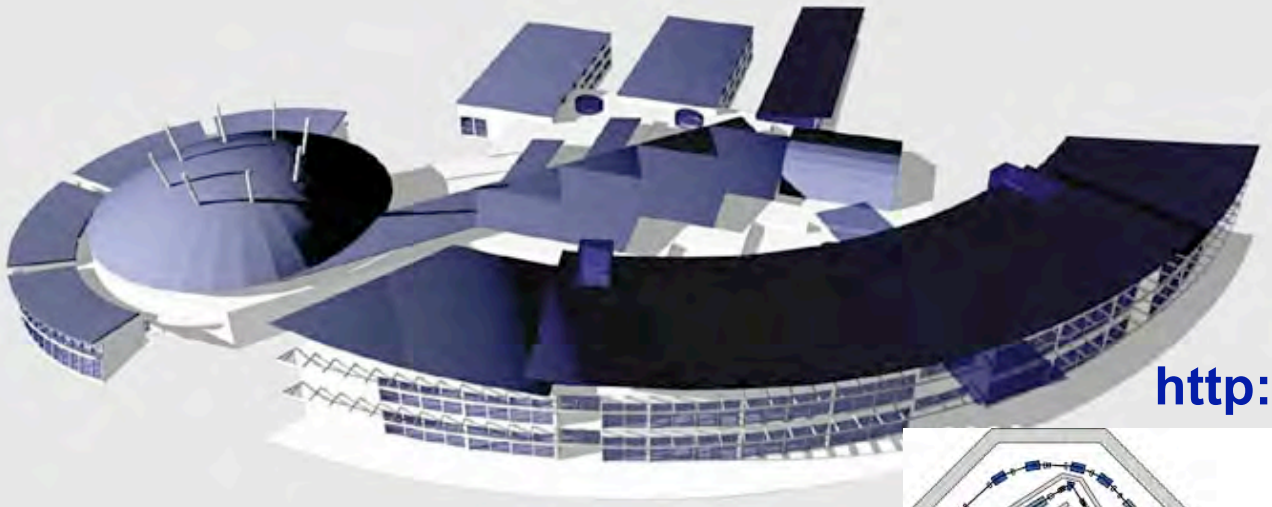
Poincaré-invariant formulation of relativistic few-body systems, relationship of different forms of relativistic dynamics (instant form, front form, point-like form), formulation of quantum field theories in point-form.

Exclusive hadronic processes, relativistic few-body systems

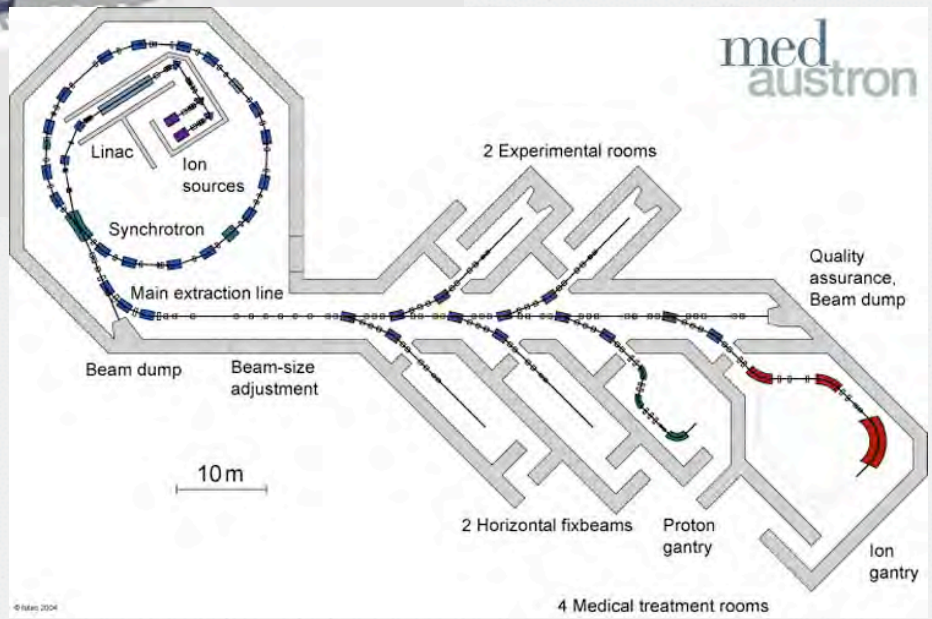
Perturbative calculations of photoproduction of mesons, production of open-charm baryons, application and modelling of generalized parton distributions.

MedAUSTRON

Proton and ion therapy and non-clinical research



http://www.medaustron.at



The partnership agreement with CERN has recently been renewed.

The first experimental operation is planned for 2013.

RESOURCES

Total investments per year into particle physics equipment, both to CERN and other labs:
HEPHY: 220 kEUR, SMI: 100 kEUR
Total investment in CMS 1996-2011 (Ministry): 3356 kEUR
Total investment by Atomic Institute in nTOF at CERN: 190 kEUR up to 2005, resources for new phase to be defined

Yearly maintenance and operation costs per year to CERN and other labs, including funds for travel and subsistence:
HEPHY: 120 kEUR (M&O), 180 kEUR (travel), 150 kEUR (subsistence)
SMI: 300 kEUR

Principal funding organisations for Austria:
- Ministry of Science and Research (funds the Universities, the Academy of Sciences and provides additional funds on a case-to-case basis)
- FWF - Science Fund, for basic research (but not big CERN experiments)
- FFG - Research promotion agency (applied industrial research)
- EU

TEACHING OVERVIEW

Universities with teaching and research activities: 22
Universities offering physics education: 7
Universities offering HEP education (Vienna, Innsbruck, Graz): 4
Estimated length of PhD in particle physics: 3 years recommended

Following the 1999 Bologna recommendations, studies have gradually been reorganized since 2003/2004. Bachelor and Master degrees were introduced. Normal duration of studies: Bachelor 6 semesters, Master additional 4 semesters.

"Fachhochschulen" (universities of applied sciences) also exist. These are not taken into account in the above list. They offer Bachelor (6 sem.), Diploma (+2 sem.) and Master (+2 sem.) degrees.

TEACHING DATA

The following data are for the winter semester 2007/2008, except for obtained degrees, which are for the academic year 2006/2007. "Physics" does not include astronomy or meteorology.

	TOTAL	FEMALE	MALE	% FEMALE	% MALE
Students per subject of study	313,632	167,941	145,691	53.5	46.5
Students overall	233,046	124,651	108,395	53.5	46.5
Nat. Science & Tech. students	92,326	37,918	54,408	41.1	58.9
- Natural Science students	39,888	24,733	15,155	62.0	38.0
- Technology students	52,438	13,185	39,253	25.1	74.9
BSc/MSc physics students	1,201	204	997	17.0	83.0
PhD physics students	629	123	506	19.6	80.4
Obtained Bsc/MSc in physics	191	40	151	20.9	79.1
- Obtained Teaching Diplomas	10	8	2	80.0	20.0
Obtained PhD in physics	49	5	44	10.2	89.8

Figures subdivided in experimental and theoretical physics are not officially available.

OUTREACH ACTIVITIES

Coordination of various events for schools, students and the public at large:

Travelling exhibition for schools
Masterclasses
University for Kids
Physics teacher education
Public lectures
Exhibitions
Lange Nacht der Forschung
Press, radio and TV contributions
etc.

REGULAR CONFERENCES

Vienna Conference on Instrumentation

Organised every 3rd year by HEPHY Vienna with the Vienna University of Technology

Vienna Central European Seminar on Particle Physics and Quantum Field Theory

Organised annually by University of Vienna, formerly Triangle Seminar

Annual Winter School Schladming

Organised annually by University of Graz

LECTURES AND SCHOOLS

Schrödinger Guest Professorships

Annual lectures by distinguished particle physicists at University of Vienna

Graduate School “Hadrons in Vacuum, Nuclei and Stars”

Organised by University of Graz

CERN Schools of Physics and Computing

Organised by CERN and HEPHY Vienna

COMPUTING

- *2002:* Tier-2 pilot project in Innsbruck

- *2008:* WLCG-MoU signed for federated Tier-2 project Vienna-Innsbruck for ATLAS-CMS (in the framework of the Austrian GRID-project, coordinated by Innsbruck). There are also preparations for PANDA-GRID.

Initial Budget: 1.3 M€ (1.053 M€ for hardware)
Budget for future M&O to be defined.

Pledges until 2010: 760 CPUs SI2k, 120 TB

Status:

	CPUs		*Storage*	
	now	end of 2008	now	end of 2008
Vienna	200	500	70	270
Innsbruck	272	272	54	54
TOTAL	472	772	124	324

Federated Tier-2 Cluster Innsbruck

Tier-2 at HEPHY Vienna

Acknowledgments

The following persons have contributed information and/or transparencies for this talk:

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