for the deeper potential with the reproduction of the data being slightly improved upon that of previous results using the 33 MeV optical model parameters.

It is expected that with the knowledge gained from this work, a more detailed reaction mechanism and nuclear structure study will ensue.

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LIGHT ELEMENT NUCLEOSYNTHESIS

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In order to examine the influence of new ^{6}Li and ^{7}Li data reported elsewhere in this report on light element nucleosynthesis via the galactic cosmic ray (GCR) + instellar medium (ISM) mechanism,[1] new calculations have recently been performed using a leaky-box model. This calculation includes cross sections from a recent review of all data relevant to Li, Be and B nucleosynthesis,[2] as well as new abundance tables for the interstellar medium and galactic cosmic rays.[3] In these calculations it is assumed that the galactic lifetime is 10^{10} years and the cosmic ray mean path for escape is 5g/cm^2. To examine the limits on ^{6}Li production established by the data, two assumptions are included concerning the (α,pn) cross section above 200 MeV: (1) This cross section decreases exponentially above 200 MeV and (2) a constant value of 3.4 mb is valid for all energies above 200 MeV. The results of the calculation are given in Table I, where they are compared with experimental abundances for Li, Be and B isotopes taken from Ref. 4.

With respect to the absolute abundance of ^{6}Li, the calculations for both α + α cross section assumptions agree with the data within the limits of error. The model calculations also give quite satisfactory agreement with the observed elemental abundance ratios, ^{6}Li/^{9}Be and B/Li, well within the error factors for these ratios. Hence, the present study reinforces previous conclusions that ^{6}Li, ^{9}Be, ^{10}B and ^{11}B can be well-accounted for by the GCR + ISM mechanism and

Table I

Lithium abundance ratios predicted by galactic cosmic ray + interstellar medium model. All abundances are relative to H = 10^{12} atoms. Parentheses indicate error factors for experimental values.

	^{6}Li	^{7}Li	^{7}Li/^{6}Li	^{6}Li/^{9}Be	B/^{6}Li
expt^a	90(2)	900(2)	12.6 ± 0.2	5.0(3)	2.2(3)
calc^b	110	160	1.4	7.3	2.3
calc^c	130	160	1.2	8.6	1.9

a - Ref. 4; however, it has been proposed that the primordial Li abundance may be significantly lower. See Ref. 7.

b - Assumes $\sigma(^6$Li) decreases exponentially beyond 200 MeV

c - Assumes $\sigma(^6$Li) = 3.4 mb for all E_α > 200 MeV demonstrates that overproduction of ^{6}Li by the $\alpha + \alpha$ reaction is not a serious problem for the model.

The inability of the GCR + ISM model to account for the well-established ^{7}Li/^{6}Li ratio (Table I) has long been recognized.[4] The results of the present measurement simply amplify this discrepancy. Since ^{7}Li is also produced in big bang nucleosynthesis, the ^{7}Li/^{6}Li isotopic ratio can be most easily understood in terms of a model in which the major source of ^{7}Li is the big bang and that for ^{6}Li is the GCR + ISM mechanism. In fact, using the standard model and a universal baryon density which reproduces the observed ^{2}H, ^{3}He and ^{4}He abundances, cosmological nucleosynthesis calculations produce just that amount of ^{7}Li required to yield the correct ^{7}Li/^{6}Li ratio. Hence, the two models - cosmological nucleosynthesis in the big bang and GCR interactions with the ISM - can successfully account for all light element nucleosynthesis in a quantitative fashion.

An alternative interpretation of the failure of the GCR + ISM model to reproduce ^{7}Li/^{6}Li is to demand - a priori - that the additional ^{7}Li must come from the big bang. The salient variable in the calculation then becomes the baryon density of the universe.[5] Using this approach, big bang calculations with the standard model require a baryon density $\rho_B \sim 5 \times 10^{-31}$ g/cm^3 to produce the required ^{7}Li. This value is an order of magnitude lower than the critical density of the universe, implying the universe is open and will expand forever (assuming neutrinos have negligible mass). Even more sensitive estimates of ρ_B, which partially account for effects due to galactic infall and astration, can be obtained by examining the ratio of ^{7}Li to ^{2}H, both of which exhibit a very sensitive dependence on ρ_B.[6]

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