Accepted Manuscript

The formulation of the Navier–Stokes equations on Riemannian manifolds

Chi Hin Chan, Magdalena Czubak, Marcelo M. Disconzi

PII: S0393-0440(17)30184-5
DOI: http://dx.doi.org/10.1016/j.geomphys.2017.07.015
Reference: GEOPHY 3039

To appear in: *Journal of Geometry and Physics*

Received date : 10 December 2016
Revised date : 11 July 2017
Accepted date : 17 July 2017

Please cite this article as: C.H. Chan, M. Czubak, M.M. Disconzi, The formulation of the Navier–Stokes equations on Riemannian manifolds, *Journal of Geometry and Physics* (2017), http://dx.doi.org/10.1016/j.geomphys.2017.07.015

THE FORMULATION OF THE NAVIER-STOKES EQUATIONS ON RIEMANNIAN MANIFOLDS

CHI HIN CHAN

Department of Applied Mathematics
National Chiao Tung University
1001 Ta Hsueh Road, Hsinchu, Taiwan 30010, ROC

MAGDALENA CZUBAK

Department of Mathematics
University of Colorado Boulder
Campus Box 395, Boulder, CO, 80309, USA

MARCELO M. DISCONZI

Department of Mathematics
Vanderbilt University
1326 Stevenson Center, Nashville, TN, 37240, USA

Abstract. We consider the generalization of the Navier-Stokes equation from $\mathbb{R}^n$ to the Riemannian manifolds. There are inequivalent formulations of the Navier-Stokes equation on manifolds due to the different possibilities for the Laplacian operator acting on vector fields on a Riemannian manifold. We present several distinct arguments that indicate that the form of the equations proposed by Ebin and Marsden in 1970 should be adopted as the correct generalization of the Navier-Stokes to the Riemannian manifolds.

Contents

E-mail addresses: cchan@math.nctu.edu.tw, magda.czubak@colorado.edu, marcelo.disconzi@vanderbilt.edu.
2010 *Mathematics Subject Classification.* 58J35, 76D05;
Key words and phrases. Navier-Stokes, formulation, Riemannian manifolds, Deformation tensor.