

物理系暨研究所
Department of Physics / Graduate Institute of Physics

天文物理研究所
Graduate Institute of Astrophysics

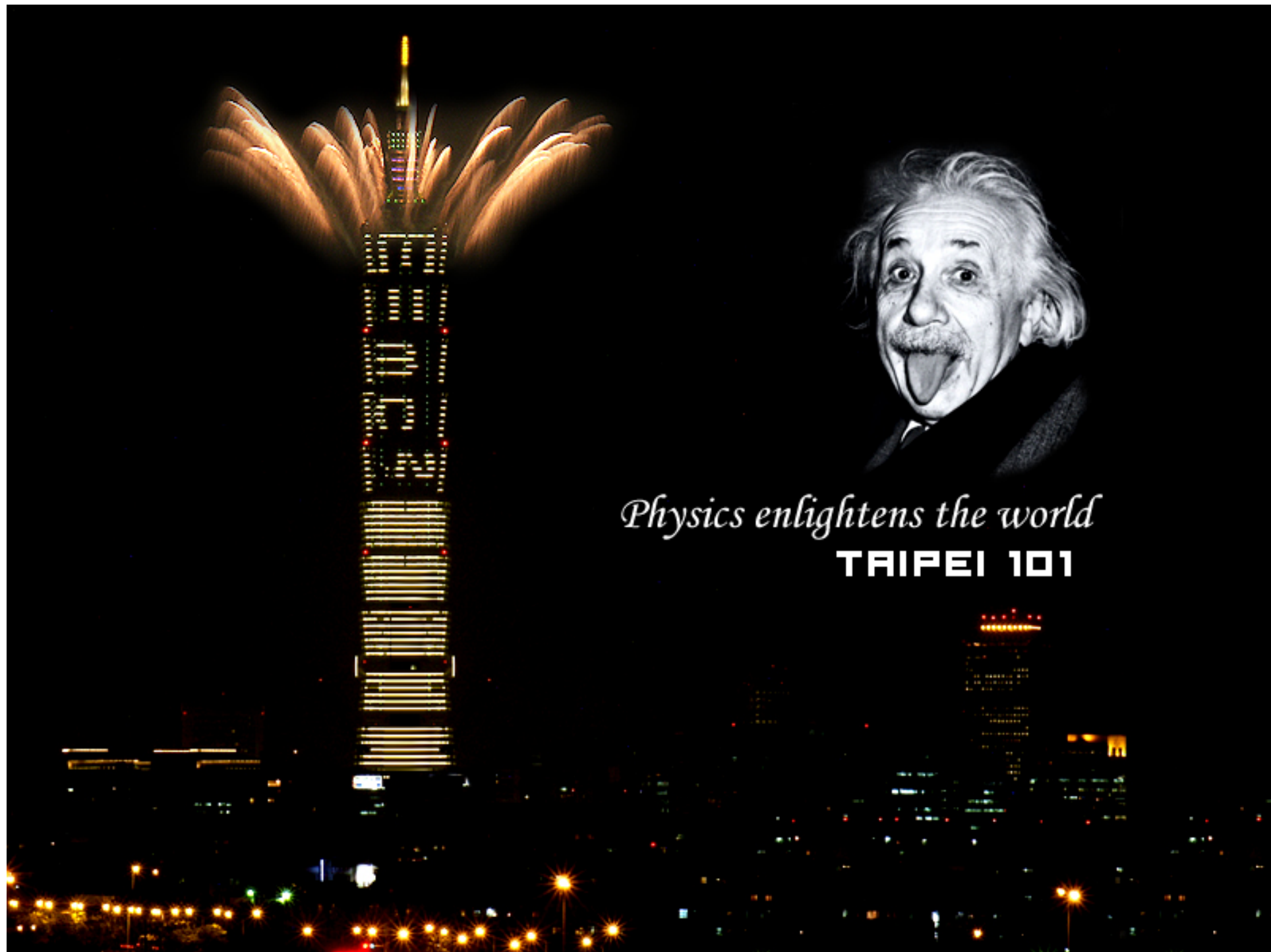
應用物理研究所
Graduate Institute of Applied Physics

臺灣大學



National Taiwan University

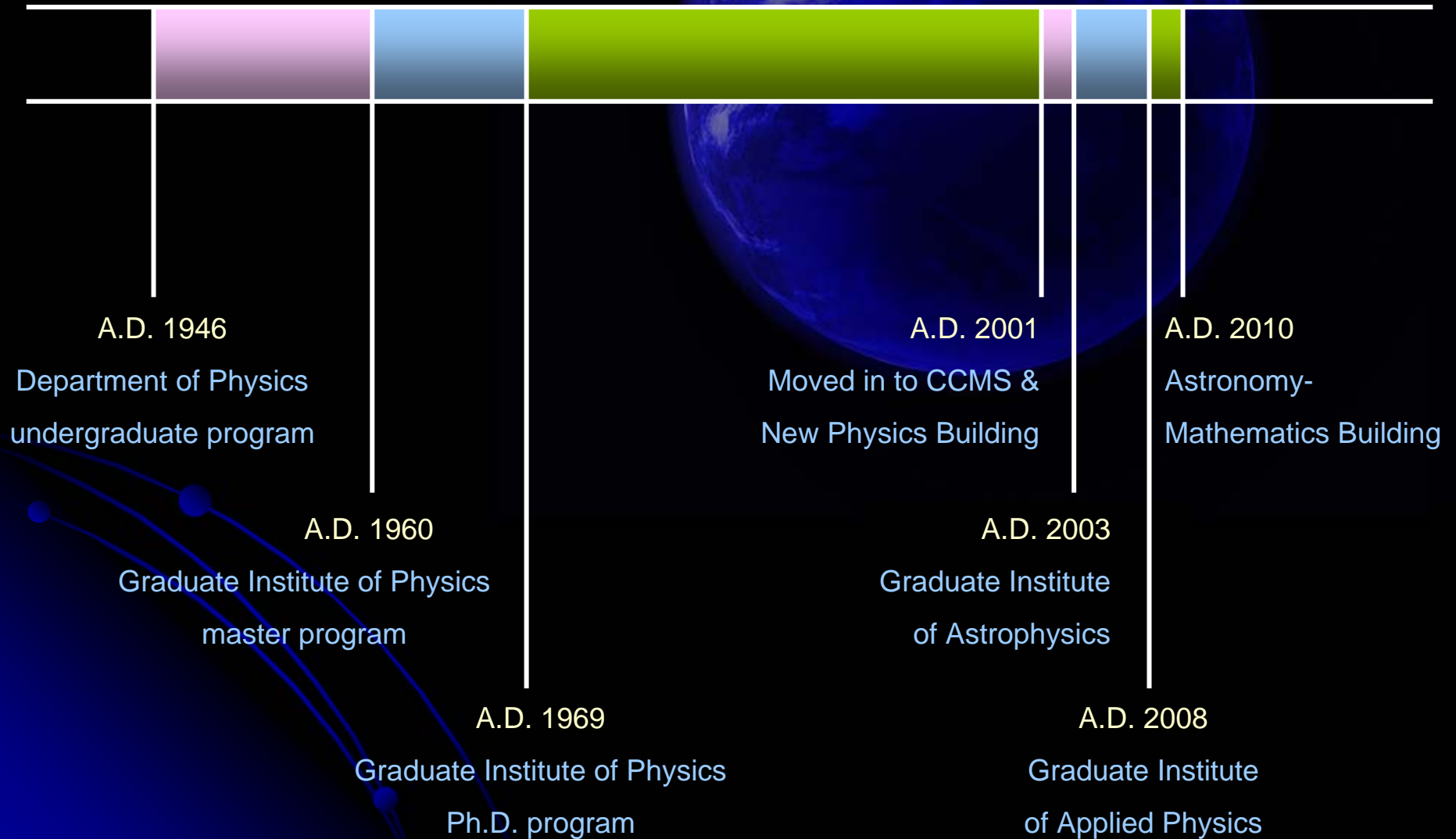
--- Director : 熊 怡 教授 Professor Hsiung, Yee Bob ---



Physics enlightens the world

TAIPEI 101

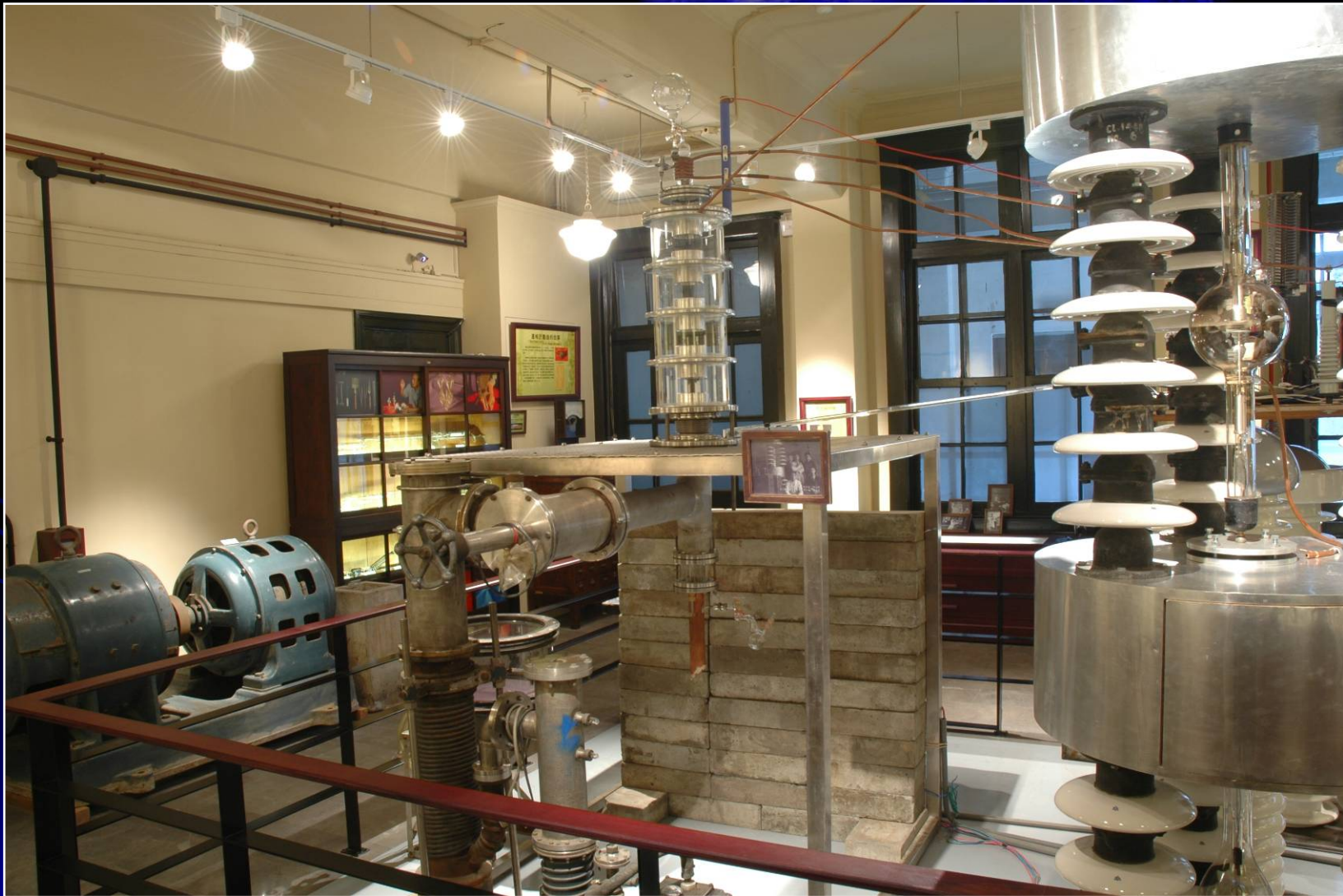
系所歷史 History



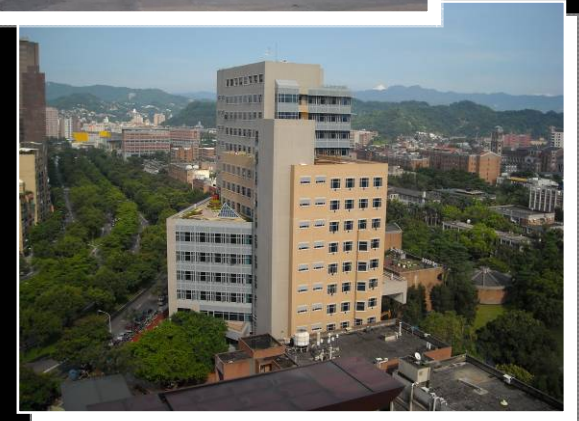
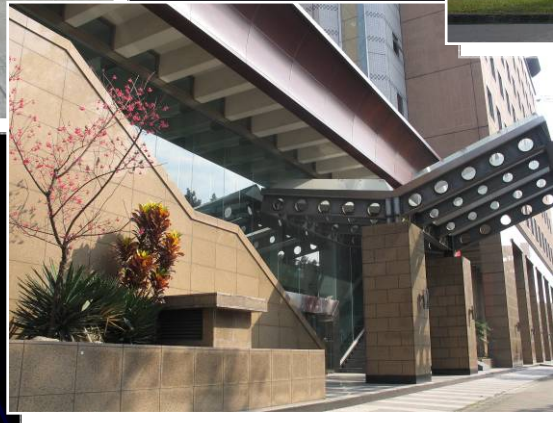
天文數學大樓 Astronomy-Mathematics Bldg. — 2009



臺大物理文物廳 NTU Heritage Hall of Physics



凝態科學中心暨物理新館 CCMS & New Physics Building

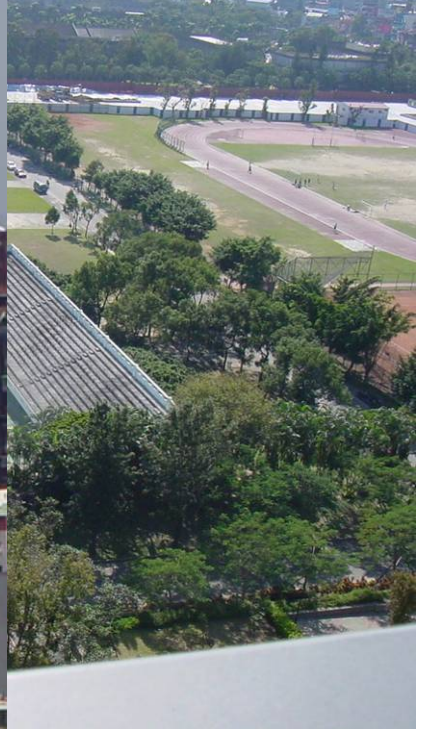
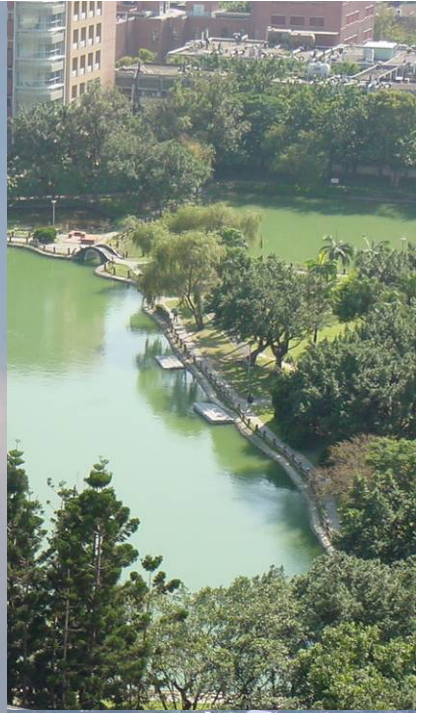




臺灣大學物理系

*National Taiwan University
Department of Physics*

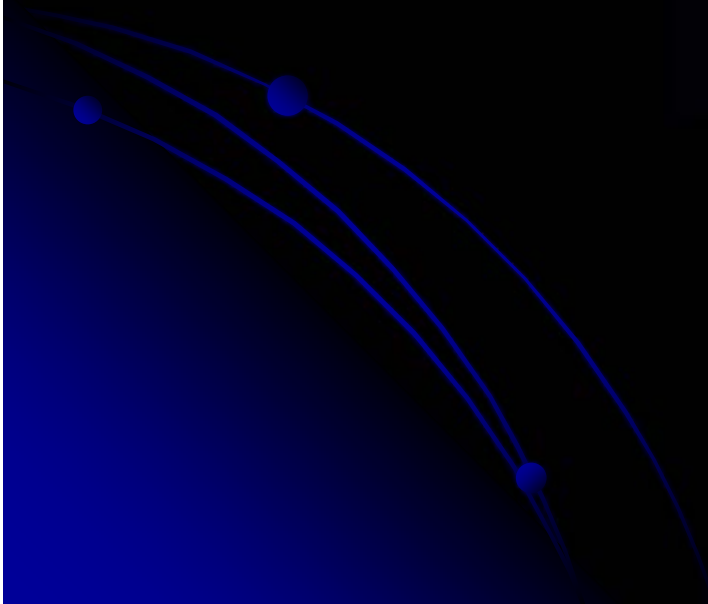




必修課程 Required Course



- † 奈米科技導論一、二 Introduction to Nanotechnology – An Overview (I) & (II)
- † 專題討論 Seminar
- † 專題研究 Research Training
- † 專題演講 Colloquium



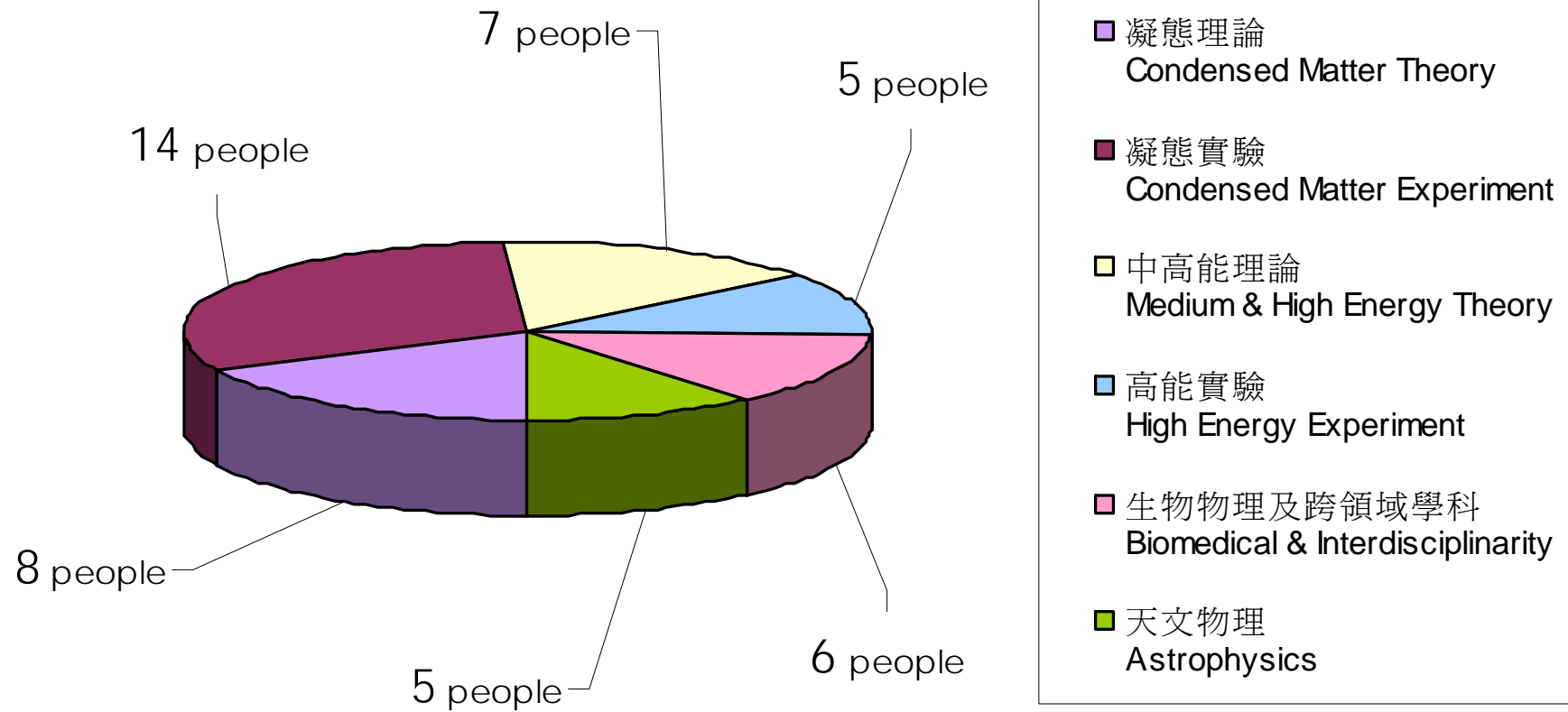
選修課程 Elective Course



- † ★ 量子力學一、二 Quantum Mechanics (I) & (II)
- † ★ 統計物理一、二 Statistical Mechanics (I) & (II)
- † ★ 古典電動力學一、二 Classical Electrodynamics (I) & (II)
- † ★ 固態物理一、二 Solid-state Physics (I) & (II)
- † 計算材料 Computational Materials Science
- † 高等有機化學 Advanced Organic Chemistry
- † 高等無機化學 Advanced Inorganic Chemistry
- † 高等分析化學 Advanced Analytical Chemistry
- † 高等材料化學 Advanced Chemistry of Materials
- † 高等物理化學一、二、三 Advanced Physical Chemistry (I) & (II) & (III)
- † 現代實驗技術 Modern Experimental Techniques

研究領域 Research Fields

Research Fields of Faculties

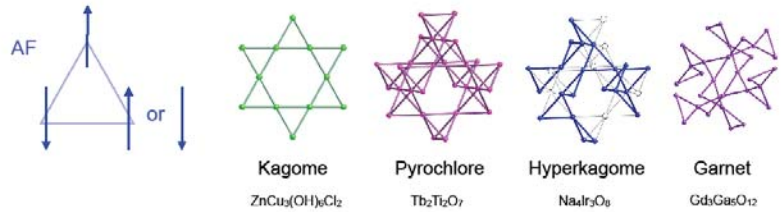


研究領域 Research Fields

凝態理論 Condensed Matter Theory

張慶瑞 教授	Professor	Chang, Ching-Ray	Ph. D., University of California, San Diego (1988)
朱時宜 教授	Professor	Chu, Shih-I	Ph. D., Harvard University (1974)
郭光宇 教授	Professor	Guo, Guang-Yu	Ph. D., University of Cambridge (1987)
胡崇德 教授	Professor	Hu, Chong-Der	Ph. D., Rutgers University (1985)
李文忠 教授	Professor	Lee, Ven-Chung	Ph. D., National Tsing-Hua University (1978)
高英哲 副教授	Associate Professor	Kao, Ying-Jer	Ph. D., University of Chicago (2001)
蔡政達 助理教授	Assistant Professor	Chai, Jeng-Da	Ph. D., University of Maryland (2005)
陳智泓 助理教授	Assistant Professor	Chern, Chyh-Hong	Ph. D., Stanford University (2004)

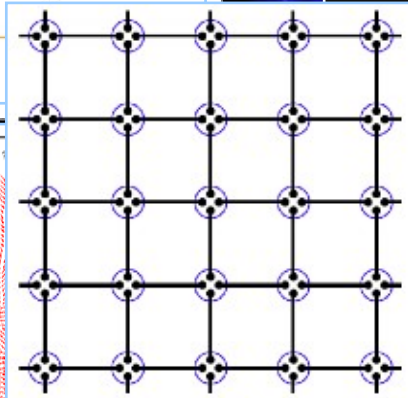
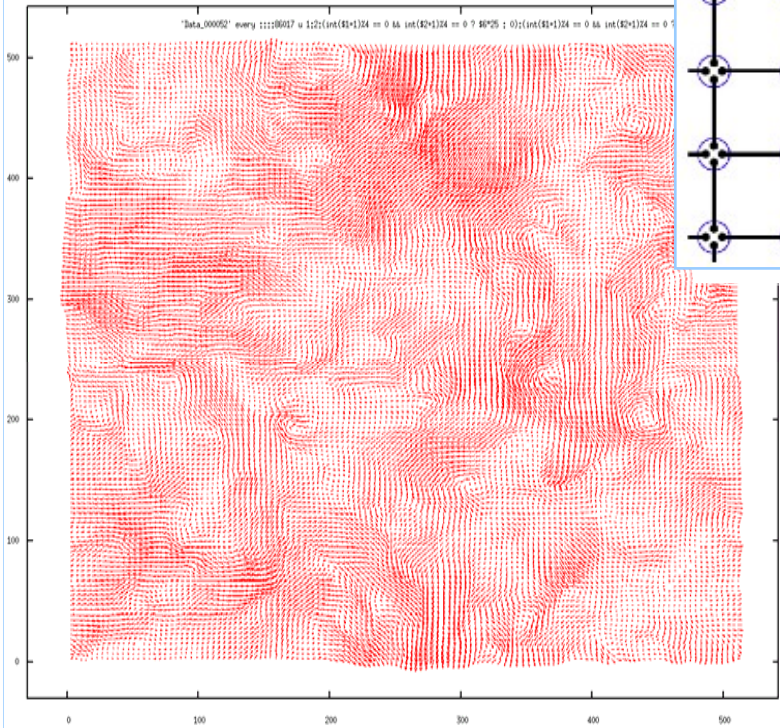
Frustration



- Large number of degenerate **classical ground states**
- Emergence of novel spin-disordered ground states due to quantum fluctuations (spin liquids, valence bond solid, chiral liquids...)
- Hard to study numerically: **size limitation** in Exact Diagonalization, **sign problem** in QMC (also fermion), dimension limit for DMRG ($d=1$)



Department of Physics
National Taiwan University



Nvidia S1070 1U System




NTU CQGE GPU cluster
16x Tesla S1070=64 Teraflops
Top 50 SC
Fastest SC: 1105 Teraflops

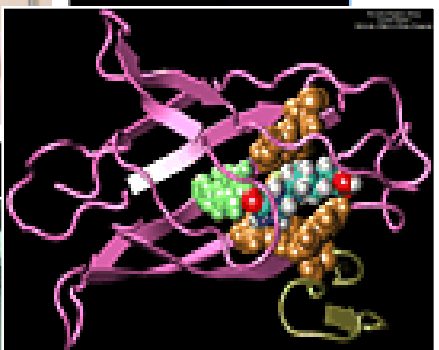
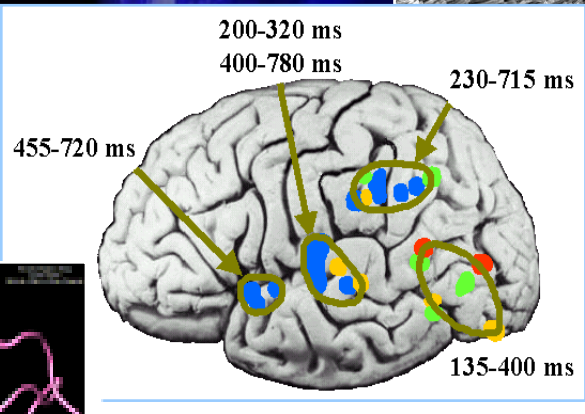
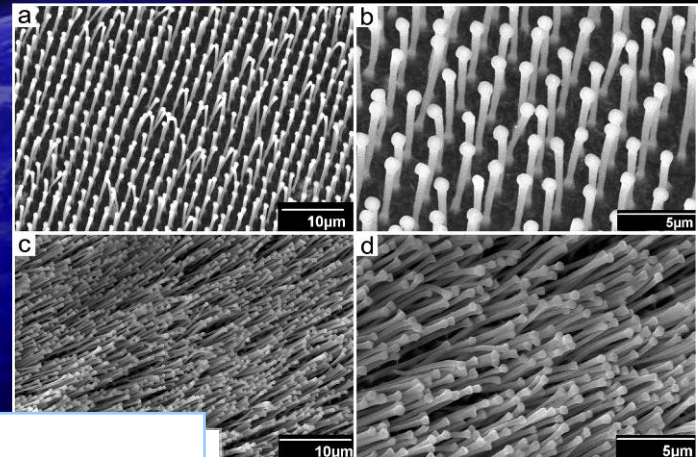
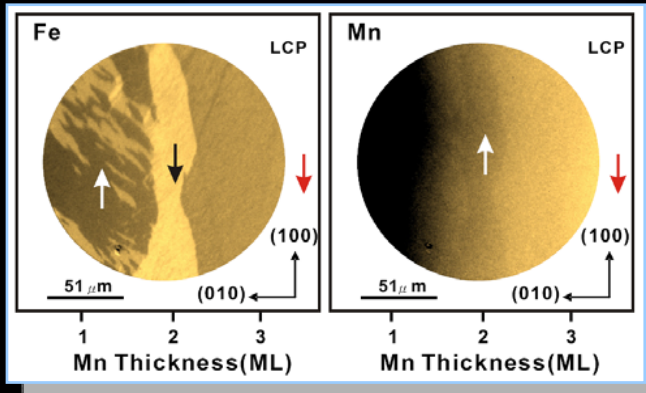
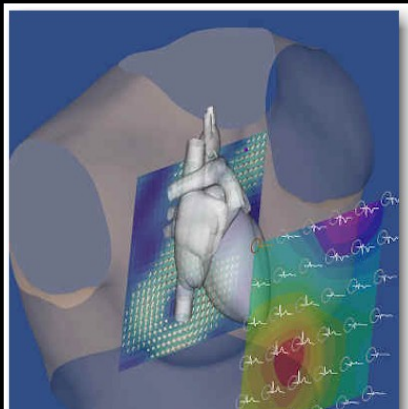
Processors	4 x Tesla T10
Number of cores	960
Core Clock	1.5 GHz
Performance	4 Teraflops
Total system memory	16.0 GB (4.0 GB per T10)
Memory bandwidth	408 GB/sec peak (102 GB/sec per T10)
Memory I/O	2048-bit, 800MHz GDDR3 (512-bit per T10)
Form factor	1U (EIA 19" rack)
System I/O	2 PCIe x16 Gen2
Typical power	700 W

研究領域 Research Fields

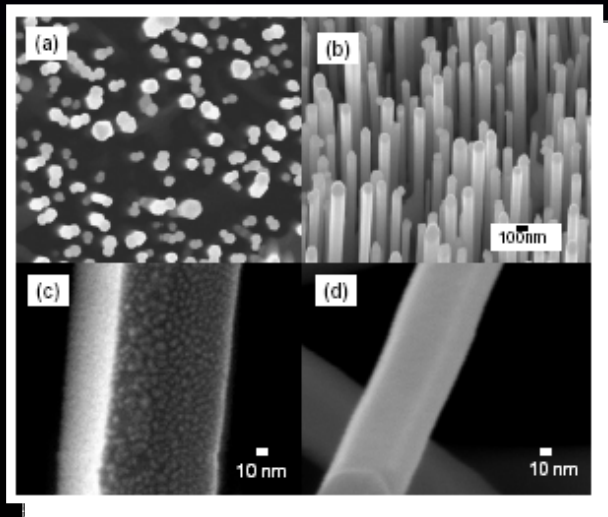
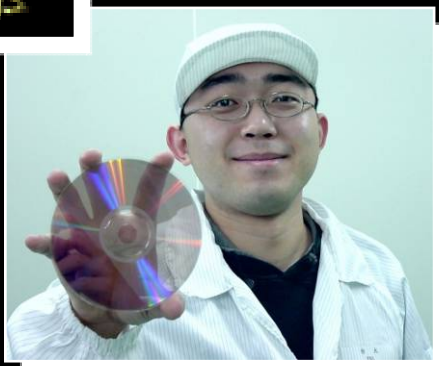
凝態實驗 Condensed Matter Experiment



張顏暉 教授	Professor	Chang, Yuan-Huei	Ph. D., State University of New York at Buffalo (1988)
趙治宇 教授	Professor	Chao, Chih-Yu	Ph. D., State University of New York at Buffalo (1997)
陳政維 教授	Professor	Chen, Jeng-Wei	Ph. D., University of California, San Diego (1986)
陳永芳 教授	Professor	Chen, Yang-Fang	Ph. D., Purdue University (1984)
陳銘堯 教授	Professor	Chern, Ming-Yau	Ph. D., Cornell University (1991)
傅昭銘 教授	Professor	Fu, Chao-Ming	Ph. D., Katholieke Universiteit Leuven (1993)
許仁華 教授	Professor	Hsu, Jen-Hwa	Ph. D., The Johns Hopkins University (1980)
梁啟德 教授	Professor	Liang, Chi-Te	Ph. D., Cambridge University (1996)
林敏聰 教授	Professor	Lin, Minn-Tsong	Ph. D., University of Halle (1996)
石明豐 教授	Professor	Shih, Ming-Feng	Ph. D., Princeton University (1998)
蔡定平 教授	Professor	Tsai, Din-Ping	Ph. D., University of Cincinnati (1990)
王立民 教授	professor	Wang, Li-Min	Ph. D., National Taiwan University (1995)
楊鴻昌 教授	Professor	Yang, Hong-Chang	Ph. D., Iowa State University (1983)
易富國 副教授	Associate Professor	Yee, Fu-Goul	Ph. D., Columbia University (1989)



AFC 蒸着機
(Sputter for Magnetic Recording Media)



Toroidal Dipolar Response in a Metamaterial

T. Kaelberer,¹ V. A. Fedotov,^{1*} N. Papasimakis,¹ D. P. Tsai,^{2,3} N. I. Zheludev^{1*}

Toroidal multipoles are fundamental electromagnetic excitations, distinct from the familiar charge and magnetic multipoles. They have been known in nuclear and particle physics, but direct evidence of their existence in a macroscopic medium remained elusive. We report on the observation of a resonant toroidal response in an artificially engineered medium, or metamaterial, that cannot be explained by the existence of a toroidal dipole. The observation of the toroidal response brings attention to the often-overlooked interactions involving toroidal multipoles, which could be particularly important especially at the macromolecule level, where toroidal symmetries are common.

multipoles, making observations of the toroidal response extremely challenging (14, 19, 20).

We demonstrate a classical system in which the electromagnetic response is directly related to the resonant excitation of the toroidal dipole. The resonant toroidal response has been observed in a “metamaterial slab,” a two-dimensional array of artificially engineered electromagnetic scatterers

Fig. 2. Electromagnetic metamaterial supporting toroidal dipolar excitation. (A) Unit cell of the metamaterial, containing four split wire loops embedded in a dielectric slab. (B and C) Two distinctively different modes of excitation corresponding to magnetic (I) and toroidal (II) dipole resonances, respectively. (D) Close-up photograph of the wire structure of the toroidal metamolecule. (E) Assembled metamaterial slab, 8 mm × 176 mm × 165 mm (green solder resist was removed before the measurements).

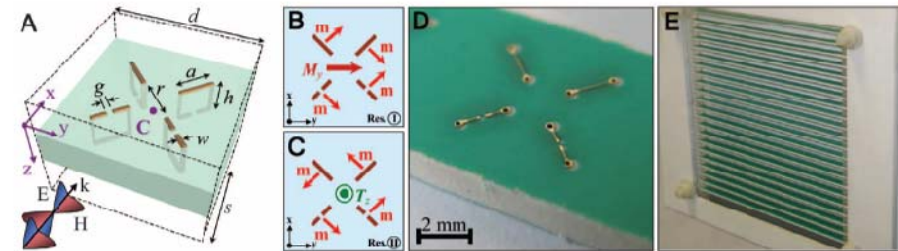
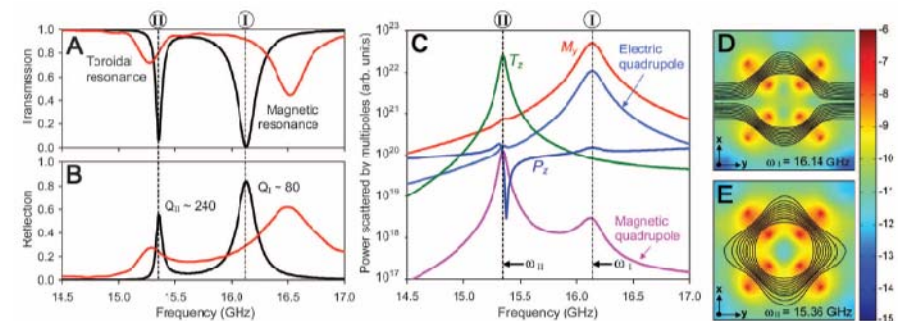


Fig. 3. Resonant toroidal response of the metamaterial. (A and B) Calculated (black lines) and measured (red lines) transmission and reflection spectra of the metamaterial. Positions of the calculated magnetic and toroidal dipole resonances, I and II, are marked by vertical dashed lines. (C) Dispersion of scattered power for various multipole moments induced in the metamolecule that contribute to the reflection and transmission spectra of the metamaterial slab. (D and E) Distributions of magnetic field lines for correspondingly magnetic (I) and toroidal (II) dipole resonances plotted over the color maps of the magnetic energy density (logarithmic scale).



研究領域 Research Fields

中高能理論 Medium & High Energy Theory

陳俊瑋 教授	Professor	Chen, Jiunn-Wei	Ph. D., University of Washington (1999)
趙挺偉 教授	Professor	Chiu, Ting-Wai	Ph. D., University of Utah (1980)
何小剛 教授	Professor	He, Xiao-Gang	Ph. D., University of Hawaii (1987)
賀培銘 教授	Professor	Ho, Pei-Ming	Ph. D., University of California, Berkeley (1995)
高涌泉 教授	Professor	Kao, Yeong-Chuan	Ph. D., University of California, Berkeley (1985)
李慶德 教授	Professor	Li, Ching-Teh	Ph. D., University of Pennsylvania (1978)
蔡爾成 副教授	Associate Professor	Tsai, Er-Cheng	Ph. D., Massachusetts Institute of Technology (1985)

研究領域 Research Fields

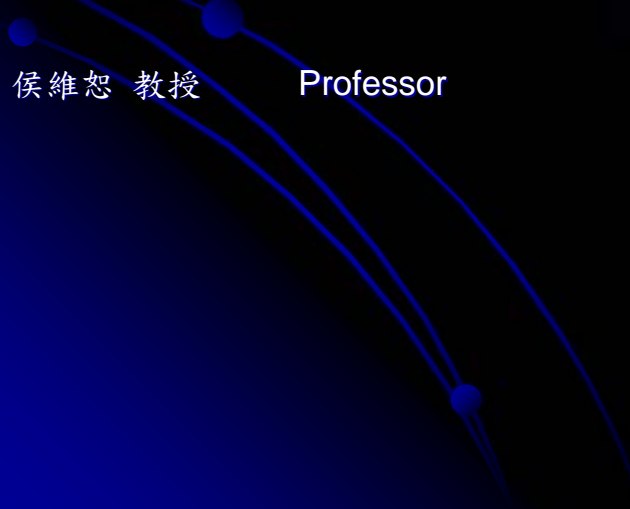


高能實驗 High Energy Experiment

張寶棣 教授	Professor	Chang, Pao-Ti	Ph. D., Northeastern University (1994)
熊 怡 教授	Professor	Hsiung, Yee Bob	Ph. D., Columbia University (1986)
王名儒 教授	Professor	Wang, Min-Zu	Ph. D., University of Iowa (1993)
陳凱風 副教授	Associate Professor	Chen, Kai-Feng	Ph. D., National Taiwan University (2005)

高能理論與實驗 High Energy Theory & Experiment

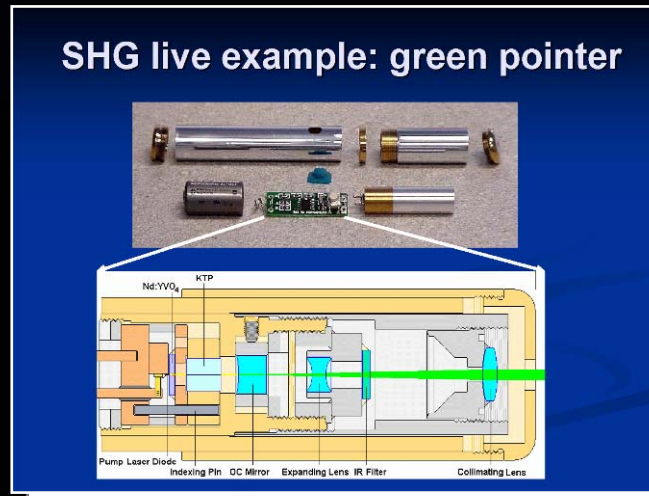
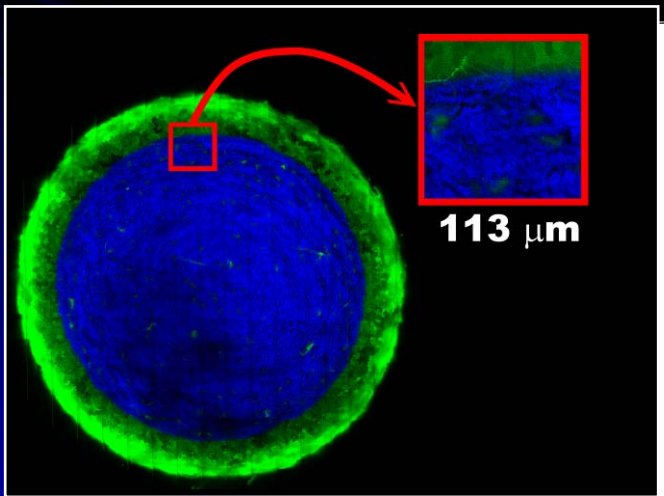
侯維恕 教授	Professor	Hou, Wei-Shu	Ph. D., University of California, Los Angeles (1985)
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研究領域 Research Fields

生物物理及跨領域學科 Biomedical & Interdisciplinarity

陳義裕 教授	Professor	Chen, Yih-Yuh	Ph. D., California Institute of Technology (1991)
朱國瑞 教授	Professor	Chu, Kwo-Ray	Ph. D., Cornell University (1972)
董成淵 教授	Professor	Dong, Chen-Yuan	Ph. D., University of Illinois at Urbana-Champaign (1998)
龐寧寧 教授	Professor	Pang, Ning-Ning	Ph. D., Columbia University (1995)
朱士維 副教授	Associate Professor	Chu, Shi-Wei	Ph. D., National Taiwan University (2004)
管希聖 副教授	Associate Professor	Goan, Hsi-Sheng	Ph. D., University of Maryland (1999)



研究領域 Research Fields



天文物理 Astrophysics

陳丕燊 教授	Professor	Chen, Pisin	Ph. D., University of California, Los Angeles (1983)
闕志鴻 教授	Professor	Chiueh, Tzihong	Ph. D., Texas University (1985)
黃偉彥 教授	Professor	Hwang, W-Y. Pauchy	Ph. D., University of Pennsylvania (1977)
孫維新 教授	Professor	Sun, Wei-Hsin	Ph. D., University of California, Los Angeles (1987)
吳俊輝 教授	Professor	Wu, Jiun-Huei Proty	Ph. D., University of Cambridge (1999)





謝謝

Thank you very much