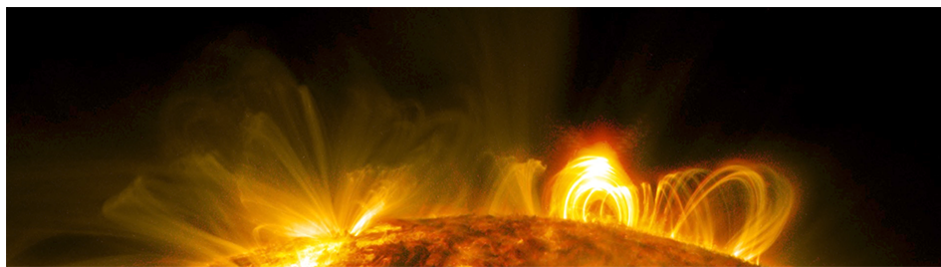


# Particle Acceleration in Solar Flares and the Plasma Universe – Deciphering its features under magnetic reconnection



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## Effects of magnetic fields on primordial abundance evolution

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Various effects of primordial magnetic fields (PMFs) on nuclear abundances are reported. It has been known that a strong PMF enhances the cosmic expansion rate and distribution functions of electrons and positrons in the early universe. Therefore, primordial nuclear abundances are a probe of the PMF during the big bang nucleosynthesis (BBN). A fast expansion due to the magnetic field energy density results in more abundant relic neutrons at the primordial helium synthesis than in standard BBN. This large neutron abundance results in a stronger destruction of  ${}^7\text{Be}$  via the  ${}^7\text{Be}(n,p){}^7\text{Li}(p,\alpha)$  reaction sequence [1]. Although the primordial Li abundance is reduced by the efficient  ${}^7\text{Be}$  destruction, the degree of the reduction is limited by significant effects on D and  ${}^4\text{He}$  abundances. A recent calculation of BBN under inhomogeneous PMFs shows that the effects on nuclear abundances significantly depend on the spatial distribution of the PMF amplitude [2]. Long after the BBN, the cosmological structure formation progresses. If there is a PMF with a comoving intensity of nano-Gauss over small structure scales, it affects motions of charged particles including  $\text{Li}^+$  ions [3]. As a result, abundances of chemical species as well as the baryonic density can evolve inhomogeneously under PMFs. This can give a solution to the cosmic Li problem, that is, a discrepancy in Li abundance between observations of metal-poor stars and the standard BBN prediction [3,4].

[1] Kawasaki, M., & Kusakabe, M. 2012, Phys. Rev. D, 86, 063003

[2] Luo, Y., et al. 2019, Astrophys. J., 872, 172

[3] Kusakabe, M., & Kawasaki, M. 2015, Mon. Not. Roy. Astron. Soc., 446, 1597

[4] Kusakabe, M., & Kawasaki, M. 2019, Astrophys. J. Lett., 876, L30

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