



ATLAS NOTE

ATL-COM-PHYS-2012-038

March 27, 2012



A Search for the Higgs boson in the $H \rightarrow WW^{(*)} \rightarrow \ell \nu \ell \nu$ decay mode using a Matrix Element Method and 4.7 fb^{-1} of data collected with the ATLAS detector at $\sqrt{s} = 7 \text{ TeV}$

R. Aben^a, J. Alison^b, M. Antonelli^c, A. Armbruster^d, O. Arnaez^e, K. A. Assamagan^f,
A. Barbero Galtieri^g, T. Baroncelli^h, J. Barreria Guimaraes da Costaⁱ, A. Belloniⁱ,
E. Berglund^j, R. Bernhard^k, M. Biglietti^h, A. Boveia^l, B. Brelrier^m, J. Bronnerⁿ, F. Canelli^l,
B. Cerio^o, P. Chang^p, M. A. Chelstowska^j, B. Chow^q, P. Conde Muino^r, G. Contiⁱ, T. Dai^d,
P. Dang^k, N. de Groot^j, B. Di Micco^c, R. Di Nardo^s, S. Diglio^t, M. Duehrssen^c, J. Elmsheuser^q,
Y. Fang^u, A. Farilla^h, P. Ferrari^a, F. Filthaut^j, J. Gevirtz^d, P. Guenther^k, D. Hall^v, S. Hassani^f,
C. Hays^v, B. Heinemann^g, Y. Hernandez^w, T. M. Hong^b, P. Hsu^e, N. Ilic^m, K. Jakobs^k,
B. Jayatikala^o, H. Ji^u, S. Jin^x, J. Jovicevic^y, L. Kashif^u, J. Keung^m, P. Kluit^a, A. Kotwal^o,
J. Kroll^b, T. Kubota^t, J. Kunkle^b, T. Lazovichⁱ, T. Lenz^a, C. Lester^b, S. Li^z, Z. Liang^v,
E. Lipeles^b, J. Long^d, L. Ma^v, J. T. Machado Miguens^r, T. Masubuchi^A, C. Meineck^q,
C. Melanchrinou^l, B. Mellado^u, C. Millsⁱ, G. C. Montoya^u, M. Neubauer^p, P. Onyisi^l,
D. Orestano^h, R. Ospanov^b, S. Pagan Griso^g, Y. Pan^u, H. Peng^z, F. Petrucci^h, R. Polifka^m,
X. Poveda^u, A. Pranko^g, J. Qian^d, W. Quayle^u, X. Ruan^B, R. Sandstromⁿ, P. Savard^m,
D. Schaefer^b, E. Schmidt^k, M. Shochet^l, D. Schouten^C, H. Skottoweⁱ, W. Spearmanⁱ,
B. Stelzer^D, O. Stelzer-Chilton^C, J. Strandberg^y, M. Testa^c, R. Thun^d, L. Tompkins^l,
I. Tsukerman^E, J. Valls^v, K. van Nieuwkoop^D, N. Venturi^m, S. Walch^d, A. Walz^k, B. Wang^p,
G. Wooden^d, S. L. Wu^u, M. Xiao^f, K. Yoshihara^A, Z. Zhang^B, Z. Zhao^z, Y. Zhu^z

^aNIKHEF, Amsterdam, The Netherlands

^bUniversity of Pennsylvania, Philadelphia, USA

^cCERN, Geneva, Switzerland

^dUniversity of Michigan, Ann Arbor, USA

^eJohannes-Gutenberg-Universitaet, Mainz, Germany

^fCEA Saclay, Gif-sur-Yvette, France

^gLawrence Berkeley National Laboratory, Berkeley, USA

- ^h*Roma Tre, Rome, Italy*
ⁱ*Harvard, Cambridge, USA*
^j*Radboud University Nijmegen, Nijmegen, The Netherlands*
^k*Albert-Ludwigs-Universitaet, Freiburg, Germany*
^l*University of Chicago, Chicago, USA*
^m*University of Toronto, Toronto, Canada*
ⁿ*Max-Planck-Institut fuer Physik, Munich, Germany*
^o*Duke, Durham, USA*
^p*University of Illinois, Urbana-Champaign, USA*
^q*Ludwig-Maximilians-Universitaet, Munich, Germany*
^r*LIP, Lissabon, Portugal*
^s*LNF & Universita' degli Studi di Roma Tor Vergata, Rome, Italy*
^t*University of Melbourne, Melbourne, Australia*
^u*University of Wisconsin, Madison, USA*
^v*Oxford University, Oxford, UK*
^w*Universidad de Valencia, Valencia, Spain*
^x*IHEP, Beijing, China*
^y*Royal Institute of Technology (KTH), Stockholm, Sweden*
^z*USTC, Hefei, China*
^A*University of Tokyo, Tokyo, Japan*
^B*Laboratoire d'Accélérateur Linéaire, Orsay, France*
^C*TRIUMF, Vancouver, Canada*
^D*Simon Fraser University, Vancouver, Canada*
^E*ITEP, Moscow, Russia*

Abstract

A search for the Standard Model Higgs boson has been performed in the $H \rightarrow WW^{(*)} \rightarrow \ell^+ \nu \ell^- \bar{\nu}$ channel with an integrated luminosity of 4.7 fb^{-1} of pp collisions at $\sqrt{s} = 7 \text{ TeV}$ collected with the ATLAS detector at the Large Hadron Collider. This analysis employs a Matrix Element Method which is used to calculate event probability densities for the signal and background hypothesis. The ratio of signal and background event probability densities is used as a discriminant variable which is used for the statistical analysis. No significant excess of events is observed over background expectations. This analysis excludes a Standard Model Higgs boson in the mass range of $128 < m_H < 263 \text{ GeV}$ at the 95% C.L. with an expected exclusion of $129 < m_H < 253 \text{ GeV}$. The ME combined exclusion limit uses the cut-based analysis results from the 2-jet channel.