

光电系统与工程

左手材料平板对傍轴高斯光束聚焦特性分析

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摘要:

在傍轴近似下,推导出了左手材料平板聚焦系统的传输矩阵,并利用ABCD定律得到了高斯光束在左手材料中和经过平板透镜聚焦后的传输公式。高斯光束在左手材料内部和像空间的传输公式的研究表明:像高斯光束和物高斯光束束腰大小一致,即左手材料平板透镜实际上对高斯光束没有聚焦作用。研究同时表明左手材料平板对高斯光束的聚焦与几何光学成像规律完全一致,而不存在一般透镜聚焦时的焦移效应。

关键词: 左手材料 ABCD定律 高斯光束 焦移

Analysis of focusing properties for paraxial Gaussian beam focused by a left-handed material slab

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Abstract:

Under paraxial approximation, the transfer matrix of left-handed slab focusing system is derived. Using ABCD law, the propagation expressions for Gaussian beam focused by a left-handed material slab are obtained. On the basis of propagation formula, the focusing properties of Gaussian beam are analyzed. The beam waist of image Gaussian beam is equal to the beam waist of object Gaussian beam under paraxial approximation, that is to say, the left-handed material slab can not focus Gaussian beam. The focusing for Gaussian beam with a left-handed material coincides with imaging rules of geometrical optics and does not have focal shift.

Keywords: left-handed material ABCD law Gaussian beam focal shift

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参考文献:

[1] VESELAGO V G. The electrodynamics of substances with simultaneously negative values of ϵ and μ [J] . Sov.Phys.Usp.,1968,10(4):509-514.

[2] SMITH D R, PADILLA W J, VIER D C, et al. A composite medium with simultaneously negative permeability and permittivity [J] . Phys. Rev. Lett., 2000, 84(18):4184-4187.

[3] PENDRY J B.Negative refraction makes a perfect lens [J] . Phys. Rev.Lett.,2000,85(18):3966-3969.

[4] SHELBY R A, SMITH D R, SCHULTZ S. Ex-perimental verification of a negative index of refraction [J] . Science, 2001,292(6):77-79.

[5] PARAZZOLI C G, GREGOR R B, LI K, et al. Experimental verification and simulation of negative index of refraction using Snell's law [J] . Phys.Rev.Lett.,2003,90(10):1074011-1074014.

[6] SMITH D R, PENDRY J B, WILTSHIRE M C K. Metamaterials and negative refractive index [J] . Science, 2004,305(5685):788-792.

[7] SHADRIVOV I V,SUKHORUKOV A A,KIVS-HAR Y S. Guided modes in negative index waveguides

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- [J] . Phys.Rev.E,2003,67(5):057602.
- [8] SHADRIVOV I V, SUKHORUKOV A A, KIVS-HAR Y S, et al. Nonlinear surface waves in left-handed materials [J] . Phys.Rev.E,2004,69(1):016617.
- [9] BROCK J B, HOUCK A A, CHUANG I L. Focusing inside negative index materials [J] . Appl Phys Lett, 2004,85(13):2472-2474.
- [10] LUO H L, HU W, REN Z Z, et al. Focusing and phase compensation of paraxial beams by a left handed material slab [J] . Opt. Commun., 2006,266:327-331.
- [11] 林振, 梁昌洪. 负媒质模型的时域有限差分法分析 [J] . 强激光与粒子束, 2006,18(4):615-617.
- LIN Zhen, LIANG Chang-hong. Time domain analysis of negative refractive index materials by FDTD method [J] . High Power Laser and Particle Beams, 2006,18(4):615-617. (in Chinese with an English abstract)
- [12] 梁斌明, 姚翠雅, 李卓, 等. 折射率偏离-1时的平板成像特性及改善 [J] .应用光学, 2010, 31(1): 19-23.
- LIANG Bin-ming, YAO Cui-ya, LI Zhuo, et al. Slab imaging performance from -1 and its improvement [J] . Journal of Applied Optics, 2010,31(1):19-23. (in Chinese with an English abstract)
- [13] CATER W H. Focal shift and concept of effective Fresnel number for a Gaussian laser beam [J] . Appl.Opt.,1982,21(11):1989-1994.

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2. 周胜国; 沈学举. 扩束准直光学系统中光学元件失调对高斯光束传输变换的影响分析[J]. 应用光学, 2008,29(2): 253-256
3. 毛红敏; 徐静; 甄胜来; 马玉芬; 俞本立. Cassegrain激光发射系统的光路设计[J]. 应用光学, 2008,29(2): 216-219
4. 于思源; 刘剑峰; 张光宇; 马晶; 谭立英. 基于拉盖尔-高斯光束的单光子捕获理论研究[J]. 应用光学, 2008,29(2): 298-302
5. 陈婷婷; 陆群英; 丁桂林. 厄米-高斯光束在内含硬边光阑光学系统中的传输[J]. 应用光学, 2007,28(6): 783-787
6. 沈洪斌; 孙玉杰; 张维; 沈学举; 黄富瑜; 李刚. 曲率波前传感器探测高斯光束时的信号误差[J]. 应用光学, 2009,30(3): 427-431
7. 黄坤; 何平安; 范若; 刘军伟; 刘欣慰; 徐明. 线激光束均匀化整形方法研究[J]. 应用光学, 2009,30(3): 523-526
8. 王龙; 沈学举; 韩玉东; 李征. 高斯光束通过非线性折射和吸收介质的光强分布[J]. 应用光学, 2010,31(1): 164-168
9. 常山; 吴波; 桑志文; 毛杰健; 朱品珍. 3种圆孔衍射的两种计算方法研究[J]. 应用光学, 2010,31(5): 734-740