

实验室概况/ Overview of the Laboratory of Optical Physics

光物理实验室最早是经中国科学院组织专家论证并批准成立的部门实验室，于 1994 年 12 月正式对国内外开放，2001 年 11 月按中科院的统一要求更名为中国科学院物理研究所光物理重点实验室。实验室为从事光物理基础研究及应用基础研究的实体，主要研究方向是光与物质相互作用的基础研究，同时开展新型人工结构和材料在光学，尤其是在光子学领域的应用基础研究，即一方面重视光物理本身的研究，另一方面将现代光学的方法和技术引入凝聚态物理和材料科学中去，开拓几种新材料在高技术产业中的可能应用。实验室瞄准国际科学前沿，在低维人工结构材料中的光科学、激光物理、光子晶体、非线性光学、量子光学、强场物理、高密度物理及超快过程研究等方面开展了在国内外有相当影响的基础和应用研究工作。在激光器件上也有较强的力量，能够研制并提供多种超短脉冲激光器件和全固态激光器件，并取得了具有国际先进水平的成果。此外将光学和物理学的方法、手段应用于生物系统也是目前正在发展的重点学科方向。与凝聚态物理与材料科学紧密结合是光物理实验室研究的重要特点。

光物理实验室拥有门类齐全的先进激光系统，如纳秒、皮秒、飞秒脉冲激光器，可调谐激光器，准分子激光器等，以及数字示波器、锁相放大器、Boxcar 积分器、单光子计数设备及工作在红外、可见和紫外波段的各类光谱仪等现代测量仪器，以及激光分子束外延薄膜设备，可以开展各类光物理的前沿研究工作。

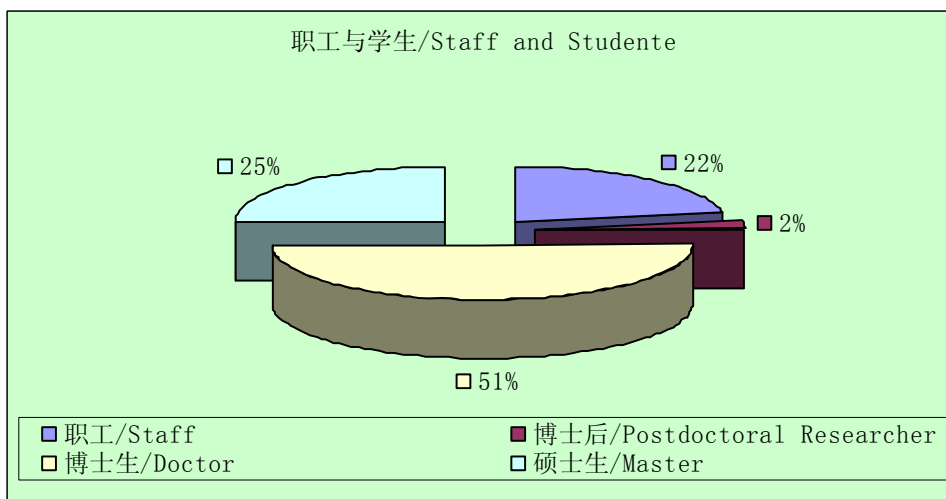
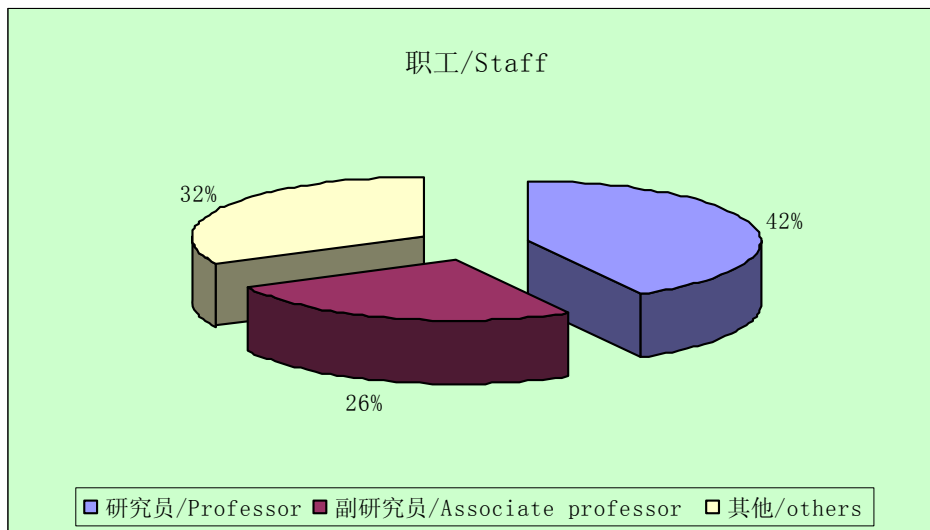
光物理实验室目前拥有二十九位研究人员，是一支具有一定综合实力的研究队伍，现为全国光学学科博士、硕士学位点和博士后流动站，有九十八名在读研究生。目前实验室的研究工作大多数已进入国际竞争的前沿，承担多项国家和省部委的重大和重点研究课题。几年来，光物理实验室在光物理及其相关领域的研究中发挥了应有的作用。光物理实验室现与国内外十几个大学和研究所建立了良好的学术合作关系，对国内外科学家提出的优秀研究项目给予资助并开展合作研究。

Optical physics was one of the earliest disciplines established in the Institute of Physics, Chinese Academy of Sciences (CAS). In December 1994 the Laboratory of Optical Physics was authorized as an Open Laboratory of CAS, and then renamed a CAS Key Laboratory in 2001. Its main focus is on the fundamental studies of laser interactions with matter, as well as applied basic research on novel materials in optics and photonics. That is, while emphasizing the physics of optics, at the same time modern optical methods and techniques are applied to condensed matter physics and material science for potential applications of new materials in high-tech industry. Current research topics include pure and applied studies in laser physics, photonic crystals, nonlinear optics, quantum optics, high laser field physics, high energy density physics and ultrafast processes. Through persistent efforts the Laboratory is becoming more and more competitive academically, with a considerable number of publications in the major international journals. Important progress has also been achieved in the fabrication of advanced laser devices and thin film materials, and many kinds of ultrashort pulsed lasers and all-solid-state lasers have been developed in-house, reaping in several national awards in science and technology. Meanwhile, the application of optical methods to biological systems has become an increasingly active research field, further demonstrating the close association of optics with condensed matter and material science in the Lab.

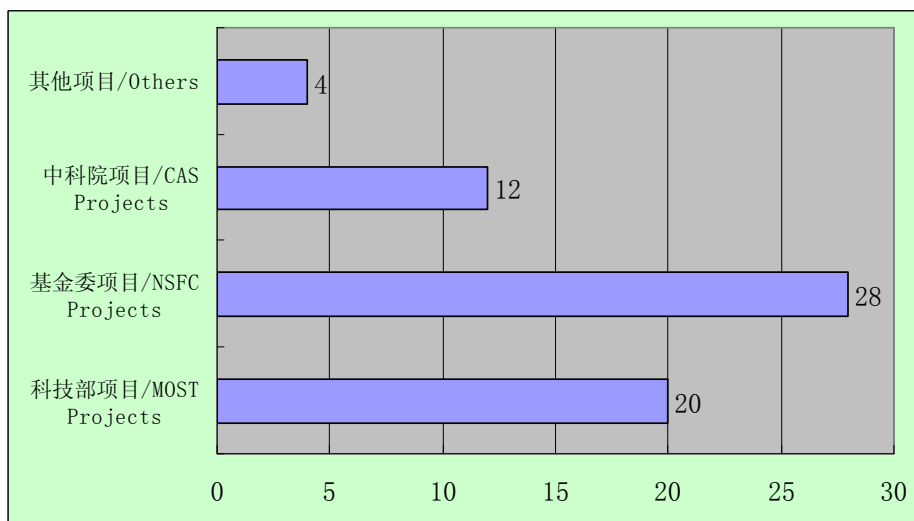
At present we have a whole range of advanced laser systems, such as pulsed lasers with nanosecond, picosecond and femtosecond pulse durations, as well as a tunable ring laser, excimer laser and widely tunable optical parametric amplifier (OPA). Modern detection instruments such as fast oscilloscopes, lock-in amplifiers, boxcars, single-photon detection counters, all types of autocorrelators, and different kinds of spectrometers covering the infrared, visible and ultraviolet regions are also available.

With a total of 29 research and administrative staff and 98 graduate students the Laboratory has emerged as a dynamic force at the forefront of research in optics, undertaking many major national programs. Successful collective projects are in progress with over a dozen external research groups both in China and abroad, and the Laboratory will continue to encourage and support such highly fruitful collaboration.

人事概况/General View of Personnel



在研项目概况/General View on Projects under Researching



人员结构/Organization

实验室主任/Director

金奎娟 研究员 Jin Kui-juan, Professor

实验室副主任/Deputy Directors

冯宝华 研究员 Feng Bao-hua, Professor

陈黎明 研究员 Chen Li-ming, Professor

研究组长/Research Group Leaders

李志远 研究员 Li Zhi-yuan, Professor

金奎娟 研究员 Jin Kui-juan, Professor

汪力 研究员 Wang Li, Professor

张杰 院士 Zhang Jie, Academician

魏志义 研究员 Wei Zhi-yi, Professor

学术委员会/Academic Committee

名誉主任/ Honour Chairmen

沈元壤 院士 Shen Yuen-Ron, Academician (美国加州大学, University of California, Berkeley)

杨国桢 院士 Yang Guo-zhen, Academician (中科院物理研究所, Institute of Physics, CAS)

张道中 研究员 Zhang Dao-zhong, Professor (中科院物理研究所, Institute of Physics, CAS)

主任/ Chairman

张杰 院士 Zhang Jie, Academician (中科院物理研究所, Institute of Physics, CAS)

副主任/ Deputy Chairmen

龚旗煌 教授 Gong Qi-huang, Professor (北京大学, Peking University)

李师群 教授 Li Shi-qun, Professor (清华大学, Tsinghua University)

许京军 教授 Xu Jing-jun, Professor (南开大学, Nankai University)

委员/Committee Members

夏宇兴 教授 Xia Yu-xing, Professor (上海交通大学, Shanghai Jiao Tong University)

祝世宁 院士 Zhu Shi-ning, Academician (南京大学, Nanjing University)

徐雷 教授 Xu Lei, Professor (复旦大学, Fudan University)

张希成 教授 Zhang Xi-cheng Professor (Rensselaer Polytechnic Institute, USA)

聂玉昕 研究员 Nie Yu-xin, Professor (中国科学院物理研究所, Institute of Physics, CAS)

曾和平 教授 Zeng He-ping, Professor (华东师范大学, East China Normal University)

汪力 研究员 Wang Li, Professor (中国科学院物理研究所, Institute of Physics, CAS)

陈润生 院士 Chen Run-sheng, Academician (中国科学院生物物理所,
Institute of Biophysics, CAS)

常铁强 研究员 Chang Tie-Qiang, Professor (北京应用物理与计算数学研究所,
Beijing Institute of Applied Physics and Computational Mathematics)

明海 教授 Ming Hai, Professor (中国科大, University of Science & Technology of China)

陈险峰 教授 Chen Xian-feng, Professor (上海交通大学, Shanghai Jiao Tong University)

王雪华 教授 Wang Xue-hua, Professor (中山大学, Sun Yat-Sen University)

金奎娟 研究员 Jin Kui-juan, Professor (中国科学院物理研究所, Institute of Physics, CAS)

杰出人才/Intelligent Staff**中国科学院院士/ Academician, CAS**

1999 杨国桢 Yang Guozhen
2003 张杰 Zhang Jie

国家杰出青年基金获得者/ National Science Fund for Distinguished Young Scholars

1997 李晓峰 Li Xiaofeng
1998 张杰 Zhang Jie
2002 魏志义 Wei Zhiyi
2004 盛政明 Sheng Zhengming
2006 李志远 Li Zhiyuan
2008 金奎娟 Jin Kuijuan
2009 李玉同 Li Yutong

国家海外青年学者合作研究基金获得者/Laureates of the 'Joint Research Fund for Overseas Chinese Young Scholars'

2000 朱湘东/吕惠宾 Zhu Xiang-dong/Lu Hui-bin
2001 张希成/张杰 Zhang Xi-cheng/Zhang Jie
2007 曹建明/张杰 Cao Jian-ming/Zhang Jie

中科院“百人计划”入选者

1998 张杰 Zhang Jie
1999 翁羽翔 Weng Yuxiang
2000 程波林 Cheng Bolin
2000 盛政明 Sheng Zhengming
2000 邹炳锁 Zou Binsuo
2004 李志远 Li Zhiyuan
2009 陈黎明 Chen Liming

国家自然科学基金优秀创新研究群体/ National Science Fund for Creative Research Groups

超强超短激光物理研究/Some forefront of high field physics and ultrafast process (60621063, 2007-2009)

张杰	Zhang Jie	激光等离子体物理、强场物理/Laser plasma, High field physics
魏志义	Wei Zhiyi	超快激光技术/Ultrafast laser technology
汪力	Wang Li	超快激光物理/Ultrafast laser physics
翁羽翔	Weng Yuxiang	超快激光光谱及激光化学/Ultrafast laser spectroscopy and laser chemistry
盛政明	Sheng Zhengming	强场激光物理/High field laser physics
金奎娟	Jin Kuijuan	激光物理理论/Laser physics
鲁欣	Lu Xin	强场激光物理理论模拟、流体力学模型
李玉同	Li Yutong	强场激光物理实验、光物理实验

光物理重点实验室人员名录/Name List

研究人员/Scientific Staff

李志远	Li Zhi-yuan	张 杰	Zhang Jie
郭红莲	Guo Hong-lian	盛政明	Sheng Zheng-ming
李家方	Li Jia-fang	李玉同	Li Yu-tong
刘荣娟	Liu Rong-juan	鲁 欣	Lu Xin
杨国桢	Yang Guo-zhen	董全力	Dong Quan-li
金奎娟	Jin Kui-juan	陈黎明	Chen Li-ming
吕惠宾	Lü Hui-bin	马景龙	Ma Jing-long
王 灿	Wang Can	王伟民	Wang Wei-min
何 萌	He Meng	魏志义	Wei Zhi-yi
郭海中	Guo Hai-zhong	李德华	Li De-hua
汪 力	Wang Li	滕 浩	Teng Hao
傅盘铭	Fu Pan-ming	王兆华	Wang Zhao-hua
吴令安	Wu Ling-an	韩海年	Han Hai-nian
王兵兵	Wang Bing-bing		

技术人员/Technical Staff

冯宝华	Feng Bao-hua	张东香	Zhang Dong-xiang
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博士后/Post-doctoral Fellows

吴 涛	Wu Tao	马海强	Ma Hai-qiang
张 珂	Zhang Ke		

博士生/Ph. D Students

李江艳	Li Jiang-yan	王 聪	Wang Cong
刘 晔	Liu Ye	王京义	Wang Jing-yi
华一磊	Hua Yi-lei	徐中堂	Xu Zhong-tang
秦 飞	Qin Fei	葛 琛	Ge Chen
周长柱	Zhou Chang-zhu	郭尔佳	Guo Er-jia
傅晋新	Fu Jin-xin	赵建领	Zhao Jian-ling
甘 霖	Gan Lin	冯 辉	Feng hui
马冬莉	Ma Dong-li	吴忠安	Wu Zhong-an
周 飞	Zhou Fei	陈希浩	Chen Xi-hao
任明亮	Ren Ming-liang	牛金艳	Niu Jin-yan
凌 林	Ling Lin	刘 骞	Liu Qian
温 娟	Wen Juan	罗开红	Lou Kai-hong
杨 芳	Yang Fang	潘学聪	Pan Xue-cong
胡春莲	Hu Chun-lian	翟 振	Zhai Zhen
张莉莉	Zhang Li-li	刘 峰	Liu Feng
陆 珩	Lu Heng	董晓刚	Dong Xiao-gang

王伟民	Wang Wei-min	宗楠	Zong Nan
李春	Li Chun	杨峰	Yang Feng
朱鹏飞	Zhu Peng-fei	谢仕永	Xie Shi-yong
王首钧	Wang Shou-jun	徐一汀	Xu Yi-ting
丁文君	Ding Wen-jun	李芳琴	Li Fang-qin
林晓宣	Lin Xiao-xuan	马庆磊	Ma Qing-lei
刘峰	Liu Feng	钟欣	Zhong Xin
张蕾	Zhang Lei	许长文	Xu Chang-wen
周木林	Zhou Mu-lin	运晨霞	Yun Chen-xia
郝彪	Hao Biao	张青	Zhang Qing
刘勋	Liu Xun	张永东	Zhang Yong-dong
杨杰	Yang Jie	刘成	Liu Cheng
毛婧一	Mao Jing-yi	玄洪文	Xuan Hong-wen
张璐	Zhang Lu	王楠	Wang Nan
刘晓龙	Liu Xiao-long	邹育婉	Zou Yu-wan
杜飞	Du Fei	施玉显	Shi Yu-xian
於陆勒	Yu Lu-le		

硕士生/Master Students

王晨	Wang Chen	胡志丹	Hu Zhi-dan
陈宇辉	Chen Yu-hui	苏鲁宁	Su Lu-ning
刘思耘	Liu Si-yun	闫文超	Yan Wen-chao
廉晋	Lian Jin	袁大伟	Yuan Da-wei
王本立	Wang Ben-li	郑轶	Zheng yi
原昆	Yuan Kun	詹敏杰	Zhan Min-jie
金昱伶	Jin Yu-ling	叶蓬	Ye Peng
王乐	Wang Le	郭淑艳	Guo Shu-yan
赵瑞强	Zhao Rui-qiang	王庆	Wang Qin
戴俊	Dai Jun	沈忠伟	Shen Zhong-wei
石洪菲	Shi Hong-fei	汪礼峰	Wang Li-feng
周文佳	Zhou Wen-jia	张金伟	Zhang Jin-wei
裴丽娅	Pei Li-ya	张龙	Zhang Long
彭典	Peng Dian	张静	Zhang Jing
江淼	Jiang Miao	黄璐	Huang Lu
贾倩倩	Jia Qian-qian	邱康生	Qiu Kang-sheng
		江曼	Jiang Man

仪器设备/Facilities

一、激光器设备 (Lasers)

1. 飞秒激光器 (Femtosecond Lasers)

性能参数 Specifications	钛宝石激光振荡器 I Ti:sapphire Oscillator I	钛宝石激光振荡器 II Ti:sapphire Oscillator II	钛宝石激光振荡器 III Ti:sapphire Oscillator III
生产厂家 Manufacturer	美国 Spectra-Physics	本室研制 Home-made	本室研制 Home-made
型号 Model	Tsunami		
输出波长 Output Wavelength	750 ~ 850nm	750 ~ 850nm	600~ 1000nm
平均功率 Average Power	1W (790nm)	1W (790nm)	400mW
脉冲宽度 Pulse width	80 ~ 120fs	~ 30fs	5~ 8fs
重复频率 Repetition Rate	82MHz	82MHz	100~300MHz
联系部门 Contact Department	公共技术	公共技术或 L07 组	L07 组

性能参数 Specifications	钛宝石激光放大器 I Ti:sapphire Amplifier I	钛宝石激光放大器 II Ti:sapphire Amplifier II	钛宝石激光放大器 III,IV Ti:sapphire Amplifier III,IV
生产厂家 Manufacturer	美国 Spectra-Physics	奥地利 Femtolasers Inc	本室研制 Home-made
型号 Model	TSA-10	FemtoPower-Pro	极光 II, III (XL II, III)
输出波长 Output Wavelength	790nm	~790nm	790nm, 810 nm
单脉冲能量 Pulse energy	5mJ	0.8mJ	640mJ, 11 J
脉冲宽度 Pulse width	200fs	~ 25fs(自加压缩后 5fs)	30fs, 30fs
重复频率 Repetition Rate	10Hz	1kHz	10Hz, 20mins/shot
联系部门 Contact Department	公共技术	L07 组	L05 或 L07 组

性能参数 Specifications	飞秒镁橄榄石激光振荡器 femtosecond Cr:forsterite laser	同步飞秒钛宝石激光器 Synchronized fs Ti:sapphire Laser
生产厂家 Manufacturer	本室研制 Home-made	本室研制 Home-made
输出波长 Output Wavelength	1250 ~1350nm	750~ 850nm
平均功率 Average Power	150mW (1280nm)	>1W
脉冲宽度 Pulse width	29fs	30~80fs
同步精度 Timing jitter		<1fs
重复频率 Repetition Rate	82MHz	82MHz
联系部门 Contact Department	L07 组	L07 组

2. 皮秒激光器 (Picosecond lasers)

性能参数 Specifications	皮秒 Nd:YAG 激光器 psNd:YAG laser	皮秒光参量放大器 ps Optical Parametrial Oscillator
生产厂家 Manufacturer	立陶宛 EKSPLA 公司	本室研制 Home-made
型号 Model	PL2143B	
输出波长 Output Wavelength	1064 532 355nm	430 ~ 2000nm
单脉冲能量 Pulse energy	80 40 20mJ	3mJ
脉冲宽度 Pulse width	25 ps (1064nm)	30ps
重复频率 Repetition Rate	10Hz	10Hz
联系部门 Contact Department	公共技术	公共技术

3. 纳秒激光器 (Nanosecond laser)

性能参数 Specifications	倍频 Nd:YAG 激光器 SHG Nd:YAG laser	倍频 Nd:YAG 激光器 SHG Nd:YAG laser	倍频钕玻璃激光器 SHG Nd:glass laser
生产厂家 Manufacturer	美国 Positive Light	美国 Spectra-Physics	
型号 Model	Evolution 30	Pro-230	Powelite-100
输出波长 Output Wavelength	527nm	532nm	527nm
单脉冲能量 Pulse energy	~20mJ (2W)	~1.4J	100J
脉冲宽度 Pulse width	>100ns	~7ns	~25ns
重复频率 Repetition Rate	1kHz	10Hz	3pph
联系部门 Contact Department	L07 组	L05 或 L07 组	L05 或 L07 组

性能参数 Specifications	准分子激光器 Excimer Laser	Nd:YAG 激光器 Nd:YAG laser	光参量振荡器 OPO
生产厂家 Manufacturer	德国 Lambda Physik	立陶宛 EKSPLA 公司	本室研制 Home-made
型号 Model	COMPEX Pro 201	NL303 型	
输出波长 Output Wavelength	308nm	1064 532 355nm	430 ~ 2000nm
单脉冲能量 Pulse energy	500mJ	500 210 135mJ	10mJ
脉冲宽度 Pulse width	~ 20ns	3 ~ 6 ns (1064nm)	3 ~ 6 ns
重复频率 Repetition Rate	10Hz	10Hz	10Hz
联系部门 Contact Department	公共技术	公共技术	公共技术

4. 连续激光器 (CW lasers)

性能参数 Specifications	钛宝石激光器 Ti:sapphire laser	倍频 Nd:YVO ₄ 激光器 SHG Nd:YVO ₄ laser	倍频 Nd:YVO ₄ 激光器 SHG Nd:YVO ₄ laser
生产厂家 Manufacturer	美国 Spectra-Physics	美国 Spectra-Physics	美国 Coherent Inc
型号 Model	3900	Millennia X	Verdi 10
输出波长 Output Wavelength	700 ~ 950nm	532nm	532nm
平均功率 Average Power	750mW (790nm)	10W	10W
线宽 Linewidth	< 40GHz		<5MHz
联系部门 Contact Department	公共技术	L07 组	L07 组

二、分析测试仪器

光栅光谱仪/Spectrometer	型微型光纤光谱仪/Mini-Spectrometer
美国 Acton Research Corporation 公司	美国 Ocean Optics 公司
型号 Model: SpectraPro-500i	型号 Model: HR-2000
波长扫描范围 Scan range: 200 ~ 1400nm	波长测量范围 Measured range: 200 ~ 1100nm
分辨率 Resolution: 0.05nm	分辨率 Resolution: 1.8nm
用于材料透射谱、吸收谱, 光波长测量等	用于光波长测量、荧光测量等
联系部门 Contact Department: 公共技术	联系部门 Contact Department: 公共技术

FR-103 型自相关仪/Autocorrelator	脉冲干涉自相关仪/Interferometer autocorrelator
美国 Femtochrome Research 公司	本室研制 Home-made
测量波长范围 Wavelength range: 460~900nm	测量波长范围 Wavelength range: 600~1000nm
测量脉宽范围 Measurable range: 50fs	测量脉宽范围 Measurable range: 3fs ~ 100fs
用于高重复频率超短激光脉冲脉宽测量	用于低重复频率超短激光脉冲脉宽测量

信号平均器/Signal average	SPIDER
美国 EG&G 公司	本室研制 Home-made
型号 Model: 4400	
输入信号 Input signal: $\pm 2\text{mV} \sim \pm 5\text{V}$	测量波长范围: Wavelength range: 600~1000nm
门宽选择 Gate : 2ns, 5ns, 10ns, 12ns, 15ns	测量脉宽范围: Measurable range: 3fs ~ 100fs
20ns 到 2ms 连续可选	

SPM100 型近场扫描光学显微镜	DG535 脉冲延时器/Delay generator
美国 RHK 公司	美国 EG&G 公司
扫描范围 Scan range: $30\mu\text{m} \times 30\mu\text{m}$	延时范围 Delay range: 0 ~ 999s
激光源 Laser sources: 465, 488, 514nm	延时通道 Delay Channel: A, B, C, D
工作模式 Modes: 接触和敲打透射模式	延时输出 Delay output: A, B, C, D, AB,
近场探针 Near filed Probe: 悬臂式光纤 Fiber	-AB, CD, -CD
分辨率 Resolution: < 100 nm	分辨率 Resolution: 5ps
联系部门 Contact Department: 公共技术	联系部门 Contact Department: 公共技术

注: 除开放基金外, 所有仪器设备均为有偿使用

获奖情况/Award

北京市科学技术三等奖：超短脉冲激光的精确同步技术

获奖者：魏志义，田金荣，王 鹏，韩海年，张 杰，赵 环

获奖个人/

香港城市大学荣誉博士：张杰

获奖研究生 /Award for excellent graduate students

2009 蔡诗东等离子体物理奖： 王伟民

2009 中科院宝洁优秀研究生奖学金：张炜

中科院物理所所长奖学金优秀奖：刘晔，杨芳，陈希浩，王首钧，杨峰，张永东

中科院物理所所长奖学金表彰奖：李江艳，华一磊，周长柱，傅晋新，甘霖，周飞，任明亮，胡春莲，张莉莉，陆珩，温娟，王聪，葛琛，郭尔佳，牛金艳，刘骞，罗开红，李春，朱鹏飞，林晓宣，刘峰，张蕾，周木林，刘勋，杨杰，丁文君，郝彪，宗楠，谢仕永，李芳琴，钟欣，许长文，刘成，张青，运晨霞，玄洪文，施玉显

三好学生：刘娅钊，胡春莲，宁廷银，孙毅民，赵建领，张翼，刘峰，鲁远甫，张炜，周斌斌，李奇楠

优秀毕业生：车明

优秀学生干部：周长柱，牛金艳

研究报告/Scientific Report

光子晶体及其应用/ Photonic crystal and its applications

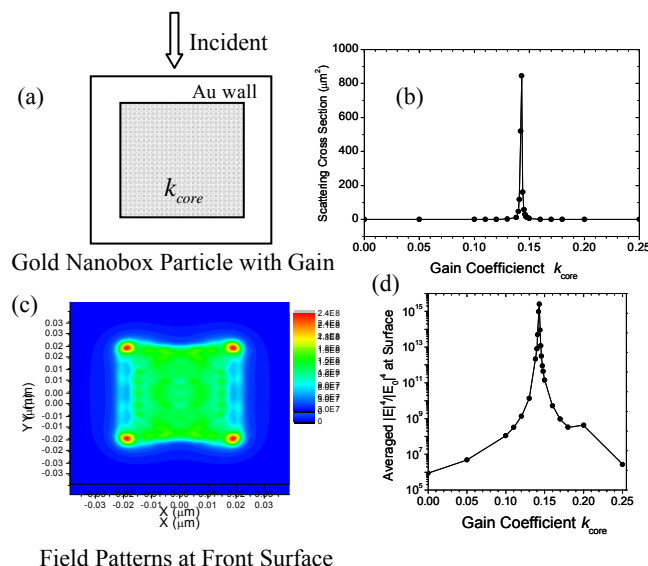
组长: 李志远

Group Leader: Li Zhi-yuan

成员: 郭红莲 李家方 刘荣娟

Members: Guo Hong-lian, Li Jia-fang, Liu Rong-juan

- ◆ 实验上在聚苯乙烯三维 Kerr 非线性光子晶体上成功观测到了 10fs 的极速全光开关响应
- ◆ 实验上设计和实现了硅基二维光子晶体对红外光的负折射效应, 并成功观测到了光线传播的高分辨率清晰轨迹
- ◆ 理论上设计了单一的铁电材料二阶非线性光子晶体, 同时实现准相位匹配、光子带隙边缘慢光效应和谐振腔共振效应, 三者合一可将二次谐波的产生效率提高 7 个数量级。
- ◆ 理论上探讨了复合增益介质金属纳米颗粒的光学特性, 发现表面等离子体共振受到能量补充而补偿了吸收损耗, 大幅度提高了共振峰的品质因子, 将单纳米颗粒的表面局域场强度和拉曼散射信号的增强因子提高到了创记录的水平
- ◆ 成功演示了性能参数可独立调谐的多光镊系统, 为开展微观生物系统的多体问题提供了良好的技术平台。



复合增益金属纳米颗粒的巨大表面增强拉曼散射效应和单分子检测

Metal Nanoparticles with Gain towards Single-Molecule Detection via Surface-Enhanced Raman Scattering

- ◆ We demonstrated 10 fs ultrafast all-optical switching in 3D polystyrene Kerr nonlinear photonic crystals.
- ◆ We designed and realized 2D silicon photonic crystal slab with negative refraction properties and observed high-resolution ray trace of negative refraction infrared beam.
- ◆ We designed a second-order nonlinear photonic crystal that can realize simultaneously quasi-phase matching, slower light effect at band gap edge, and cavity resonance effect and enhance second-harmonic generation efficiency by seven orders of magnitude.
- ◆ We found that surface plasmon resonance can be amplified by introducing gain medium into metal nanoparticles with simple geometry, which leads to significant increase of the quality factor of the resonance peak and enhancement of local field intensity and Raman scattering signal to an unprecedented level for single particle.
- ◆ We constructed and demonstrated multiple optical tweezers with separate and full control over each tweezers, and this offers a technological platform for studying many-body problems in microbiological systems.

低维氧化物体系的设计、激光法制备及其物理研究/ Designing and manufacturing low dimension Oxide materials by Laser and studying their properties

组长: 金奎娟

Group Leader: Jin Kui-juan

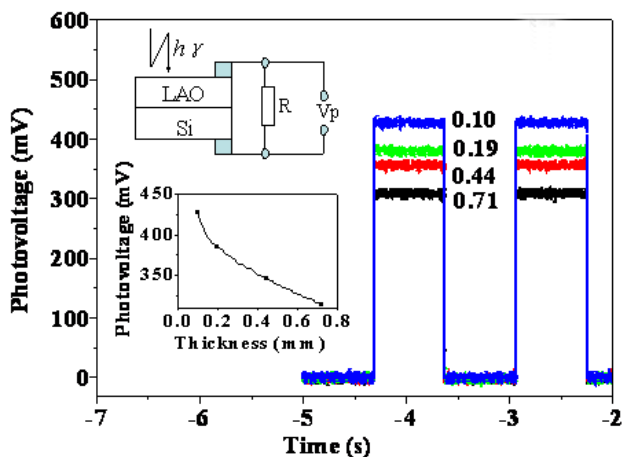
成员: 杨国桢(院士) 吕惠宾

Members: Yang Guo-zhen (Academician), Lü Hui-bin,

王 灿 何 萌 郭海中

Wang Can , He Meng, Guo Hai-zhong

- ◆研制出 2 种可见盲和 2 种日盲高灵敏度紫外光探测器, 其中关于 LaAlO_3 日盲探测器的论文, 被“Laser Focus Worlds”在其“新突破栏目”进行了转载报道。
- ◆理论上进一步深入研究了氧化物低维体系横向光电响应的动态物理过程, 揭示了激光能量对横向光伏产生机制的重要转换作用。
- ◆研制出一种新的高三阶非线性光学性质材料, 即 CCTO ($\text{CaCu}_3\text{Ti}_4\text{O}_{12}$) 嵌入 Au 颗粒的复合材料。纯 CCTO 的三阶非线性为少数最高材料之一, 以 CCTO 为基质的金属纳米团簇复合材料的三阶非线性又提高接近 2 倍; 用减少金属纳米团簇总质量, 并增加团簇的锐度的方法来增加三阶非线性系数和优值比。我们将此方法用于 ZnO/Au 复合材料薄膜, 测量显示 $r(3)$ 达 $1.3\text{--}2.96 \times 10^{-5}(\text{esu})$, 而优值比 $r(3)/\alpha$ 达 $1.1 \times 10^{-9} \text{ esu}\cdot\text{cm}$ 。
- ◆光反射差法在生命科学中应用的研究工作取得进展, 目前在蛋白质与蛋白质、核酸与核酸杂交反应的研究中, 达到一次可无标记检测 1000 个样品点的生物芯片。



$\text{LaAlO}_3\text{-}\delta/\text{Si}$ 异质结的光电响应灵敏度会随着硅衬底厚度的减小而得到很大改善。最大的光电响应灵敏度达到了 85.6 V/W 。

The photoelectric sensitivity of $\text{LaAlO}_3\text{-}\delta/\text{Si}$ heterostructures is improved greatly by decreasing the thickness of the Si substrates. The maximum photoelectric sensitivity reaches 85.6 V/W .

Appl. Phys. Lett. 94, 061118 (2009)

- ◆Two kinds of visible-blind and solar-blind ultraviolet photodetectors have been fabricated, respectively. In particular, the work on LaAlO_3 solar-blind photodetectors has been highlight by the “New breakout” in “Laser Focus World”.
- ◆The dynamic process of the lateral photovoltage has been theoretically studied in low dimensional oxide system and the importance of the laser energy on the mechanism of lateral photovoltage has been revealed.
- ◆A new material with high optical nonlinearity has been developed by doping Au nanoparticles into CCTO ($\text{CaCu}_3\text{Ti}_4\text{O}_{12}$). CCTO itself is one of the materials which possess very high optical nonlinear susceptibility. The enhanced optical nonlinearity of the composite films is about 2~3 times larger than that of the pure $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ films. Both of the optical nonlinearity and the figure of merit could be improved by increasing the acutance but reducing the amount of Au nanoparticles. After being applied this method, the third order nonlinear susceptibility of ZnO/Au is $2.93 \times 10^{-5} \text{ esu}$, and the value of $\chi^{(3)}/\alpha$ is $1.1 \times 10^{-9} \text{ esu}\cdot\text{cm}$.
- ◆Oblique-incidence reflectivity difference method (OI-RD) has made progress in research on applied life science. At current stage, OI-RD is capable of label-free detecting end points of 1000-spot biomolecular microarray in study of reations of proteins and hybridizations of oligonucleotides.

太赫兹和超快光谱学/ Terahertz and ultrafast spectroscopy

组长: 汪 力

Group Leader: Wang Li

成员: 傅盘铭 吴令安 王兵兵

Members: Fu Pan-ming, Wu Ling-an, Wang Bing-bing

- ◆对亚波长金属圆柱一维阵列的太赫兹频率响应进行了实验测量和数值模拟, 发现局域激发下产生的近场波以真空中光速在系统中传播、并在 SPP 机制描述的频率附近存在两个共振模式; 设计、制作并实验验证了一种宽带可调谐太赫兹滤波器, 其性能优于已知的商业和实验室器件; 在现有 THz-TDS 测量系统中, 设计、制作了一个具有独特功能的反射样品架, 可以实现光程保持和角度连续可调下的高精度反射谱测量。
- ◆研究多普勒增宽系统中的六波混频(SWM), 提出用量子干涉来控制 SWM 中的极化干涉, 还提出一种新型的高分辨 Autler-Townes 光谱学。在强激光场与物质相互作用的研究中, 建立了分子在激光场中高阶阈值上电离的频域方法, 提出分子电离谱中全部相干条纹的来源以及利用高频激光场进行更清晰的分子结构成像; 还系统地研究了超短强激光脉冲中的原子非序列电离过程, 首次提出激光辅助碰撞电离机制。该机制是非序列双电子电离与序列双电子电离之间的过渡电离机制, 明确解释了最近相关实验结果。
- ◆首次以真热光演示无透镜的鬼成像。理论证明热光场高阶鬼成像中对比度的提高主要源于 N 阶聚束效应, 其贡献为所有 $N-1$ 阶聚束效应之和。计算得基于纠缠光子对的二阶 Talbot 效应, 可获得放大的关联成像, 而干涉分辨率可提高二倍。

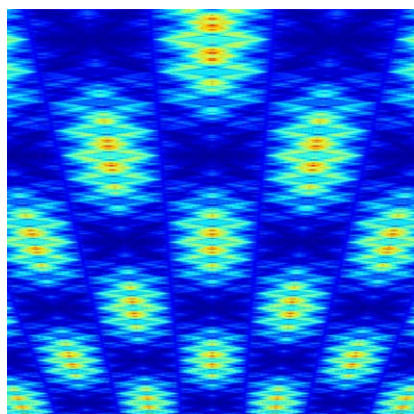


Image from "Second-order Talbot effect with entangled photon pairs", Phys. Rev. A **80** 043820 (2009). For a periodic object, the second-order Talbot self-image may be magnified.

登载于 PRA 万花筒网页上的“基于纠缠光子对的二阶 Talbot 效应地毯图”, 显示周期物体的二阶关联 Talbot 图可以被放大。

- ◆The terahertz responses of 1-D metallic wire array was studied in experiments and numerical simulations. Under local excitation the generated near field waves were found propagating along the array at the light speed in vacuum and having two resonant modes. A terahertz filter was designed, manufactured and demonstrated in experiments, which performance is better than commercial and laboratory counterparts.
- ◆We have studied six-wave mixing in a Doppler-broadened system. Quantum interference is proposed to control the polarization interference in SWM. On the other hand, a new type of high resolution Autler-Townes spectroscopy is also proposed.
- ◆In the study of interaction between matter and strong laser fields, we demonstrated that an angle-resolved HATI spectrum carries three pieces of important information: the fingerprint of the molecular wave function, the geometrical structure of the molecule, and the interaction between the ionized electron and the laser field. We found a new NSDI mechanism in a strong laser pulse: laser-assisted collision ionization process.
- ◆Performed the first true thermal light demonstration of lensless ghost imaging. Showed theoretically that the improved visibility of high order ghost imaging with thermal light stems mainly from N th order photon bunching, which equals the sum of the contributions from all orders up to $N-1$. Simulations of the 2nd order Talbot effect based on entangled photons show that the self-image may be magnified, while the resolution in quantum interference is improved by a factor of 2

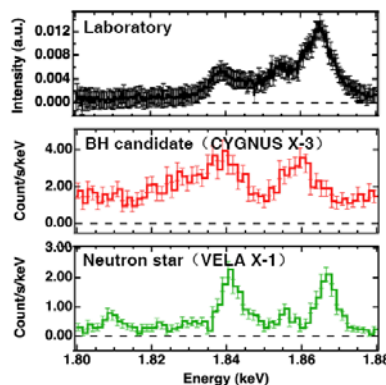
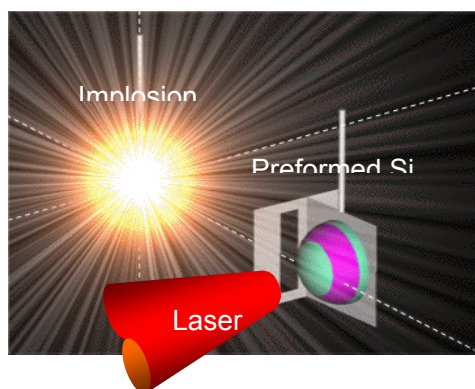
超强激光与物质相互作用/ Ultra-Intense Laser Interaction with Matter

组长: 张杰 (院士)

Group Leader: Zhang Jie (Academician)

成员: 盛政明 李玉同 鲁欣 董全力 Members: Sheng Zheng-ming, Li Yu-tong, Lu Xin, Dong Quan-li.
陈黎明 马景龙 王伟民 Chen Li-ming, Ma Jing-long, Wang Wei-min

- ◆对致密天体(黑洞、中子星等)辐射产生的光电离、太阳表面的磁重联射流、与高能宇宙射线和高能粒子加速相关的的无碰撞冲击波等天体过程进行了实验室模拟。其中和日本合作的光电离前期结果已发表在 Nature Physics 5, 821 (2009)。
- ◆针对强激光质子加速过程中的类“瑞利-泰勒不稳定”和类“成丝不稳定”，提出三个解决方案:利用不稳定后期的自组织过程、横向 Hermite 与高斯光束模式的组合来延长加速时间、与横向光强分布相匹配的变厚度薄膜靶。[PRL 103, 024801 (2009)、PRL 103, 135001 (2009)。
- ◆在快点火激光核聚变核心问题--高能电子在高密度等离子体中的传输研究中,理解了碰撞效应和背景等离子体温度对输运时诱发的成丝不稳定性 and 双流不稳定性、以及斜向模的重要作用。[PRE 79, 046409(2009)、PRE80, 066402(2009)]
- ◆实验演示了基于强激光的高功率 THz 源, 其单脉冲能量高达 55 微焦/sr, 其峰值功率>MW/sr。



利用上海高功率激光物理国家实验室的“神光II”和日本大阪大学的“Gekko XII”等强激光装置,对黑洞周围的光电离过程以及发出的X光辐射进行了实验室模拟。左图为实验布局示意图,强激光驱动内爆CH靶丸,产生0.5 keV的强x射线辐射场,之后电离Si预等离子体。右图为实验得到的光电离谱与天文观测的黑洞和中子星发射谱的比较,得到谱分布非常类似。其中利用“Gekko XII”得到的前期结果已于发表在Nature Physics 5, 821 (2009)。

China-Japan-Korea joint laboratory experiments of photoionized plasmas of astronomical compact objects such black holes or neutron stars with Shenguang II and Gekko XII laser facility have been done. The left figure shows the experimental setup. An implosion CH shell was used to generate an intense x-ray radiation fields, which photoionized a Si preplasma. The right figures show the comparison of the laboratory results with the astronomical observations.

- ◆Astrophysical phenomena of photoionized plasmas, shock wave and jet generation have been studied with high power laser facility in laboratory. The results of self-emission x-ray spectra of the SiO₂ plasma have been published on Nature Physics 5, 821 (2009).
- ◆Three schemes to overcome RT-like and filamentation instability in the laser proton acceleration have been proposed: the self-organizing structure in the later stage of the instability, using of two Hermite-Gaussian laser beams, shaped targets with changing target thickness in the transverse direction.
- ◆Effects of collisions and background plasma temperature on the relativistic filamentation and two-stream instability in the fast electron transport are clarified.
- ◆Experimental demonstration of laser-based high power THz radiation with energy of as high as 55 μ J/sr (power of more than MW/sr).

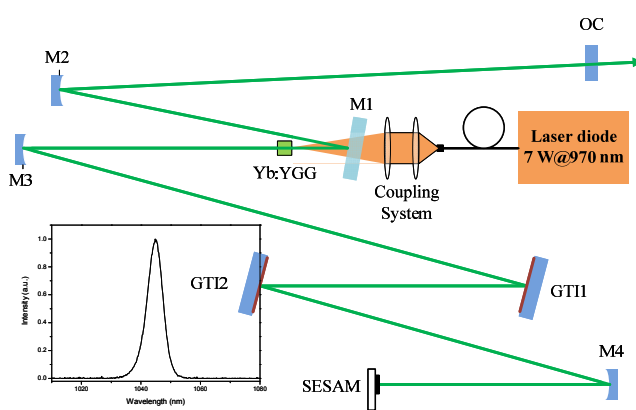
超短脉冲激光与精密测量物理研究/ Ultrafast Laser Technology and Precision Measurement Physics

组长: 魏志义

Group Leader: Wei Zhi-yi

成员: 李德华 滕浩 王兆华 韩海年 Members: Li De-hua, Teng Hao, Wang Zhao-hua, Han Hai-nian

- ◆ 实现差分泵浦的飞秒激光光谱展宽技术, 进一步扩展了飞秒激光的光谱带宽, 显著提高了激光的透过率, 通过脉冲压缩技术进一步得到了 4.4fs 的国内最短激光脉冲。
- ◆ 研制成功国际先进水平的 1.1GHz 重复频率亚 10fs 激光振荡器, 开展了天文光学频率梳及紫外光学频率梳的研究, 初步实现飞秒激光的共振增强振荡。
- ◆ 首创全固态飞秒 Yb:GYSO 激光及 Yb:YGG 激光, 首次在国际上实现 1053nm 波长的飞秒 Yb:YAG 激光。获得国际最高输出功率的飞秒陶瓷 Yb:YAG 激光输出。
- ◆ 研制成功 Yb:LSO、Yb:YAG 等系列实用化全固态皮秒激光振荡器, 首次在国际上实现上准三能级的皮秒 Nd:GSAG 激光。
- ◆ 系统开展了飞秒超强激光对比度提高的研究, 设计并建成双啁啾脉冲放大系统, 成功实现交叉偏振滤波 (XPW) 及超长环形腔再生放大技术, 将对比度提高了近两个量级。



二极管激光泵浦的全固态飞秒 Yb:YGG 激光实验光路图。采用 SESAM 作为锁模元件, Gires - Tournois 干涉镜片补偿腔内色散, 我们实现了该激光的首次锁模, 得到脉宽 245fs, 中心波长 1045nm, 输出功率 570mW 的稳定飞秒激光脉冲。左下角插图为例锁模脉冲的光谱曲线。

The schematic layout of the diode-pumped all-solid-state Yb:YGG laser. By using SESAM as mode-locking device, Gires - Tournois interferometer mirrors for dispersion compensation, we realized the femtosecond operation of the laser for the first time, stable laser pulses of short as 245 fs at the central wavelength of 1045 nm have been obtained, the maximum output power was 570 mW. Insert is the spectrum of the mode-locking laser

- ◆ By differencing pump the none gas into the hollow fiber, we greatly broaden the spectrum bandwidth and increase the transmissionvity, the laser pulse was further compressed to 4.4fs which is the shortest one domestically.
- ◆ We obtained the sub-10fs Ti:sapphire laser at repetition rate up to 1.1GHz, the frequency combs for astromony application and work at UV range are being developed, the enhancement oscillation of femtosecond laser was observed.
- ◆ For the firstly time we realized femtosecond Yb:GYSO and Yb:YGG laser. A femtosecond Yb:YAG laser at 1053nm was demonstrated for the first time. Laser power high as 1.9W was generated from a femtosecond ceramic Yb:YAG laser which is the highest one in the world up to now.
- ◆ A series of all-solid-state picosecond lasers such as Yb:LSO, Yb:YAG were established, for the first ime we get a picosecond Nd:GSAG at 942nm.
- ◆ Researches on increasing the contrast ratio of ultraintense femtosecond laser pulses are carried out. By establishing the doubled chirped pulse amplification and using the XPW and ultralong ring cavity, the contrast ratio was increased about 2 orders.

专利/Patents

申请专利/Patents Applied

- [1] 200910080129.7; 一种测量激光束径的系统和方法; 发明; 凌林, 郭红莲, 李兆霖, 黄璐, 张道中, 李志远
- [2] 200910091794.6; 用于测量近场扫描光学显微镜探针孔径的标样和测量方法; 发明; 李江艳、张东香、宁廷银、王志芳、江潮、李志远、沈电洪、张泽渤
- [3] 200910093030.0; 三维光镊系统; 发明; 凌林、郭红莲、李兆霖、黄璐、周飞、张道中、李志远
- [4] 200920246718.3; 用于近场扫描光学显微镜的光纤固定器; 实用新型; 李江艳、李志远、张泽渤
- [5] 200910008646.3; 一种固态非线性体材料及其制备方法; 发明; 宁廷银、周岳亮、陆珩、陈聪、沈鸿、张东香、金奎娟、杨国桢
- [6] 200910008647.8; 一种基于金属纳米团簇阵列的非线性光学材料及制备方法; 发明; 宁廷银、周岳亮、陆珩、陈聪、沈鸿、张东香、金奎娟、杨国桢
- [7] 200910086594.1; 一种热释电探测器; 发明; 陈聪、周岳亮、宁廷银、陆珩、王灿、张东香、王沛、明海、杨国桢
- [8] 200910081896.X; 一种热释电薄膜材料及其制备方法; 发明; 陈聪、周岳亮、宁廷银、陆珩、王灿、张东香、王沛、明海、杨国桢
- [9] 200910081894.0; 可编程偏振光脉冲延时器及电脉冲延时器; 发明; 赵建领、吴令安
- [10] 200910082400.0; 可编程光脉冲延时器及电脉冲延时器; 发明; 赵建领、吴令安
- [11] 200910080706.2; 高稳定高重复频率单块光学频率梳; 发明; 魏志义、韩海年、张炜、赵研英、杜强、腾浩

授权专利/Patents Approved

- [1] ZL200710002797.9; 一种高分辨率的光子晶体滤波器; 发明; 任承、陶海华、刘娅钊、李志远、程丙英、张道中
- [2] ZL200820080575.9; 光纤与波导元件的有源对准及固定装置; 实用新型; 刘娅钊、李志远、张道中
- [3] ZL200410069292.0; 在硅衬底上外延生长有铝酸镧薄膜材料及制备方法; 发明; 吕惠宾、何萌、相文峰、黄延红、陈正豪、周岳亮、程波林、金奎娟、杨国桢
- [4] ZL200510071811.1; 一种快响应宽频段光探测器; 发明; 赵昆、吕惠宾、黄延红、何萌、金奎娟、陈正豪、周岳亮、杨国桢
- [5] ZL200510077170.0; 一种制备硼掺杂的 n 型高硬度透明导电氧化锌薄膜的方法; 发明; 赵嵩卿、周岳亮、刘震、王淑芳、韩鹏、赵昆、相文峰、陈正豪、吕惠宾、程波林、金奎娟、何萌、杨国桢

- [6] ZL200510082701.5; 用掺杂氧化物和硅异质结材料制的超快宽波段光探测器; 发明; 吕惠宾、何萌、黄延红、赵昆、金奎娟、陈正豪、周岳亮、杨国桢
- [7] ZL200510086585.4; 一种用于激光分子束外延设备中的衬底加热器; 发明; 吕惠宾、何萌、陈正豪、周岳亮、金奎娟、杨国桢
- [8] ZL200510107826.9; 一种 ZnO/MgB₂ 异质结材料及制备方法; 发明; 赵嵩卿、周岳亮、赵昆、刘震、王淑芳、韩鹏、陈正豪、吕惠宾、程波林、何萌、杨国桢
- [9] ZL200510135499.8; 具有磁电阻特性的异质结材料; 发明; 吕惠宾、何萌、赵昆、黄延红、金奎娟、刘国珍、刑杰、陈正豪、周岳亮、杨国桢
- [10] ZL200510082702.X; 用钙钛矿氧化物单晶材料制作的快响应高灵敏度紫外光探测器; 发明; 吕惠宾、何萌、赵昆、黄延红、金奎娟、周岳亮、陈正豪、杨国桢
- [11] ZL200510135209.X; 一种兼有干涉效应和等离子振荡效应的传感器及其用途; 发明; 吕国伟、程波林、周岳亮、沈鸿、陈正豪、何萌、金奎娟、吕惠宾、杨国桢
- [12] ZL200610001808.7; 一种具有可控磁场的脉冲激光沉积制膜系统; 发明; 宁廷银、周岳亮、赵嵩卿、王淑芳、韩鹏、程波林、金奎娟、吕惠宾、陈正豪、何萌、刘知韵、杨国桢
- [13] ZL200610001809.1; 一种可加电场的脉冲激光沉积制膜系统; 发明; 宁廷银、周岳亮、赵嵩卿、王淑芳、韩鹏、程波林、金奎娟、吕惠宾、陈正豪、何萌、刘知韵、杨国桢
- [14] ZL200610001810.4; 一种日光盲的紫外光光探测器及其制备方法; 发明; 赵嵩卿、周岳亮、赵昆、王淑芳、刘震、韩鹏、金奎娟、陈正豪、吕惠宾、程波林、何萌、杨国桢
- [15] ZL200610001811.9; 一种探测波长在红外至远远红外光的探测器及制法; 发明; 赵嵩卿、周岳亮、赵昆、王淑芳、刘震、韩鹏、金奎娟、陈正豪、吕惠宾、程波林、何萌、杨国桢
- [16] ZL200610114104.0; 一种具有全波长的光探测器及其制备方法; 发明; 孙志辉、周岳亮、宁廷银、曹玲柱、张洪艳、陆珩、刘知韵
- [17] ZL200610114105.5; 一种从深紫外至远红外光的探测器及制备方法; 发明; 孙志辉、周岳亮、宁廷银、曹玲柱、张洪艳、陆珩、刘知韵
- [18] ZL200610114337.0; 一种用于脉冲激光沉积系统中的调节基片角度的装置; 发明; 曹玲柱、孙志辉、宁廷银、赵嵩卿、张洪艳、陆珩、杨慧、周岳亮、金奎娟、吕惠宾、杨国桢
- [19] ZL200410091373.0; 一种产生随机数的方法及其装置; 发明; 马海强、吴令安
- [20] ZL200510123856.9; APD 单光子探测器雪崩信号的提取方法; 发明; 孙志斌、杨捍东、马海强、翟光杰、吴令安
- [21] ZL200510066313.8; 一种飞秒电子衍射装置; 发明; 张杰、刘运全、梁文锡
- [22] ZL200610076255.1; 一种啁啾脉冲压缩方法及装置; 发明; 武慧春、盛政明、张杰
- [23] ZL200820079434.5; 一种电动启动锁模装置; 实用新型; 刘成、滕浩、杜强、朱江锋、赵研英、魏志义

发表论文/Publications in Journal

1. X-ray Astronomy in the Laboratory with a Miniature Compact Object Produced by Laser-Driven Implosion, Shinsuke Fujioka, Hideaki Takabe, Norimasa Yamamoto, David Salzmann, Feilu Wang, Hiroaki Nishimura, Yutong Li, Quanli Dong, Shoujun Wang, Yi Zhang, Yong-Joo Rhee, Yong-Woo Lee, Jae-Min Han, Minoru Tanabe, Takashi Fujiwara, Yuto Nakabayashi, Gang Zhao, Jie Zhang, Kunioki Mima, **Nature Physics** **5**, 821 (2009).
2. Novel Multifunctional Properties Induced by Interface Effects in Perovskite Oxide Heterostructures, Kui-juan Jin, Hui-bin Lu, Ken Zhao, Chen Ge, Meng He, Guo-Zhen Yang, **Advanced Materials** **21**, 4636(2009).
3. Metal Nanoparticles with Gain toward Single-Molecule Detection by Surface-Enhanced Raman Scattering, Li Zhiyuan, Xia Younan, **Nano Letter** **10**, 243-249 (2010)
4. Enhanced Collimated GeV Monoenergetic Ion Acceleration from a Shaped Foil Target Irradiated by a Circularly Polarized Laser Pulse, M Chen, A. Pukhov, TP Yu, and ZM Sheng, **Physical Review Letters** **103**, 024801 (2009).
5. Collimated Proton Beam, from Laser Foil Interaction at 7×10^{21} W/cm², XQ Yan, HC Wu, ZM Sheng, JE Chen, J. Meyer-ter-Vehn, Self-Organizing GeV, Nanocoulomb, **Physical Review Letters** **103**, 135001 (2009)
6. Reply to the Comment on "Generating High-Current Monoenergetic Proton Beams by a Circularly Polarized Laser Pulse in the Phase-Stable Acceleration Regime, XQ Yan, C Lin, ZM Sheng, ZY Guo, BC Liu, YR Lu, JX Fang, JE Chen, **Physical Review Letters** **102**, 239502 (2009).
7. Etching and Growth: An Intertwined Pathway to Silver Nanocrystals with Exotic Shapes, Cobley C M, Rycenga M, Zhou F, Li Z Y, Xia Y, **Angewandte Chemie International Edition** **48**, 4824(2009).
8. Electron injection into laser wakefields by colliding circularly-polarized laser pulses, WM Wang, ZM Sheng, J Zhang, **Laser and Particle Beams** **27**, 3-7 (2009).
9. 10 fs ultrafast all-optical switching in polystyrene nonlinear photonic crystals, Liu Y, Qin F, Wei ZY, Meng QB, Zhang DZ, Li ZY, **Applied Physics Letters** **95**, 131116(2009).
10. The substrate thickness dependence of the photovoltage in LaAlO₃- /Si heterostructures, Juan Wen, Kui-Juan Jin, Meng He, Hui-bin Lu, Fang Yang, Guo-Zhen Yang, **Applied Physics Letters** **94**, 61118(2009).
11. Strong terahertz radiation from air plasmas generated by an aperture-limited Gaussian pump laser beam, XY Peng, C Li, M Chen, T Toncian, R Jung, O. Willi, YT Li, WM Wang, SJ Wang, F Liu, A Pukhov, ZM Sheng, and J Zhang, **Applied Physics Letters** **94**, 101502 (2009).
12. Diagnostic of laser contrast using target reflectivity, A. S. Pirozhkov, W. Choi, JH Sung, S K Lee, T J Yu, T M Jeong, J. Kim, N. Hafz, C. M. Kim, K. H. Pae, Y.C. Noh, D.K. Ko, J. Lee, A. P. L. Robinson, P. Foster, S. Hawkes, M. Streeter, C. Spindloe, P. McKenna, D. C. Carroll, C.G. Wahlström, M. Zepf, D. Adams, B. Dromey, K. Markey, S. Kar, YT Li, MH Xu, **Applied Physics Letters** **94**, 241102 (2009).
13. Giant enhancement of second harmonic generation in nonlinear photonic crystals with distributed Bragg reflector mirrors, Ren ML, Li ZY, **Optics Express** **17**, 14052(2009).

14. Ray trace visualization of negative refraction of light in two-dimensional air-bridged silicon photonic crystal slabs at 1.55 μm , Gan L, Liu YZ, Li JY, Zhang ZB, Zhang DZ, Li ZY, **Optics Express** **17**, 9962 (2009).
15. K-shell x-ray emission enhancement via selfguided propagation of intense laser pulses in Ar clusters, Feng Liu, LiMing Chen, XiaoXuan Lin, Feng Liu, JingLong Ma, RunZe Li, YuTong Li, ZhaoHua Wang, ShouJun Wang, ZhiYi Wei, and Jie Zhang, **Optics Express** **17**, 16379-16384 (2009)
16. Triggering and guiding HV discharge in air by filamentation of single and dual fs pulses , Zhang Z, Lu X, Liang WX, ZuoQiang Hao, MuLin Zhou, ZhaoHua Wang, Xun Liu and Jie Zhang, **Optics Express** **17**, 3461-3468 (2009)
17. A 350MHz Ti:sapphire laser comb based on a monolithic scheme and absolute frequency measurement of a 729nm laser, Wei Zhang, Hainian Han, Yanying Zhao, Qiang Du, Zhiyi Wei, **Optics Express** **17**, 6059(2009).
18. Diode-pumped quasi-three-level CW Nd:CLNGG and Nd:CNGG lasers, Kunna He, Zhiyi Wei, Dehua li, Zhiguo Zhang, Jiyang Wang, Chunqing Gao, **Optics Express** **17**, 19292(2009).
19. Triggering and guiding HV discharge in air by filamentation of single and dual fs pulses, Zhe Zhang, Xin Lu, WenXi Liang, ZuoQiang Hao, MuLin Zhou, ZhaoHua Wang, Xun Liu and Jie Zhang, **Optics Express** **17**, 3462(2009).
20. Solar-blind deep-ultraviolet photodetectors based on an LaAlO₃ single crystal, Jie Xing, Er-Jia Guo, Kui-juan Jin, Hui-bin Lu, Juan Wen, Guo-zhen Yang, **Optics Letters** **34**, 1675(2009).
21. Lensless ghost imaging with true thermal light, XiHao Chen, Qian Liu, KaiHong Luo, LingAn Wu, **Optics Letters** **34**, 695(2009).
22. Diode-pumped passively mode-locked Yb:Y₃Ga₅O₁₂ laser, Yongdong Zhang, Zhiyi Wei, Binbin Zhou, Changwen Xu, Yuwan Zou, Dehua Li, Zhiguo Zhang, Huaijin Zhang, Jiyang Wang, Haohai Yu, Kui Wu, Bin Yao, Junli Wang, **Optics Letters** **34**, 3316(2009).
23. Diode-pumped passively mode-locked Nd: GSAG laser at 942 nm, Changwen Xu, Zhiyi Wei, Yongdong Zhang, Dehua Li, Zhiguo Zhang, X. Wang, S.Wang, H.J.Eichler, Chunyu Zhang, Chunqing Gao, **Optics Letters** **34**, 2324(2009).
24. Generation of 210 fs laser pulses at 1093 nm by a self-starting mode-locked Yb:GYSO laser, Binbin Zhou, Zhiyi Wei, Yongdang Zhang, Xin Zhong, Hao Teng, Lihe Zheng, Liangbi Su, Jun Xu, **Optics Letters** **34**, 31(2009).
25. Measuring the Optical Absorption Cross Sections of Au-Ag Nanocages and Au Nanorods by Photoacoustic Imaging, Chou E C, Kim C, Zhou F, Cobley C M., Song K H, Chen J, Li Z Y, Wang L V. , Xia Y, **The Journal of Physical Chemistry C** **113**, 9023 (2009).
26. Controlled Etching as a Route to High Quality Silver Nanospheres for Optical Studies, Cobley C M, Rycenga M, Zhou F, Li Z Y, Xia Y, **The Journal of Physical Chemistry C** **113**, 16975(2009).
27. Imaging the geometrical structure of the H₂⁺ molecular ion by high-order above threshold ionization in an intense laser field, Yingchun Guo, Panming Fu, ZongChao Yan, Jiangbin Gong, and Bingbing Wang, **Physics Review A** **80**, 63408(2009).

28. Role of multiphoton bunching in high-order ghost imaging with thermal light sources, Qian Liu, XiHao Chen, KaiHong Luo, Wei Wu, LingAn Wu, **Physical Review A** **79**, 53844(2009).
29. Second-order Talbot effect with entangled photon pairs, KaiHong Luo, Jianming Wen, XiHao Chen, Qian Liu, Min Xiao, LingAn Wu, **Physical Review A** **80**, 43820(2009).
30. Surface-Enhanced Raman Scattering: Comparison of Three Different Molecules on Single-Crystal Nanocubes and Nanospheres of Silver, Rycenga M, Kim M H, Camargo P H. C., Claire C., Li Z Y, Xia Y, **The Journal of Physical Chemistry A** **113**, 3932(2009).
31. Optical Quality Improvement of Si Photonic Devices Fabricated by Focused-Ion-Beam Milling, Tian J, Yan W, Liu YZ, Luo J, Zhang DZ, Li ZY, Qiu M, **Journal of Lightwave Technology** **27**, 4306(2009).
32. Relativistic collisional current-filamentation instability and two-stream instability in dense plasma, Biao Hao, ZM Sheng, C Ren, and J Zhang, **Physical Review E** **79**, 046409 (2009).
33. Single-cycle strong terahertz pulse generation from a vacuum-plasma interface driven by intense laser pulses, XG Dong, ZM Sheng, HC Wu, WM Wang, and J Zhang, **Physical Review E** **79**, 046411 (2009)
34. Plasma thermal effect on the relativistic current-filamentation and two-stream instabilities in a hot-beam warm-plasma system, Biao Hao, WJ Ding, ZM Sheng, C Ren, and J Zhang , **Physical Review E** **80**, 066402 (2009).
35. Inverse bremsstrahlung absorption with nonlinear effects of high laser intensity and non-Maxwellian distribution, SM Weng, ZM Sheng, and J Zhang, **Physical Review E** **80**, 056406 (2009).
36. Bulk resonance absorption induced by relativistic effects in laser-plasma interaction, WenJun Ding, ZM Sheng, J Zhang, and MY Yu, **Physics of Plasmas** **16**, 042315 (2009).
37. Soft x-ray emission, angular distribution of hot electrons, and absorption studies of argon clusters in intense laser pulses, Yunquan Liu, Quanli Dong, Xiaoyu Peng, Zan Jin, and Jie Zhang, **Physics of Plasmas** **16**, 0423301 (2009).
38. Self-induced magnetic focusing of proton beams by Weibel-like instability in the laser foil-plasma interactions, XQ Yan, M Chen, ZM Sheng, and J E Chen, **Physics of Plasmas** **16**, 044501 (2009).
39. Laser pulse guiding and electron acceleration in the ablative capillary discharge plasma, T. Kameshima, H. Kotaki, M. Kando, I. Daito, K. Kawase, Y. Fukuda, LM Chen, T. Homma, S. Kondo, T. Zh. Esirkepov, N. A. Bobrova, P. V. Sasorov, and S. V. Bulanov, **Physics of Plasmas** **16**, 093101(2009)
40. Evolution of a relativistic electron beam-plasma return current system, X Kong, C Ren, J. Park, Z M Sheng, J. W. Tonge, **Physics of Plasmas** **16**, 032107 (2009).
41. Blue Light Generation of Strongly Focused Gaussian Beams by Frequency Doubling of Nd:GSAG Laser, X. Wang, Frank Kallmeyer, S. Wang, Hans J. Eichler, Adalbert M. G. Ding, and Zhiguo Zhang, **IEEE Journal of Quantum Electronics** **45**, 783(2009).
42. Laboratory spectroscopy of silicon plasmas photoionized by mimic astrophysical compact objects, S Fujioka, N Yamamoto, D Salzmann, F Wang, Y Li, Q Dong, S Wang, Y Zhang, Y-J Rhee, Y-W Lee, J-M Han, D-H Kwon, J Zhong, G Zhao, M Tanabe, T Fujiwara, Y Nakabayashi, J Zhang, H

- Nishimura, H Takabe¹, and K Mima, **Plasma Physics and Controlled Fusion** **51**, 124032 (2009)
43. Analytic modal solution to transmission and collimation of light by one-dimensional nanostructured subwavelength metallic slits, Hua YL, Li ZY, **Journal of Applied Physics** **105**, 13104(2009).
44. Ultrafast and low-power photonic crystal all-optical switching with resonant cavities, Liu Y, Qin F, Zhou F, Li ZY, **Journal of Applied Physics** **106**, 83102(2009).
45. Photoelectric effects of ultraviolet fast response and high sensitivity in LiNbO₃ single crystal, Er-Jia Guo, Jie Xing, Kui-Juan Jin, Hui-Bin Lu, Juan Wen, and Guo-Zhen Yang, **Journal of Applied Physics** **106**, 23114(2009).
46. Polarization interference in six-wave mixing in a Doppler-broadened N-type four-level system, Niu JY, Wang RQ, Wu LA, Fu PM, **Journal of Optical Society of America B** **26**, 2268(2009).
47. Light propagation through two-dimensional photonic crystal slab waveguide bends solved by three-dimensional plane-wave transfer-matrix method, Che M, Li ZY, **Journal of the Optical Society of America B** **26**, 493(2009).
48. Plasma Bragg density gratings produced by optical-field ionization, LuLe Yu, ZM Sheng, and J Zhang, **Journal of Optical Society of America B** **26**, 2095(2009).
49. Energy interchange between large-scale free propagating filaments and its background reservoir, Hao ZQ, Zhang J, Lu X, Xi TT, Zhang Z, Wang ZH, **Journal of Optical Society of America B** **26**, 499-502 (2009)
50. Long distance filamentation of 400 nm femtosecond laser pulses in air, Z. Zhang, X Lu, TT Xi, WX Liang, ZQ Hao, Y Zhang, ML Zhou, ZH Wang, J Zhang, **Applied Physics B** **97**, 207-213 (2009)
51. Field effect transistor based on SiO₂-Si with SrTiO₃- δ as the source and drain, Fang Yang, Kui-juan Jin, Hui-bin Lu, Meng He and Guo-Zhen Yang, **Journal of Physics D: Applied Physics** **42**, 45116(2009).
52. A numerical design of opto-thermionic refrigeration with perovskite oxide heterostructures, Li-li Zhang, Peng Han, Kui-juan Jin, Leng Liao, Chun-lian Hu and Hui-bin Lu **Journal of Physics D: Applied Physics** **42**, 125109(2009).
53. Interfacial contribution to magnetocapacitance in La_{0.05}Tb_{0.95}MnO₃/La_{0.67}Sr_{0.33}MnO₃/SrTiO₃ heterojunctions, Ying-Tang Zhang, Chun-Chang Wang, Meng He and Hui-Bin Lu, **Journal of Physics D: Applied Physics** **42**, 55309(2009).
54. Ultraviolet fast-response photoelectric effects in LiTaO₃ single crystal, Er-jia Guo, Jie Xing, Hui-bin Lu, Kui-juan Jin, Juan Wen, Guo-zhen Yang, **Journal of Physics D: Applied Physics** **42**, (2009).
55. Six-wave mixing spectroscopy in a Doppler-broadened cascade four-level system, Niu JY, Wang RQ, Wang BB, Wu LA, Fu PM, **Journal of Physics B: Atomic, Molecular and Optical Physics** **42**, 175505(2009).
56. Laser-assisted collision effect on non-sequential double ionization of helium in a few-cycle laser pulse, H Li, J Chen, H Jiang, J Liu, P Fu, Q Gong, ZC Yan and B Wang, **Journal of physics B: At. Mol. Opt. Phys** **42**, 125601(2009).
57. The ferroelastic phase transition and non-180° domain switching in La-modified lead zirconate

- titanate ferroelectric ceramics, Wang C, Redfern S, Aguadol F, Daraktchiev M, **Journal of Physics: Condensed Matter** **21**, 295901(2009).
58. Numerical and experimental investigation of a continuous-wave and passively mode-locked Yb:YAG laser at a wavelength of 1.05 μm , Binbin Zhou, Zhiyi Wei, Dehua Li, Hao Teng, and Gilbert L. Bourdet, **Applied Optics** **48**, 5978(2009).
59. Q-switched 935nm Nd:CNGG laser, Qinan Li, Baohua Feng, Dongxiang Zhang, Zhiguo Zhang, Huaijin Zhang, Jiyang Wang, **Applied Optics** **48**, 1898 (2009)
60. Numerical analysis of the transport processes in manganite–titanate Schottky junctions, Peng Han, Jin-feng Jia, Meng He, **Applied Surface Science** **255**, 6262(2009).
61. Interfacial layer in La_{0.95}Tb_{0.05}MnO₃/Nb-SrTiO₃ heterojunction, Ying-tang Zhang, Chun-chang Wang, XM Feng, Meng He, Hui-bin Lu, **Solid State Communications** **149**, 2065(2009).
62. Theoretical study on the positive magnetoresistance in perovskite oxide p-n junctions, Chun-lian Hu, Kui-juan Jin, Peng Han, Hui-bin Lu, Leng Liao, Guo-zhen Yang, **Solid State Communications** **149**, 334(2009).
63. Dynamic process of photovoltaic effect in La_{0.9}Sr_{0.1}MnO₃/SrNb_{0.01}Ti_{0.99}O₃ heterojunction, Leng Liao, Kui-juan Jin, Hui-bin Lu, Peng Han, Meng He, Guo-zheng Yang, **Solid State Communications** **149**, 915(2009).
64. Enhancement of third harmonic emission by interaction of two colored filament with droplet in air, Xi TT, Lu X, Zhang J, **Optics Communications** **282**, 3140-3143 2009.
65. Diode-pumped passively Q-switched Nd:LuVO₄ laser at 916 nm, Kunna He, Chunqing Gao, Zhiyi Wei, Dehua Li, Zhiguo Zhang, Huaijin Zhang, Jiyang Wang, **Optics Communications** **282**, 2413(2009).
66. Wavelength conversion in a Ti:PPSMgLN channel waveguide, YL Chen, G Liu, BB Zhou, ZY Wei, YQ Zheng, **Optics Communications** **282**, 2524(2009).
67. Characterization of ultra-weak fluorescence using picosecond non-collinear optical parametric amplifier, Shifeng Du, Dongxiang Zhang, Yuxian Shi, Qinan Li, Baohua Feng, Xiaofeng Han, Yuxiang Weng, and Jing-yuan Zhang, **Optics Communications** **282**, 1884 (2009)
68. High-peak power multi-wavelength picosecond pulses generated from a BaWO₄ Raman-seeded optical parametric amplifier, Shifeng Du, Yuxian Shi, Dongxiang Zhang, Qinan Li, Baohua Feng, Jing-yuan Zhang, Jingcun Zang, **Optics Communications** **282**, 2960 (2009)
69. Review of Energetic Particle Generation and Electromagnetic Radiation from Intense Laser-Plasma Interactions at the Institute of Physics, Yutong Li, Zhengming Sheng, Liming Chen, Xin Lu, Jinglong Ma, Zhaohua Wang, Quanli Dong, Zhiyi Wei and Jie Zhang, Chinese Academy of Sciences, **Plasma and Fusion Research** **4**, 023 (2009).
70. Comparison between simulated and experimental emission spectra of photoionizing nitrogen plasma, Feilu Wang, Gang Zhao, David Salzmann, Hiroaki Nishimura, Shinsuke Fujioka, Yutong Li, Hideaki Takabe, Jie Zhang, **High Energy Density Physics** **5** (2009) 219–220
71. Giant room-temperature magnetoresistance in LaTbMnO under the low magnetic fields, Ying-Tang

- Zhang, Zi-Yu Chen, Chun-Chang Wang, Qiu Jie, and Hui-Bin Lu, **Journal of Magnetism and Magnetic Materials** **321**, 1199(2009).
72. High-visibility intensity interference and ghost imaging with pseudo-thermal light, I. N. Agafonov, M. V. Chekhova, T. S. Iskhakov, LingAn Wu, **Journal of Modern Optics** **56**, 422(2009).
73. A designer approach to plasmonic nanostructures: tuning their resonance from visible to near-infrared, Lia J, Gu Y, Zhou F, Li ZY, Gong QH, **Journal of Modern Optics** **56**, 1396(2009).
74. High contrast femtosecond laser driven intense hard x-ray source for imaging application, LM Chen, WM Wang, M. Kando, L. T. Hudson, F Liu, XX Lin, JL Ma, YT Li, S. V. Bulanov, T. Tajima, Y. Kato, ZM Sheng, J Zhang, **Nuclear Instruments and Methods in Physics Research A** **11**, 048(2009)
75. Theoretical study on the photodoping effects in $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3/\text{SrNbTi}_{1-y}\text{O}_3$ p-n heterojunction, Leng Liao, Kui-juan Jin, Hui-bin Lu, Jie Qiu, Peng Han, and Li-li Zhang, **Physics Status Solidi A** **206**, 1655(2009).
76. Spectral Responses by Chains of Subwavelength-Size Metallic Spheres in Terahertz (THz) Region, Wei Yan, Hua Chen, Yimin Sun and Li Wang, **International Journal of Terahertz Science and Technology** **2**, 31(2009).
77. Novel THz radiation from relativistic laser-plasmas, Harnessing Relativistic Plasma Waves as Novel Radiation Sources from Terahertz to X-Rays and Beyond, edited by Dino A. Jaroszynski, Antoine Rousse, ZM Sheng, HC Wu, WM Wang, XG Dong, M Chen, J Zhang, **Proc. SPIE Vol. 7359**, 735910 (2009).
78. Terahertz radiation from the interaction of laser pulses with gas target, Harnessing Relativistic Plasma Waves as Novel Radiation Sources from Terahertz to X-Rays and Beyond, edited by Dino A. Jaroszynski, Antoine Rousse, M Chen, A. Pukhov, XY Peng, O Willi, ZM Sheng, and J Zhang, **Proc. SPIE Vol. 7359**, 735912 (2009).
79. High resistance modulation by the electric field based on $\text{La}_{0.9}\text{Sr}_{0.1}\text{MnO}_3/\text{SrTiO}_3/\text{Si}$ structure, fang Yang, Meng He, Juan Wen, Kui-juan Jin, Hui-bin Lu, Guo-zhen Yang, **Science in China Series G: Physics, Mechanics & Astronomy** **52**, 1299(2009).
80. Spin-glass like behaviors in $\text{La}_{1-x}\text{TbxMnO}_3$ perovskite, Ying-tang Zhang, Chun-chang Wang, Wei-bin Liu, Zhong Wang, Hui-bin Lu, Zi-yu Chen, **Science in China Series G: Physics, Mechanics & Astronomy** **52**, (2009).
81. Synchronously pumped femtosecond optical parametric oscillator at 1053nm, Zhong Xin, Zhu Jiangfeng, ZhouBinBin, Wei Zhiyi, **Science in China Series G Physics, Mechanics & Astronomy** **52**, 1187(2009).
82. Effect of Schottky barrier on the transport property in perovskiteoxide heterostructures, Peng Han, Hui-bin Lu, Kui-juan Jin, Jin-feng Jia, Jie Qiu, Chun-lian Hu, Leng Liao, **Physica B** **404**, 1332(2009).
83. Long-Distance Femtosecond Laser Filaments in Air, J Zhang, X Lu, YY Maa, TT Xi, YT Li, ZM Sheng, LM Chen, JL Ma, QL Dong, ZH Wang, and ZY Wei, **Laser Physics** **19**, 1769–1775 (2009)
84. High-Q Microcavity in Two-Dimensional Diamond Photonic Crystal Thin Films Realized via a Mode Gap, Zhou CZ, Xiong ZG, Li ZY, **Chinese Physics Letters** **26**, 94201(2009).
85. Energy Squeeze of Ultrashort Light Pulse by Kerr Nonlinear Photonic Crystals, Liu Ye, Zhou Fei,

- Zhang DaoZhong, Li ZhiYuan , **Chinese Physics Letters 26**, 14208(2009).
86. Ultrafast Electron Diffraction with Spatiotemporal Resolution of Atomic Motion, Liang WenXi, Zhu PengFei, Wang Xuan, Nie ShouHua, Zhang ZhongChao, Clinite Rick, Cao JianMing, Sheng ZhengMing, Zhang Jie, **Chinese Physics Letters 26**, 020701 (2009).
87. Ray-Tracing Simulation on Filamentation of Prefocused and Freely Propagated Laser Pulses in Air, Ma YuanYuan Lu Xin, Xi TingTing, Gong QiHuang, Zhang Jie, **Chinese Physics Letters 26**, 095201 (2009).
88. Acceptor Concentration Effects on Photovoltaic Response in the La_{1-x}Sr_xMnO₃/SrNb_{1-y}Ti_{1-y}O₃ Heterojunction, Leng Liao, Kui-juan Jin, Peng Han, Li-li Zhang, Hui-bin Lu, Chen Ge, **Chinese Physics Letters 26**, 57301(2009).
89. Influence of Oxygen Vacancy on Transport Property in Perovskite Oxide Heterostructures, Peng Han, Kui-juan Jin, Hui-bin Lu, Jin-feng Jia, Jie Qiu, Chun-lian Hu, Guo-zhen Yang, **Chinese Physics Letters 26**, 27301(2009).
90. Field-Effect Transistor Based on Si with LaAlO_{3-δ} as the Source and Drain, Fang Yang, Kui-Juan Jin, Hui-bin Lu, Meng He, Guo-zhen Yang, **Chinese Physics Letters 26**, 77301(2009).
91. High-order above-threshold ionization of H₂⁺ in intense laser field, Y Guo, P Fu and B Wang, **Chinese Physics Letters 26**, 34204(2009).
92. Measurement of carrier-envelope phase and field strength of a few-cycle pulse by nonsequential double ionization, H Li, J Chen, H Jiang, J Liu, P Fu, Q Gong, ZC Yan and B Wang, **Chinese Physics Letters 26**, 104207(2009).
93. Reversible Conformational Changes of PsbO Protein Detected by Terahertz Time-Domain Spectroscopy, Chen Hua, Chen Guiying, Li Shuqing and Wang Li, **Chinese Physics Letters 26**, 84204(2009).
94. Investigation of Ag₂O Thermal Decomposition by Terahertz Time-Domain Spectroscopy, Chen Hua and Wang Li, **Chinese Physics Letters 26**, 54209(2009).
95. Generation of 170-fs Laser Pulses at 1053nm by a Passively Mode-Locked Yb:YAG Laser, Zhou BinBin, Wei ZhiYi, Li DeHua, Teng Hao, Bourdet G.L, **Chinese Physics Letters 26**, 54208(2009).
96. Generation of Sub-10 fs Laser Pulse by a Ring Oscillator with High Repetition Rate, Zhang Qing, Zhao YanYing, Wei ZhiYi, **Chinese Physics Letters 26**, 44208(2009).
97. Nd:YAG Lasers Operating at 1064nm and 946nm by Direct Pumping and Thermally Boosted Pumping, Xu ChangWen, Wei ZhiYi, He KunNa, Li DeHua, Zhang YongDong, Zhang ZhiGuo, **Chinese Physics Letters 26**, 14213(2009).
98. Generation of Continuum Extreme-Ultraviolet Radiation by Carrier-Envelope-Phase-Stabilized 5-fs Laser Pulses, Teng Hao, Yun ChenXiao, Zhu JiangFeng, Han HaiNian, Zhong Xin, Zhang Wei, Hou Xun, Wei ZhiYi, **Chinese Physics Letters 26**, 113201(2009).
99. Observation of antiphase state in self-Q-switched Cr,Nd:YAG laser, Shi Yuxian, Li Qinan, Du Shifeng, Zhang Dongxiang, Zhang Zhiguo, Feng Baohua, Zhang Shiwen, **Chinese Physics Letters 26**, 014212 (2009)

100. Mechanisms of electron injection into laser wakefields by a weak counter-propagating pulse, ZM Sheng, WM Wang, R. Trines, P. Norreys, M Chen, and J Zhang, **The European Physical Journal - Special Topics** **175**, 49-55 (2009).
101. Sub-10 fs laser pulses with repetition rate of 1.1 GHz by a Ti: sapphire oscillator, Zhang Qing, Zhao YanYing, Wei ZhiYi, **Chinese Science Bulletin** **54**, 3649(2009).
102. Novel Properties in Oxide Heter Ostructures, Chen Ge, Kui-juan Jin, Hui-bin Lu, Can Wang, **Modern Physics Letters B** **23**, 1129(2009).
103. Influence of Initial Amplitude Perturbations on Filament Length of Pre-focused Femtosecond Laser Pulses, Ma Yuanyuan , Lu Xin , Xi Tingting , Gong Qihuang , Zhang Jie, **Plasma Science and Technology** **11**, 1-5, (2009)
104. Plasma channel formed by ultraviolet laser pulses at 193 nm in air, Yuanyuan Ma , Xin Lu, Tingting Xi , Qihuang Gong , and Jie Zhang , **Chinese Optics Letters** **7**, 865, (2009)
105. Diode-pumped self-Q-switched Cr,Nd:YAG laser with 7-W average output power, Yuxian Shi, Sumei Wang, Qinan Li, Jing Zhang, Shifeng Du, Dongxiang Zhang, Baohua Feng, Zhiguo Zhang, Shiwen Zhang, **Chinese Optics Letters** **7**, 1015 (2009)
106. Investigation of transmission resonances on the one-dimensional metallic cylindrical gratings in THz, Chen Hua, Sun Yimin and Wang Li, **Chinses Physics B** **18**, 4287(2009).
107. The transmission enhancement of a THz pulse through an Ag/Ag₂O layer detected by terahertz time-domain spectroscopy, Chen Hua and Wang Li, **Chinses Physics B** **18**, 2785(2009).
108. A dual-loop Sagnac interferometer, Ma HaiQiang, Zhao JianLing, Wu LingAn, **Chinese Physics B** **18**, 2801(2009).
109. Triggering and guiding of high voltage discharge by using femtosecond laser filaments with different parameters, Zhang Zhe, Lu Xin, Liang WenXi, et al., **Chinese Physics B** **18**, 1136-1140 (2009)
110. Interaction of light filaments in air, Xi TingTing, Lu Xin, Hao ZuoQiang, Ma YuanYuan, and Zhang Jie, **Chinese Physics B** **18**, 4303-4305 (2009)
111. Generation of 10 fs Ti:sapphire laser at repetition rate of 525MHz and measurement of carrier-envelope phase frequency, Zhang Wei, Han HaiNian, Teng Hao, Wei ZhiYi, **Chinese Physics B** **18**, 1105(2009).
112. Efficient frequency upshift of 10 fs laser pulses propagating in a 5-cm length birefringent photonic crystal fibre, Li ShuGuang, Zhang Wei, Wei ZhiYi, Zhou GuiYao, and Hou LanTian, **Chinese Physics B** **18**, 1674(2009).
113. Collisional effects on the current filamentation instability in a dense plasma, Hao Biao, Sheng Zheng-Ming, Zhang Jie, **Chinese Physics C** **33** 171 (2009).
114. 十二重准晶中的方向缺陷, 冯志芳, 刘荣鹏, 李志远, **物理学报** **58**, 1948(2009).
115. Epitaxial growth of La_{0.67}Sr_{0.33}MnO₃ on glass by laser molecular beam epitaxy, Ying-tang Zhang, Meng He, Zi-Yu Chen, Hui-bin Lu, **Acta Physica Sinica** **58**, 2002(2009).

116. 基于偏振纠缠光子对的单光子源, 马海强, 王素梅, 吴令安, **物理学报** **58**, 717(2009).
117. 强激光与稠密等离子体作用引起的冲击波加速离子的研究, 何民卿 董全力 盛政明 翁苏明 陈民 武慧春 张杰, **物理学报** **58**, 363, (2009)
118. 超快电子衍射系统的时间空间分辨能力研究及其优化, 梁文锡 朱鹏飞 王 聂守华 张忠超 曹建明 盛政明 张杰, **物理学报** **58**, 5539, (2009)
119. 用超快电子衍射技术研究!" 薄膜的超快动力学行为, 梁文锡 朱鹏飞 王 聂守华 张忠超 曹建明 盛政明 张杰, **物理学报** **58**, 5546, (2009)
120. 激光等离子体相互作用的受激拉曼散射饱和效应, 张蕾, 董全力, 赵静, 王首钧, 盛政明, 何民卿, 张杰, **物理学报** **58**, 1833, (2009)
121. 采用多通腔望远镜谐振腔结构的 10MHz 重复频率飞秒钛宝石激光器特性研究, 赵研英, 韩海年, 滕浩, 魏志义, **物理学报** **58**, 1709(2009).
122. 全固态激光直接抽运技术的发展和研究现状, 何坤娜, 魏志义, 张治国, 高春, **中国激光** **36**, 1679(2009).
123. 连续锁模皮秒 Yb:LSO 激光实验研究, 周斌斌, 邹育婉, 李德华, 魏志义, 郑丽和, 苏良碧, 徐军, **中国激光** **36**, 1806(2009).
124. 大芯径光纤整形飞秒激光脉冲空间分布的研究, 王向林, 侯洵, 魏志义, **光子学报** **38**, 2738(2009).

国际会议邀请报告/Invited Plenary Talks at International Conference

- [1]. **Li Zhiyuan** “Surface Plasmon Resonance in Metallic Nanoparticles: Designs and Applications”, **Invited talk** on ICQS Annual Conference 2009 on Nanophotonics, 2009-6-8, Beijing, Chian
- [2]. **Li Zhiyuan** “Photonic Crystal Integrated Optical Devices: Theory and Experiment”, **Invited talk** on NTU CRP Workshop on Nanophotonics and Metamaterials, 2009-7-3, Singapore
- [3]. **Li Zhiyuan** “Photonic Crystal Integrated Optical Devices: Theory and Experiment”, **Invited talk** on 2009 Sino-Swedish Workshop on Nanophotonics, 2009-7-30, Stockholm, Sweden
- [4]. **Li Zhiyuan** “Nonlinear photonic crystals for frequency conversion and optical switching”, **Invited talk** on SNOMP 2009, 2009-6-21, Melbourne, Australia
- [5]. **Li Zhiyuan** “Plane-wave transfer-matrix method and its application to photonic crystal structures”, **Invited talk** on ICMAT 2009 Conference, 2009-6-28, Singapore
- [6]. **Li Zhiyuan** “Plane-wave transfer-matrix method and its application to photonic crystal structures”, **Invited talk** on The International Conference on Nanophotonics 2009, 2009-5-11, Ha Rbin, China
- [7]. **Li Zhiyuan** “Plane-wave transfer-matrix method and its application to photonic crystal structures”, **Invited talk** on IEEE/LEOS Winter Topical Meeting, 2009-1-12, Innsbruck, Austria
- [8]. **Jin Kuijuan** “Lateral photovoltage effect on perovskite heterostructures”, **Invited talk** on International Conference on Applications of Optical Metamaterials, 2009.06.22-25, Tianjin China
- [9]. **金奎娟** “低维氧化物的光物理研究”, **Invited talk** on 2009 凝聚态及光物理学术研讨会, 2009.12.14-20, 中国香港
- [10]. **Wang Bingbing** “Imaging molecular structure by high-order above threshold ionization spectrum in intense laser fields”, **Invited talk** on 3rd Asian workshop on generation and applications of coherent XUV and X-ray radiation, 2009.6.10-12, Wu Han, China
- [11]. **Wu Lingan** “Lensless “ghost” imaging and high-visibility high-order imaging with thermal light”, **Invited talk** on 3rd International Meeting on Frontiers of Physics, 2009.01.12-16, Malaysia, Kuala Lumpur
- [12]. **Wu Lingan** “High-order ghost imaging with thermal light and multi-photon bunching”, **Invited talk** on 18th International Laser Physics Workshop, 2009.07.13-17, Spain, Barcelona
- [13]. **Wu Lingan** “Lensless High-Visibility High-Order Ghost Imaging with Thermal Light”, **Invited talk** on 4th International Symposium on Quantum Optics, 2009.08.03-04, Pakistan, Islamabad
- [14]. **Wu Lingan** “I. Lensless High-Visibility High-Order “Ghost” Imaging with Thermal Light, II. Second-Order Talbot Effect with Entangled Photons”, **Invited talk** on 第三届海峡两岸光学微结构与雷射技术研讨会, 2009.10.04-06, 台北
- [15]. **Zhang Jie** “High energy density physics research in China”, **Invited talk** on The Sixth International Conference on Inertial Fusion Sciences and Applications. 2009.9.6 -11, San Francisco, UAS.
- [16]. **Li Yutong** “Recent studies of laboratory astrophysics at the Institute of Physics”, **Invited talk** on The 8th Pacific Rim Conference on Lasers and Electro-Optics (CLEO®/Pacific Rim 2009), 2009,.8.30-9.3, Shanghai, China.

- [17]. **Sheng Zhengming** “Novel THz radiation from relativistic laser-plasmas”, **Invited Talk**, The Sixth Joint Meeting of Chinese Physicists Worldwide (OCPA6) - International Conference on Physics Education and Frontier Physics, 2009. 8. 3-7, Lanzou University, Lanzhou, China
- [18]. **Sheng Zhengming**, “Novel THz radiation from relativistic laser-plasmas”, **Invited Talk**, 4th Asia Summer School and Symposium (4th ASS & S) on Laser-plasma Acceleration and Radiation, 2009, 8.17-21, National Synchrotron Radiation Research Center, Hsinchu, Taiwan
- [19]. **Sheng Zhengming**, “Schemes for producing GeV proton beams and beyond by ultra-relativistic laser pulses”, **Invited Talk**, 7th General Scientific Assembly of the Asia Plasma and Fusion Association in 2009 and Asia-Pacific Plasma Theory Conference in 2009, 10. 27-30, Aomori, Japan
- [20]. **Sheng Zhengming**, “Novel THz radiation sources from relativistic laser-plasmas”, **Invited Talk**, SPIE Europe Optics + Optoelectronics, 2009.4.20-23, Prague Congress Centre, Prague, Czech Republic
- [21]. **Chen Liming** “Laser-Driven intense 10fs monochromatic hard x-ray source for application”, (Plenary Lecture) 11th International Symposium on Radiation and Physics, 2009.9. 20-25, Victoria, Australia
- [22]. **Chen Liming** “Recent Research Activities in IOP”, (Invited talk) The Second International Symposium on Laser-Driven Relativistic Plasma Applied to Science, Industry and Medicine, 2009. 1.19-23, Kizugawa, Japan
- [23]. **Wei Zhiyi**, “Spectrum characteristics of high order harmonic wave driven by Carrier- Envelope Phase controlled 5-fs Ti:sapphire laser”, **Invited talk** on The 3rd Asian Workshop on Generation and Applications of Coherent XUV and X-ray Radiation, 2009.6.10-12, Wuhan, Chian
- [24]. **Wei Zhiyi** “Push laser pulse toward attosecond duration, locked carrier envelope phase and XUV range”, **Invited talk** on ICQFT'09, 2009.7.17 -21, Shanghai, China
- [25]. **Wei Zhiyi** “Carrier Envelope Phase stabilized sub-5fs laser for attosecond pulse generation” , **Invited talk** on 2th International Conference on Attosecond Science, 2009.7.28- 8.1, Kansas, USA
- [26]. **Wei Zhiyi** “DPL mode-locked solid-state lasers” , **Invited talk** on The first China-Russia Bilateral Forum on Materials, 2009.11.16-17, Shanghai, China

学位论文/Dissertations

1. 博士学位论文

- [1] 车 明, 基于平面波展开的传递矩阵方法在光子晶体中的应用; 导师: 李志远
- [2] 刘娅钊, 二维光子晶体结构研究与器件研制; 导师: 李志远
- [3] 宁廷银, 金纳米团簇复合薄膜的非线性光学性质研究; 导师: 杨国楨
- [4] 廖 棱, 钙钛矿氧化物异质结光电效应的理论研究; 导师: 金奎娟
- [5] 孙毅民, THz 辐射与结构材料的相互作用; 导师: 汪力
- [6] 梁文锡, 超快电子衍射: 原子时空尺度结构动力学的直接测量; 导师: 张杰
- [7] 张 喆, 飞秒激光与非线性介质相互作用及其应用的实验研究; 导师: 张杰
- [8] 张 翼, 激光等离子体推进技术和实验室天体物理; 导师: 张杰
- [9] 王伟民, 基于强激光等离子体的新型粒子加速和辐射的理论和数值模拟研究; 导师: 盛政明
- [10] 周斌斌, 近红外波段全固态飞秒激光器的研究; 导师: 魏志义
- [11] 赵研英, 高能量及近周期飞秒钛宝石脉冲激光的产生与宽带自差频研究; 导师: 魏志义
- [12] 张 炜, 基于飞秒钛宝石激光的新型单块光学频率梳及光频测量研究; 导师: 魏志义
- [13] 李奇楠, 准三能级全固态激光器与激光特性研究; 导师: 冯宝华
- [14] 杜仕峰, 皮秒光参量放大技术应用于超微弱光信号探测及 Cr, Nd:YAG 全固态绿光激光器研究;
导师: 冯宝华
- [15] 张小富, 飞秒激光泵浦的小型 X 射线激光模拟研究; 导师: 许祖彦
- [16] 周 勇, 两种紫外、深紫外非线性光学晶体的特性表征和应用前景评估; 导师: 许祖彦
- [17] 崔前进, 高功率中红外全固态光参量激光技术研究; 导师: 许祖彦
- [18] 鲁远甫, 高功率高光束质量全固态黄光激光技术研究; 导师: 许祖彦
- [19] Muhammad Abbas Bari, 用于离子加速的等离子体和激光相互作用中原子过程的研究;
导师: 张杰

光物理系列学术报告 / Optical Physics Series Academic Report

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报告人：Dr. Baohua Jia (Centre for Micro-Photonics and CUDOS, Faculty of Engineering and Industrial Sciences, Swinburne University of Technology, Australia)

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报告人：Prof. Shunrato Watanabe (Institute for solid state physics, University of Tokyo, Japan)

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题目：Long Wavelength Laser based on Semiconductor Broken-Gap Heterostructures

报告人：赵光安 教授 (瑞典 Lund 大学教授)

光物理系列学术报告（三十八）

题目：Density-functional theoretical study of excited states and dynamics involving excited states of atomic systems

报告人：Dr. Zhongyuan Zhou (Department of Chemistry University of Kansas, USA)

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题目：Opportunities in nanophotonics

报告人：Prof. Shanhuai Fan (Stanford University, USA)

光物理系列学术报告（四十）

题目：InAs / GaAs 量子薄片中电子自旋的控制性光激发及初始相干动力学

报告人：徐士杰 教授 (香港大学物理系)

光物理系列学术报告（四十一）

题目：The study of Nanophotonic Devices Made From Photonic Crystals

报告人：Prof. Mahi R. Singh (Department of Physics and Astronomy, The University of Western Ontario, London, Canada N6A 3K7)

光物理系列学术报告（四十二）

题目：Bound states and resonance states of few-body atomic and molecular systems

报告人：Dr. Sabyasachi Kar (Harbin Institute of Technology 哈尔滨工业大学, China)

光物理系列学术报告（四十三）

题目：The unique role of atomic many-body theory in fundamental physics

报告人：Dr. Bijaya Kumar Sahoo （Kernfysisch Versneller Instituut (KVI) Zernikelaan, Netherlands）

光物理系列学术报告（四十四）

题目：High-Throughput Characterization of Biomolecular Interactions Using a Combination of Molecular Microarrays and Ellipsometry-based Scanning Microscope

报告人：Prof. Xiangdong Zhu （University of California, USA）

光物理系列学术报告（四十五）

题目：Multi-photon laser-cooling of “difficult” atomic species

报告人：吴赛骏博士（Joint Quantum Institute, National Institute of Standards and Technology, USA）

光物理系列学术报告（四十六）

题目：Toward the generation of Attosecond keV x-ray pulses driven by Thomson scattering

报告人：Prof. Dong Eon Kim （The physics department at POSTECH, Korea.）

光物理系列学术报告（四十七）

题目：Photonic Band Gap Materials: Light Trapping Crystals

报告人：Prof. Sajeev John （Department of Physics, University of Toronto, Canada）

学术组织与期刊任职/Academic Service

国际学术组织任职/Service to the International Professional Societies

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国际期刊任职/Service to International Journals

张杰 Jie Zhang	Associate Editor, Optics Express Associate Editor, Physics of Plasmas Member of Editorial Board, High Energy Density Physics Member of Editorial Board, Chemical Physics Letters Member of Editorial Board, Journal of Plasma and Fusion Research
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魏志义 Zhiyi Wei	Member of International Advisory Board, Measurement Science and Technology
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国内学术组织任职/Service to the Domestic Professional Societies

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张道中	中国物理学会光物理专业委员会 主任 (2003-2009)
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国内期刊任职/Service to the Domestic Journals

聂玉昕	《物理学报》编委 《中国物理》编委 《中国科学》G 副主编 《光谱学与光谱分析》副主编
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魏志义	《Chinese Optics Letters》常务编委 《量子电子学报》第六届编委会委员
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李志远	《光学学报》常务编委 《科学通报》编委

客座人员名单及客座研究课题/Visitors List & Open Subjects

客座人员名单/Visitor List

序号	姓名	性别	专业	职称	工作单位
1	张希成	男	激光物理	教授	美国 Rensselaer Polytechnic Institute
2	朱湘东	男	物理	教授	美国加州大学戴维斯分校
3	郁明阳	男	光学	教授	德国鲁尔大学
4	俞进	男	光学	教授	法国里昂大学
5	曹建明	男	光学	教授	美国佛罗里达州立大学
6	张坚地	男	材料学	教授	美国佛罗里达国际大学
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12	张泽勃	男	光学	研究员	中国科学院物理研究所
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15	周岳亮	男	光学	研究员	中国科学院物理研究所

实验室资助的客座研究课题/Open Subjects

序号	课题名称	负责人	职称	单位	起止时间
1	非线性的光物理现象-铟离子的红绿荧光强度反转的研究	陈晓波	教授	北京师范大学	2008.11-2009.11
2	超宽带超短脉冲钛宝石激光器的研究	张志刚	教授	北京大学	2009.10-2009.11
3	信息微纳晶透明激光玻璃陶瓷的制备与性能研究	燕青芝	教授	北京科技大学	2009.01-2009.12

选录论文/Selected Papers

1. X-ray Astronomy in the Laboratory with a Miniature Compact Object Produced by Laser-Driven Implosion, Shinsuke Fujioka, Hideaki Takabe, Norimasa Yamamoto, David Salzmann, Feilu Wang, Hiroaki Nishimura, Yutong Li, Quanli Dong, Shoujun Wang, Yi Zhang, Yong-Joo Rhee, Yong-Woo Lee, Jae-Min Han, Minoru Tanabe, Takashi Fujiwara, Yuto Nakabayashi, Gang Zhao, Jie Zhang, Kunioki Mima, **Nature Physics** **5**, 821 (2009).
2. Novel Multifunctional Properties Induced by Interface Effects in Perovskite Oxide Heterostructures, Kui-juan Jin, Hui-bin Lu, Ken Zhao, Chen Ge, Meng He, Guo-Zhen Yang, **Advanced Materials** **21**, 4636(2009).
3. Metal Nanoparticles with Gain toward Single-Molecule Detection by Surface-Enhanced Raman Scattering, Li Zhiyuan, Xia Younan, **Nano Letter** **10**, 243-249 (2010)
4. 10 fs ultrafast all-optical switching in polystyrene nonlinear photonic crystals, Liu Y, Qin F, Wei ZY, Meng QB, Zhang DZ, Li ZY, **Applied Physics Letters** **95**, 131116(2009).
5. The substrate thickness dependence of the photovoltage in LaAlO₃/Si heterostructures, Juan Wen, Kui-Juan Jin, Meng He, Hui-bin Lu, Fang Yang, Guo-Zhen Yang, **Applied Physics Letters** **94**, 61118(2009)
6. K-shell x-ray emission enhancement via selfguided propagation of intense laser pulses in Ar clusters, Feng Liu, LiMing Chen, XiaoXuan Lin, Feng Liu, JingLong Ma, RunZe Li, YuTong Li, ZhaoHua Wang, ShouJun Wang, ZhiYi Wei, and Jie Zhang, **Optics Express** **17**, 16379-16384 (2009)
7. Diode-pumped passively mode-locked Yb:Y₃Ga₅O₁₂ laser, Yongdong Zhang, Zhiyi Wei, Binbin Zhou, Changwen Xu, Yuwan Zou, Dehua Li, Zhiguo Zhang, Huaijin Zhang, Jiyang Wang, Haohai Yu, Kui Wu, Bin Yao, Junli Wang, **Optics Letters** **34**, 3316(2009).
8. Diode-pumped passively mode-locked Nd: GSAG laser at 942 nm, Changwen Xu, Zhiyi Wei, Yongdong Zhang, Dehua Li, Zhiguo Zhang, X. Wang, S.Wang, H.J.Eichler, Chunyu Zhang, Chunqing Gao, **Optics Letters** **34**, 2324(2009).
9. Imaging the geometrical structure of the H₂⁺ molecular ion by high-order above threshold ionization in an intense laser field, Yingchun Guo, Panming Fu, ZongChao Yan, Jiangbin Gong, and Bingbing Wang, **Physics Review A** **80**, 63408(2009).
10. Second-order Talbot effect with entangled photon pairs, KaiHong Luo, Jianming Wen, XiHao Chen, Qian Liu, Min Xiao, LingAn Wu, **Physical Review A** **80**, 43820(2009).