



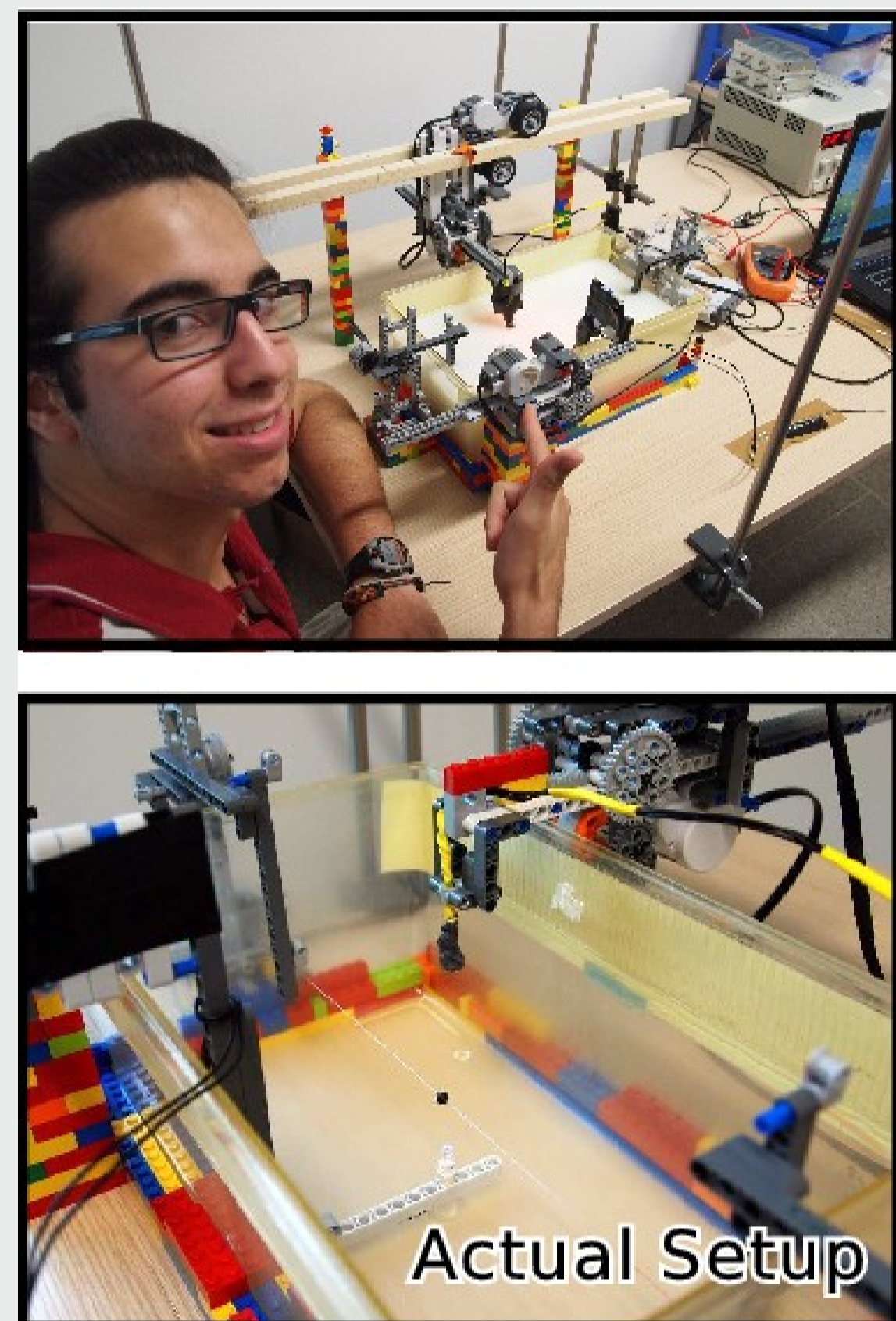
Taisuke Minagawa, Peyman Zirak, Udo M. Weigel,
Anna K. Kristoffersen, Nicolas Mateos, Alejandra Valencia, Turgut Durduran
ICFO- Institut de Ciències Fotòniques,
Mediterranean Technology Park, 08860 Castelldefels (Barcelona), Spain

ABSTRACT

We have developed a LEGO based Diffuse Optical tomography set-up that could be introduced to the advanced undergraduate or early graduate curriculum. A recent highschool graduate has learnt diffuse optics and the process of tomography through building the set-up. The concept was tested, and a 3D tomographic image was reconstructed at the end of study.

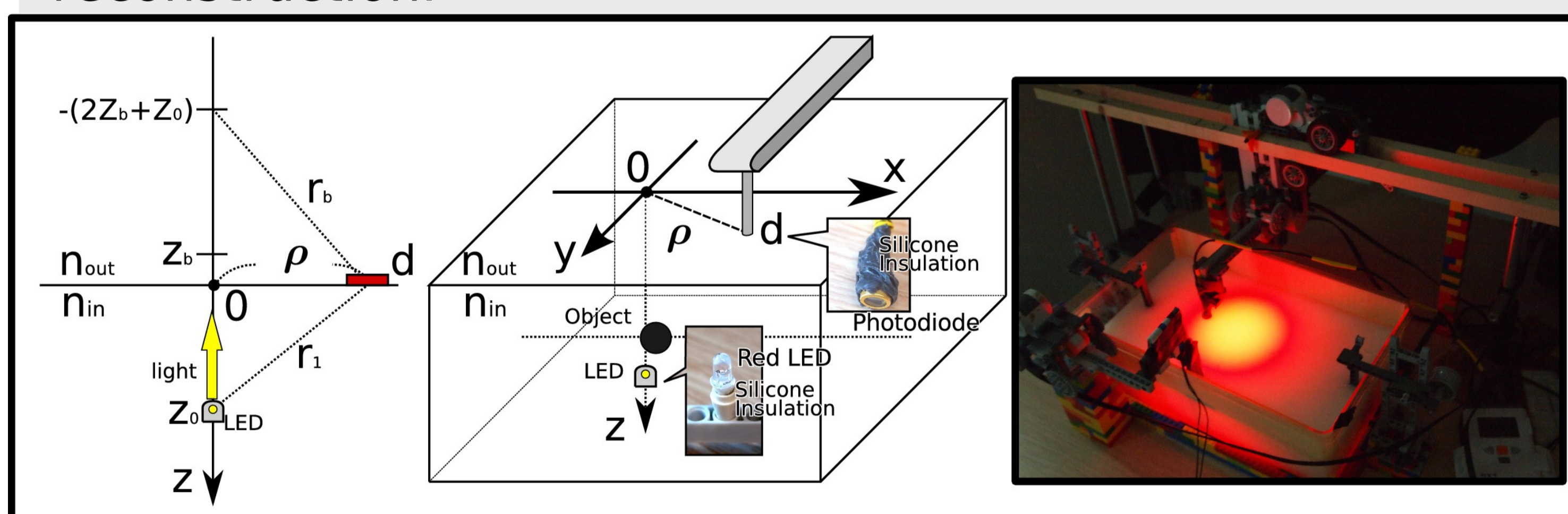
INTRODUCTION

- An educational experimental set-up for undergraduates/early graduates to learn diffuse optical spectroscopy (DOS) and diffuse optical tomography (DOT).
- A recent high-school graduate has spent a month to build a LEGO based DOT scanner.
- LEGO Mindstorms NXT (NXT) facilitates students to learn robotics of set-up and control codes quickly.
- It's fun to learn and teach DOS and DOT through LEGO set-up!



SETUP

- NXT to control a LED(631 nm), a photo-diode, a 2D scanning platform and the data acquisition process.
- A plastic container filled with water mixed with scatterers (Lipofundina, LIPO) with a hidden black sphere (3 mm diameter).
- Two sets of experiments were performed: measurement of μ_s' in homogeneous media and a tomographic image reconstruction.



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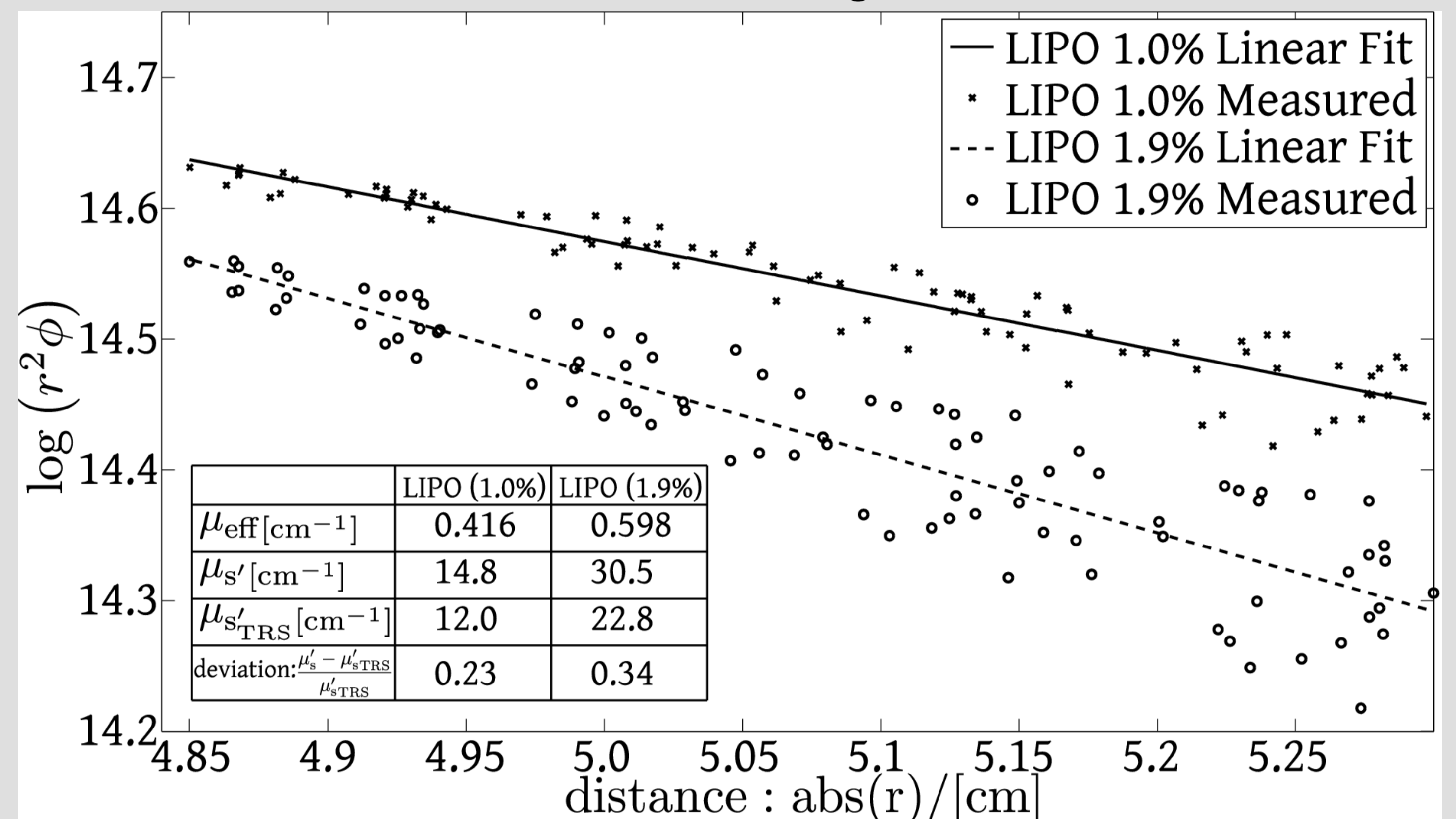
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RESULTS

Characterization of homogeneous media

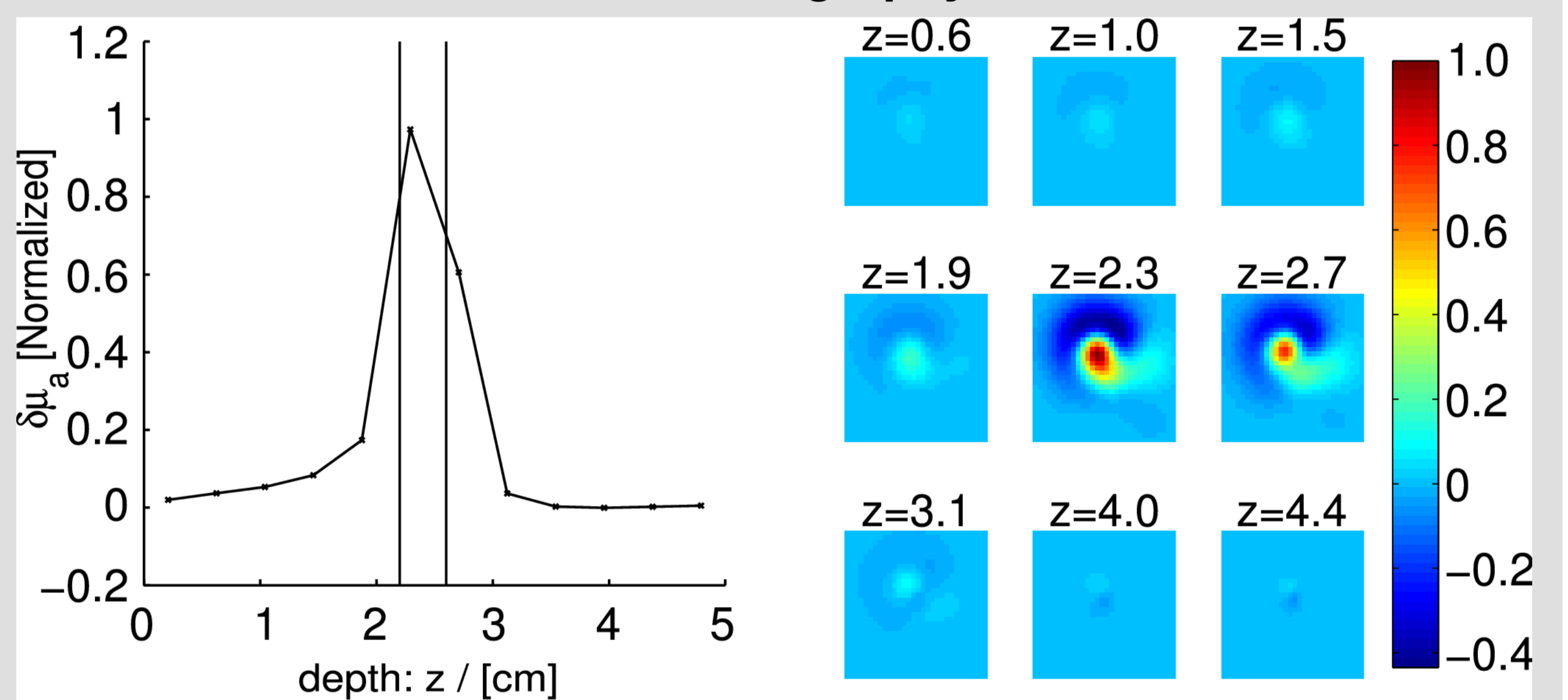


- Surface fluence of 30x31 points were fitted with:

$$\ln \Phi = -\sqrt{3\mu_a\mu_s'} r + const.$$

- for different LIPO concentrations
- Measurements have a deviation of 23-34% from the Time Resolved Spectroscopy (TRS) estimates

3D Tomography



- We have used 6 surface fluence scans for re-construction (3 source positions with/without a black sphere).
- Succeeded localizing a black sphere hidden in turbid medium There is a strong absorption peak in the position of the object.

CONCLUSIONS

- Total cost of approximately 400 Euros.
- The data fidelity was sufficient to estimate the scattering coefficient and the tomographic reconstruction. The student succeeded to localize the hidden black sphere in turbid medium.
- We have introduced the concept of diffuse optics and tomographic image reconstruction to a recent high-school graduate.
- Further details on how to replicate and utilize for education are available in [11]