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Λ(1405) mediated triangle singularity in the K^- d → p Σ^- reaction

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We study for the first time the $p\Sigma^- \to K^- d$ and $K^- d \to p\Sigma^-$ reactions close to threshold and show that they are driven by a triangle mechanism, with the $\Lambda(1405)$, a proton and a neutron as intermediate states, which develops a triangle singularity close to the $\bar{K}d$ threshold. We find that a mechanism involving virtual pion exchange and the $K^- p \to \pi^+ \Sigma^-$ amplitude dominates over another one involving kaon exchange and the $K^- p \to K^- p$ amplitude. Moreover, of the two $\Lambda(1405)$ states, the one with higher mass around 1420 MeV, gives the largest contribution to the process. We show that the cross section, well within measurable range, is very sensitive to different models that, while reproducing $\bar{K}N$ observables above threshold, provide different extrapolations of the $\bar{K}N$ amplitudes below threshold. The observables of this reaction will provide new constraints on the theoretical models, leading to more reliable extrapolations of the $\bar{K}N$ amplitudes below threshold and to more accurate predictions of the $\Lambda(1405)$ state of lower mass.

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