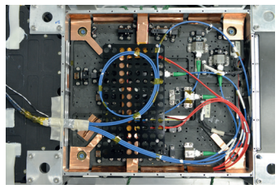
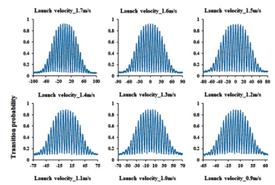
Research Group of Space Cold Atom Clock in Tiangong-2
Shanghai Institute of Optics and Fine Mechanics , Chinese Academy of Sciences

空间冷原子钟环境试验现场
The space cold atom clock under environmental test



空间冷原子钟的小型化光学系统
The miniaturized optical system for the space cold atom clock



在轨获得的 Ramsey 条纹
Ramsey fringes obtained in orbit

After more than twenty years of continuous efforts, the group proposed the technical roadmap of the space cold atom clock and made breakthroughs in a series of key technologies, such as the physics package operated for microgravity environment, the long-term autonomously-operating optical system used for the preparation and manipulation of cold atoms, the ultra-low-noise microwave synthesizer for cold atom clock, etc. Besides, the reliability problems to operate a cold atom clock in space were overcome. Based on the above-mentioned breakthroughs and innovations, the group developed the world-first space cold atom clock that had successfully been operating in orbit, demonstrated laser cooling of atoms and long-term continuous closed-loop operation of cold atom clock in orbit. The physics in cold atom clock was further studied and a frequency instability of 10^{-16} was proved under microgravity. The space cold atom clock had been stably operating in orbit for almost three years and the mission was successfully accomplished. This achievement made China at the forefront of space-based cold atom sensors in the world and had a profound impact on future space researches based on cold atom technologies, benefiting the development of quantum physics and precision measurements.

Outstanding contributors of this research group

Wang Yuzhu

Based on atomic clock and cold atom physics, he put forward a series of physical proposals for space cold atom clock operated under microgravity and confirmed the technical roadmap of the space cold atom clock in Tiangong-2 space laboratory.

Liu Liang

He analyzed the principal mechanism of space cold atom clock operated under microgravity and designed the physics package and the compact laser-cooling system of the space cold atom clock.

Chen Weibiao

He confirmed the proposals of the laser sources, laser frequency stabilization unit and optical bench of the space cold atom clock in Tiangong-2 space laboratory and completed the design and verification of the reliability of the payload.

Major contributors

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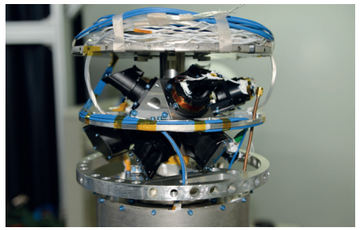
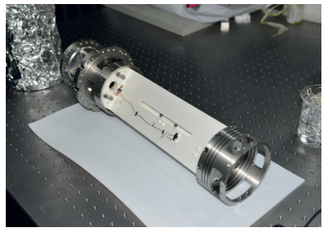


空间冷原子钟的磁光阱
The magneto-optical trap for the space cold atom clock



空间冷原子钟的环形微波激励腔
The microwave cavity for the space cold atom clock

空间冷原子钟照片
Photo of the space cold atom clock

天宫二号空间冷原子钟
The space cold atom clock in Tiangong-2 space laboratory

研究集体
Group photo

天宫二号空间冷原子钟研究集体

推荐单位：中国科学院上海光学精密机械研究所

研究集体主要科技贡献：

该研究集体经过二十多年不懈努力，提出了空间冷原子钟总体技术路线，突破了微重力环境下运行的冷原子钟物理系统、长期自主运行的冷原子制备与操控光学系统和冷原子钟超低噪声微波频率源等一系列关键技术，攻克了冷原子钟空间应用的可靠性难题。基于上述突破与创新，研制了世界第一台在轨成功运行的空间冷原子钟，首次在轨实现了激光冷却原子与冷原子钟长期闭环，深入研究了其中的物理规律，验证了冷原子钟在轨天稳达到 10^{-16} 量级的能力。空间冷原子钟在轨运行近三年，性能稳定，圆满完成预定任务，使我国在天基冷原子传感领域走在了世界前列，对未来基于冷原子技术的空间科学研究有着深远影响，对量子物理及精密测量科学的发展具有重大意义。

研究集体突出贡献者

王育竹 Wang Yuzhu

王育竹 中国科学院上海光学精密机械研究所
主要科技贡献：在原子钟和冷原子物理的基础上，提出了在微重力环境下冷原子钟的多种物理系统设计方案，并最终确定了天宫二号空间冷原子钟的总体技术路线。

刘　亮 Liu Liang

刘　亮 中国科学院上海光学精密机械研究所
主要科技贡献：分析了冷原子钟在微重力环境下的运行机制，设计了空间冷原子钟的物理系统和集成激光冷却装置。

陈卫标 Chen Weibiao

陈卫标 中国科学院上海光学精密机械研究所
主要科技贡献：确定了空间冷原子钟激光单元、激光稳频以及光学平台单元的方案，完成了整个系统的可靠性设计和验证。

研究集体主要完成者

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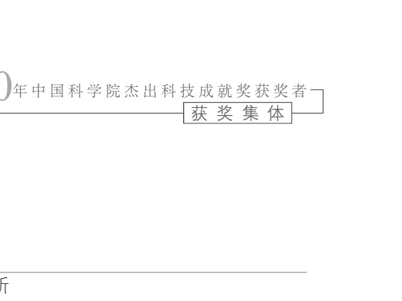

空间冷原子钟研制现场
The laboratory of the space cold atom clock

空间冷原子钟抵达发射场测试大厅
The space cold atom clock arrived at the AIT hall of the launch center