ChipScope

The physical laws of diffraction generally limit the spatial resolution of optical systems, being about 200 nm for light in the visible range. That is the reason why we usually cannot directly observe e.g. single proteins, DNA molecules or the development of internal cellular macromolecular complexes and structures with conventional optical microscopes.

ChipScope is developing the first chip-sized optical microscope with super-resolution capabilities.

ChipScope will revolutionize the way science and applications related to optical microscopy will be done in the future.

ChipScope will realize highest resolution, separately addressable nano LED arrays, with pixel sizes smaller than the diffraction limit.

ChipScope will integrate the nano LED arrays with a photodetector with single photon and sub-ns detection capabilities.

ChipScope will develop the theoretical background of optical interaction between nano LED arrays and nano-objects.

ChipScope promotes the ChipScope concept in the scientific, the industrial and the social environments in order to trigger further applications and to facilitate a better use of the results.

Project Objectives

ChipScope will develop the scientific and technological basis for a completely new approach to optical superresolution microscopy, with a resolution smaller than the diffraction limit, based on semiconductor nano LED arrays with individual pixel control, which will lead to extreme miniaturisation, simplicity and cost-effectiveness.

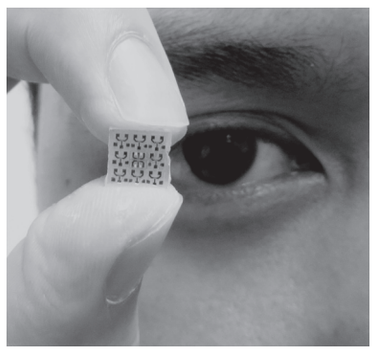
Proof of the Concept

ChipScope will prove the concept by using a real-time imaging device to study the in-cell mechanisms.

Outlook

ChipScope will revolutionize optical microscopes with super-resolution capabilities, making them chip-sized, convenient, affordable and ubiquitously available, not only for laboratories working in manifold research fields, but also in everyday life.

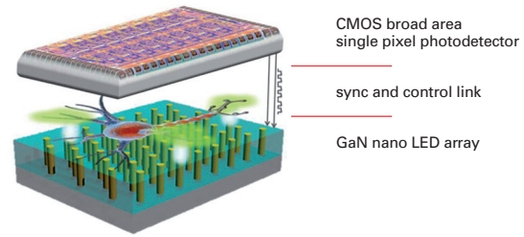
The ChipScope project prepares the base for a vast product variety and thus carries the inherent innovation potential to strengthen the European industry.



The Completely New ChipScope Approach

Nano LED light sources will deliver not only microchip based, sub-diffraction optical resolution without optical elements, but also combine this with fluorescence imaging capabilities.

Basic principle of the ChipScope approach to achieve sub-wavelength resolution (not to scale)



The nano LED array will consist of a 2D arrangement of individual, independent nano LEDs, regularly spaced at nanometric distances. This will enable to switch on and off one single nano LED after another, separately and at a high repetition speed. A highly sensitive photodetector will then sequentially measure signals that originate from different well-known locations in space (i.e., from each nano LED) in each time slot. Thus, the photodetector signal in time can be transferred into a real space transmission image, showing the "shadow" image of the object under investigation, which is in close contact with the nano LED array, at this particular LED-on position.

Hence, the optical detection system does not require particular alignments, complex optical focussing systems or spatially resolved detectors.

Spatial resolution will be provided by the illumination source, not by the optical detection system.

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Consortium

ChipScope relies on a highly interdisciplinary consortium with a strong background. It includes leading universities and research centers as well as an SME.

The European industry leaders in the market of imaging and microscopy are included via an Industry Advisory Board.

UNIVERSITAT DE BARCELONA	Universitat de Barcelona
Technische Universität Braunschweig	Technische Universität Braunschweig
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY	Austrian Institute of Technology
Università di Roma Tor Vergata	University of Rome
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN	Ludwig-Maximilians-Universität
MEDIZINISCHE UNIVERSITÄT WIEN	Medizinische Universität Wien
fsrm CROSSROADS OF MICROTECHNOLOGY	Swiss Foundation for Research in Microtechnology

Project Details

FULL TITLE
Overcoming the Limits of Diffraction with super-resolution Lighting on a Chip

DURATION
01.01.2017 - 31.12.2020

EU FUNDING
3.75 M€ by the European Union's Research Programme Horizon 2020, GA 737089

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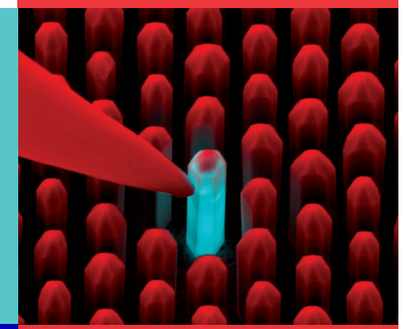
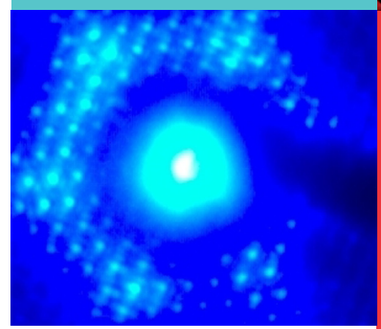
Overcoming the Limits of Diffraction with





Super-Resolution Lighting on a Chip

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