On regularity and irregularity of the Cauchy-Szegő projection in several complex variables
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Abstract. This is a summary of my long-term collaboration with E. M Stein and the announcement of our final project (which I am in the process of writing up at this time). It is known that for domains $D \subseteq \mathbb{C}^n$ that are of class $C^2$ and are strongly pseudo-convex, the Cauchy-Szegő projection is bounded in $L^p(bD, d\Sigma)$ for $1 < p < \infty$. (Here $d\Sigma$ is induced Lebesgue measure.) We show, using appropriate worm domains, that this fails for any $p \neq 2$, when we assume that the domain in question is only weakly pseudo-convex. Our starting point are the ideas of Kiselman-Barrett introduced more than 30 years ago in the analysis of the Bergman projection. However the study of the Cauchy-Szegő projection raises a numer of new issues and obstacles that need to be overcome. We will also compare these results to the analogous problem for the Cauchy-Leray integral, where however the relevant counter-example is of much simpler nature.