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PPT states of almost maximal Schmidt number

We construct PPT states on $\mathbb{C}^m \otimes \mathbb{C}^n$ that have Schmidt number asymptotically approaching the smaller local dimension. More specifically, we construct a PPT state with Schmidt number at least

$$\left\lceil \frac{m+n-\sqrt{(m-n)^2+4(m+n-1)}}{2} \right\rceil.$$

In the case of equal local dimensions ($m = n$), this becomes $n - \lfloor\sqrt{2n-1}\rfloor$, far exceeding previous constructions, which achieved $n/2 + O(1)$. In the case of unequal local dimensions, our result shows that there exists a PPT state on $\mathbb{C}^n \otimes \mathbb{C}^{3n-4}$ with Schmidt number at least $n-1$.