Aix+Marseille université

PIIM
Physique des Interactions Ioniques et Moléculaires

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Upgrade of the teaching/popular science tool for holography: the color holography kit

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I. Introduction

Jonathan Ross

Science outreach at the Aix-Marseille University

http://cps.univ-amu.fr/culture-scientifique

Why ?

- Diffusion of knowledge is a fundamental mission of the universities
- Attract young students to university

What ?

- In 2012, creation of the ***Aix-Marseille University outreach division***
- 35 different workshops / year (meetings researchers/students) :
  - ***who*** **:** over 3000/year junior high and high school student
  - ***What*** : from human sciences to physics
  - ***duration*** **:** from 1h30 to 6 h
- Exhibitions and **museums**
- **Original forms** (*Souk des Sciences*, *Reporter de sciences*...)
- **International collaborations** (*British Council* (UK), *Alexandrina Bibliotheca* (Egypt),...

The first kit for holography: the origins

Th. Voslion, A. Escarguel, Eur. J. Phys. 33 1803-1811 (2012)

Many outreach and education actions on holography: *need for a compact device !*

→ *Creation of the kit for holography (2010)*
- → *Outreach*
- → *Teaching*
- → *Continuing education...*

→ **Everything needed to produce high quality holograms INSIDE THE CASE :**
→ Laser,
→ Optics,
→ Plates,
→ developping tool,
→ Hair dryer...

→ **Who used it so far** : students university projects, conferences and outreach events, Highschool teachers with their classes, continuing education, highschool student science clubs,...

Teaching holography at the Aix-Marseille University

→**Beginning in 2004 :** creation of **pedagogic projects on holography** (1st year student, physics)

→**Since 2013** duplication of the pedagogic case for **several International Masters of Science** (Master **SPACE**, Master **POESII**, Master **IOL**)

→Development of experiments with the case for holography :

- →Inteferometry,
- →notch filters (Raman spectroscopy),
- →diffraction gratings (spectroscopy),
- →Multiplexing (HVD)

→**Continuing education for high-school teacher : 20/year**

The kits for holography are lend to teachers for a few weeks for educational projects on holography.

→ 5 versions of the kit in the university, and 2 for other institutions

The new color kit for holography: why ?

- **Bigger color** holograms
  - **High quality, very bright (Yves Gentet's Ultimate O8 color plates**
    http://www.ultimate-holography.com/)
    → More spectacular for science outreach
  - More experiments for teaching at the unversity :
    → Double transmission/reflexion holograms
    → Improvement of the diffraction holographic gratings experiments
    → Wavelength multiplexing

- **Improvement of the design of the plate/object support**
  → Very robust against vibrations
  → Cheaper

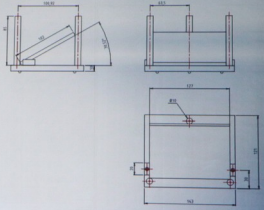
- **EVERYTHING NEEDED** to realize the holograms is always « in the box » ... but it is a bit bigger ☺...

The color kit for holography: some photos...

- 2 lasers (HeNe **red**, DPSS **green**)
- **Blue** laser is expensive and is not necessary for color, unless perfection is needed... but this is NOT the aim !

The color kit for holography

- ***20 mW lasers + dichroïc mirror + 1 neutral density + diverging lens***
- ***Optimized plate/object support***
  - *→ Reflecting prism replaced by a front surface mirror*
- **Denisyuk** mono beam type holograms
- Optional spatial filter



The kit for holography: single shot reflexion/transmission hologram

→Special plate/object support, with 2 objects on each sides
→Realization of two single beam holograms, a reflexion and a transmission one
→ **Very pedagogic for our students !**

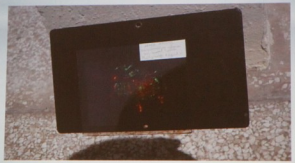
The kit for holography: wavelength multiplexing hologram (HVD)

- **Monochromatic holography kit : angular multiplexing**

→ On the same plate, exposing a first object with an incident angle α_1, and a second object with an incident angle α_2.

- **Color holography kit : wavelength multiplexing**

→ On the same plate, exposing a first object with the red laser and a second object with the green laser

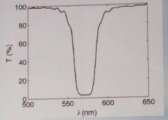


The kit for holography: holographic diffraction grating

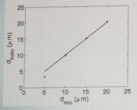
- The front surface mirror is positionned vertically behind the holographic plate placed with a 30° angle.
  - → Realization of a large diffraction grating (Richardson grating)
  - → monochromatic kit : optimisation of the experiment
  - → Effect of the wavelength on the groove number/mm
  - → Deviation of a laser beam : measurement of the dispersion

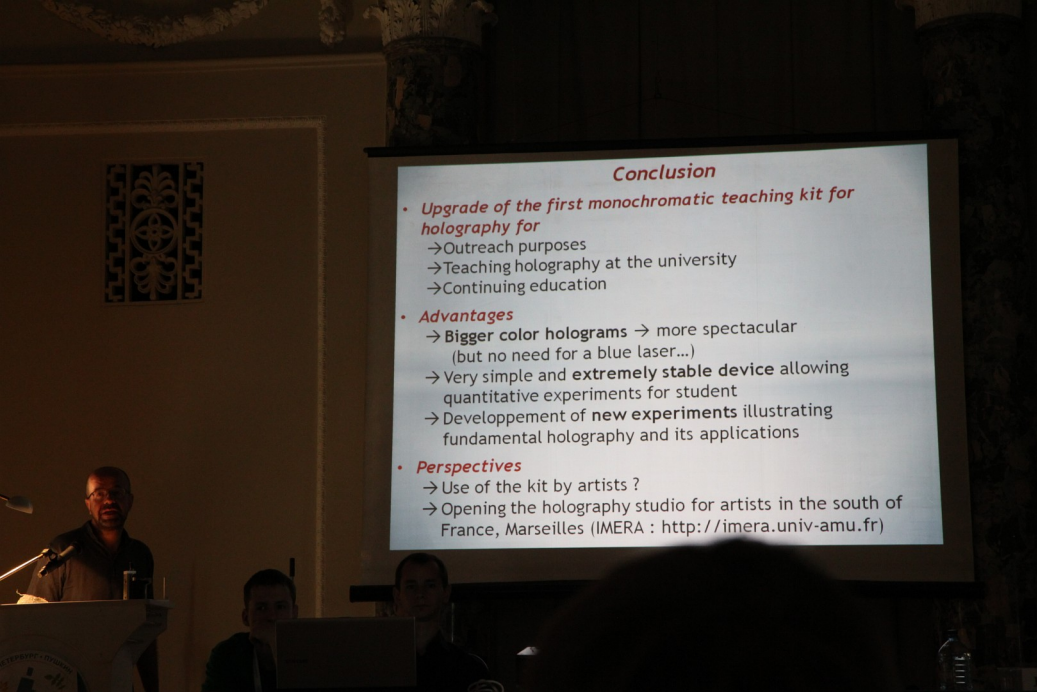
Notch filter for Raman spectroscopy

→ Used in Raman spectroscopy.
→ Hologram of a front surface mirror placed on the holographic plate. Characterization by the measurement of the transmission coefficient T (%) with a spectrometer and a white light source.



Double exposition holographic interferometry of a metallic foil




Conclusion
• Upgrade of the first monochromatic teaching kit for holography for
→Outreach purposes
→Teaching holography at the university
→Continuing education
• Advantages
→ Bigger color holograms → more spectacular (but no need for a blue laser…)
→ Very simple and extremely stable device allowing quantitative experiments for student
→ Developpement of new experiments illustrating fundamental holography and its applications
• Perspectives
→ Use of the kit by artists ?
→ Opening the holography studio for artists in the south of France, Marseilles (IMERA : http://imera.univ-amu.fr)