A limiting free boundary problem in Orlicz-Sobolev spaces

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A free boundary optimization problem involving the Φ-Laplacian in Orlicz-Sobolev spaces is considered for the case where Φ does not satisfy the natural conditions introduced by Lieberman. A minimizer u_Φ having non-degeneracy at the free boundary is proved to exist and some important consequences are established, namely, the Lipschitz regularity of u_Φ along the free boundary, the locally uniform positive density of positivity set of u_Φ and that the free boundary is porous with porosity $\delta > 0$ and has finite $(N - \delta)$-Hausdorff measure. The method is based on a truncated minimization problem in terms of the Taylor polynomial of Φ of order $2k$. The proof demands to revisit the Lieberman's proof of a Harnack inequality and verify that the associated constant with this inequality is independent of k provided that k is sufficiently large.