

A NEW BOUND FOR THE FIRST EIGENVALUES OF THE BIHARMONIC OPERATOR ON MANIFOLD

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Abstract. Consider (M^n, g) as a complete simply connected Riemannian manifold. Also let N^m for $m \leq n$ be a complete noncompact submanifold in M . In this paper, we are going to find a lower bound for the first eigenvalues of famous buckling and clamped plate problems on submanifold N with mean curvature H .

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REFERENCES

- [1] J. BENEDIKT AND P. DRABEK, *Estimates of the principal eigenvalue of the p -biharmonic operator*, *Nonlinear Anal.* (2012), 5374–5379.
- [2] G. BESSA AND F. MONTENEGRO, *Eigenvalue estimates for submanifolds with locally bounded mean curvature*, *Ann. Global Anal. Geom.* **24** (2003) 279–290.
- [3] L. CHEUNG AND P. LEUNG, *Eigenvalue estimates for submanifolds with bounded mean curvature in the curvature in the hyperbolic spaces*, *Math Z.* **32** (2001), 525–530.
- [4] M. GAFFNEY, *A special Stokes's theorem for complete Riemannian manifolds*, *Ann. Math.* **60** (1) (1954), 140–145.
- [5] M. GAFFNEY, *The heat equation method of Milgram and Rosenbloom for open Riemannian manifolds*, *Ann. Math.* **60** (3) (1954), 458–466.
- [6] D. HOFFMAN AND J. SPRUCK, *Sobolev and isoperimetric inequalities for Riemannian submanifolds*, *Comm. Pure Appl. Math.* **27** (1974), 715–727.
- [7] H. LIN, *Eigenvalue estimate and gap theorems for submanifolds in the hyperbolic space*, *Nonlinear Anal.* **148** (2017), 126–137.
- [8] P. MCKEAN, *An upper bound for the spectrum of Δ on manifold of negative curvature*, *J. Diff. Geom.* **4** (3) (1970), 359–366.
- [9] V. PRIKAZHCHIKOV AND A. KLUNNIK, *Estimates for eigenvalues of a biharmonic operator perturbed by the variation of a domain*, *J. Math Sci.* **84** (1997), 1298–1303.
- [10] R. REILLY, *Applications of the Hessian operator in a Riemannian manifold*, *Indiana Univ. Math. J.* **26**, (1977) 459–472.
- [11] S. SETO AND G. WEI, *First eigenvalue of the p -Laplacian under integral curvature condition*, *Nonlinear Anal.* **163** (2017), 60–70.
- [12] R. SCHOEN AND S. YAU, *Lectures on differential geometry*, International press, Cambridge, 2010.
- [13] H. SUN, C. HAN AND L. ZENG, *Lower bounds for the first eigenvalues of the p -Laplacian and the weighted p -Laplacian*, *J. Inequal. Appl.* (2020), 505–517.
- [14] L. ZHANG AND YAN ZHAO, *The lower bounds of the first eigenvalues for the biharmonic operator on manifolds*, *J. Inequal. Appl.* (2016), 1–9.