

Prospects For Charged Higgs Discovery At Colliders (CHARGED 2010)

Monday 27 September 2010 - Thursday 30 September 2010

Uppsala

Book of Abstracts

Contents

Evolution of Universe to a modern state if Dark Matter is given by additional Higgs doublet (inert model)	1
Charged Higgs production and decay for Signature of Inert Higgs Doublet Model.	1
$t\bar{t}$ backgrounds in charged Higgs searches	2
Implications of Yukawa texture in the charged Higgs boson phenomenology within 2HDM-III	2
Charged-Higgs phenomenology in the Aligned two-Higgs-doublet model	3
Status of the CMS experiment	3
Status of the ATLAS experiment	3
ATLAS discovery prospects for the charged Higgs in the $H^{\pm} \rightarrow \tau \nu$ final state	4
CMS performance on b reconstruction	4
Missing E_t and jets, trigger and reconstruction efficiency in CMS	4
Charged Higgses production via vector-boson fusion at NNLO in QCD	5
Charged Higgs in CP-conserving 2HDM	5
double charged scalars of littlest higgs model in ee colliders	6
Status of the LHC machine	6
Status of the ATLAS experiment	6
Status of the CMS experiment	6
Coffee break	6
Review of charged Higgs searches at the Tevatron	6
Review of indirect charged Higgs searches at B factories	7
Interpretation of charged Higgs effects in low energy flavour physics	7
Light charged Higgs in NMSSM	7
Charged Higgs in Extended Higgs models (non-type II model)	7

Higher order corrections to charged Higgs production including EW corrections	7
Tools for charged Higgs bosons	7
Reports from the Charged Higgs Benchmark working group: general 2HDM	8
Charged Higgs production at NLO in 4FS vs 5FS	8
Contributed talks	8
Associated charged Higgs and top production in MC@NLO	8
HiggsBounds	8
Contributed phenomenology talks	8
Tau trigger and tau reconstruction, efficiency and fake rates in ATLAS	8
b reconstruction, efficiency and fake rates in CMS	9
Missing ET and jets, trigger and reconstruction efficiency	9
QCD backgrounds in charged Higgs searches	9
W + jets backgrounds in charged Higgs searches	9
ttbar backgrounds in charged Higgs searches	9
Search strategies for charged Higgs in ATLAS	9
Search strategies for charged Higgs in CMS	9
Systematics in charged Higgs searches in ATLAS	10
Systematics in charged Higgs searches in CMS	10
ATLAS discovery prospects for the charged Higgs in the $H^{+-} \rightarrow \tau \nu$ final state	10
ATLAS discovery prospects for a light charged Higgs in the $H^{+-} \rightarrow c \bar{s}$ channel	10
Charge Higgs physics at CLIC/ILC	10
Summary and outlook for theory	10
Summary and outlook for experiment	10
Tau trigger and tau reconstruction, efficiency and fake rates in ATLAS	11
Welcome by Vicerector Joseph Nordgren	11
Charged Higgs production via vector-boson fusion at NNLO in QCD	11
Evolution of Universe to a modern state if Dark Matter is given by additional Higgs doublet (inert model)	12
The Inert Doublet Model as the Dark matter	12
Charged Higgs production and decay for Signature of Inert Higgs Doublet Model	12

Hidden Higgs Doublet model	12
Double charged scalars of littlest higgs model in ee colliders	12
2HDMC –a two Higgs Doublet Model Calculator	12
Flavour constraints and SuperIso	12
Constraining the Charged Higgs Mass in the MSSM: A Low-Energy Approach	13
Charged Higgs in CP-conserving 2HDM	13
Implications of Yukawa texture in the charged Higgs boson phenomenology within 2HDM-III	13
Charged-Higgs phenomenology in the Aligned two-Higgs-doublet model	13
Higher-order corrections to M_{H^+} and $stop_i \rightarrow sbottom_j H^+$	13
Registration	13
Report from the Charged Higgs benchmark working group: NMSSM	13
Report from the Charged Higgs benchmark working group: Sparticle prod and decay	14
Transfer function treatment of leptonic tau decays in the Matrix Element Method	14

0

Evolution of Universe to a modern state if Dark Matter is given by additional Higgs doublet (inert model)

Author: Ilya Ginzburg¹

Co-authors: Konstantin Kanishev²; Maria Krawczyk³

¹ *Sobolev Inst*

² *Novosibirsk State University*

³ *Warsaw University*

Corresponding Author: ginzburg@math.nsc.ru

We discuss thermal evolution of Universe after inflation in the frame of Inert doublet model in the case when modern state of Universe with dark matter is described by inert doublet model.

Summary:

There is an opportunity that Dark Matter is given by additional as compare SM, Higgs doublet (inert model). This Higgs doublet interacts with standard Higgs doublet and don't interact to fermions. During cooling down of Universe parameters of this interaction vary. It can results in change of phase states of Universe. In particular, very probable variant is that after EWSB transition the Universe comes to the state without candidates for Dark Matter and only later on it comes to the modern state with Dark Matter either via 1-st order phase transition or via chain of two 2-nd order phase transitions.

1

Charged Higgs production and decay for Signature of Inert Higgs Doublet Model.

Author: Ilya Ginzburg¹

Co-author: Konstantin Kanishev²

¹ *Sobolev Inst. of Mathematics SB RAS*

² *Novosibirsk State University*

Corresponding Author: ginzburg@math.nsc.ru

We propose method for using of production of charged Higgs pair in e^+e^- collisions (at LC) for discovery of Dark Matter (DM) particles and measuring of their mass if they appear as scalar of Inert doublet model. In many cases this approach is also useful for another mechanisms of DM.

Summary:

There is an opportunity that Dark Matter is given by additional as compare SM, Higgs doublet (inert model). This Higgs doublet interacts with standard Higgs doublet and don't interact to fermions. This additional Higgs doublet is realized as 3 scalars, neutral scalar D and pseudoscalar D_A and charged scalar D^\pm , with conservation of D -parity. In this model D realizes Dark Matter (DM) while D^\pm and D_A are more heavy. Typically $M_D < 80$ GeV. The best machine for checking on this model is e^+e^- Linear Collider. The dominant decay of D^\pm is decay to DW^\pm with W either on mass shell (if mass of D^\pm is high enough) or beyond. The main discovery channel is $e^+e^- \rightarrow D^+D^- \rightarrow W^+W^-DD$. The cross section of this process is about 5% from that of entire hadron production. We suggest to observe W bosons in two jet modes and to measure their effective mass M_{jj} . The signature of this process is observation of these two W 's with large missed transverse energy. The SM processes with such production

has much lower cross section (additional factors α for each additional neutrino). The details of momentum distribution of produced W allow to determine masses D^\pm and D with reasonable accuracy. The measuring of cross sections $e^+e^- \rightarrow D^+D^-h$ and $e^+e^- \rightarrow D^+D^-hh$, $e^+e^- \rightarrow D^+D^-DD$ allows to determine all couplings of model.

2

ttbar backgrounds in charged Higgs searches

Author: Martin Flechl¹

¹ *Universität Freiburg*

Corresponding Author: martin.flechl@cern.ch

Top quark pair production is the main background for searches in most charged Higgs boson channels. The characteristics of this background are shown, as well as the contribution of the different ttbar decay modes: they can be separated into “irreducible” ttbar modes with the same final state as the signal, and “reducible” modes which contributes e.g. if an electron is misreconstructed as a tau. I will then present techniques to suppress and estimate the ttbar background contribution to the charged Higgs boson searches.

3

Implications of Yukawa texture in the charged Higgs boson phenomenology within 2HDM-III

Author: Jaime Hernández-Sánchez¹

Co-authors: Alfonso Rosado¹; Lorenzo Diaz¹; Roberto Noriega-Papaqui²; Stefano Moretti³

¹ *Benemerita Universidad Autónoma de Puebla*

² *Universidad Autonoma del Estado de Hidalgo*

³ *School of Physics and Astronomy, University of Southampton, Highfield, Southampton SO17 1BJ, UK.*

Corresponding Author: jaimeh@ece.buap.mx

We discuss the implications of assuming a four-zero Yukawa texture for the properties of the charged Higgs boson within the context of the general 2-Higgs Doublet Model of Type III. We begin by presenting a detailed analysis of the charged Higgs boson couplings with heavy quarks and the resulting pattern for its decays, including the decay $H^+ \rightarrow W^+\gamma$ at 1-loop level. The parameters chosen can still avoid the $B \rightarrow X_s\gamma$ constraint, the perturbativity and ρ_0 bound. Also, we present the constraints of $B0 - \bar{B}0$ mixing and of the radiative corrections to the $Zb\bar{b}$ vertex in the regime small $\tan\beta$. The production of charged Higgs bosons is also sensitive to the modifications of its couplings, so that we also evaluate the resulting effects on the top decay $t \rightarrow bH^+$ as well as on direct $c\bar{b} \rightarrow H^+ + c.c.$ and indirect $q\bar{q}, gg \rightarrow \bar{t}bH^+ + c.c.$ production. Significant scope exists at the Large Hadron Collider for several H^\pm production and decay channels combined to enable one to distinguish between such a model and alternative 2-Higgs doublet scenarios.

Summary:

1. Implications of four-zero Yukawa texture for the 2HDM-III.
2. A detailed analysis of the charged Higgs boson coupling with fermions.
3. The resulting pattern for the decays of the charged Higgs boson.

4. The decay $H^+ \rightarrow W^+\gamma$ at one-loop level.
5. Some electroweaks constraints for mass of the charged Higgs bosons and for parameters of Higgs potential.
6. The top decay $t \rightarrow bH^+$
7. The direct' $c\bar{b} \rightarrow H^+ + c.c.$ and indirect' $q\bar{q}, gg \rightarrow \bar{t}bH^+ + c.c.$ production.
8. We evaluate the events rates at the LHC.

4

Charged-Higgs phenomenology in the Aligned two-Higgs-doublet model

Author: Martin Jung¹

¹ *IFIC*

The alignment in flavour space of the Yukawa matrices of a general two-Higgs-doublet model results in the absence of tree-level flavour-changing neutral currents. In addition to the usual fermion masses and mixings, the aligned Yukawa structure only contains three complex parameters, which are potential new sources of CP violation. For particular values of these three parameters all known specific implementations of the model based on discrete Z_2 symmetries are recovered.

One of the most distinctive features of the two-Higgs-doublet model is the presence of a charged scalar. In this talk, I will discuss its main phenomenological consequences in flavour-changing processes at low energies, ranging from leptonic decays to the recently widely discussed like-sign dimuon charge asymmetry.

5

Status of the CMS experiment

Author: Alexandre Nikitenko¹

¹ *Imperial College*

Corresponding Author: alexandre.nikitenko@cern.ch

The review of the latest CMS physics results related to the preparation for the charged Higgs boson discovery at LHC will be given. In particular, the performance of the jet and missing E_t reconstruction, b-jet tagging, the measurement of the jet-tau fake rate will be presented. The results on the W and Z cross-section measurement and observation of $t\bar{t}$ events will also be shown.

6

Status of the ATLAS experiment

Author: Domizia Orestano¹

¹ *Universita di Roma Tre and INFN*

Corresponding Author: domizia.orestano@cern.ch

The ATLAS Experiment at the CERN Large Hadron Collider was operated with colliding proton beams at 7 TeV center of mass energy since March 2010. It will study a broad range of particle physics at the highest available laboratory energies, from measurements of the standard model to searches for new physics beyond the standard model. At the time of writing ATLAS, with high data taking efficiency, has integrated a luminosity of 330 nb⁻¹, which allowed already observation and measurement of standard model processes, like vector boson and top production. Detector status, event reconstruction and particle identification performance in this first period of operation will be presented together with the first physics results.

7

ATLAS discovery prospects for the charged Higgs in the H[±]→taunu final state

Author: Miika Klemetti¹

¹ *McGill University*

Corresponding Author: miika@hep.physics.mcgill.ca

We present projections for the ATLAS sensitivity to a light charged Higgs boson in channel H[±]→taunu→lν, present in models beyond the Standard Model, with an expected dataset corresponding to an integrated luminosity of 1fb⁻¹ gathered at the ATLAS detector with the LHC running at 7 TeV. The results are based on re-scaling expectations from detailed analyses at 10 TeV using cross-section ratios.

8

CMS performance on b reconstruction

Author: Jyothsna Rani KOMARAGIRI¹

Co-author: CMS collaboration²

¹ *Karlsruher Institut für Technologie (KIT)*

² *CERN*

Corresponding Author: jyothsna.rani.komaragiri@cern.ch

The identification of jets containing the weak decay of a B-hadron is an essential tool for a wide range of analyses in the context of the Standard Model and beyond. A variety of algorithms exploit the long lifetime and the presence of soft leptons to discriminate these jets from those associated to light quarks. The distributions of the corresponding observables - track impact parameters, secondary vertices and lepton momenta - were measured in pp collisions at sqrt(s) = 7 TeV and compare well to the predictions of Monte Carlo simulation. First results on efficiencies and mis-identification rates are shown.

9

Missing Et and jets, trigger and reconstruction efficiency in CMS

Author: Matti Kortelainen¹

¹ *Helsinki Institute of Physics*

Corresponding Author: matti.kortelainen@cern.ch

The reconstruction of the missing transverse energy and jets, the trigger plans and the reconstruction efficiencies in the CMS detector are discussed. The performance with the 7 TeV proton-proton collision data is presented.

10

Charged Higgses production via vector-boson fusion at NNLO in QCD

Author: Marco Zaro¹

Co-authors: Fabio Maltoni²; Paolo Bolzoni³; Sven-Olaf Moch³

¹ *Center for Particle Physics and Phenomenology*

² *CP3 - Louvain*

³ *DESY-Zeuthen*

Corresponding Author: marco.zaro@uclouvain.be

We present the total cross sections at next-to-next-to-leading order (NNLO) in the strong coupling for single and double charged Higgs production via weak boson fusion. Results are obtained via the structure function approach, which builds upon the approximate, though very accurate, factorization of the QCD corrections between the two quark lines. We also provide an estimate for the theoretical uncertainty on the total cross sections at the LHC from higher order corrections and the parton distribution uncertainties.

11

Charged Higgs in CP-conserving 2HDM

Author: Rui Santos¹

Co-authors: Kei Yagyu²; Renato Guedes³; Shinya Kanemura²; Stefano Moretti⁴

¹ *University of Southampton and NExT Institute*

² *University of Toyama*

³ *CFTC*

⁴ *SHEP*

Corresponding Author: santos@pp.rhul.ac.uk

The LHC has started colliding protons. Several extensions of the Standard Model predict a charged scalar particle which according to the LEP bound could be as light as 100 GeV. In this work we compare the four flavour conserving Yukawa versions of a CP-conserving two-Higgs doublet model (2HDM) regarding charged Higgs production and decay. We define a set of benchmarks where an early detection is possible at the 14 TeV LHC. Furthermore, we determine the luminosity required to distinguish between the four Yukawa versions of the CP-conserving 2HDM for a chosen set of benchmarks.

14

double charged scalars of littlest higgs model in ee colliders

Author: Ayse Cagil¹

¹ *Exptl. High Energy Physics Lab.-Physics Department-Middle East T*

Corresponding Author: ayse.cagil@cern.ch

Little higgs models, as a result of extended symmetry group of S.M contain heavy scalars in their content of particles. In the littlest Higgs model of little Higgs models there exists a new heavy scalar triplet. The physical states of this triplet contains a double charged scalar, a single charged scalar, as well as a neutral scalar and a neutral pseudoscalar. In little higgs models a majorana type mass term can also be implemented in yukawa lagrangian, resulting lepton flavour violation.

In this work the pair production of double charged scalars in the context of littlest higgs model in ee colliders is studied. Also the final signatures of double charged scalars are investigated depending on lepton flavour violation parameters. Finally it is seen that if there is lepton flavour violation double charged scalars can be observed without any SM background in ee colliders with a collider signal of four leptons, otherwise if there is no lepton flavour violation they can be reconstructed with a background analysis.

Invited talks on experiment / 15

Status of the LHC machine

Corresponding Author: steve.myers@cern.ch

Invited talks on experiment / 16

Status of the ATLAS experiment

Corresponding Author: domizia.orestano@cern.ch

Invited talks on experiment / 17

Status of the CMS experiment

Corresponding Author: alexandre.nikitenko@cern.ch

18

Coffee break

Invited talks on experiment / 19

Review of charged Higgs searches at the Tevatron

Corresponding Authors: gut@fnal.gov, pgtierrez@ou.edu

Invited talks on experiment / 20

Review of indirect charged Higgs searches at B factories

Corresponding Author: maria.rozanska@cern.ch

Invited talks on theory and phenomenology / 21

Interpretation of charged Higgs effects in low energy flavour physics

Corresponding Author: tobias.hurth@cern.ch

Invited talks on theory and phenomenology / 22

Light charged Higgs in NMSSM

Corresponding Author: dermisek@indiana.edu

Invited talks on theory and phenomenology / 23

Charged Higgs in Extended Higgs models (non-type II model)

Corresponding Author: andrew.akeroyd@gmail.com

Invited talks on theory and phenomenology / 24

Higher order corrections to charged Higgs production including EW corrections

Corresponding Author: claudio.verzegnassi@cern.ch

Invited talks on theory and phenomenology / 25

Tools for charged Higgs bosons

Corresponding Author: oscar.stal@desy.de

discussion on benchmark scenarios / 26

Reports from the Charged Higgs Benchmark working group: general 2HDM

Corresponding Authors: per.osland@cern.ch, maria.krawczyk@cern.ch

Contributed talks on theory and models / 27

Charged Higgs production at NLO in 4FS vs 5FS

Corresponding Author: michael.kraemer@cern.ch

28

Contributed talks

Contributed talks on phenomenology and tools / 29

Associated charged Higgs and top production in MC@NLO

Corresponding Author: tilman.plehn@cern.ch

Contributed talks on phenomenology and tools / 30

HiggsBounds

Corresponding Author: oliver.brein@physik.uni-freiburg.de

31

Contributed phenomenology talks

Contributed talks on charged Higgs analysis tools and backgrounds / 32

Tau trigger and tau reconstruction, efficiency and fake rates in ATLAS

Corresponding Author: coadou@cppm.in2p3.fr

Contributed talks on charged Higgs analysis tools and backgrounds / 33

b reconstruction, efficiency and fake rates in CMS

Corresponding Author: jyothsna.rani.komaragiri@cern.ch

Contributed talks on charged Higgs analysis tools and backgrounds / 34

Missing ET and jets, trigger and reconstruction efficiency

Corresponding Author: matti.kortelainen@cern.ch

Contributed talks on charged Higgs analysis tools and backgrounds / 35

QCD backgrounds in charged Higgs searches

Corresponding Author: alexandros.attikis@cern.ch

Contributed talks on charged Higgs analysis tools and backgrounds / 36

W + jets backgrounds in charged Higgs searches

Corresponding Author: fabien.tarrade@cern.ch

Contributed talks on charged Higgs analysis tools and backgrounds / 37

ttbar backgrounds in charged Higgs searches

Corresponding Author: martin.flechl@cern.ch

Contributed talks on charged Higgs analysis tools and backgrounds / 38

Search strategies for charged Higgs in ATLAS

Corresponding Author: arnaud.ferrari@physics.uu.se

Contributed talks on charged Higgs analysis tools and backgrounds / 39

Search strategies for charged Higgs in CMS

Corresponding Author: michele.gallinaro@cern.ch

Contributed talks on charged Higgs search strategies and systematic / 40

Systematics in charged Higgs searches in ATLAS

Corresponding Author: simonetta.gentile@cern.ch

Contributed talks on charged Higgs search strategies and systematic / 41

Systematics in charged Higgs searches in CMS

Corresponding Author: lauri.wendland@cern.ch

Contributed talks on charged Higgs search strategies and systematic / 42

ATLAS discovery prospects for the charged Higgs in the $H^{\pm} \rightarrow \tau \mu$ final state

Corresponding Author: miika@hep.physics.mcgill.ca

Contributed talks on charged Higgs search strategies and systematic / 43

ATLAS discovery prospects for a light charged Higgs in the $H^{\pm} \rightarrow c \bar{s}$ channel

Corresponding Author: ukyang@hep.man.ac.uk

Contributed talks on charged Higgs search strategies and systematic / 44

Charge Higgs physics at CLIC/ILC

Corresponding Author: marco.battaglia@cern.ch

Concluding session with summary and outlook / 45

Summary and outlook for theory

Corresponding Author: stefano.moretti@cern.ch

Concluding session with summary and outlook / 46

Summary and outlook for experiment

Corresponding Author: karl.jakobs@uni-freiburg.de

47

Tau trigger and tau reconstruction, efficiency and fake rates in ATLAS

Author: Yann Coadou¹

¹ *CPPM Marseille*

Tau leptons will play an important role in the physics program at the LHC. In particular, they provide a useful signature in searches for new phenomena like charged Higgs bosons or Supersymmetry. In addition, they are being used for standard model electroweak measurements and for detector related studies such as the determination of the missing transverse energy scale.

Due to the huge background from QCD processes, efficient tau identification techniques with large fake rejection are essential. Tau objects appear as collimated jets with low track multiplicity and single variable criteria are not enough to efficiently separate them from jets and electrons.

We report on the commissioning steps and performance of the tau trigger, which is designed to efficiently reject low-energy jets while keeping a high efficiency with respect to hadronic tau leptons identified by the offline algorithms.

We present the current status of tau reconstruction and identification at the LHC with the ATLAS detector. Reconstructed tau candidates in dijet backgrounds and $W \rightarrow \tau \nu$ signal events are studied in data and compared with predictions from Monte Carlo simulation. The performance of the fake tau rejection is estimated in a dijet data sample. We discuss the plans for measuring tau identification efficiency using $Z \rightarrow \tau \tau$ signal events and the fake rate using photon+jet and Z +jets background events. Both cut-based and more advanced multivariate techniques which make optimal use of all the information available are presented. These standard model measurements are instrumental in validating tau identification for discovery physics.

Invited talks on experiment / 48

Welcome by Vicerector Joseph Nordgren

Contributed talks on theory and models / 49

Charged Higgs production via vector-boson fusion at NNLO in QCD

Corresponding Author: marco.zaro@uclouvain.be

Contributed talks on theory and models / 50

Evolution of Universe to a modern state if Dark Matter is given by additional Higgs doublet (inert model)

Corresponding Author: ginzburg@math.nsc.ru

Contributed talks on theory and models / 51

The Inert Doublet Model as the Dark matter

Corresponding Author: mgust@fysik.su.se

Contributed talks on theory and models / 52

Charged Higgs production and decay for Signature of Inert Higgs Doublet Model

Corresponding Author: ginzburg@math.nsc.ru

Contributed talks on theory and models / 53

Hidden Higgs Doublet model

Corresponding Author: glenn.wouda@fysast.uu.se

Contributed talks on theory and models / 54

Double charged scalars of littlest higgs model in ee colliders

Corresponding Author: ayse.cagil@cern.ch

Contributed talks on phenomenology and tools / 55

2HDMC –a two Higgs Doublet Model Calculator

Contributed talks on phenomenology and tools / 56

Flavour constraints and SuperIso

Corresponding Author: mahmoudi@in2p3.fr

Contributed talks on phenomenology and tools / 57

Constraining the Charged Higgs Mass in the MSSM: A Low-Energy Approach

Corresponding Author: ckolda@nd.edu

Contributed talks on phenomenology and tools / 58

Charged Higgs in CP-conserving 2HDM

Corresponding Author: santos@pp.rhul.ac.uk

Contributed talks on phenomenology and tools / 59

Implications of Yukawa texture in the charged Higgs boson phenomenology within 2HDM-III

Corresponding Author: jaimeh@ece.buap.mx

Contributed talks on phenomenology and tools / 60

Charged-Higgs phenomenology in the Aligned two-Higgs-doublet model

Contributed talks on phenomenology and tools / 61

Higher-order corrections to M_{H^+} and $\text{stop}_i \rightarrow \text{sbottom}_j H^+$

Corresponding Author: sven.heinemeyer@cern.ch

Registration from 13:00 / 62

Registration

discussion on benchmark scenarios / 63

Report from the Charged Higgs benchmark working group: NMSSM

Corresponding Authors: martin.flechl@cern.ch, stefano.moretti@cern.ch

discussion on benchmark scenarios / 64

Report from the Charged Higgs benchmark working group: Sparticle prod and decay

Corresponding Authors: sven.heinemeyer@cern.ch, ketevi.adikle.assamagan@cern.ch

Contributed talks on charged Higgs analysis tools and backgrounds / 65

Transfer function treatment of leptonic tau decays in the Matrix Element Method

Corresponding Author: camille.belanger-champagne@cern.ch