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**Generalized Spaces with Differential Forms on Smooth Manifolds: Density, Energy Gaps, and Applications to Regularity Estimates for the Hodge Laplacian**

We study generalized Sobolev-Orlicz spaces with differential forms on smooth manifolds. We establish sharp conditions for density of smooth functions and Lavrentiev phenomenon. We explore the Hodge Laplacian in variable exponent spaces with differential forms on smooth manifolds. We present several results, including the Hodge decomposition in variable exponent spaces and a priori estimates. As an application, we derive Calderón-Zygmund estimates for variable exponent problems involving differential forms and discuss numerical approximations for nonlinear models with differential forms, which have applications in superconductivity. This talk is based on several works with Swarnendu Sil and Mickail Surnachev.