Linak-Halka Tipli Çarpıştırıcılar: Işınlık ve Fizik
(son 3 yılda ne değişti?)

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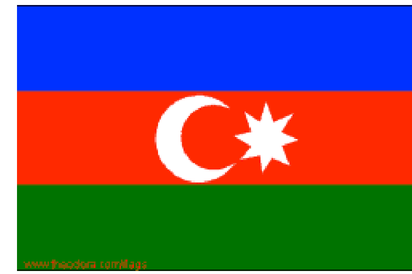
CERN ATLAS, LHeC and CLIC Collaborations
TAEK-CERN Bilim Komitesi



Önsöz: Şehitler Ölmez !

1. Bir önceki sunumun (30 Aralık 2011) özeti
2. LHeC/QCD-E: son durum
3. TAC SCF: Son durum
4. LHC → FCC dönemi: 2030'lar

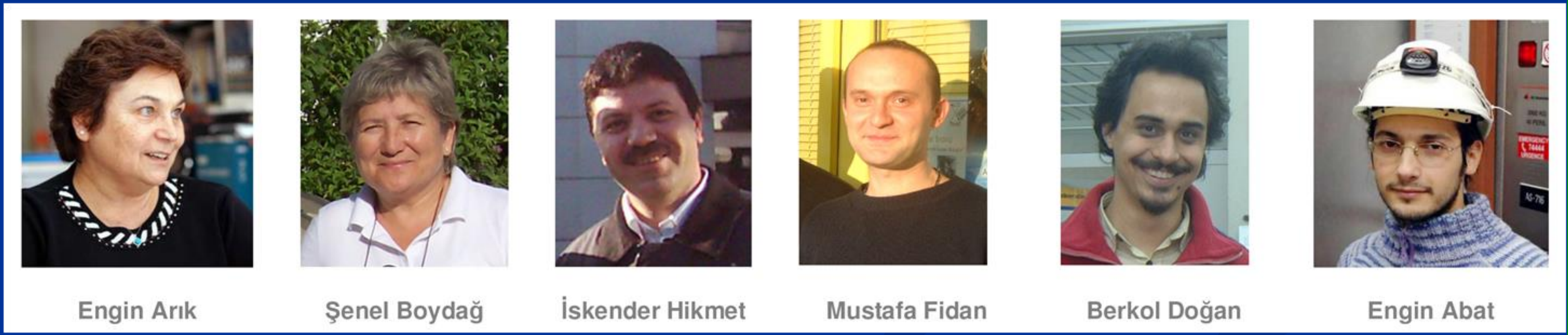
Sonsöz: Asla şüphem yoktur ki …

Yarının ilmi nedir, halbuki? Gayet müthiş!
"Maddenin kudret-i zerriyesi" uğraştığı iş … Safahat (1919)

Prologue: Şehitler Ölmez !

30.11.2007 tarihinde Isparta’daki uçak kazasında kaybettiğimiz

Bilim Şehitlerimiz



Saygıyla ve rahmetle anıyoruz…

Bayrakları Bayrak yapan …

… Bu dünyada kimse kalmaz, giderim.

Yaşamını Türkiye'nin kalkınmasına adamış ve ülkemizin CERN üyeliği sürecini başlatan bilim şehidimiz

Prof. Dr. Engin Arık (1948-2007)

Uçak düşürülmeseydi, bugün:

- Türkiye CERN'ün asil üyesi olurdu
- Türkiye Toryum yarışında liderler arasında olurdu
- TAC kurulum aşamasında olurdu
- Türk Bilim Kentinde ilk Ulusal Laboratuarlar çalışmaya başlardı
- …

Linak-Halka Tipli Çarpıştırıcılar: Işınlık ve Fizik

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TOBB ETÜ Fen-Edebiyat Fakültesi Fizik Birimi
Azerbaycan Elmler Akademiyası Fizika İnstitutu
TAEK-CERN Bilim Komitesi üyesi

1. Prologue: Rutherfod ve Mehmet Akif
2. Linak-Halka Tipli Çarpıştırcılar
3. LHeC/QCD-E
4. TAC Super-Charm Fabrikası
5. Epilogue: Şehitler Ölmez…

Ek 1: Türkiye'nin CERN Serüveni

Ek 2: ICFA Seminer 2011'de TAC projesi

UPHUK1: 2001, Ankara, TAEK
UPHUK2: 2004, Ankara, ATO
UPHUK3: 2007, Bodrum, TFD
UPHUK4: 2010, Bodrum, TFD

TAC projesi: 1993 ilk makale, 1997-2000 1.DPT projesi, 2002-2005 2.DPT projesi, 2006-2009(→2013) 3.DPT projesi, 2014-2023 TAC'ın kurulması

Three Main Areas of Applications

- Fundamental Research in Particle and Nuclear Physics

  Example: Standard Model of electro-weak and strong interactions (analog of the electro-magnetic unification)

- Analysis of Physical, Chemical and Biological Objects

  Example: Human Genome (impossible without SR and SN sources)

- Modification of the Physical, Chemical and Biological Properties of Matter

  Example: ion implantation (cornestone of modern micro-electronics)

+ Energy Amplifier (ADS): Thorium as Fuel – Green Nuclear Energy

AB ve TÜRKİYE

Avrupa Birliği ortalaması göz önünde tutularak, 65 milyon nüfuslu Türkiye'de, Yüksek Enerji Fiziğinin ana alanlarında olması gereken ve mevcut doktoralı eleman sayısı Tablo 1'de verilmiştir:

	Gereken, 1995	Mevcut, 1995	Gereken, 2010
Fenomenoloji+Teorik YEF	~250	~50	~300
Deneysel YEF+Dedektör Fiziği	~450	~30	~600
Hızlandırıcı Fizikçisi	~200	~0	~300

Tablo 1. *Avrupa standartları göz önünde tutularak 90'lı yıllarda Türkiye'de YEF'in ana alanlarında çalışması gereken Doktoralı eleman sayısı, gerçek sayılar ve 2010 yılında gereken sayıların tahmini.*

Kaynak: S. Sultansoy "Parçacık Hızlandırıcıları: Dün, Bugün, Yarın" (UPHUK-1, Ekim 2001, TAEK)

Soru: Mevcut, 2015 ?

Plenary ECFA – CERN (25-26 November 2010)

https://indico.cern.ch/event/111130/contribution/27/material/slides/1.pdf

Classification of colliders

1. Colliding particles
- hadrons
- leptons
- lepton-hadron

2. Collider schemes
- ring-ring
- linear
- linac-ring

The ring-ring colliders are the most advanced ones from technology point of view and are widely used around the (developed) world.

The linear (linac-linac) colliders are less familiar; however, a lot of experience is gained through Standard Linear Collider (SLC) operation and ILC/CLIC related workout.

The linac-ring colliders require more R&D.

S. SULTANSOY 25.11.2010 CERN 4

Linac-ring type colliders: two directions*

Lepton-hadron and photon-hadron colliders:

UNK+VLEPP (Mid 1980's) → THERA (End 1990's) → LHeC → Energy Frontier / QCD Explorer

THERA → eRHIC/EIC/ELIC

Factories:

B-factory (Grosse-Wiesmann) → c-τ-factory → Super-Charm factory (TAC project)

c-τ-factory → ϕ-factory (Ankara group)

* For details and ref's see: A. Akay, H. Karadeniz and S. Sultansoy, Review of Linac-Ring-Type Collider Proposals, Int. J. Mod. Phys. A 25 (2010) 4589

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International Journal of Modern Physics A
Vol. 25, No. 24 (2010) 4589–4602

DOI: 10.1142/S0217751X10049165

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REVIEW OF LINAC–RING-TYPE COLLIDER PROPOSALS

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Received 11 February 2010

There are three possible types of particle colliders schemes: familiar (well-known) ring–ring colliders, less familiar but sufficiently advanced linear colliders, and less familiar and less advanced linac–ring-type colliders. The aim of this paper is twofold: to present a possibly complete list of papers on linac–ring-type collider proposals and to emphasize the role of linac–ring-type machines for future HEP research.

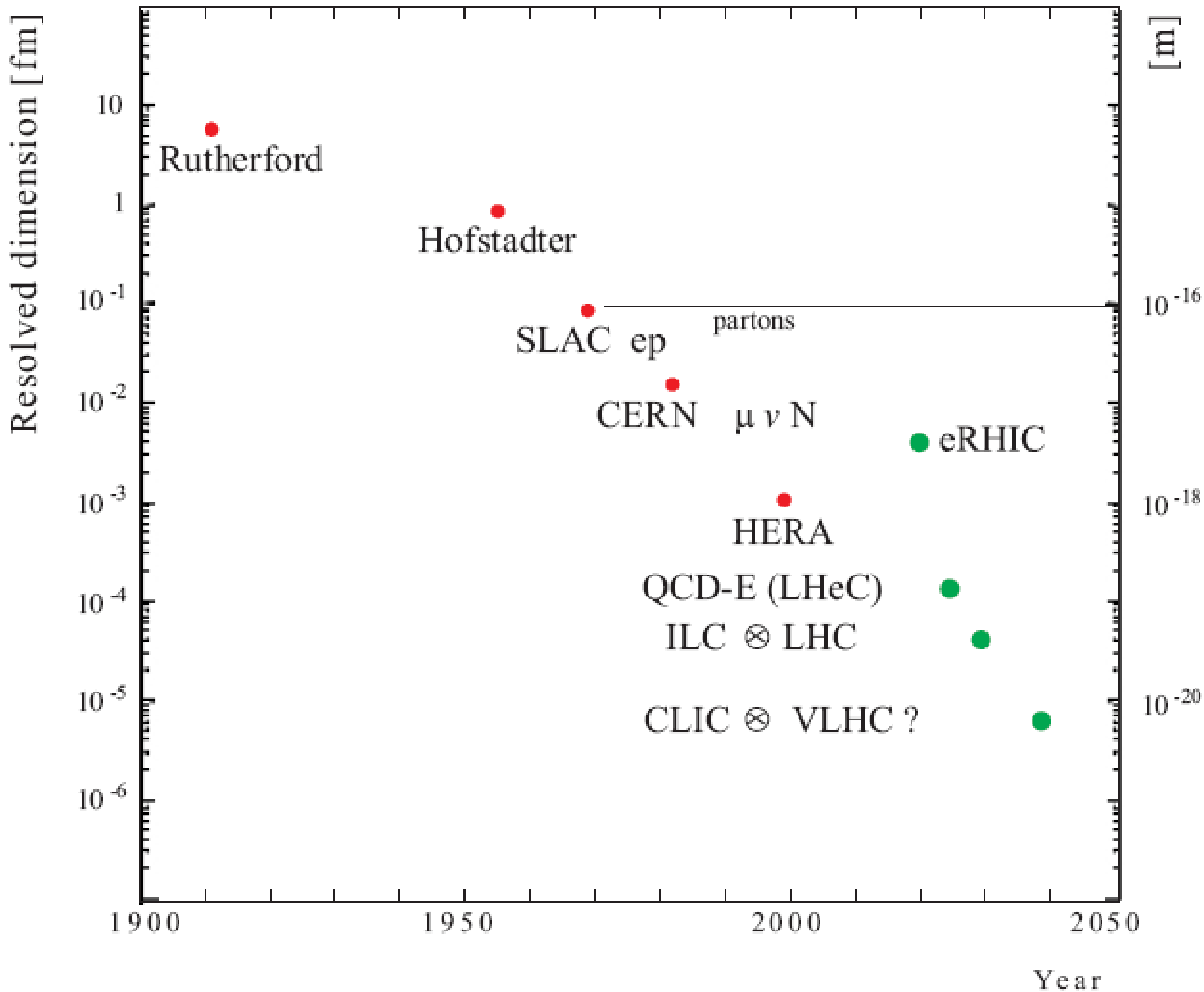


Fig. 1. The development of the resolution power of the experiments exploring the inner structure of matter over time from Rutherford experiment to CLIC ⊗ VLHC.

Forty years ago, John Rees[2] proposed a collision of 20 GeV SLAC electron beam with 3 GeV stored positrons in order to handle 15.5 GeV center-of-mass energy electron–positron collisions with a luminosity of 5×10^{29} cm^{-2}s^{-1}. Two years later, this proposal was reconsidered in Ref. 3 keeping in mind 2 GeV stored electrons (or positrons) which corresponds to 12.6 GeV center-of-mass energy with

a luminosity of 2.4×10^{29} cm^{-2}s^{-1}. Both proposals were considered as possible upgrades for SLAC accelerator.[4] In the subsequent 15 years, only one paper on this subject was published.[5] The purpose was to choose a linear collider option for SLAC upgrade: the SLC construction began in 1983 and completed in 1989. In 1979, linac–ring scheme was considered merely as an alternative to SSC-based ring–ring-type of 140 GeV+20 TeV electron–proton collider (Ref. 6; see also Ref. 7).

The idea was reborn in mid-1980's when it was proposed to combine linear electron–positron and ring-type proton colliders to realize additional TeV scale lepton–hadron collider option. Namely, it was proposed to construct VLEPP tangentially to UNK.[8] This scheme would provide an opportunity to handle TeV scale γp colliders too.[9] This line went on by THERA, EIC/EPIC and QCD-E/LHeC projects (for references see the corresponding sections below). An important stage in this direction was made at the International Workshop held in Ankara in 1997.[10] Reviews on the subject can be found in Refs. 11–15 and 1.

Another line deals with particle factories (Fig. 2): in 1988 Grosse-Wiesmann proposed linac–ring-type B-factory.[16–19] In 1993, linac–ring-type charm-tau factory was proposed as the regional project for Turkey and abroad.[20] The last stage of this line is represented by Super Charm Factory as part of the Turkic Accelerator Complex (TAC) Project.[21]

The present review is organized as follows. In Sec. 2, the main parameters of linac–ring-type lepton–hadron collider proposals are considered, namely, UNK + VLEPP, THERA, eRHIC, EIC, QCD Explorer (LHeC linac–ring option) and energy frontier. Photon–hadron colliders which would be constructed on the base of these colliders are considered in Sec. 3. Section 4 is devoted to proposals of linac–ring-type particle factory. Finally, in Sec. 5 some concluding remarks and recommendations are presented.

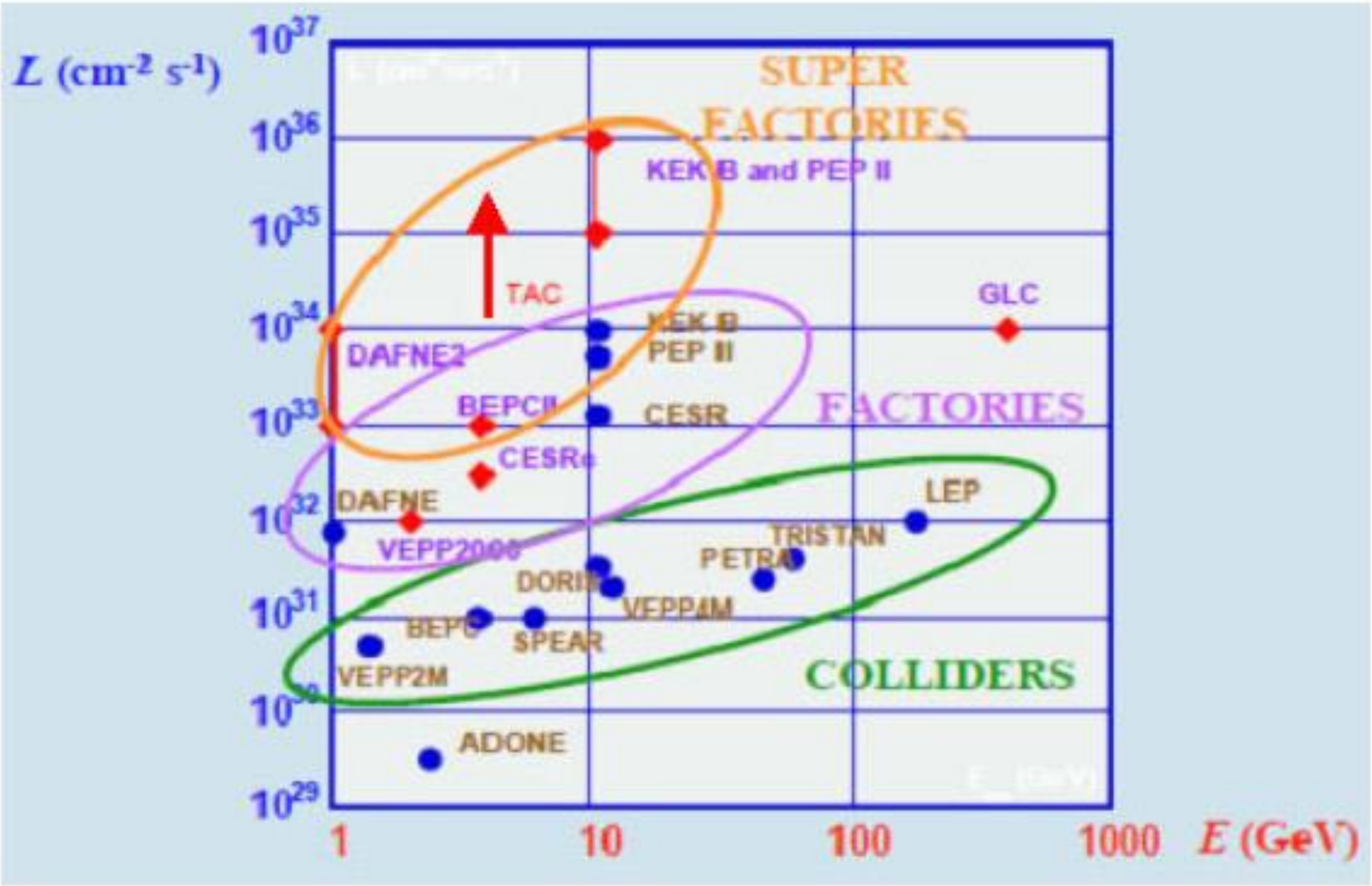


Fig. 2. Past, present and future e^+e^- colliders.

2.1. *UNK+VLEPP (IHEP, Protvino)*

In 1980's there were two projects of energy frontier collider in the former USSR, namely, $\sqrt{s} = 6$ TeV proton–proton collider UNK and $\sqrt{s} = 2$ TeV linear electron–positron collider VLEPP. The construction of the first one started at IHEP (Protvino, Moscow region), and the second one was planned at BINP (Novosibirsk). In mid-1980's, the construction of VLEPP tangential to UNK was proposed in order to provide additional opportunity to handle energy frontier ep (Ref. 8) and γp (Ref. 9) colliders.

In the following we give a brief summary of luminosity estimations. More details can be found in Ref. 11. Two possible versions of placing VLEPP and UNK are shown in Fig. 3. Two options of ep and γp collisions were considered for the UNK+VLEPP: on extracted proton beam (Fig. 4(a)) or in proton ring (Fig. 4(b)). It was shown that $L = 10^{30}$ cm^{-2}s^{-1} and $L = 6 \times 10^{30}$ cm^{-2}s^{-1} were achievable for the first and second options, respectively.

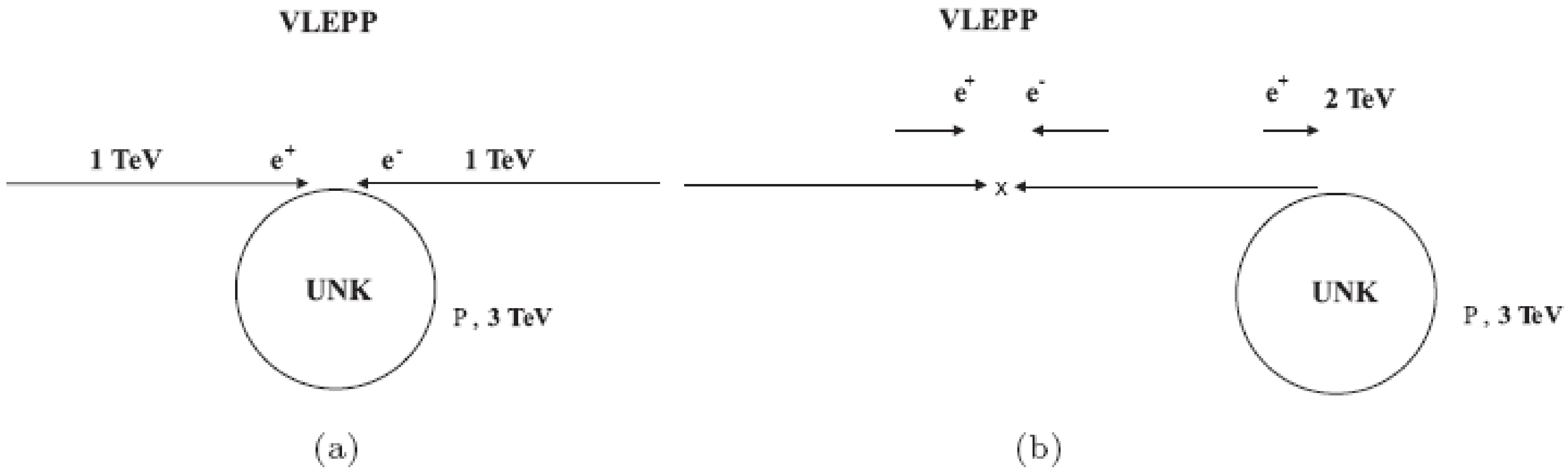


Fig. 3. (a) Symmetric version of ep (γp) collider; (b) asymmetric version.[11]

Note that this consideration was the main scientific reason for moving VLEPP from Novosibirsk to Protvino. Unfortunately, in the final design, VLEPP placement was chosen to cross the UNK ring, instead of tangential placement. Obviously, this choice eliminated ep and γp options (clear indication of the collapse of Eastern Block).

Önemli Not (2015): Bu hatanın benzerleri CERN'de (LHeC ile ilgili) ve TAC'da (Super-Charm Fabrikası ile ilgili) yapılmaktadır !!!

Table 3. THERA beam energies and luminosities.

Option	E_e, GeV	E_p, GeV	$\sqrt{s}$, TeV	L, 10^{30} cm^{-2}s^{-1}
1	250	1000	1	4
2	500	500	1	25
3	800	800	1.6	16

2.2. *THERA (DESY)*

THERA activity has been initiated since 1996 by B. Wiik and S. Sultansoy.[25] A lot of work was down in 1999–2000 during the preparation of TESLA TDR, which include THERA[26] as inseparable part together with photon collider and fixed target options. Moreover, THERA provided the main scientific reason for moving TESLA from Zeuthen to Hamburg. Results of this two-year study are published in the THERA book.[27] Concerning the beam energies and corresponding luminosities, three alternatives were analyzed (see Table 3).

2.4. *QCD Explorer (LHeC linac–ring option, CERN)*

QCD Explorer means to construct a moderate energy electron linac (50–100 GeV) tangentially to LHC ring. This construction will provide opportunity to utilize highest energy hadron beams for lepton–hadron collisions. QCD Explorer has two main goals:

(i) to get more precise data on PDF's which will be necessary for adequate interpretation for future LHC data;
(ii) to enlighten fundamentals of QCD.

For this purpose, the technologies for electron–positron colliders, which have developed up to now can be used or new technologies can be created.

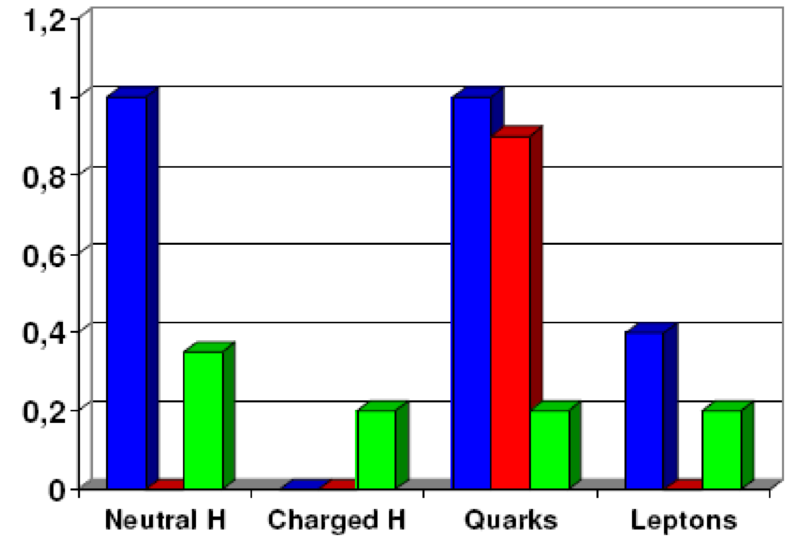
2.5. *Energy frontier (CERN)*

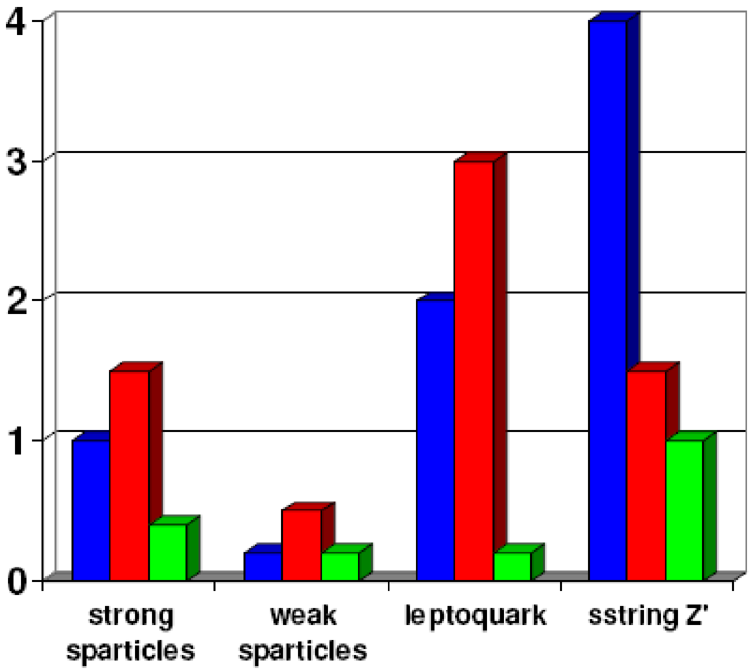
If $E_c \geq 500$ GeV, LHC based ep colliders are named as energy frontier. These high energies are inconvenient to use energy recovery. Nevertheless, $L = 10^{32}$ cm^{-2}s^{-1} seems to be achievable with pulsed linac.[41] It is useful to compare physics search potential of three colliders which can be considered as energy frontiers in foreseen future. Namely,

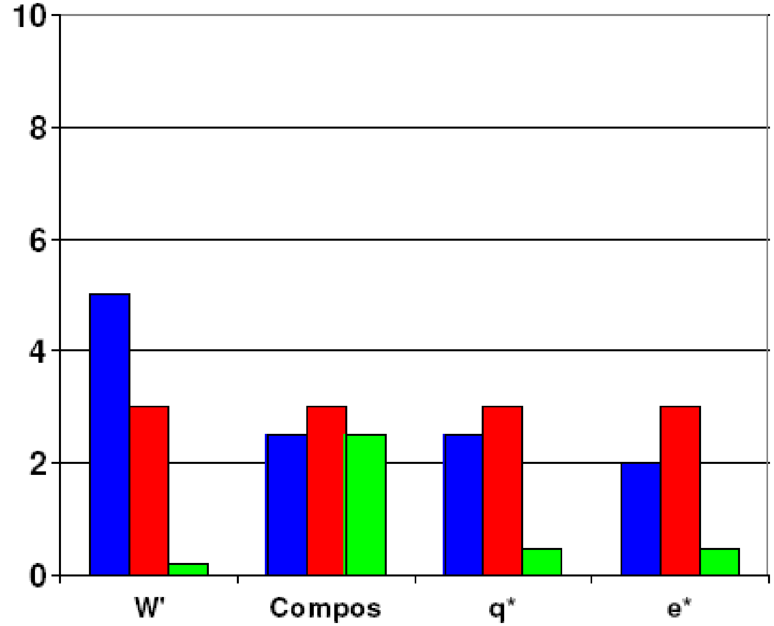
(i) $\sqrt{s} = 14$ TeV pp collider with $L = 10^{34}$ cm^{-2}s^{-1} (LHC);
(ii) $\sqrt{s} = 0.5$ TeV e^+e^- collider with $L = 10^{34}$ cm^{-2}s^{-1} (ILC);
(iii) $\sqrt{s} = 3.7$ TeV ep collider with $L = 10^{32}$ cm^{-2}s^{-1} ("ILC" $\times$ LHC).

Rough estimations[14] show that the total capacity of ep and γp options for BSM physics (SUSY, compositeness, etc.) research essentially exceeds that of 0.5 TeV linear collider.

Discovery limits in TeV
(rescaled from U. Amaldi 87)







S. Sultansoy 01.09.2009, Divonne 9

Bu projelerin Türk Dünyasına Katkısı

- **UNK+VLEPP**

  AMEA Fizika İnstitutu 1.No'lu Devlet AR-GE Programına katıldı

Maalesef, YerPHI benzerinin Azerbaycan'da kurulma imkanı engellendi…

- **Linac-HERA**

  1996 yılında DESY Ankara Üniversitesi ile İşbirliği Anlaşması imzaladı

Maalesef, bu Anlaşmanın sağladığı imkanlar yeterince kullanılmadı. DESY yönetimi TESLA'dan yana karar alınca, S-band linak'ın test tesisini bize hibe etmeyi önerdi. Uygun bir yer ve taşıma masrafı bulamadığımız için 15 yıl önce yüksek kaliteli elektron demetine sahip olma şansını kaçırdık.

- **Linac-LHC**

  Türk fizikçileri CLIC ve LHeC projelerine katıldı

Uluslararası **CTF3 projesi** AÜ ile CERN'in imzalarıyla resmen başladı!
Bu imzaları AÜ tarafından Prof. Dr. A. K. Çiftçi, CERN tarafından Dr. J. P. Delahaye attı…

Bu projelerin Türk Dünyasına Katkısı

✡ **LR Charm-Tau**

Turkic Accelerator Complex (TAC) projesinin temel taşı

Maalesef, Super-Charm ve Proton Hızlandırıcısı kısımları ihmal ediliyor.

+ Türk bilim insanlarının **EPAC, PAC, IPAC, ECFA ve ICFA** 'ya katılımı

EPS-HEP 2003 Konferansında ve PAC 2005'te Çağrılı konuşmalar;

ICFA 2002 "Future Perspectives in HEP" seminerinin kapanış oturumunda "Turkish comments on …" sunumu (**E. Arik, S. Sultansoy**, e-Print: hep-ph/0302012)

BOUN-HEP-2003-01
GU-HEP-2003-01
17 January 2003

Turkish Comments on "Future Perspectives in HEP"

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Abstract

These comments were prepared during the ICFA Seminar on "Future Persrectives in High Energy Physics" held at CERN (8-11 October 2002) and partially presented at the Panel and General Discussion on Interregional Collaboration for Future Facilities (10 October). Comments include arguments favoring the existence of the fourth SM family and new level of compositness. Then, the possible role of the linac-ring type colliders for future HEP research is discussed emphasizing TeV scale lepton-hadron and photon-hadron colliders. This preprint presents prepared transparencies and some illuminating remarks with corresponding references.

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1

ICFA Seminar, CERN, 10 Oct 2002

TURKISH COMMENTS ON

"Future Perspectives in HEP"

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[2] Gazi Univ., Ankara, TÜRKİYE

[3] Institute of Physics, Baku, Azerbaycan

1. *Periodic Table of Elementary Particles*
2. *Flavour Democracy → the Fourth SM Family*
3. *SUSY vs Compositness → SUSY at pre(pre)onic level*
4. *TeV scale lepton-hadron and photon-hadron colliders*
5. *Linac-Ring type factories: TAC Project*

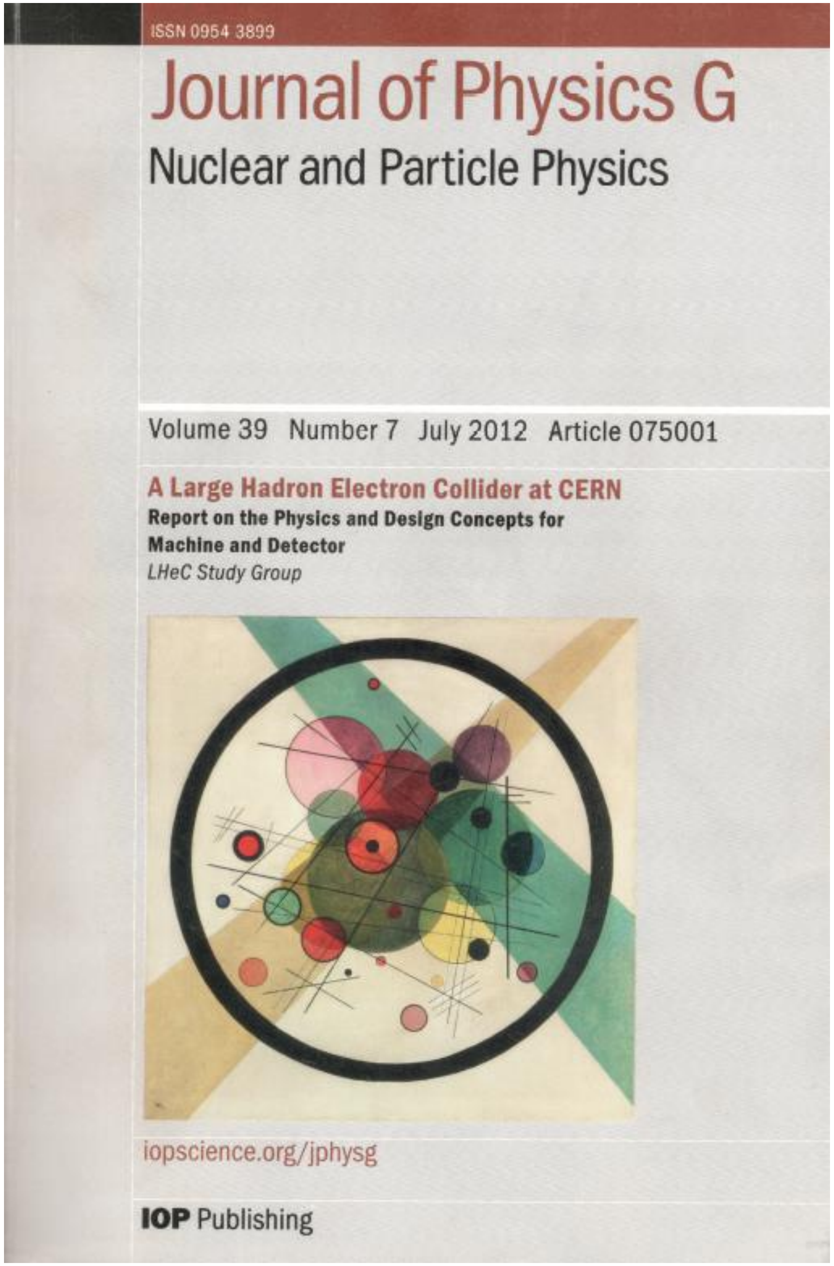
2

18 Kasım 2008: Başbakanımız Sayın Recep Tayip ERDOĞAN CERN'ü ziyaret etti ve ülkemizin CERN üyeliği sürecini başlattı

2. LHeC/QCD-E: son durum

A Large Hadron electron Collider at CERN. Webpage:
http://lhec.web.cern.ch/
Mirror site:
http://www.ep.ph.bham.ac.uk/exp/LHeC/

CDR is published in Journal of Physics G: Nuclear and Particle Physics
Volume 39, Number 7, July 2012.



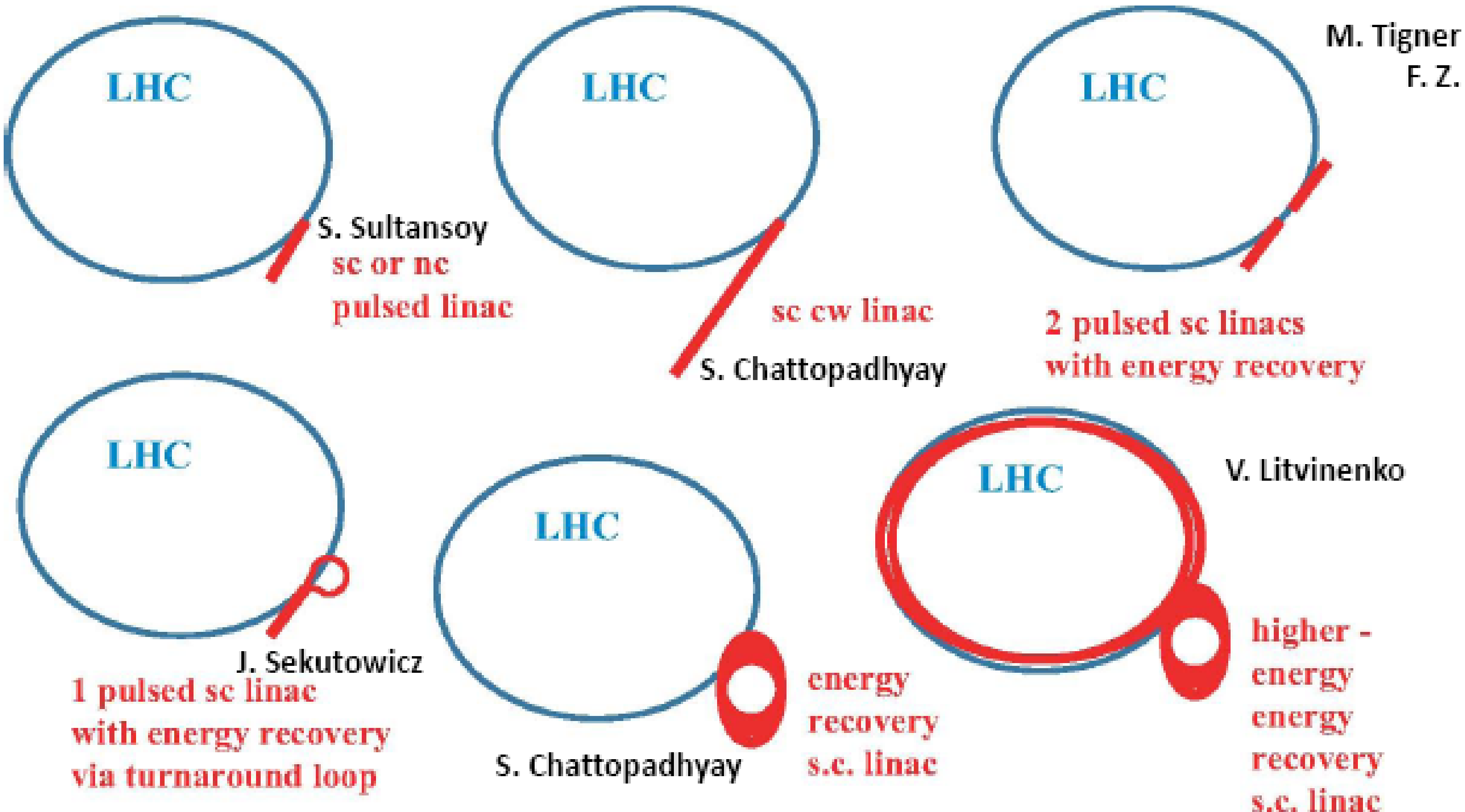
(F. Zimmermann, 1st ECFA-CERN LHeC Workshop, 02.09.2008)

LR e-p motivation

- colliding 7 TeV p's with 25-140 (-300) GeV e-'s:
  - → extending LHC discovery reach
  - → enabling LHC precision physics
- history: - Ankara workshop 1997, Turkish JP, 22, 7 (1998)
  - -S. Sultansoy, Aachen 2003, EPJ C33: S1064 (2004)
  - -D.Schulte,F.Zimmermann, EPAC'04 (CLIC-1/LHC p s-bunch)
  - -H. Aksakal et al, NIM A576: 287 (2007) (CLIC & ILC vs LHC)
  - - S. Chattopadhyay: ***cw!, ERL!*** (2007), A. Eide's report (2008)
  - -V. Litvinenko, CERN AB Form 11 March 2008
  - -F. Zimmermann et al, EPAC'08
  - -J. Skrabacz' report (2008)
- e- linac offers several distinct advantages
  e.g.: separation from LHC, high beam quality, synergies

(F. Zimmermann, 1st ECFA-CERN LHeC Workshop, 02.09.2008)

LR scenarios



s.c. linac , long trains of bunches, 25-ns or 50-ns spacing, matching LHC p beam (*PLACET: stable*); long pulse or cw → high luminosity; optional energy recovery → higher luminosity; 1.3 GHz (ILC) or 700 MHz (SPL)

LHeC CDR

Abstract

The physics programme and the design are described of a new electron-hadron collider, the LHeC, in which electrons of 60 to possibly 140 GeV collide with LHC protons of 7000 GeV. With an *ep* design luminosity of about $10^{33}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$, the Large Hadron Electron Collider exceeds the integrated luminosity collected at HERA by two orders of magnitude and the kinematic range by a factor of twenty in the four-momentum squared, Q^2, and in the inverse Bjorken x. The physics programme is devoted to an exploration of the energy frontier, complementing the LHC and its discovery potential for physics beyond the Standard Model with high precision deep inelastic scattering (DIS) measurements. These are projected to solve a variety of fundamental questions in strong and electroweak interactions. The LHeC thus becomes the world's cleanest high resolution microscope, designed to continue the path of deep inelastic lepton-hadron scattering into unknown areas of physics and kinematics. The physics programme also includes electron-ion (eA) scattering into a $(Q^2,\ 1/x)$ range extended by four orders of magnitude as compared to previous lepton-nucleus DIS experiments. The LHeC may be realised either as a ring-ring or as a linac-ring collider. Optics and beam dynamics studies are presented for both versions, along with technical design considerations on the interaction region, magnets, cryogenics, RF, civil engineering and further components. A design study is also presented of a detector suitable to perform high precision DIS measurements in a wide range of acceptance using state-of-the art detector technology, which is modular and of limited size enabling its fast installation. The detector includes tagging devices for electron, photon, proton and neutron detection near to the beampipe. The LHeC is designed to be built and operated while the LHC runs. It is a major opportunity for progress in particle physics and further exploits the investment made in the LHC.

LHeC Study Group

C.Adolphsen[39], S.Alekhin[40,11], A.N.Akai[01], H.Aksakal[30], P.Allport[17], J.L.Albacete[37], V.Andreev[25], R.B.Appleby[23], N.Armesto[38], G.Azuelos[26], M.Bai[47], D.Barber[11], J.Bartels[12], J.Behr[11], O.Behnke[11], S.Belyaev[10], I.BenZvi[47], N.Bernard[16], S.Bertolucci[10], S.Bettoni[10], S.Biswal[32], J.Bluemlein[11], H.Boettcher[11], H.Braun[48], S.Brodsky[39], A.Bogacz[28], C.Bracco[10], O.Bruening[10], E.Bulyak[08], A.Bunyatian[11], H.Burkhardt[10], I.T.Cakir[54], O.Cakir[53], R.Calaga[47], E.Ciapala[10], R.Ciftci[01], A.K.Ciftci[01], B.A.Cole[29], J.C.Collins[46], J.Dainton[17], A.De.Roeck[10], D.d'Enterria[10], A.Dudarev[10], A.Eide[43], E.Eroglu[45], K.J.Eskola[14], L.Favart[06], M.Fitterer[10], S.Forte[24], P.Gambino[42], T.Gehrmann[50], C.Glasman[22], R.Godbole[27], B.Goddard[10], T.Greenshaw[17], A.Guffanti[09], V. Guzey[28], C.Gwenlan[34], T.Han[36], Y.Hao[47], F.Haug[10], W.Herr[10], B.Holzer[10], M.Ishitsuka[41], M.Jacquet[33], B.Jeanneret[10], J.M.Jimenez[10], H.Jung[11], J.M.Jowett[10], H.Karadeniz[54], D.Kayran[47], F.Kocac[45], A.Kilic[45], K.Kimura[41], M.Klein[17], U.Klein[17], T.Kluge[17], G.Kramer[12], M.Korostelev[23], A.Kosmicki[10], P.Kostka[11], H.Kowalski[11], D.Kuchler[10], M.Kuze[41], T.Lappi[14], P.Laycock[17], E.Levichev[31], S.Levonian[11], V.N.Litvinenko[47], A.Lombardi[10], C.Marquet[10], B.Mellado[07], K.H.Mess[10], S.Moch[11], I.I.Morozov[31], Y.Muttoni[10], S.Myers[10], S.Nandi[26], P.R.Newman[03], T.Omori[44], J.Osborne[10], Y.Papaphilippou[10], E.Paoloni[35], C.Pascaud[33], H.Paukkunen[38], E.Perez[10], T.Pieloni[15], E.Pilicer[45], A.Polini[04], V.Ptitsyn[47], Y.Pupkov[31], V.Radescu[13], S.Raychaudhuri[27], L.Rinolfi[10], R.Rohini[27], J.Rojo[24], S.Russenschuck[10], C.A.Salgado[38], K.Sampei[41], E.Sauvan[19], M.Sahin[01], U.Schneekloth[11], A.N.Skrinsky[31], T.Schoerner Sadenius[11], D.Schulte[10], H.Spiesberger[21], A.M.Stasto[46], M.Strikman[46], M.Sullivan[39], B.Surrow[05], S.Sultansoy[01], Y.P.Sun[39], W.Smith[20], I.Tapan[45], P.Taels[02], E.Tassi[52], H.Ten.Kate[10], J.Terron[22], H.Thiesen[10], L.Thompson[23], K.Tokushuku[44], R.Tomas.Garcia[10], D.Tommasini[10], D.Trbojevic[47], N.Tsoupas[47], J.Tuckmantel[10], S.Turkoz[53], K.Tywoniuk[18], G.Unel[10], J.Urakawa[44], P.VanMechelen[02], A.Variola[37], R.Veness[10], A.Vivoli[10], P.Vobly[31], R.Wallny[51], G.Watt[10], G.Weiglein[12], C.Weiss[28], U.A.Wiedemann[10], U.Wienands[39], F.Willeke[47], V.Yakimenko[47], A.F.Zarnecki[49], F.Zimmermann[10], F.Zomer[33]

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Max Klein, University of Liverpool, and **Herwig Schopper**, University of Hamburg and CERN.

CERN Courier June 2014

Electrons at the LHC: a new beginning

A new committee is providing direction on the case for an electron–hadron collider, both at the LHC and at a Future Circular Collider complex.

From time to time, great experimental progress in particle physics suddenly reveals a crisis in theoretical physics. This happened in the early 1960s when a plethora of hadrons had been discovered, while strong-interaction theory dealt with analytical properties of the S matrix and a number of phenomenological models. At that time, Murray Gell-Mann, who had just introduced the notion of quarks, seconded by Georg Zweig, argued for focusing on "a higher-energy accelerator so that we can do more experiments over the next generation and really learn more about the basic structure of matter" (Gell-Mann 1967). The current situation is not so different.

At the LHC, the Standard Model is being subjected to a thorough confirmation, including the remarkable completion of its particle contents with the discovery of a Higgs boson. Important as these results are, however, there is still no indication of the existence of

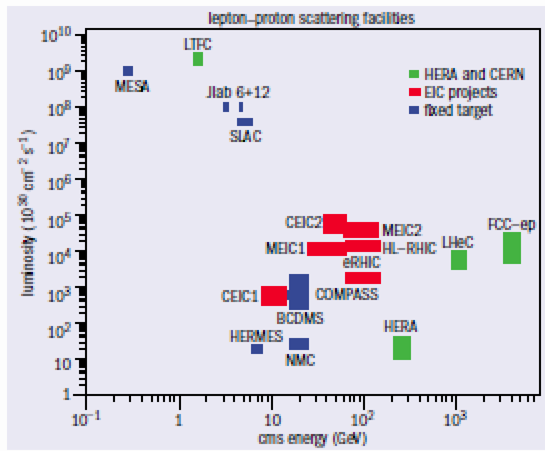


Fig. 1. Lepton–proton scattering projects – using fixed targets (blue), future medium-energy electron–ion collider projects (red), HERA and CERN's electron–proton concepts (green) – in terms of luminosity and centre-of-mass energy.

CERN Courier June 2014

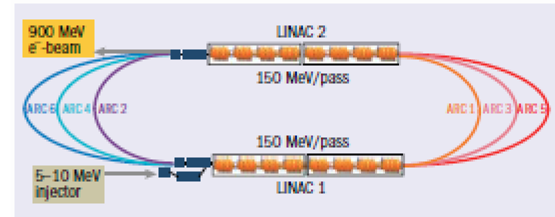


Fig. 4. The final stage of the ERL test facility being designed at CERN. (Image credit: Alessandra Valloni/CERN.)

Yanlış seçim!!!

LHeC'in amacı Higgs bozonun özelliklerini incelemek veya SUSY aramak değil, **QCD temellerini (özellikle küçük x bölgesini) incelemektir.**
Bunun için çok yüksek ışınlığa gerek yok.

X→1 bölgesi EIC/eRHIC çarpıştırıcılarında incelenecektir.

Higgs bozonu görünür Evrenin kütlesinin sadece %2'sini temin etmektedir. Kalan kısmı kuvvetli etkileşmelerden geliyor.
LHeC/QCD-E'nin kurulması bu nedenle kaçınılmazdır.

3. TAC Super-Charm Fabrikası: son durum

2010 yılında ECFA toplantısında yaptığım sunumdan bazı slaytlar

Ercan Alp vs Saleh Sultansoy

ECFA EUROPEAN COMMITTEE FOR FUTURE ACCELERATORS

EIGHTY-EIGHTH PLENARY ECFA MEETING

25-26 November 2010, CERN

THE CORNESTONE OF THE TAC PROJECT: LINAC-RING TYPE SUPER-CHARM FACTORY

Saleh Sultansoy

TOBB ETÜ, Ankara

Institute of Physics, Baku

S. SULTANSOY 25.11.2010 CERN 1

Birth of TAC

Region means: Mid East + Balkans + Caucasus + Central Asia

Doğa – Tr. J. of Physics
17 (1993) , 591 – 597.

Regional Project for Elementary Particle Physics Linac-Ring Type c-τ-Factory *

Saleh F. SULTANSOY
Institute of Physics, Academy of Sciences,
Baku-AZERBAIJAN

Received 25.1.1993

Abstract

Linac-ring type e^+e^- collider with $\sqrt{s} = 3 - 5$ GeV is proposed as the regional project for elementary particle physics. It is shown that modern accelerator technology makes it possible to achieve luminosity $\mathcal{L} = 10^{34} cm^{-2}S^{-1}$. The possible physical goals of this machine in investigation of charmed particles, τ-lepton and ν_τ properties is briefly discussed.

1. Introduction

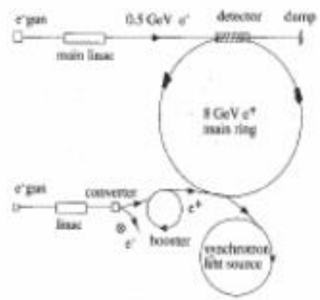


Figure 1. The proposed scheme for linac-ring c-τ-factory

Table 1. Basic parameters of linac-ring c-τ-factory

Parameters	e^--linac		e^+-ring
Energy (GeV)	0.5		8.0
$\sqrt{s}$ (GeV)		4	
Radius (m)	-		100
Length (m)	50		-
Particles per bunch, n (10^{10})	0.1		10
Collision rate, f_c (MHz)		30	
Bunches per ring, k	-		60
Current, I (mA)	5		500
Energy loss/turn, ΔE (MeV)	-		3.6
Power (MW)	2.5		> 1.7
Beam size at IP, $\sigma_{x,y} (\mu m)$	1		1
$\beta_{x,y}$ at IP (cm)	-		0.25
Bunch length, σ_z (cm)	0.1		0.2
Luminosity, $\mathcal{L}(cm^{-2}S^{-1})$		$2.4{\cdot}10^{34}$	

d) Synchrotron radiation. There are two possibilities: 1)to use the main positron ring as the source of synchrotron radiation; 2) to construct a new ring for this purpose. Let

c–τ–factory proposals in 1990's

- Ring–Ring: Spain (1991), JINR and BINP (1994)

$$L = 10^{33} cm^{-2} s^{-1}$$

- Linac–Ring: Ankara group (1993)

$$L = 10^{34} cm^{-2} s^{-1}$$

Before Crab–Waist scheme (2006) LR seemed to provide about 10 times higher Lumi.

ICFA Statement on a Tau Charm Factory 31 January 1996

ICFA has noted that several intensive workshops have been held on the physics potential of a tau-charm factory. This collider is intended to operate at a luminosity of $10^{33}\ cm^{-2}s^{-1}$, one hundred times the luminosity of the Beijing Electron-Positron Collider. The conclusion of these workshops is that a tau-charm factory can address issues concerning the tau, charmed particles, and light quark spectroscopy in a unique manner. Many of the issues can only be addressed by a tau-charm factory and cannot be fully addressed by B factories now under construction, or by high energy fixed target experiments.

There has been strong interest in a tau-charm factory by physicists from all regions of the world. Physicists from two nations, China and Russia, are seriously developing plans to construct such a facility. ICFA is pleased to note that the Chinese government has awarded funds of 5 million Yuan to the Institute of High Energy Physics in Beijing for the purpose of designing a tau-charm factory.

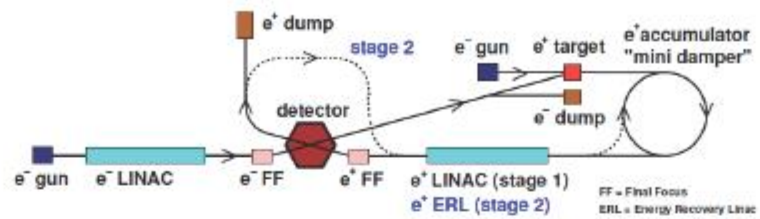
ICFA Statement on a Tau Charm Factory 31 January 1996 (cont.)

ICFA is pleased that international workshops on a tau-charm factory have been held over the past several years and that there are plans to hold additional ones in the future. In addition, the ICFA Beam Dynamics Panel is in the process of establishing a subpanel to assist in identifying and solving the beam dynamics issues associated with a tau-charm factory. ICFA supports the planning that must be done in advance of the construction of such a facility, and supports its construction, since there is ample justification for one such facility.

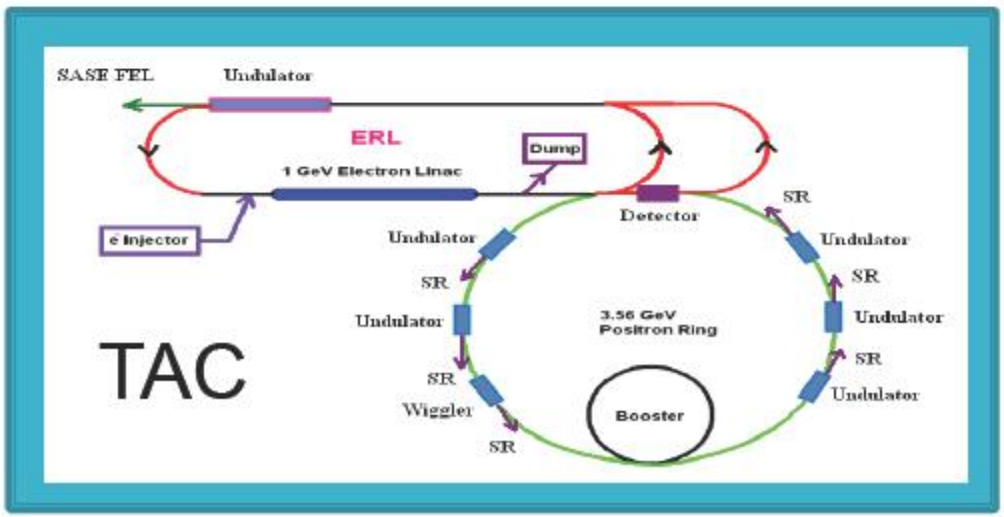
ICFA looks forward to the day when a tau-charm factory can begin operation, and encourages exploitation open to an international team in accordance with the existing ICFA Guidelines for Utilization of Major Regional Experimental facilities for High Energy Particle Physics.

BEPC II srarted in 2008

c−τ−factory proposals 2010



A. Schöning / Nuclear Physics B (Proc. Suppl.) 169 (2007) 387–392



All three proposals promise

$$L = 10^{35} cm^{-2} s^{-1}$$

25.11.2010 CERN 10

Tentative parameter list for TAC Super-C Factory

Positron ring	
Positron beam energy (GeV)	**3.56**
Number of positrons per bunch (10^{11})	2
Beta functions at IP β_x / β_y (mm)	80/5
Normalized emittances ε_x^N / ε_y^N (μm)	110/0.36
σ_x / σ_y (μm)	36/0.5
σ_z (mm)	5
Beam-beam tune shift	0.012/0.13
Energy loss / turn (MeV)	0.7
Number of buches, n_b	300
Revolution frequency (MHz)	0.5
Circumference, C (m)	600
Beam current (A)	4.8

Electron ERL	
Electron beam energy (GeV)	**1**
Number of electrons per bunch (10^{10})	2
Beta functions at IP β_x / β_y (mm)	80/5
Normalized emittances ε_x^N / ε_y^N (μm)	31/0.1
σ_x / σ_y (μm)	36/0.5
σ_z (mm)	5
Disruption Dx/Dy	0.33/60
Beam current (A)	0.48
Collider Parameters	
Crossing angle (mrad)	34
Collision frequency (MHz)	150
Luminosty	$1.4 \cdot 10^{35}$

Studies for reducing Dy are continuing

Further Lumi increase could be achieved by:
- increasing collision frequency
- shortening electron bunches with subsequent use of "dynamic focusing" (Brinkmann-Dohlus, DESY-M-95-11 (1995))

Physics at Super-Charm Factory

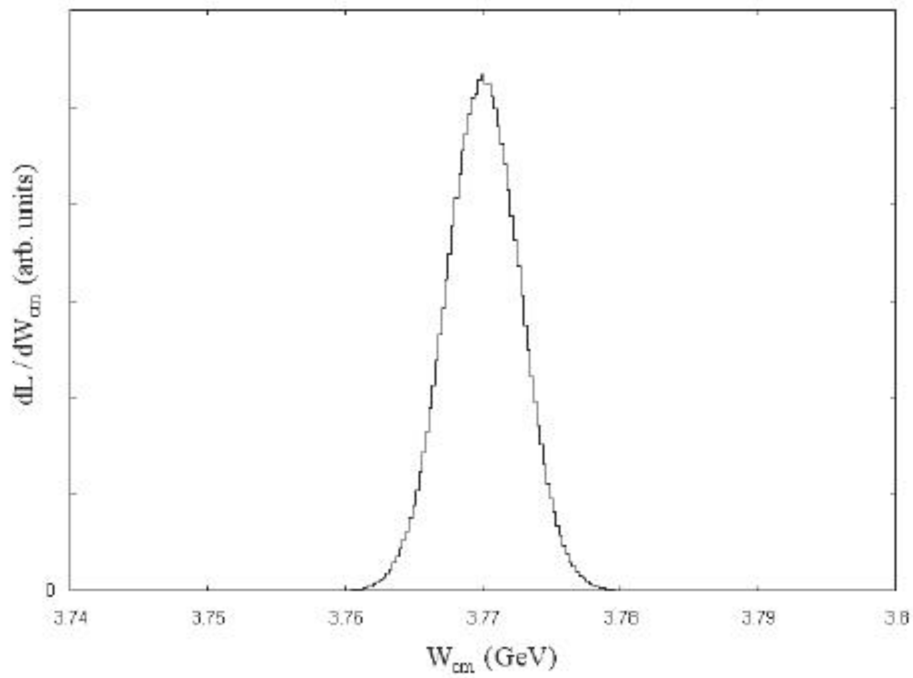
- τ option is weak.
  SuperB vs Super-c-τ: 2.5 times lower σ, but 10 times higher L

- Basic operation at $\Psi(3S)$

- Energy asymmetry is essential for time-dependent CPV analysis
  - Boost examples from *B*-factories are:
  - KEKB, the boost is $\beta\gamma = 0.43$.
  - PEP-II, used a slightly larger boost $\beta\gamma = 0.55$.

In TAC/PF, the boost is $\beta\gamma = 0.68$.

Luminosity spectrum for the TAC charm factory.



- Center of mass energy spread $< \Gamma_{\Psi(3S)} \approx 24$ MeV.
- $\Psi(3S)$ is about 10^{10} per working year (10^7 s)
- D^+D^- and D^0D^0 decay modes are dominant channels for $\Psi(3S)$ decays.

Outlook

For Charm Factory

Benchmark physics processes should be reviewed for a factory with asymmetrical beam energies.

Various synergy options within the TAC project should be evaluated.

- TAC SR (same e+ ring vs dedicated ring, sharing infrastructure)
- TAC FEL (time, infrastructure, expertise etc... sharing)

International collaborations with similar projects will be mutually beneficial:

- LHeC LR option, eRHIC LR option

For TAC in general

1 GeV SNS (based on TAC PA) is mandatory.

ADS studies (based on TAC PA) should be intensified.

Strong international cooperation opportunities should be seized.

We are seeking ECFA support for LR type colliders in general and for TAC project in particular.

Ercan Alp vs Saleh Sultansoy

TÜRKİYE CUMHURİYETİ
DEVLET PLANLAMA TEŞKİLATI

PROJE SONUÇ RAPORU

Proje No: DPT-97K-120420

"Parçacık Hızlandırıcıları: Türkiye'de Neler Yapılmalı"

Ankara Üniversitesi, Fen Fakültesi
Fizik ve Fizik Mühendisliği Bölümleri

Proje Ekibi

Yürütücü : Doç. Dr. Ömer YAVAŞ*
Üye : Doç. Dr. A. Kenan ÇİFTÇİ
Üye : Yrd. Doç. Dr. Metin YILMAZ (Gazi Ü.)
Üye : Araş. Gör. Erdal RECEPOĞLU

Danışman : Prof. Dr. Saleh SULTANSOY (DESY)

Aralık 2000, Ankara

* Tel: 312-212 67 20 / 1192 E-mail: yavas@science.ankara.edu.tr

Teşekkür

Temel Parçacık Fiziğinin (Yüksek Enerji Fiziği) deneysel çalışılması ve parçacık hızlandırıcılarına dayalı teknolojilerden yararlanılması konusunda ülke olarak kapatılması bir hayli güç görünen açığımızı üniversitemizde sözleşmeli olarak çalıştığı 1993-1999 yılları arasındaki tespitlerine dayandırarak, bu açığı hızla kapatmak için yeni bir yapılanmaya gitmek ve bu çerçevede Türkiye'de Türk Cumhuriyetleriyle de işbirliği yaparak ortak bir enstitü ve hızlandırıcı laboratuvarı kurma fikrini ortaya atan ve dolayısıyla bunun ön çalışmasını projelendiren ve bu projeye 1997-99 yılları arasında yürütücü ve daha sonra ise danışman olarak büyük katkı veren ve yönlendiren Sayın **Prof. Dr. Saleh SULTANSOY**'a;

Proje taslağı kendilerine sunulduktan sonra olumlu yaklaşarak projeye destek veren Devlet Planlama Teşkilatı'na ve başta Sayın **İsmail Hakkı YÜCEL** olmak üzere ilgili DPT uzmanlarına;

Projenin yazılıp verilme aşaması olan 1997 yılı içinde yöneticilerimiz olan ve idari anlamda projenin verilmesine destek olan, Ankara Üniversitesi Fizik Bölümü Başkanı Sayın **Prof. Dr. Arsın Aydın Uraz**'a, Ankara Üniversitesi Fen Fakültesi Dekanı Sayın **Prof. Dr. Cemal Aydın**'a ve Ankara Üniversitesi Araştırma Fonundan sorumlu rektör yardımcısı **Prof. Dr. Cemal Taluğ**'a;

Proje süresince değişik zamanlarda konuyla ilgili çalışma ve tartışma için ziyaret ettiğimiz zamanlarda bize kapılarını açan ve her açıdan destek olan ve aynı zamanda ülkemizde sadece üniversitemiz ile bilimsel işbirliği anlaşması olan Alman Elektron Sinkrotronu Laboratuvarı (DESY, Hamburg, Almanya) yöneticilerinden eski direktör Sayın **Prof. Dr. B.H. Wiik**'e, yeni direktör Sayın **Prof. Dr. A. Wagner**'e, DESY Direktoryum üyesi ve hızlandırıcılardan sorumlu başkan yardımcısı Sayın **Dr. D. Trines**'e, bize tartışmaları ile ışık tutan DESY hızlandırıcı fizikçilerinden Sayın **Prof. Dr. G. –A. Voss**'a, Sayın **Dr. F. Willeke**'ye, Sayın **Dr. R. Brinkmann**'a ve Argonne National Laboratory (USA)'den Sayın **Dr. Ercan ALP**'e;

Projenin yürütülmesi esnasında büyük desteklerini gördüğümüz Ankara Üniversitesi Araştırma Fonu yetkililerine ve çalışanlarına proje ekibi olarak teşekkür ederiz.

TAC 2000: Saleh Sultansoy

Temel Parçacık Fiziğinin (Yüksek Enerji Fiziği) deneysel çalışılması ve parçacık hızlandırıcılarına dayalı teknolojilerden yararlanılması konusunda ülke olarak kapatılması bir hayli güç görünen açığımızı üniversitemizde sözleşmeli olarak çalıştığı 1993-1999 yılları arasındaki tespitlerine dayandırarak, bu açığı hızla kapatmak için yeni bir yapılanmaya gitmek ve bu çerçevede Türkiye'de Türk Cumhuriyetleriyle de işbirliği yaparak ortak bir enstitü ve hızlandırıcı laboratuvarı kurma fikrini ortaya atan ve dolayısıyla bunun ön çalışmasını projelendiren ve bu projeye 1997-99 yılları arasında yürütücü ve daha sonra ise danışman olarak büyük katkı veren ve yönlendiren Sayın **Prof. Dr. Saleh SULTANSOY**'a;

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TAC 2000: Ercan Alp

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TAC 2015 …

THM Projesi Uluslararası Bilimsel Danışma Komitesi (ISAC)

Unvanı-Adı Soyadı	Kurumu
Prof. Dr. Ercan Alp (Head)	Argonne National Lab., USA
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Prof. Dr. Frank Zimmermann	CERN, Switzerland
Prof. Dr. Ken Peach	Oxford University, UK
Prof. Dr. Swapan Chattopadhyay	Cockcroft Institute, UK
Prof. Dr. Roland Sauerbrey	HZDR, Germany
Prof. Dr. David Asner	Pasific Northwest Nat. Lab., USA
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Prof. Dr. Zehra Sayers	Sabancı University, Turkey
Doç. Dr. Gökhan Ünel	CERN, Switzerland
Dr. Ali Tanrıkut	TAEK, Turkey

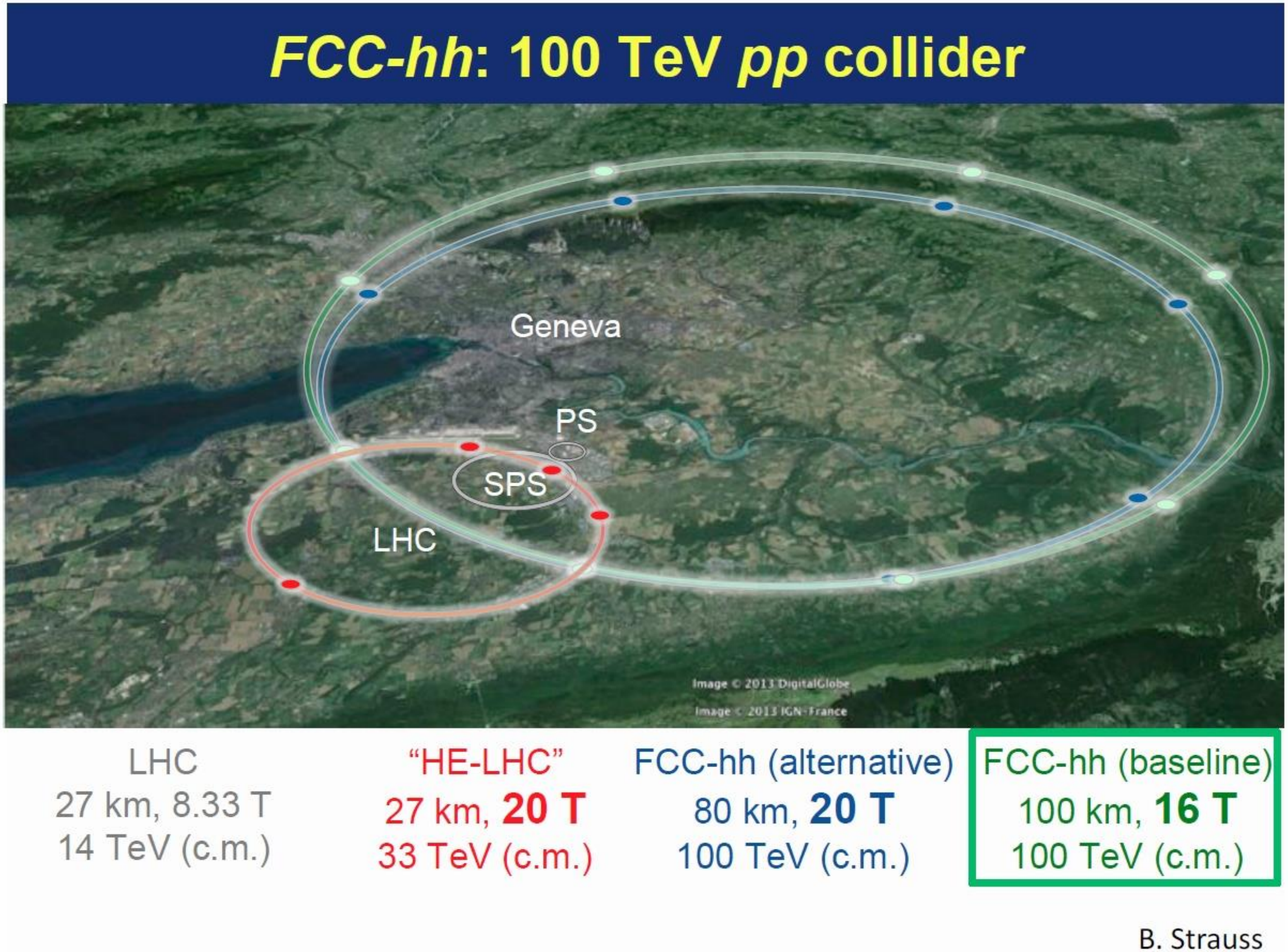
2007 yılında benim 3 yıllık Gazi Üniv'den kovulma sürecim başarıyla tamamlandı. Tüm eşyalarım kutulara doldurularak "karanlık oda"ya konuldu.

Bu kutuları 2009 yılında TOBB ETÜ'deki ofisime taşıdık.

Bu binalarda bana bir ofis bulunamadı…
Ercan Alp'ın Açılış töreninde söyledikleri:
"Bu adam (yani Saleh) bu binaya yakışmıyor!"

Bir önceki slaytta gösterdiğim kutuların Hızlandırıcı kısmını HTE'ye taşıyacaktım…

4. LHC → FCC dönemi: 2030'lar

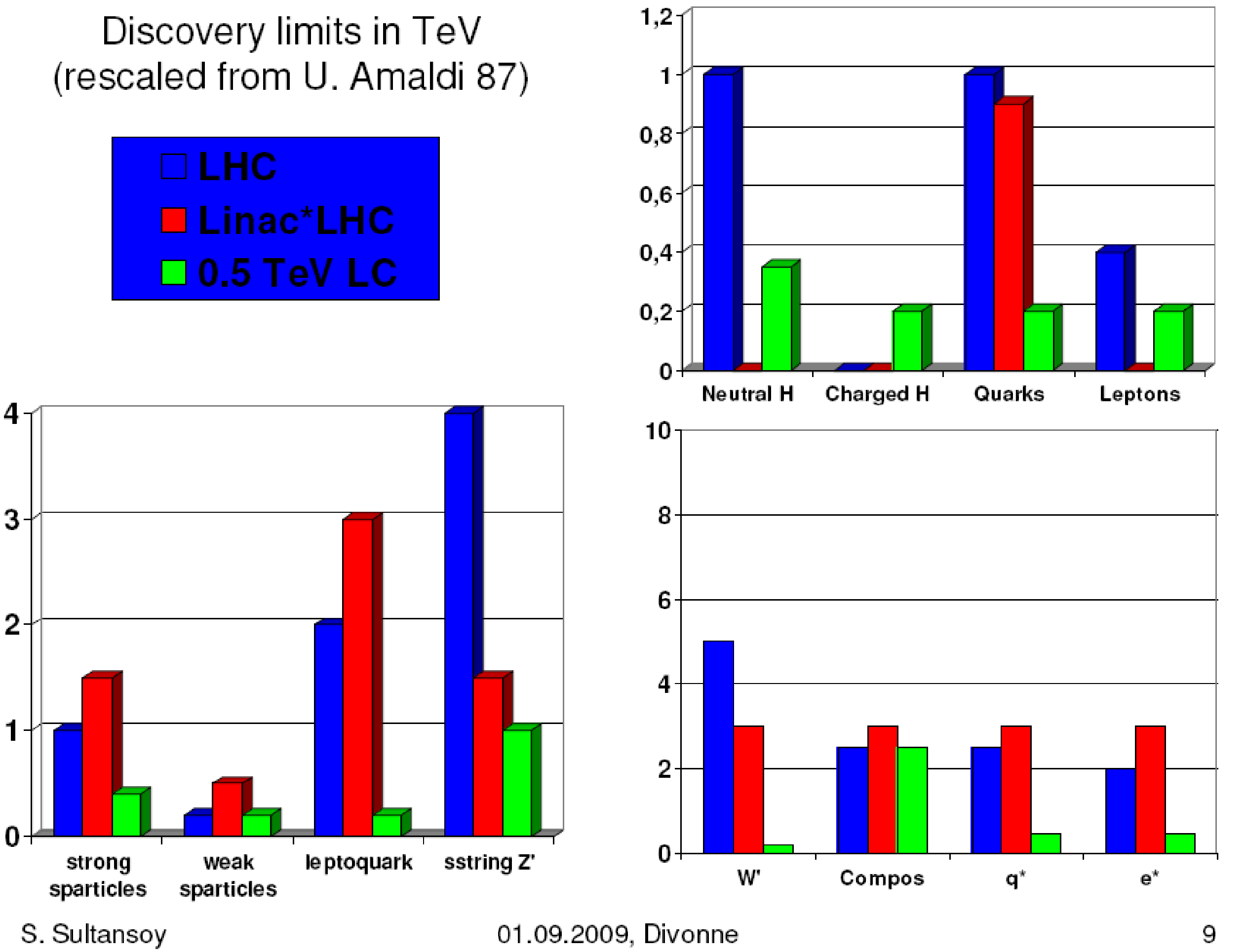


LHC ve FCC temelli ep çarpıştırıcıları

	E_e, GeV	E_p, TeV	$\sqrt{s}$, TeV	L, $10^{33}\ cm^{-2}s^{-1}$	L_{int}, $fb^{-1}(10^7 s)$
ERL60-LHC	60	7	1.3	1 (LHeCCDR)	10
OPL60-LHC	60	7	1.3	0.09 (LHeCCDR)	0.9
OPL140-LHC	140	7	2.0	0.04 (LHeCCDR)	0.4
OPL500-LHC	500	7	3.7	0.01	0.1
OPERL150-LHC	150	7	2.0	100 (LHeCCDR)	1000
OPERL500-LHC	500	7	3.7	30	300
ERL60-FCC	60	50	3.5	10 (Frank)	100
FCC-e80	80	50	4.0	23 (Frank)	230
FCC-e120	120	50	4.9	12 (Frank)	120
OPL1000-FCC	1000	50	14.1	0.04	0.4
OPERL1000-FCC	1000	50	14.1	100	1000

ERL: Energy Recovery Linac; OPL: One Pulse Linac;
OPERL: One Pulse Energy Recovery Linac

Tablodaki ışınlık değerleri pp ve ep modlarının eşzamanlı çalışmasını öngörmektedir. LHC ve FCC'nin ep moduna ayarlanmış durumunda OPL opsiyonu için ışınlık değerleri en az bir mertebe artırılabilir. Bu konuda çalışmalarımız devam etmektedir.



Bu slayt bir çok yerde gösterildi (EPS HEP Conference 2003, PAC 2005 vb) ve LHeC projesinin kabul edilmesinde kritik rol oynadı.

Bunun benzerini FCC, CLIC ve Linac-FCC için hazırlamalıyız !

Sonsöz

Asla şüphem yoktur ki, Türklüğün unutulmuş medeni vasfı ve büyük medeni kabiliyeti, bundan sonraki inkişafı ile âtinin yüksek medeniyet ufkunda yeni bir güneş gibi doğacaktır.