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## Direct measurement of astrophysical $S(E)$ for the ${}^9\text{Be}(p,\alpha){}^6\text{Li}$ and ${}^9\text{Be}(p,d){}^8\text{Be}$ reactions at low energy

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The  $p$ - ${}^9\text{Be}$  reactions play a key role in accurate prediction of primordial abundance of beryllium, and its abundance can be used to exquisitely probe the nucleosynthesis and mixing mechanism of stars. In the present work, astrophysical  $S(E)$  factors of the  ${}^9\text{Be}(p,d){}^8\text{Be}$  and  ${}^9\text{Be}(p,\alpha){}^6\text{Li}$  reactions have been obtained from thick-target yield  $\text{Yield}(E_i)$  for proton energies from 18 to 100 keV. A full Rmatrix analysis was performed to fit both the  ${}^9\text{Be}(p,d){}^8\text{Be}$  and  ${}^9\text{Be}(p,\alpha){}^6\text{Li}$  reactions, simultaneously. The resulting astrophysical  $S(E)$  factors agree well with direct measurements, leading to  $S(0) = 17.3 \pm 2.1$  and  $13.9 \pm 1.8$  MeV·b for the  ${}^9\text{Be}(p,d){}^8\text{Be}$  and  ${}^9\text{Be}(p,\alpha){}^6\text{Li}$  reactions, respectively. The reaction rates were also calculated in the temperature range from 0.01 to 1 T $^9$ , which improve the precision of standard database NACRE and NACRE II.

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