Possible Future Contributions to CLIC and CLIC*LHC Colliders by Ankara Group

A. Kenan Çiftçi, Ömer Yavaş and Orhan Çakır
Ankara University

ABSTRACT

A general overview of future contributions of Turkish group to CLIC related issues will be presented. Problems to be investigated on CLIC*LHC based ep, eA, γp and γA colliders including QCD Explorer on both machine and physics issues will be introduced (A.K.Çiftçi).

CLIC*LHC based FEL*Nucleus collider can be used to study nuclear spectroscopy. Problems related to this machine will be argued for machine and physics issues after a short summary (Ö. Yavaş).

Limitations on the main collider parameters from the beam dynamics affect the physics studies considerable in some cases. The beam energy spread, initial-state radiation and beamstrahlung will have effects on the production of new particles beyond the SM. Especially, resonance signatures are sensitive to the characteristics of the luminosity spectrum. Some of the benchmark physics processes are under study at CLIC high-energy frontier (O. Çakır).

The Turkish contribution to **"Physics at the CLIC Multi-TeV Linear Collider"** Yellow Report Book, (CERN-2004-005)

- 5.2 Fourth Family
  - Pair and quarkonia production at e^+e^- and $\gamma\gamma$ colliders
- 5.3 Leptoquarks
  - Production at $e\gamma$ collider
- 5.5 Excited Electrons
  - Production at $e\gamma$ collider

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PHYSICS AT THE CLIC MULTI-TeV LINEAR COLLIDER

Report of the CLIC Physics Working Group

Editors: M. Battaglia, A. De Roeck, J. Ellis, D. Schulte

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2004

CLIC Physics Working Group

E. Accomando (INFN, Torino), A. Aranda (Univ. of Colima), E. Ateser (Kafkas Univ.), C. Balazs (ANL), D. Bardin (JINR, Dubna), T. Barklow (SLAC), M. Battaglia (LBL and UC Berkeley), W. Beenakker (Univ. of Nijmegen), S. Berge (Univ. of Hamburg), G. Blair (Royal Holloway College, Univ. of London), E. Boos (INP, Moscow), F. Boudjema (LAPP, Annecy), H. Braun (CERN), P. Burikham (Univ. of Wisconsin), H. Burkhardt (CERN), M. Cacciari (Univ. Parma), O. Çakır (Univ. of Ankara), A.K. Ciftci (Univ. of Ankara), R. Ciftci (Gazi Univ., Ankara), B. Cox (Manchester Univ.), C. Da Via (Brunel), A. Datta (Univ. of Florida), S. De Curtis (INFN and Univ. of Florence), A. De Roeck (CERN), M. Diehl (DESY), A. Djouadi (Montpellier), D. Dominici (Univ. of Florence), J. Ellis (CERN), A. Ferrari (Uppsala Univ.), J. Forshaw (Manchester Univ.), A. Frey (CERN), G. Giudice (CERN), R. Godbole (Bangalore), M. Gruwe (CERN), G. Guignard (CERN), T. Han (Univ. of Wisconsin), S. Heinemeyer (CERN), C. Heusch (UC Santa Cruz), J. Hewett (SLAC), S. Jadach (INP, Krakow), P. Jarron (CERN), C. Kenney (MBC, USA), Z. Kırca (Osmangazi Univ.), M. Klasen (Univ. of Hamburg), K. Kong (Univ. of Florida), M. Krämer (Univ. of Edinburgh), S. Kraml (HEPHY Vienna and CERN), G. Landsberg (Brown Univ.), J. Lorenzo Diaz-Cruz (BUAP, Puebla), K. Matchev (Univ. of Florida), G. Moortgat-Pick (Univ. of Durham), M. Mühlleitner (PSI, Villigen), O. Nachtmann (Univ. of Heidelberg), F. Nagel (Univ. of Heidelberg), K. Olive (Univ. of Minnesota), G. Pancheri (INFN, Frascati), L. Pape (CERN), S. Parker (Univ. of Hawaii), M. Piccolo (LNF, Frascati), W. Porod (Univ. of Zurich), E. Recepoglu (Univ. of Ankara), P. Richardson (Univ. of Durham), T. Riemann (DESY-Zeuthen), T. Rizzo (SLAC), M. Ronan (LBL, Berkeley), C. Royon (CEA, Saclay), L. Salmi (HIP, Helsinki), D. Schulte (CERN), R. Settles (MPI, Munich), T. Sjostrand (Lund Univ.), M. Spira (PSI, Villigen), S. Sultansoy (Gazi Univ., Ankara and IP Baku), V. Telnov (Novosibirsk, IYF), D. Treille (CERN), M. Velasco (Northwestern Univ.), C. Verzegnassi (Univ. of Trieste), G. Weiglein (Univ. of Durham), J. Weng (CERN, Univ. of Karlsruhe), T. Wengler (CERN), A. Werthenbach (CERN), G. Wilson (Univ. of Kansas), I. Wilson (CERN), F. Zimmermann (CERN)

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- CLIC*LHC based electron-proton and electron-nucleus colliders
  - Conveyer: Saleh Sultansoy
- CLIC*LHC based gamma-proton and gamma-nucleus colliders
  - Conveyer: A. Kenan Çiftçi
- CLIC*LHC based FEL-nucleus collider
  - Conveyer: Ömer Yavaş
- Effects of CLIC beam dynamics on physics research potential
  - Conveyer: Orhan Çakır

Ankara Project Team

- A. K. Çiftçi (Coordinator)
- S. Sultansoy
- Ö. Yavaş
- O. Çakır
- H. Koru (P)
- E. Arık (P)
- M. A. Çetiner (M+N)
- M. Yılmaz (M+P)
- B. Demircioğlu (N)
- E. Guliyev (N)
- S. A.Çetin (P)
- B. B. Şirvanlı (P)
- Ş.Turhan (N)
- İ. Türk Çakır (P)
- E. Recepoğlu (M)
- H. Karadeniz (P)
- M. Kaplan (N)
- S. Aydın (N)
- S. Keleş (N)
- Ş. Yiğit (M)
- R. Çiftçi (P)
- A. Özcan (N)
- H. Aksakal (M)
- Z. Nergiz (M)
- M. Karadağ (N)
- S. C. İnan (P)
- A. A. Billur (P)
- M. Şahin (P)

P:Particle P. M:Machine
N:Nuclear P.

As smaller group, we had contributed two parts of TESLA TDR; we hope to contribute more to CLIC Collaboration!

1 The Photon Collider at TESLA

B. Badelek[43], C. Blöchinger[44], J. Blümlein[12], E. Boos[28], R. Brinkmann[12], H. Burkhardt[11], P. Bussey[17], C. Carimalo[33], J. Chyla[34], A.K. Çiftçi[4], W. Decking[12], A. De Roeck[11], V. Fadin[10], M. Ferrario[15], A. Finch[24], H. Fraas[44], F. Franke[44], M. Galynskii[27], A. Gamp[12], I. Ginzburg[31], R. Godbole[6], D.S. Gorbunov[28], G. Gounaris[39], K. Hagiwara[22], L. Han[19], R.-D. Heuer[18], C. Heusch[36], J. Illana[12], V. Ilyin[28], P. Jankowski[43], Yi Jiang[19], G. Jikia[16], L. Jönsson[26], M. Kalachnikow[8], F. Kapusta[33], R. Klanner[12,18], M. Klasen[12], K. Kobayashi[41], T. Kon[40], G. Kotkin[30], M. Krämer[14], M. Krawczyk[43], Y.P. Kuang[7], E. Kuraev[13], J. Kwiecinski[23], M. Leenen[12], M. Levchuk[27], W.F. Ma[19], H. Martyn[1], T. Mayer[44], M. Melles[35], D.J Miller[25], S. Mtingwa[29], M. Mühlleitner[12], B. Muryn[23], P.V. Nickles[8], R. Orava[20], C. Pancheri[15], A. Penin[12], A. Potylitsyn[42], P. Poulose[6], T. Quast[8], P. Raimondi[37], H. Redlin[8], F. Richard[32], S.D. Rindani[2], T. Rizzo[37], E. Saldin[12], W. Sandner[8], H. Schönnagel[8], E. Schneidmiller[12], H.J. Schreiber[12], S. Schreiber[12], K.P. Schüler[12], V. Serbo[30], A. Seryi[37], R. Shanidze[38], W. da Silva[33], S. Söldner-Rembold[11], M. Spira[35], A.M. Stasto[23], S. Sultansoy[5], T. Takahashi[21], V. Telnov[10,12], A. Tkabladze[12], D. Trines[12], A. Undrus[9], A. Wagner[12], N. Walker[12], I. Watanabe[3], T. Wengler[11], I. Will[8,12], S. Wipf[12], Ö. Yavaş[4], K. Yokoya[22], M. Yurkov[12], A.F. Zarnecki[43], P. Zerwas[12], F. Zomer[32].

[1] RWTH Aachen, Germany
[2] PRL, Ahmedabad, India
[3] Akita KeizaiHoka University, Japan
[4] Ankara University, Turkey
[5] Gazi University, Ankara, Turkey
[6] Indian Institute of Science, Bangalore, India
[7] Tsinghua University, Beijing, P.R. China
[8] Max–Born–Institute, Berlin, Germany
[9] BNL, Upton, USA
[10] Budker INP, Novosibirsk, Russia
[11] CERN, Geneva, Switzerland
[12] DESY, Hamburg and Zeuthen, Germany
[13] JINR, Dubna, Russia
[14] University of Edinburgh, UK
[15] INFN-LNF, Frascati, Italy
[16] Universität Freiburg, Germany
[17] University of Glasgow, UK
[18] Universität Hamburg, Germany
[19] CUST, Hefei, P.R.China
[20] University of Helsinki, Finland
[21] Hiroshima University, Japan
[22] KEK, Tsukuba, Japan
[23] INP, Krakow, Poland
[24] University of Lancaster, UK
[25] UCL, London, UK
[26] University of Lund, Sweden
[27] Inst. of Physics, Minsk, Belarus
[28] Moscow State University, Russia
[29] N.Carolina Univ., USA
[30] Novosibirsk State University, Russia
[31] Inst. of Math., Novosibirsk, Russia
[32] LAL, Orsay, France
[33] Université de Paris VI–VII, France
[34] IP, Prague, Czech Republic
[35] PSI, Villingen, Switzerland
[36] UCSC, Santa Cruz, USA
[37] SLAC, Stanford, USA
[38] Tbilisi State University, Georgia
[39] University of Thessaloniki, Greece
[40] Seikei University, Tokyo, Japan
[41] Sumimoto Heavy Industries, Tokyo, Japan
[42] Polytechnic Institute, Tomsk, Russia
[43] Warsaw University, Poland
[44] Universität Würzburg, Germany

2 THERA

Electron–Proton Scattering at $\sqrt{s} \sim 1\mathrm{TeV}$

H. Abramowicz[40], S.P. Baranov[21], J. Bartels[17], W. Bialowons[13], R. Brinkmann[13], O. Çakır[4], A. Caldwell[12], V. Chekelian[32,31], A.K. Çiftçi[4], J.G. Conteras[14], M. Corradi[7], J.A. Crittenden[8], J. Dainton[23], K. Daum[44], A. Deshpande[45], D. Eckstein[13], E. Elsen[13], B. Foster[9], L. Frankfurt[40], E. Gabathuler[23], J. Gassner[38], U. Gensch[13], I. Ginzburg[33], L. Gladilin[43], M. Glück[14], N. Gogitidze[21], K. Golec-Biernat[17], E. Gotsman[40], T. Greenshaw[23], V. Guzey[2], P. Jankowski, U. Jezuita-Dabrowska[41], H. Jung[13], U.F. Katz[8], R. Klanner[13,17], M. Klasen[17], M. Klein[13], B. Kniehl[17], H. Koru[5], P. Kostka[13], H. Kowalski[13], M. Krawczyk[41], T. Kurča[20], M. Kuze[19], P. Landshoff[10], T. Laštovička[37], B. Levchenko[30], E. Levin[40], A. Levy[40], K. Long[24], L. Lönnblad[25], U. Maor[40], M. McDermott[23], K. Nagano[19], T. Naumann[13], W. van Neerven[22], P. Newman[6], N. Nikolaev[18], C. Pascaud[34], E. Perez[39], D. Pitzl[13], B. Pötter[32], G. Rädel[1], V. Ravindran[3], I. Redondo[26], E. Reya[14], A. De Roeck[11], E. Rondio[42], J. Ruan[15], W. Schäfer[18], S. Schlenstedt[13], P. Schleper[13], U. Schneekloth[13], S. Söldner-Rembold[16,11], H. Spiesberger[27], U. Stösslein[13], M. Strikman[36], S. Sultansoy[5], K. Tuchin[40], W.K. Tung[29], R. Wallny[46], D. Waters[35], P. Wesolowski[13], F. Willeke[13], M. Wing[28], Ö. Yavaş[4], M. Yılmaz[5], A.F. Żarnecki[41], A. Zembrzuski[41], A. Zhokin[31], V. Zoller[31], N.P. Zotov[30].

CLIC*LHC based electron-proton and electron-nucleus colliders

Bunch structure of LHC and CLIC does not fit each other. Consequently one or other should be altered. Two types of machine is possible.

- QCD Explorer: e beam (75 GeV), p beam (7 TeV) $\sqrt{s} = 1.4 TeV$
  - Alter LHC to have superbunch and fit the transverse bunch sizes of CLIC to LHC bunch size. (D. Schulte and F. Zimmerman)
  - If altering of LHC is not possible, Upgrade CLIC parameters as much as Acc. Physics permits.
- Energy frontier: e beam (0.5 TeV, 1 TeV, 3 TeV) p beam (7 TeV) $\sqrt{s} = 3.74 TeV, 5.3 TeV, 9.16\, TeV$
  - Same as QCD-E.

Problems to tackle on accelerator

- Superbunched QCD-E has been studied by D. Schulte and F. Zimmerman. (L= 1.1×10^{31} $cm^{-2}s^{-1}$)

- Even without altering LHC and CLIC (5 CLIC bunches collide instead 154), L= 10^{28} $cm^{-2}s^{-1}$
- Superbunched ep Energy Frontier (L=10^{31} $cm^{-2}s^{-1}$)*
- CLIC upgraded QCD-E (L= 10^{31} $cm^{-2}s^{-1}$)*
  - $N_e = 4 \times 10^9 \rightarrow 10 \times 10^9$, increase number of trains per RF pulse
- CLIC upgraded ep Energy Frontier (L= 10^{31} $cm^{-2}s^{-1}$)*

*Detailed machine study is planned, Luminosities are projected or preliminary values

Physics Problems to investigate:

- QCD Explorer:
  - SM physics topics (structure functions, hadronic final states, high Q^2 (1-10 TeV^2) and small x_g (10^{-5}-10^{-6}) region etc.)
  - Leptoquarks, leptogluons, if their masses smaller than 1TeV
- Energy frontier:
  - Excited electrons
  - Excited neutrinos
  - Leptoquarks
  - Higgs
  - SUSY
- Electron nucleus collider (L_{eA}*A= 10^{31} $cm^{-2}s^{-1}$)
  - Physics search program direct extention of HERA eA program

CLIC*LHC based gamma-proton and gamma-nucleus colliders

High energy gamma beam is produced by Compton back-scattering of laser beam e-beam.

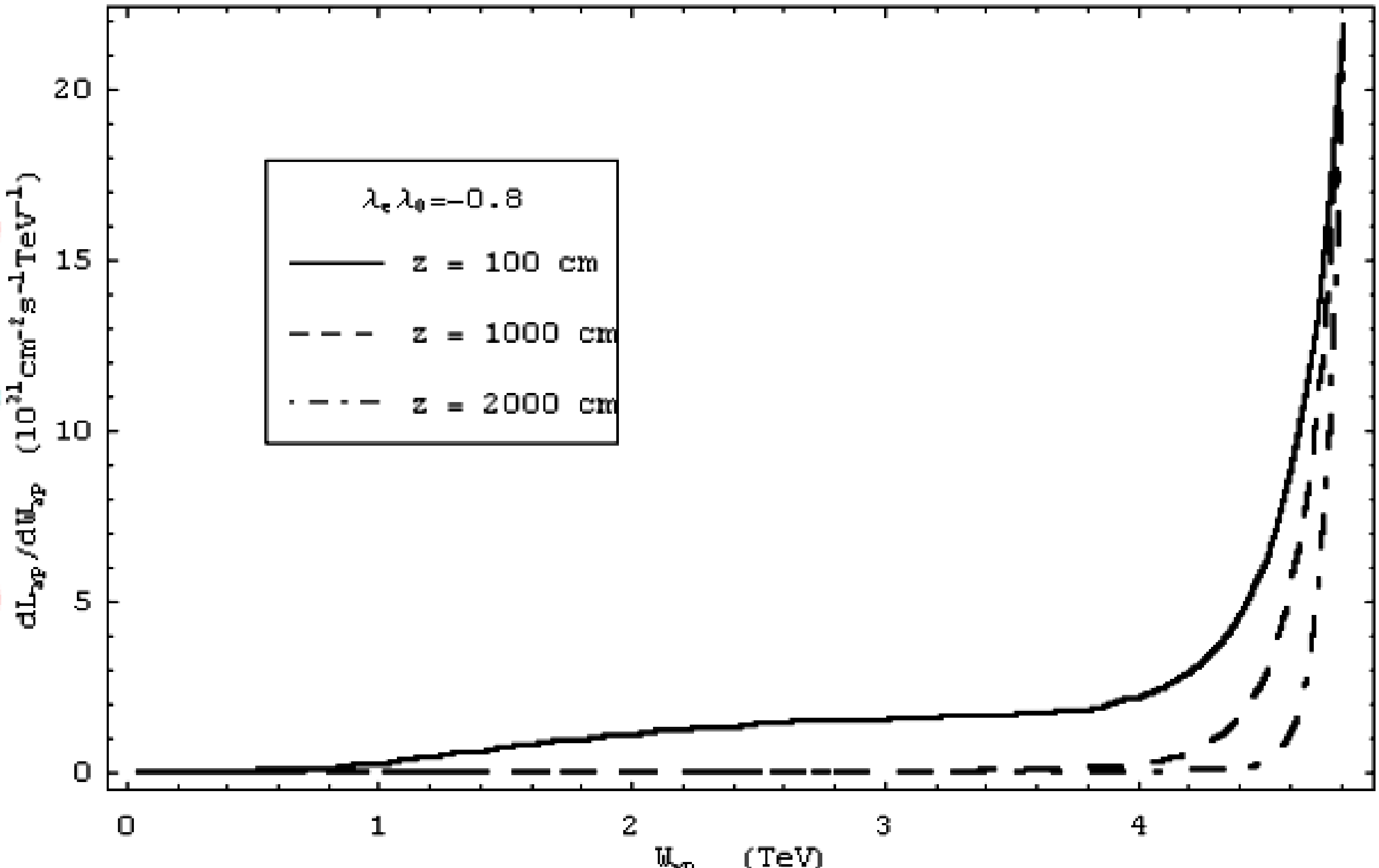
About 60 % of the electrons produces gamma beam. Max Energy of gamma beam equals 83% of e-beam energy.

The choice of laser should be made in such a way that e+e- pair creation in the field of electrons and photons is prevented.

Unmatched bunch time structure exists as in CLIC*LHC ep collider.

Same as ep case: Superbunched or Upgraded QCD-E-γp; Superbunched or Upgraded Energy Frontier-γp

A Sample of Luminosity Spectrum



Collider Problems to investigate:

- How to get rid of electrons after γ conversion:
  - Remove before collision point. (Lots of SR)
  - Defocus, so its collisions with p-beam become insignificant!
- Choosing e beam size in such a way that p-beam and γ beam sizes match at the collision point.
- How does smaller γ beam size effect p-beam
- What is min. distance between conversion and collision point.
- Selection of laser: For example
  - 4.026 eV Xe-Chloride laser for QCD-E
  - 12.4μm conventional or free electron lasers for 3 TeV e-beam
- Computing luminosity Spectrum by considering e-beam energy spread.

Physics problems to investigate:

- QCD-E-γp:
  - Study QCD related problems such as investigation of small x_g region through $c\bar{c}$ and $b\bar{b}$ pair production.
- Energy Frontier-γp:
  - Small x_g region
  - Excited quarks
- γA physics problems should be determined