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## 2003年Hallowe' en磁暴后新质子带形成和损失机制的研究

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The study for the formation and loss mechanism of new proton radiation belt after Hallowe' en storm in 2003

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摘要

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摘要 本文利用低高度极轨卫星NOAA/POES的观测数据,对2003年Hallowe'en磁暴期间新质子带的形成和损失机制做了细致的研究和分析.结果表明新质子带的形成是诸多因素共同作用的结果,包括强太阳质子事件(Solar Proton Events, SPEs)、大的地磁暴和行星际激波.所有这些因素构成了新质子带形成的前提条件,尤其是行星际激波是形成新质子带不可缺少的因素.此外本文提出了磁暴主相对高能质子注入磁层稳定捕获区起到重要贡献.本文还运用绝热捕获判据分析了新质子带的损失机制,证明了由于磁暴期间环电流积累造成磁场大的扰动,破坏绝热不变量的守恒,导致新质子带粒子的损失.

关键词 磁暴, 太阳质子事件, 行星际激波, 新质子带

Abstract: The formation and loss mechanism of the new proton belt in Hallowe' en storm of 2003 has been studied by using the polar orbit satellite NOAA/POES data. The results show that the formation of new proton belts is the result of the cooperation of various effects, including strong SPEs (Solar Proton Events), big magnetic storms, and interplanetary shock wave. All these are the preconditions for the formation of the new proton belt, especially the last one (the interplanetary shock) is indispensable. This paper newly addresses the effective role of storm main phase which helps to drive protons inward to the stably trapped region. We also present the loss mechanism of newly trapped protons using the adiabatic trapping criterion. We demonstrate that the magnetic field perturbation of sufficient magnitude due to ring current build up could cause the destruction of adiabatic invariant conservation, which lead to the losses of the new belt particles.

Keywords Magnetic storm, SPEs, Interplanetary shock, New proton belt

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