The lowest excited states in ^{13}O

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Spectroscopy of exotic nuclei far from stability is crucial to understanding of nuclear structure. The exotic nucleus, ^{13}O, is also of potential importance for the p-p chain of reactions in population III metal poor stars via the (p,γ) reaction on ^{12}N [1]. We have measured the lowest excited states in ^{13}O for the first time using the inverse kinematics thick target method [2]. The experiment was carried out on TwinSol radioactive beam facilities [3] at the University of Notre Dame nuclear structure laboratory. Elastic proton scattering on ^{12}N was measured in the laboratory energy range from 4 - 10 MeV and analyzed in the framework of the **R**-matrix formalism and with a potential model. The two lowest excited states in ^{13}O have the spin and parities of $1/2^+$ at 2.69 MeV and ($1/2^-$, $3/2^-$) at 3.29 MeV. Single particle spectroscopic factors were defined for these states based on different assumptions for a shell model potential of ^{13}O. On the basis of the obtained data, we calculate the relevant astrophysical reaction rate of ^{12}N(p,γ)^{13}O process and discuss its implications for population III stars.

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