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交叉学科

超晶格量子阱的沟道辐射及其谱分布

吴木营, 陈琼, 李洪涛, 罗诗裕#, 张伟风, 邵明珠

(东莞理工学院电子工程学院， 广东 东莞523106)

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摘要

在经典物理框架内和偶极近似下， 导出了超晶格量子阱沟道辐射频率和辐射谱分布。指出了对于自发辐射谱分布， 存在一个普适的线型因子， 而粒子的最大辐射能量与相对论因子γ 有关， 且与γ3/2成正比。以正弦平方势为例进行了具体讨论。结果表明， 由于势阱深度和噪音的影响， 谐波数l只取少数几个值。超晶格量子阱沟道辐射只存在不多的几条谱线， 为进一步应用提供了可能。最后， 还给出了一种可能的实验方案， 讨论了如何利用弯晶把超晶格量子阱的沟道辐射改造为相干辐射。

In the frame of classical physics and the dipole approximation the radiation frequency and the spectral distribution are derived for the channeling radiation of a charged particle in a superlattice quantum well. It indicated that there is a line type factor f(ξ) suited to various cases in the spontaneous radiations spectrum. Results also show that the maximum radiation energy is proportional to γ 3/2 , but the relativistic effects have double effects in the spontaneous radiation of a charged particle. The case for the sine squared potential is discussed specifically. The harmonic number can be defined as a few variable values by the effects of the potential well depth and noise. In general there is a few spectral lines in the channeling radiation spectrum for the superlattice quantum well, and possibilities are provided for further application. Finally, a possible experimental scheme is proposed, and it is discussed that how to transform the channeling radiation in the quantum well into the cohenent radiation by the bent crystal.

关键词 超晶格量子阱 自发辐射 频率 谱分布 相对论效应

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通讯作者:

作者个人主页: 吴木营; 陈琼; 李洪涛; 罗诗裕#; 张伟风; 邵明珠