CERN Stratégiai Fórum
Krakkó – 2012. Szept.

„European Strategy for Particle Physics”
(Előző ESPP: 2006 – Orsay)

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A „European Strategy for Particle Physics” tanulmány elkészítése
– a CERN koordinálása mellett

Menetrend:
A „CERN Strategy Group” és a WG-k ülésezése

2012. Márc. 16. : SG 1. ülés (CC)
2012. Jún. 9.: SG 2. ülés (CC)
2012. Szept. 10-12: Open Forum, Krakkó (500 résztvevő)
2012. Szept. 12: SG 3. ülés – Írott report a WG-ktől
2012. Szept. 18: SG 4. ülés (CC) – Krakkói tanulságok
2012. Dec. 11: SG 5. ülés (CC) – WG reportok

2013. Jan.21-26: Erice, a Stratégiai Jelentés fogalmazása (40 fő)
2013. Márc. SG 6. ülés (CC) – CERN Council elé terjesztés
2013. Május 22: Brüsszel – „EU Council of Ministers” elé terjesztés
2013. Május 29: Brüsszel – CERN Outreach
→ lobbizás az EU Parlament tagjainál
A Stratégia elfogadása a legmagasabb EU szinten (!?)

A „Strategy Group” 5 munkacsoportja (WG):

1. **Working Mode of CERN Council for the European Strategy matters**
   Chair: M. Spiro (F)

2. **Faremwork for the European particiaption to a global project and role of national laboratories and CERN Geneva laboratory**
   Chair: S. de Jong (NL)

3. **CERN relation with the European and International bodies such as EU, ESFRI, and others**
   Chair: B. Asman

4. **Knowledge Transfer and Industrial relation**
   Chair: E. Augé

5. **Education, Outreach and communication**
   Chair: S. Bethke

Személyes benyomások a Krakkó – ESPP konferenciáról:

1. Az első napon elhangzott összefoglaló előadások kiválóak voltak.
   „Must see!!!” Feltöltöttem őket ezen előadás mellé (Krakko01-08)
   A Konferncia WEB lapja: „http://espp2012.ifj.edu.pl/”
   Előadások: „http://indico.cern.ch/conferenceDisplay.py?confId=182232”

2. Japán bejelentése: Fukushima közelében az újjáépítési támogatásból
   felépítenek egy új tudományos központot (Tsukuba-2), ahol megépítik
   a J-ILC-t, méghozzá 3 ütemben: [Yamauchi előadása a végén]
   - 250 GeV, Higgs-gyár (J-LEP) < 2025 (?) [< 2030]
   - 500 GeV upgrade, precíziós mérések
   - 1 TeV upgrade (SC mágnesek) LHC eredmények igazolása
   50 % japán + 50 % nemzetközi

3. USA: FERMILAB 2011-ben leállt, nehéz lesz újraindítani (mu-mu coll?)
   - Cosmic Frontier: Dark Matter, Dark Energy (sok ‚kicsi’ kísérlet)
   - Energy Frontier: HL-LHC, HE-LHC upgrades, R&D (16T tér)
   - Intensity Frontier: Neutrinó kísérletek, föld alatti detektorok
     Project-X, HI-gyorsítók, Nagy távolságok

Back to the Future

Picture courtesy of R. Rattazzi

What would have happened if in 1996 the CERN directorate had accepted the offer of the German company who was producing the LEP superconductive cavities and spent XX MCHF to buy 32 extra cavities?

- the Higgs is discovered in the Spring of 2000
- the democrats understand that Clinton made a mistake in canceling the SSC and they decide to resume the project
- science becomes a major topic in the campaign and people understand that the results in Florida is not a statistical fluctuation but a fraud
- Al Gore becomes the 43rd US president
- no war in Afghanistan nor in Iraq
- no economical crisis
- Japan starts building an ILC in 2010, CLIC construction starts in 2011.
- LHC discovers SUSY in the fall of 2012... Etc, Etc...

We are only a few years behind schedule!

Konklúziók a különböző területekről

(Nakada bezáró előadásából)

Elhangzott előadások nagyon jók voltak !!!

High Energy Frontier

- Discovery of Higgs-like state is a landmark for the field (and a triumph for the LHC)
- Plethora of SM measurements with increasing precision (QCD,t,W,Z,VV,...)
- Searches for NP leading to o(TeV) limits on new particles

- Excellent prospects (much increased NP reach!) for 14 TeV LHC (300 fb^{-1}) and many studies
- Higgs measurements & WW unitarity require HL-LHC 3000 fb^{-1} upgrade (detectors + machine)

- Excellent physics case for the study of „Higgs" state (+top, EW) in depth with high precision and complementary to LHC in e^+e^- ($\gamma\gamma$?, ep??)
- Announcement from Japanese community to aim hosting ILC (250-500 GeV) as global project
- Assess which machine best suited for this program (linear vs. circular)
- Time matters – technical readiness also

- In absence of direct evidence for NP and strong theoretical guidance too early to decide on post-LHC facility for HEF (CLIC, HE-LHC(33), UHE-LHC(50+), µC, Plasma??, ...)
- Maintain critical R&D and feasibility studies

Summary of Flavour Physics and Symmetry Session

- Recent Progress
  - B Factories (Belle and Barbar) have completed data taking and continue to provide wide range of interesting results, including CP violation and rare decays.
  - LHCb has demonstrated that precision flavour physics is possible at hadron collider
  - High-p_T experiments (CDF, D0, ATLAS, CMS) also doing excellent flavour physics
  - Detailed study made of CP violation and rare decays in B system (now including B_s)
  - NA62 is completing its preparation for precision kaon physics
  - MEG at PSI is improving a search for $\mu \rightarrow e\gamma$ at 2.4×10^{-12}
- Open Issues
  - No clear sign of physics beyond the Standard Model in flavour sector, and possible key measurements (a la G. Isidori) are as follows.
    - Φ_s, $|V_{ub}|$, CP angle gamma, B rare decays such as $B_s \rightarrow \mu\mu$ and $B \rightarrow \tau\nu$
    - CP violation in charm
    - K rare decays such as $K \rightarrow \pi\nu\nu$
    - Charged lepton flavor violation (CLFV) eg. $\mu \rightarrow e\gamma$, $\mu N \rightarrow eN$, $\mu \rightarrow eee$, $\tau \rightarrow \mu\gamma$, etc.
    - Muon g-2 and EDM (neutron, electron, muon, atom)
- Towards a Strategic Plan
  - Essential to maintain a diverse programme (B, D, K, charged leptons)
  - Flavour experiments typically on smaller scale than Higgs/neutrino, but crucial for search for/understanding of New Physics
  - LHCb and its upgrade form an important part of the exploitation of the LHC
  - An upgraded B Factory will give complementary physics coverage
  - CLFV (μ and τ) and EDM could provide a clean demonstration of new physics

Summary slide, strong interaction session Open Symposium on European Strategy for Particle Physics, Cracow, Poland, Sep. 2012

2 talks: P. Newman, QCD at HE frontier H. Appelshaeuser, QGP

Summary QCD: new facility LHeC + ongoing projects (Compass, LHC expts,...)
Discussion: LHeC-- unprecedented kinematic range for DIS studies ep, eA
low x (saturation) physics, some capability for Higgs physics.
Improved pdf constrains as required for HL-LHC. important input for QGP?
Or is pp/pA sufficient? Time scale around 2025. Interference with HL LHC?
Proton spin physics: Compass, RHICpp, JLAB12, and future eRHIC/eLIC

Summary QGP: top priority: LHC ion running and ALICE upgrade, to 2025
also: interesting physics remains at high baryon density (5 < sqrt(s) < 40 GeV)
Discussion: important discovery potential with 50 kHz Pb-Pb running for ALICE, ATLAS, CMS
Ions in HE LHC?
LHC program complementary to RHIC

high baryon density: RHIC-BES, SPS, NICA, FAIR/CBM (SIS300?)
need of experiments at all 4 facilities? coordination needed, time scales?
special role of SPS

Astroparticle physics, gravitation and cosmology - session summary

- **Large variety of exciting experiments and physics topics** - APP community size has grown fast in recent 5 years: in Europe now ~ 2000 scientists
- **The following synergies were identified** :
  - LHC searches for new particles and direct/indirect searches for dark matter , axions
  - Specific models may relate $0\nu\beta\beta$ measurements (low E) and LHC results (high E)
  - Sterile neutrinos and dark matter
  - HE cosmic rays and LHC measurements, eg AUGER and LHC cross sections
  - Next LBL neutrino detector should have capabilities for astroparticle physics to justifty investment ; therefore it should go underground
- **On the role of CERN:**
  - There should be a closer collaboration between ApPEC and CERN, eg exchange of information
  - The CERN convention allows research in the field of cosmic rays
- **Organisation of APP projects:**
  - Present planning stops around 2020 (with exceptions): wait for results for next phases
  - Global planning is needed on worldwide scale
  - APP is in between astrophysics, cosmology and particle physics – which community decides on core business of given project?
  - CERN, national agencies and ApPEC should support R&D program on neutrino detectors & beam design studies

Summary of the ν session

- ν mass and mixings confirmed by many experiments and remain, with dark matter, the only present evidence of beyond the Standard Model physics.
- As the highest priority we should determine the unknown oscillation parameters and look for surprises. CP violation and the ν mass hierarchy could be keys to the matter/antimatter asymmetry of the Universe.
- A large and effective European community exists in this area.
- Long baselines are optimal for determining the mass hierarchy, real advantage of the CERN → Pyhäsalmi baseline and, to a lesser extent, LBNE.
- The CERN → Pyhäsalmi baseline is also near optimal for a Neutrino Factory.
- Shorter (~hundreds of kilometres) baselines with huge detectors would allow very high statistics measurements more helpful for CP violation, particularly if hierarchy is known. This is the case of T2HK (also European alternatives such as CERN → Frejus, CERN → Canfranc, or ESS-based ν beam)
- For best performance and synergy an experiment of each category is needed → Coherence with efforts in other regions. Coordination and cooperation with our international colleagues mandatory.
- Anomalies in a range of phenomena at lower energies perhaps point to sterile neutrinos, and a proposed experiment at CERN would be highly competitive.
- More sophisticated future projects, which EUROnu has concluded should be a Neutrino Factory, necessary to achieve the desired sensitivity to the CP phase and probe new physics.
- R&D including projects such as MICE and nuStorm (which may also offer a definitive test for sterile neutrinos) should be supported.
- Experiments in absolute neutrino mass, especially in neutrinoless double-beta decay, are also a top priority.
- Hadron production, neutrino cross-section, and other support measurements will be essential to reach the neutrino oscillation sensitivity goals.

Accelerator Science & Technology Session

LHC & high-energy hadron collider

- LHC operating successfully (a huge technology success!)
- technology to go to 13-14 TeV and HL-LHC at hand with some development needed
- possibility to go to 26-33 TeV with 16-20 T magnets (HE-LHC), but substantial R&D needed ; higher energy requires a new tunnel (80 km → 80-100 TeV)

high-energy lepton collider

- great progress in SRF for ILC makes project possible ; very advanced proposal
- CLIC could be alternative, esp. if one wants to go to 3 TeV with still significant R&D
- new ideas for circular or $\gamma\gamma$ colliders; more studies needed on performance reach
- SRF ERL/RLA technology is attractive for many applications (LHeC, $\gamma\gamma$)
- to go to much higher energy using leptons requires muon collider, dielectric acceleration or plasma acceleration with increasing complexity and R&D needed

high intensity beams

- high power linacs being constructed (ESS, IFMIF, Project-X?); technology in hand
- improving neutrino beams with optimized existing infrastructures is possible
- high-intensity ν beam requires ν factory, with intense R&D
- technology for very-high luminosity flavor factories exists

many R&D topics common for various accelerators including other fields, ex. high-field magnets, RF structures & RF sources, particle sources, alignment & stabilization

collaboration with other fields should be promoted further

Instrumentation, Computing and General Infrastructure

Detector R&D for Discovery Science:

-Many ongoing R&D efforts in Tracking (50%) / Calorimetry / PID / electronics
-New technologies: ~15 years R&D from conception to production ➔ need to start early
-Step from R&D to realization requires industrialization / Technology transfer.

Discussion: More coherent / collaborative work among R&D communities.
More effort on education of and recognition for young physicists on detectors.
Is there a need to revive the DRDC committee?

Large scale projects / Infrastructures:

-LHC experiments pioneered an approach applicable to future large projects,
-Project management and strong host laboratory is pivotal to deliver large scale projects,
-Maintain local expertise at large laboratories to cope with production/commissioning.

Discussion: Training and education of young generation via specialized schools has to be supported / stronger role of Universities advisable.
Support of small size experiments as training platform for next generation.
How best to provide infrastructure/support for "greenfield" experiments?

Computing:

-Great success of LHC computing / WLCG, but needed ~15 years development
-Tier-structure lead to speedy delivery of results. Future funding uncertainties ? new computing model needed ?
-Must handle multiple core processors in future ➔ Experienced computing engineers needed
-GEANT4 very successful, but need further developments to cope with experiments and detector R&D of the future.

Summary of the theory session

Theory has been playing a crucial role in Higgs discovery and its interpretation
Other recent developments (tension with naturalness, models strongly constrained) are rapidly changing the theoretical scene
Lattice field theory results provide increasingly precise input for experiment.
Connection with astroparticle, cosmology and nuclear is increasingly important

Common training of theory and experimental students should be further encouraged with opening to the neighbouring fields

Less glamorous but very important work should be recognised (long term difficult projects with little initial output, support to experiments)

No strategy for theory research direction but better coordination in the areas that can profit from it

Specific features of theoretical research should be recognised by EU programs

Significant dedicated computing infrastructure needed (lattice QFT)