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Parabolic Muckenhoupt weights

We discuss parabolic Muckenhoupt weights related to a doubly nonlinear parabolic partial differential equation (PDE). In the natural geometry of the PDE, the time variable scales to the power in the structural conditions for the PDE. Consequently, the Euclidean balls and cubes are replaced by parabolic rectangles respecting this scaling in all estimates. The main challenge is that in the definition of parabolic Muckenhoupt weights one of the integral averages is evaluated in the past and the other one in the future with a time lag between the averages. Another main motivation is that the parabolic theory is a higher dimensional version of the one-sided setting and the corresponding one-sided maximal function. The main results include a characterization of weak and strong type weighted norm inequalities for forward in time parabolic maximal functions and parabolic versions of the Jones factorization and the Coifman–Rochberg characterization. In addition to parabolic Muckenhoupt weights, the class of parabolic A_∞ weights is discussed from the perspective of parabolic reverse Hölder inequalities. We consider several characterizations and self-improving properties for this class of weights and study their connection to parabolic Muckenhoupt conditions. A sufficient condition is given for the implication from parabolic reverse Hölder classes to parabolic Muckenhoupt classes.