T 82: Invited Topical Talks 6

Time: Thursday 14:00–15:40   Location: T-H16

Invited Topical Talk   T 82.1   Thu 14:00   T-H16
Searches for new scalar particles at the LHC — •Dominik Duda
— Max-Planck-Institut für Physik

The Higgs boson discovery by the ATLAS and CMS experiments at the
Large Hadron Collider was a great success. Ever since, numerous stud-
ies have been performed to establish whether it is a Standard Model
particle or rather the first observed physical state of an extended scalar
sector beyond the Standard Model.

Extended scalar sectors are well motivated as they can modify the
electroweak phase transition and facilitate baryogenesis, enhance vac-
uum stability, provide a dark matter candidate or provide a solution
to the strong CP problem (i.e. predict axions). In short, extending the
scalar sector provides solutions to some of the questions the Standard
Model fails to answer.

Various theories beyond the Standard Model predict the existence
of new Higgs bosons in addition to the already discovered one. E.g.,
the introduction of a second Higgs doublet field in the minimal super-
symmetric extension of the Standard Model leads to the prediction of
three neutral and two charged Higgs bosons, while an additional Higgs
triplet field e.g. in models with a type-II seesaw mechanism would re-
sult in seven scalars in total. The discovery of such new scalar particles
would be a direct evidence of new physics.

In this presentation, the latest searches for additional neutral and
charged scalars performed with the ATLAS and CMS experiments will
be reviewed.

Invited Topical Talk   T 82.2   Thu 14:25   T-H16
**Novel approaches to search for new physics in rare charm
decays** — •Dominik Stefan Mitzel — TU Dortmund University,
Germany

Recent studies of rare b-hadron decays have revealed a coherent pattern
of deviations from Standard Model predictions in $b \rightarrow s\ell^+\ell^-$ transi-
tions, known as *flavour anomalies*. Rare charm decays are sensitive
to $c \rightarrow u\ell^+\ell^-$ flavour-changing neutral-current processes and offer the
unique and complementary opportunity to search for anomalies in the
up-type quark sector that has hardly been explored in the past. For
long, rare charm decays have been considered as less promising due
to difficulties in the description of its low energy dynamics. During
this talk, I will discuss how exact or approximate symmetries in the
charm system allow to construct clean null-test observables, yielding
an excellent road to the discovery of New Physics.

Invited Topical Talk   T 82.3   Thu 14:50   T-H16

**Constraining the Higgs-charm Yukawa coupling with the
CMS experiment** — •Luca Mastrolorenzo — RWTH, Aachen,
Germany

In this talk, an overview of the most recent results of the direct search
for the VH, H→cc process with the CMS experiment is presented. The
search targets Higgs bosons produced in association with a vector bo-
son (W, Z) exploiting the full Run-2 data set. The analysis is carried
out in mutually exclusive channels selecting specific leptonic decays of
the vector bosons: Z→ $\ell\ell$, Z→ $\nu\nu$, W→ $\ell\nu$, with ℓ=electron or muon.
To fully exploit the topology of the Higgs boson decay in the differ-
ent regimes of the Higgs boson transverse momentum, two strategies
have been adopted aiming to reconstruct the Higgs boson candidate
through two distinct Ak4 jets or via a unique Ak15 "fat-jet". Remark-
able improvements have been brought to the analysis techniques with
respect to the previous public results: from new and more efficient al-
gorithms to tag charm-initiated jets to dedicated jet energy and mass
regression techniques, conceived exploiting advanced machine learning
methods. The analysis strategy has been extensively validated by ob-
serving the VZ, Z→cc process for the first time at a hadron collider
experiment. The results represent the world's most stringent limit on
the VH, H→cc process and on the Higgs-charm Yukawa coupling.

Invited Topical Talk   T 82.4   Thu 15:15   T-H16
**Characterization of H boson events in the $\tau\tau$ decay channel
with the full CMS Run-2 data set** — •Sebastian Wozniewski
— Georg-August-Universität, Göttingen, Germany

The LHC Run-2 data set of proton-proton collisions provides first
deeper insights into the properties and production of Higgs bosons.
Besides the verification of the assumed coupling structure, which re-
mains a challenge, also differential investigations of Higgs boson events
are important tests of the Standard Model (SM) Higgs sector. More-
over, models based on supersymmetry allow for modifications of the
couplings of the SM-like Higgs boson to (down-type) fermions, which
puts particular interest on the decay channel into tau leptons. The
analysis of di-tau events of the full LHC Run-2 data set, taken by the
CMS experiment, in the STXS framework for differential cross sections
measurements is presented. It is based on modern technologies in terms
of object identification, data-driven background modeling, and neural-
network based multiclass event-classification. The full granularity of
the differential STXS measurement, with twelve signal components, is
reflected by the neural networks, in addition to the major background
contributions.