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Upper bounds for the first eigenvalue of the Laplacian on non-orientable surfaces

In 1980 Yang and Yau proved the celebrated upper bound for the first eigenvalue on an orientable surface of genus γ . Later Li and Yau gave a simple proof of this bound by introducing the concept of conformal volume of a Riemannian manifold. In the same paper they proposed an approach for obtaining a similar estimate for non-orientable surfaces. We will discuss a formalisation of this approach which also leads to improved bounds.