

论文

Φ750 mm口径望远镜光学系统的检测

明名, 杨飞, 王富国, 吕天宇

中国科学院长春光学精密机械与物理研究所, 长春 130033

摘要:

为了探测更高轨道的空间目标,研制了一台通光口径为Φ750 mm的望远镜.该望远镜为主焦点光学系统,由一片二次非球面反射元件和四片透射元件组成,具有大视场(4°),大相对孔径(1:1.32)和宽光谱(500~800 nm)的特点.本文以该望远镜的研制为基础,介绍了其光学系统各个元件的单独检测和系统装调完成后的整体检测方法和过程.采用样板法对系统中的球面透射元件进行了单独检测,采用透射无像差补偿器法对二次非球面反射镜进行了单独检测,采用反射无像差补偿器法对组合起来的透射校正镜组进行了检测,并且对系统装调对准之后的光学系统进行室内平行光管和室外对星观测两种方法进行检测.测量结果均满足设计要求,其中球面透镜的面形误差小于0.1个光圈,反射元件和透射元件非球面表面的面形误差均优于λ/30(λ=632.8 nm),透射校正镜组的波像差优于λ/30(λ=632.8nm).光学系统整体检测结果表明,室内和室外检测结果一致,其像面的80%能量集中度直径在4°的全视场范围内均小于2个像元,达到了设计的成像要求.

关键词: 望远镜 光学检测 补偿器 平行光管测量

Optical Measurement of Φ750 mm Telescope System

MING Ming, YANG Fei, WANG Fu-guo, LV Tian-yu

Changchun Institute of Optics, Fine Mechanics and Physics, Chinese Academy of Sciences, Changchun 130033, China

Abstract:

For detecting space debris in the high orbit, a telescope with wide field of view (4°), large relative aperture (1:1.32) and broad wavelength (500 nm to 800 nm) is obtained. The telescope, whose clear aperture is Φ750 mm, consists of primary mirror and refractive corrector group. The surface type of primary mirror is parabolic, and the refractive corrector group includes one ellipsoid lens and three spherical lenses. The advanced methods of optical elements measurement and whole system are introduced respectively. Firstly, the figure error of spherical lens is measured using template method. A compensation test method of null lens is used to test the hyperbolic primary mirror and ellipsoid corrector lens. Next, when the corrector lens group is aligned, the whole corrector lens group is tested making use of a new spherical mirror method. And at last, it is adopted to measure the optical telescope with collimator test in the room and with nature star observation outdoors. All of the measurement results are satisfying the requirement of design. The figure errors of spherical lenses are less than 0.1 fringe in the first step, the figure errors of primary mirror and ellipsoid lens are less than λ/30 (RMS), and the wavefront error at the third step is less than λ/30 (RMS). After measuring the whole telescope optical system in the room, the 80% encircled energy is within 2 pixels, at the side of that, when observing the stars outdoors, the 80% encircled energy is also within 2 pixels in the whole field of view, 4° diagonal.

Keywords: Telescope Optical measurement Compensator Collimator test

收稿日期 2011-11-25 修回日期 2012-01-13 网络版发布日期

DOI: 10.3788/gzxb20124105.0505

基金项目:

The National High Technology Research and Development Program of China (No. 2009AA8080202)

通讯作者:

作者简介:

扩展功能

本文信息

▶ Supporting info

▶ PDF(1232KB)

▶ HTML

▶ 参考文献

服务与反馈

▶ 把本文推荐给朋友

▶ 加入我的书架

▶ 加入引用管理器

▶ 引用本文

▶ Email Alert

▶ 文章反馈

▶ 浏览反馈信息

本文关键词相关文章

▶ 望远镜

▶ 光学检测

▶ 补偿器

▶ 平行光管测量

本文作者相关文章







▶ 明名

▶ 杨飞

▶ 王富国

▶ 吕天宇

参考文献:

- [1] SEBRING T A, DUNHAM E, MILLIS R, *et al.* The discovery channel telescope: a wide field telescope in northern arizona[C]. *SPIE*, 2004, 5489: 658-666. 
- [2] KREMER R M, DEBOO B J, SASIAN J M, *et al.* Null corrector design for white light scatterplate interferometry on a large conic surface[C]. *SPIE*, 2001, 4442: 26-33.
- [3] QUAN Gui-qin, AN Yu-ying, LI Qing-guo, *et al.* Test of large aperture parabola mirror by laser interferometric[J]. *Acta Photonica Sinica*, 2008, 37(10): 2035-2038.
- [4] MING Ming, WANG Jian-li, MA Pei-li. A new method for testing the whole lens group[J]. *Acta Photonica Sinica*, 2011, 40(3): 419-423. 
- [5] MING Ming, YANG Fei, CHEN Bao-gang, *et al.* The mistake during the process of testing aspheric mirror using compensator[J]. *Opto-Electronic Engineering*, 2010, 37(10): 116-121.
- [6] CHEN Wei. Interferogram processing method of optical surface[J]. *Acta Photonica Sinica*, 2011, 40(8): 1191-1195. 
- [7] LIU Juan-juan, GUO Bang-hui, WU Hong-shen, *et al.* Design of 300-1 100 nm band-waveband optical system[J]. *Acta Photonica Sinica*, 2010, 39(10): 1766-1769. 
- [8] MALACARA Z, MALACARA-DOBLADO D, MALACARA-HERNANDEZ D, *et al.* Astigmatic optical surface, characteristics, testing, and differences between them[J]. *Optical Engineering*, 2007, 46(12): 123001-1-9. 
- [9] SEONG K, GREIVENKAMP J E. Surface figure measurement based on the transmitted wavefront with reverse raytracing[J]. *Optical Engineering*, 2008, 47(4): 043602-1-12. 
- [10] KUMLER J J, CALDWELL J B. Measuring surface slope error on precision aspheres[C]. *SPIE*, 2007, 6671: u01-u09.

本刊中的类似文章

- 1. 陈伟.光学元件干涉检测数据的定位处理方法[J]. *光子学报*, 2011,40(8): 1191-1195
- 2. 于志辉;余重秀;吴强;王葵如;王旭.间插取样光纤光栅多通道色散补偿器[J]. *光子学报*, 2006,35(8): 1234-1237
- 3. 曹召良;胡五生;胡立发;刘永军;穆全全;宣丽.液晶相息图用于光学检测[J]. *光子学报*, 2006,35(12): 1941-1945
- 4. 陈伟;姚汉民;伍凡;范斌;吴时彬;陈强.波前功率谱密度(PSD)测量滤波器的设计[J]. *光子学报*, 2006,35(1): 130-132
- 5. 王大勇;伏西洋;郭红锋;赵博;郑怡嘉;陶世荃.光学稀疏孔径系统的成像及其图像复原[J]. *光子学报*, 2005,34(10): 1557-1560
- 6. 邵永红;赵振明;姜耀亮;钱龙生.MGTI型光交错复用器的色散特性分析[J]. *光子学报*, 2004,33(8): 942-944
- 7. 王磊;王斌;吴兴坤.基于PLC的PMD补偿器中PDL效应的分析[J]. *光子学报*, 2005,34(9): 1380-1384
- 8. 曹召良 胡五生 穆全全 胡立发 彭增辉 刘永刚 宣丽.子孔径光学检测拼接准确度实验研究[J]. *光子学报*, 2008,37(6): 1233-1237
- 9. 明名,王建立,马佩立.一种检测大口径光学系统中透射镜组的新方法[J]. *光子学报*, 2011,40(3): 419-423
- 10. 李婷 杨建峰 阮萍 姜晓军.月基光学天文望远镜 (LOT) 的杂散光分析[J]. *光子学报*, 2007,36(Sup1): 136-141
- 11. 李国强 贾宏 陈恩涛 傅伟纯.空间太阳望远镜主镜精密温度控制方案介绍[J]. *光子学报*, 2007,36(Sup1): 239-243
- 12. 曹召良 穆全全 胡立发 李大禹 宣丽.模拟双星的液晶自适应校正分辨[J]. *光子学报*, 2008,37(4): 785-788
- 13. 陈钦芳,李英才,马臻,李旭阳,郭永祥.离轴非球面反射镜补偿检验的计算机辅助装调技术研究[J]. *光子学报*, 2010,39(12): 2220-2223
- 14. 陈宝刚,董磊,林旭东.傅里叶望远镜外场实验系统拼接主镜[J]. *光子学报*, 2011,40(1): 87-91
- 15. 董磊,刘欣悦,陈宝刚,林旭东,卫沛峰.傅里叶望远镜外场实验与结果分析[J]. *光子学报*, 2011,40(9): 1317-1321

文章评论 (请注意:本站实行文责自负, 请不要发表与学术无关的内容!评论内容不代表本站观点.)

反馈人	<input style="width: 95%;" type="text"/>	邮箱地址	<input style="width: 95%;" type="text"/>
反馈标题	<input style="width: 95%;" type="text"/>	验证码	<input style="width: 95%;" type="text" value="6273"/>
<div style="border: 1px solid black; height: 40px; width: 100%;"></div>			

