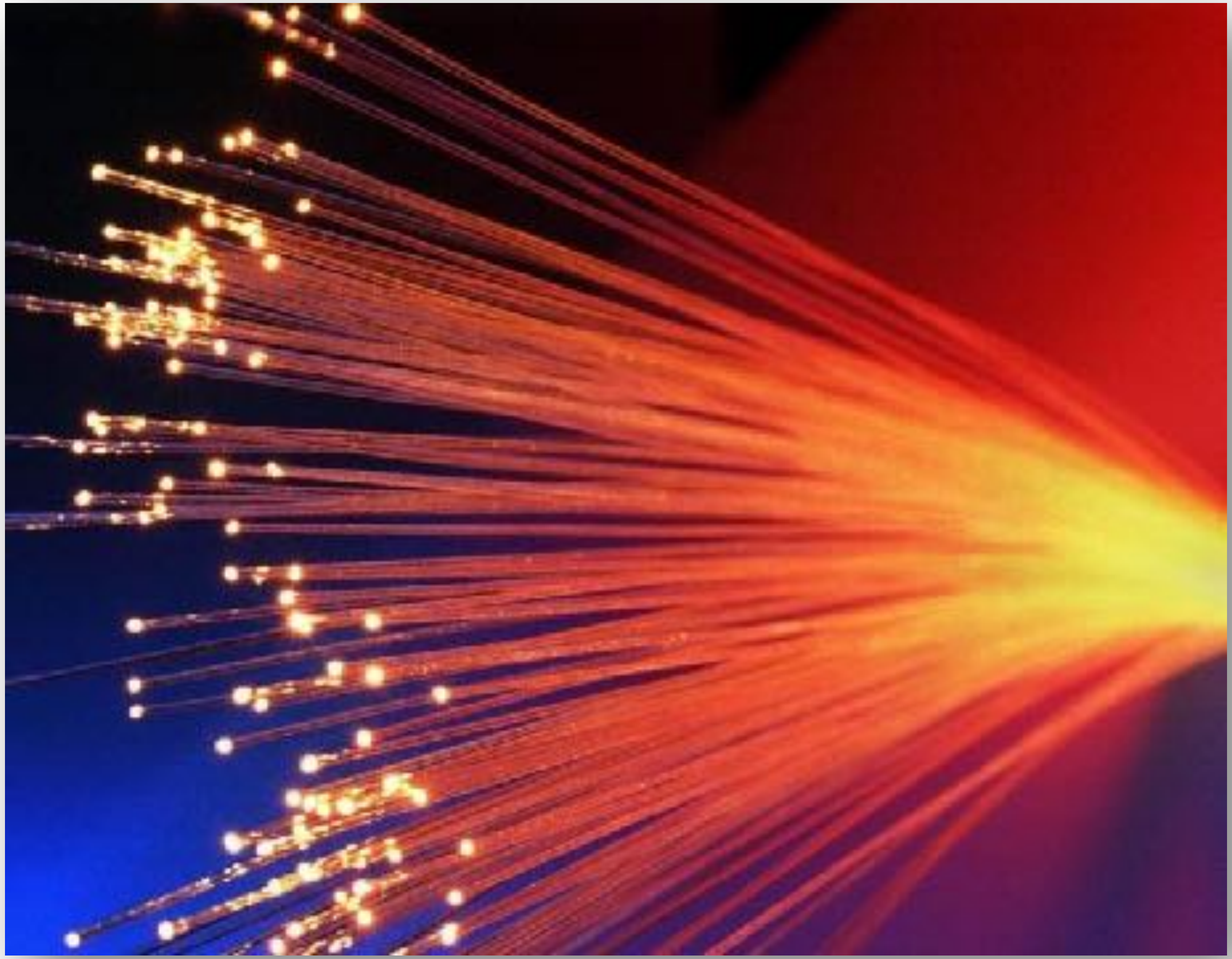
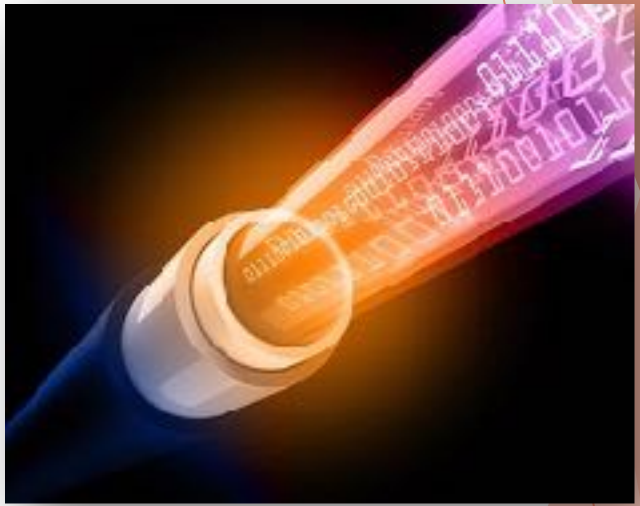
ICT

INFORMATION & COMUNICATION TECHNOLOGY

Why?

To take advantage of light speed to send informations all over the world





TARGETS

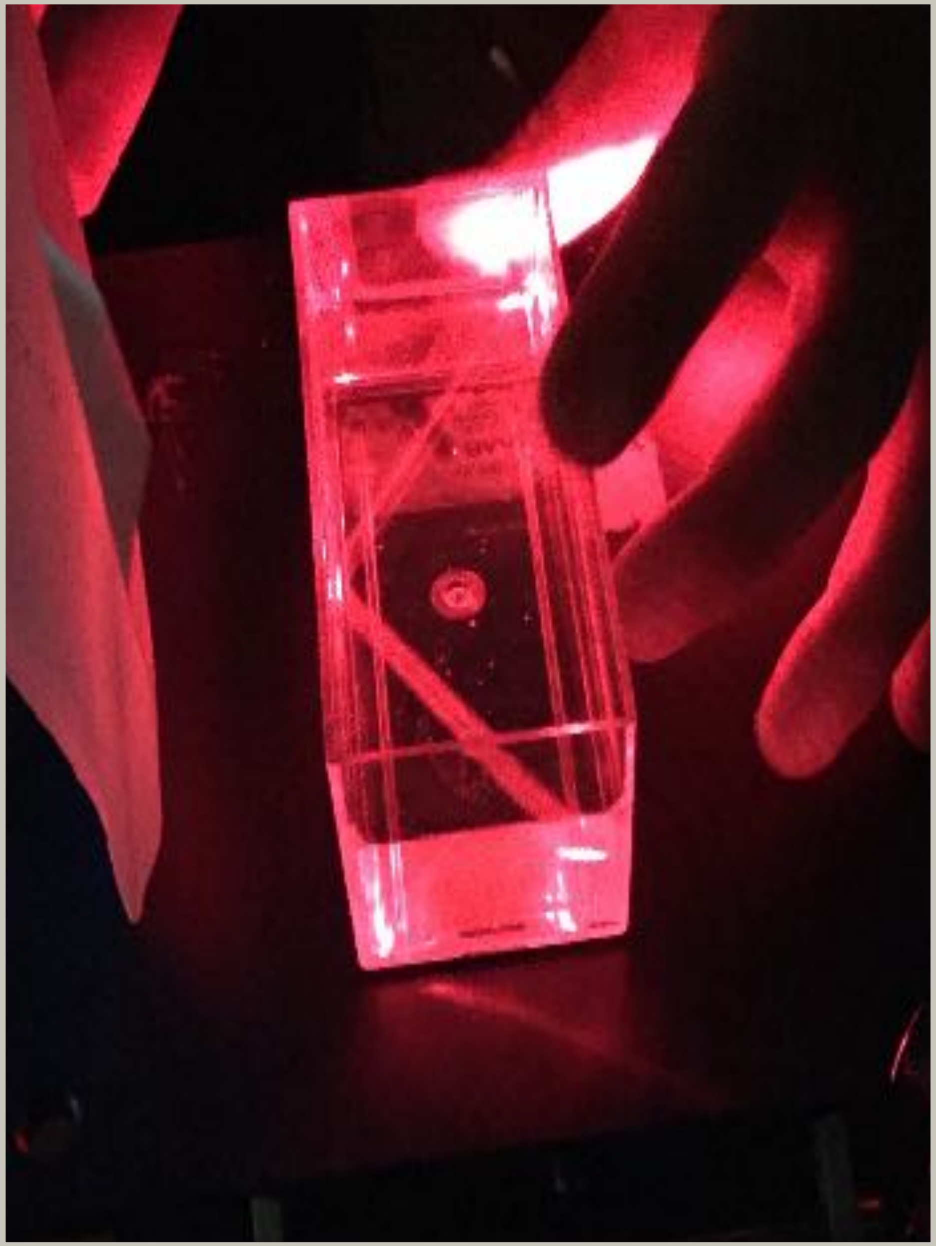
-Studying guided optical principles

-Studying the propagation and interaction between light and substance

-Ideation and creation of an optical waveguide

-Grating and channel waveguide characterization with different microscopies

-Coupling the light in a channel and planar waveguide



SOME OPTICAL NOTION

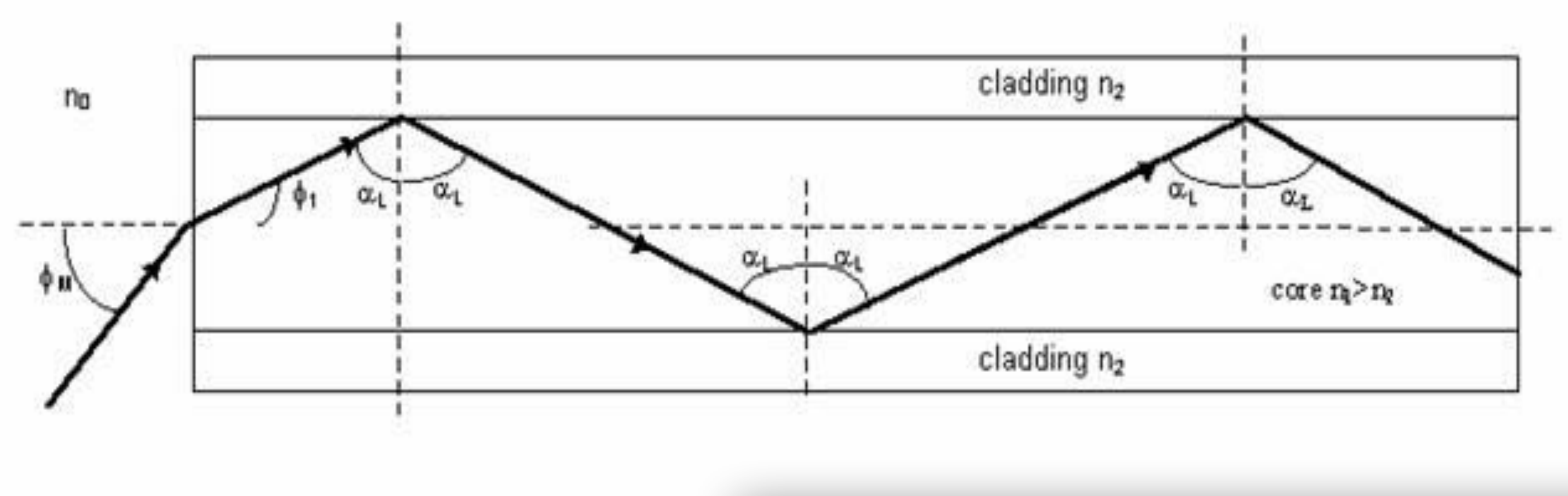
How to do?

To keep the light into the waveguides we need to avoid the dispersion that light has every time it hits a surface. We remove the refractions with the total internal reflection derived by Snell's Law.

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

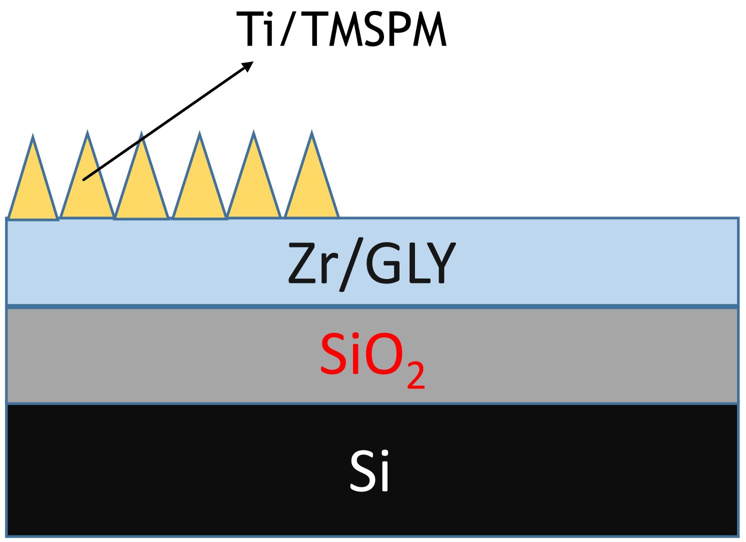
Willebrord Snellius

TOTAL INTERNAL REFLECTION

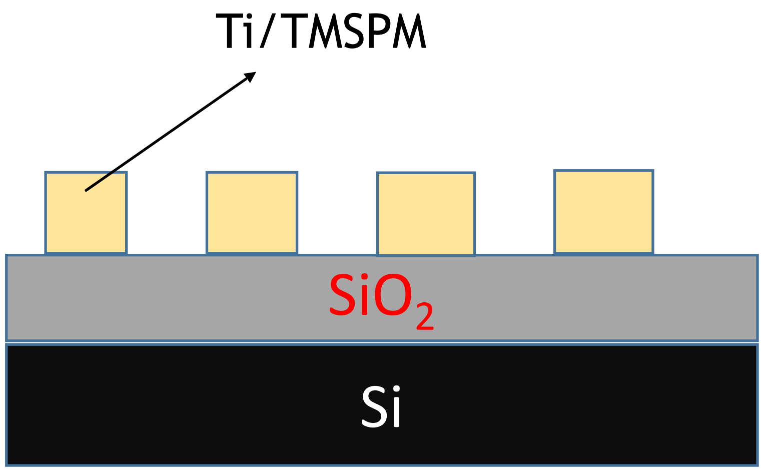


Specifically, we can obtain a total internal reflection for an angle greater than a "critical" one. This is possible only if the refractive index of the core is greater than the cladding layers.

WAVEGUIDES



PLANAR WAVEGUIDE



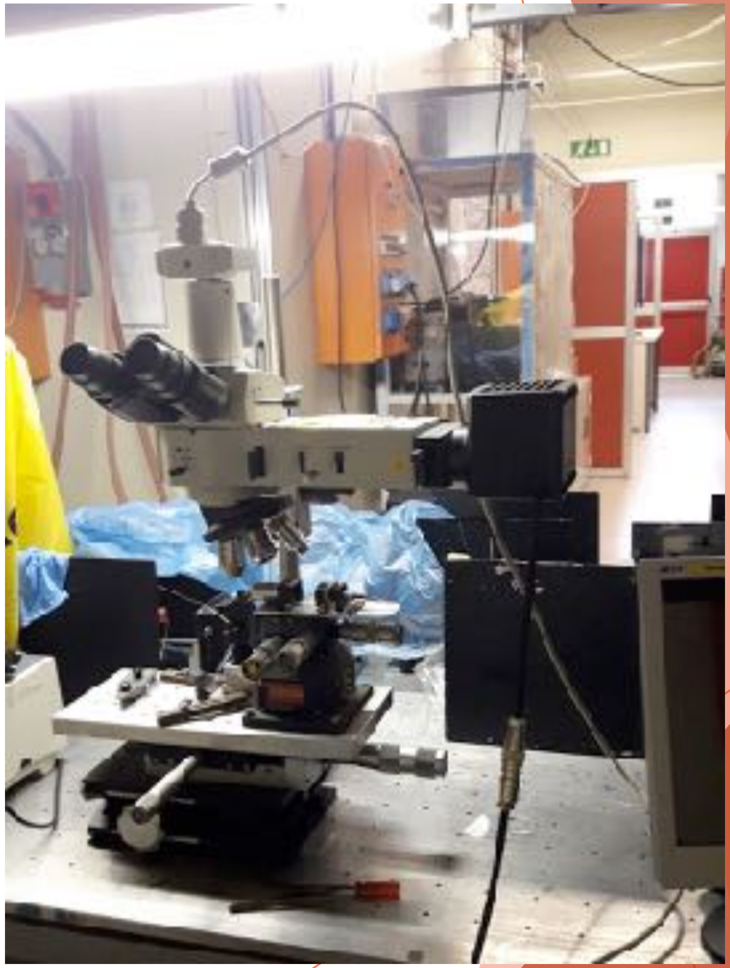
CHANNEL WAVEGUIDE

LIGHT COUPLED INTO THE PLANAR WAVEGUIDE

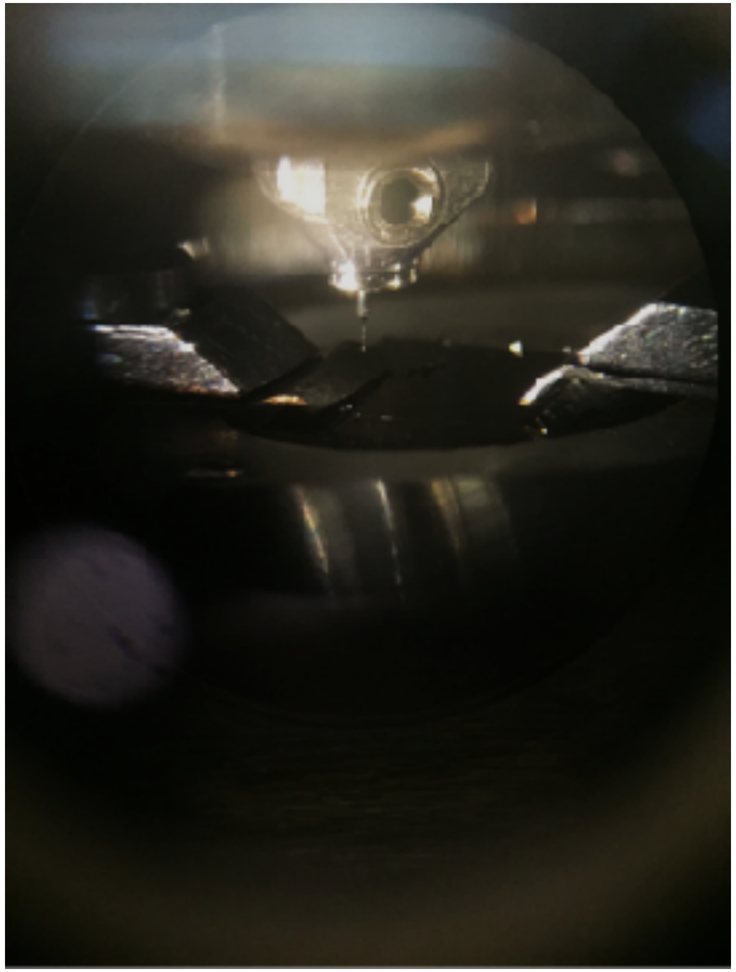
LIGHT INTO THE
PLANAR WAVEGUIDE

Optical

The **optical microscope** is a type of microscope which uses visible light and a system of lenses to magnify images of small samples. Optical microscopes are the oldest design of microscope and were invented by Galileo Galilei in their present compound form in the 17th century.

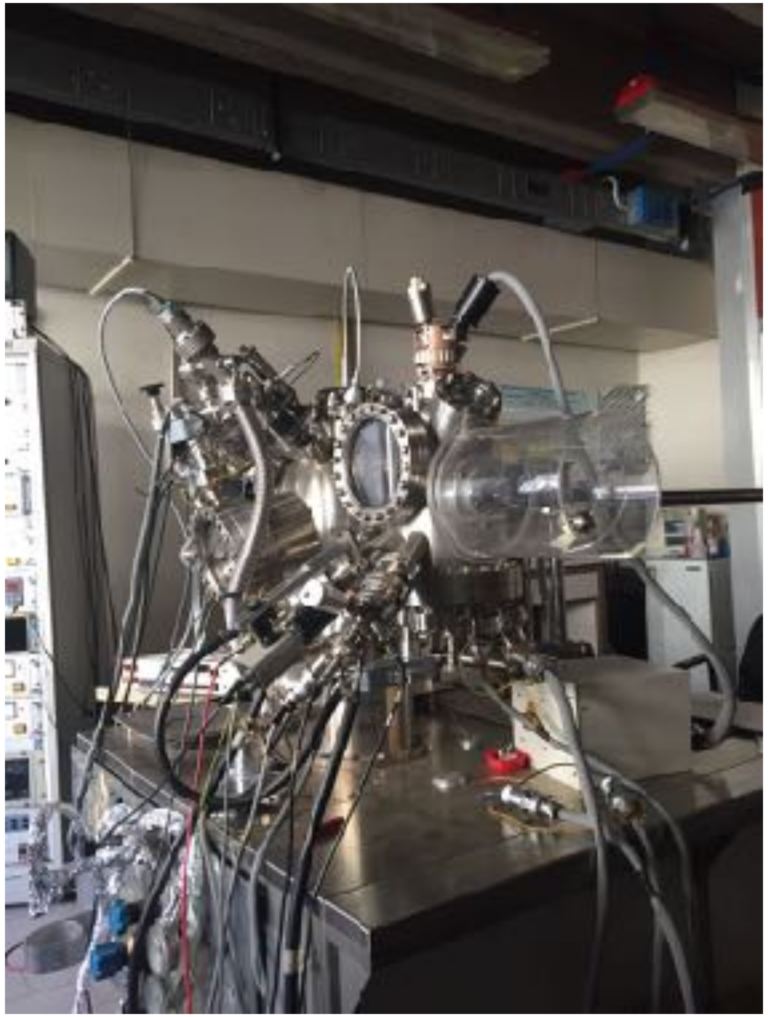


SPM
(Scanning Probe Microscopy)



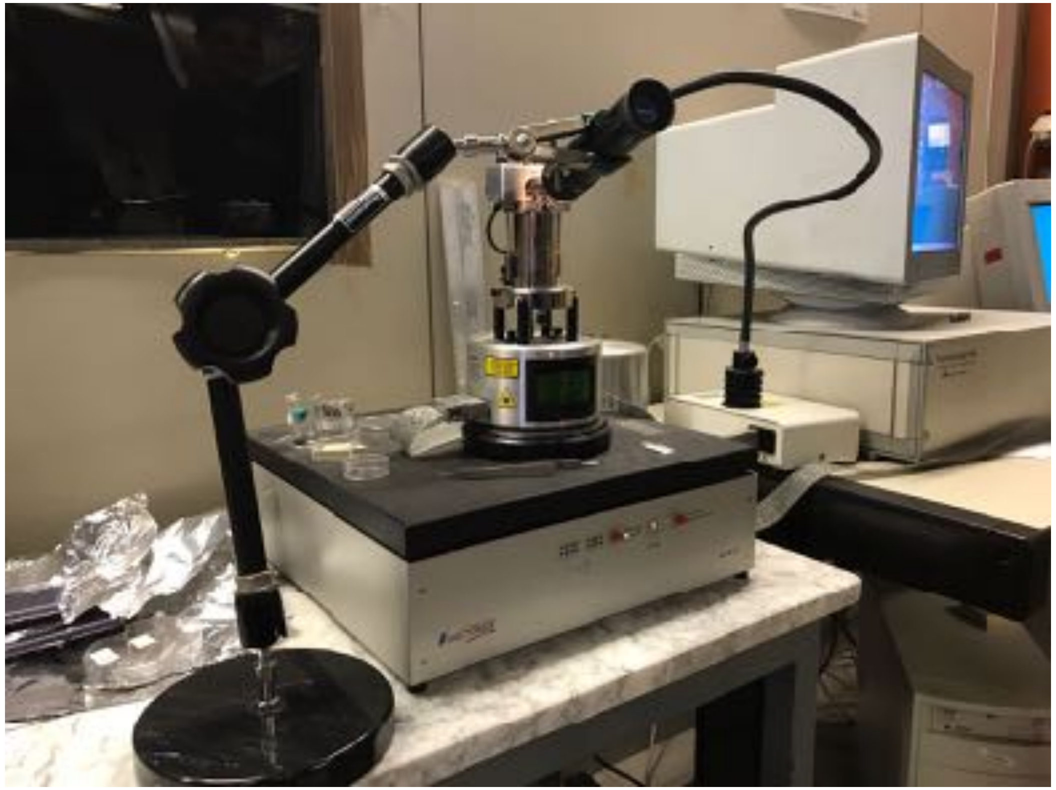
SPM techniques reach a rather impressive atomic resolution using a physical probe that scans the samples. This is because piezoelectric actuators can execute motions with a precision and accuracy at atomic level.

STM
(Scanning Tunneling Microscopy)


Ultra- High Vacuum chamber

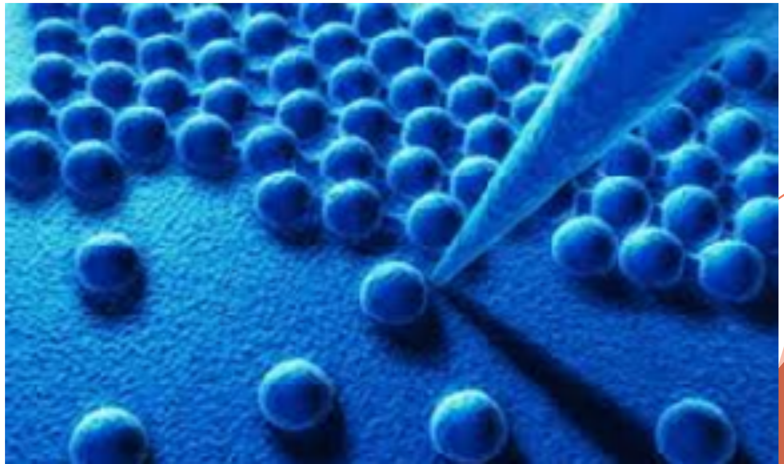
It is an instrument for imaging surfaces at the atomic level, it was invented in 1981 by Gerd Binnig and Heinrich Rohrer. The STM is based on the concept of quantum tunneling. When a conducting tip is brought very near to the surface to be examined, a bias (voltage difference) applied between the two can allow electrons to tunnel through the vacuum between them.

AFM
(Atomic Force Microscopy)

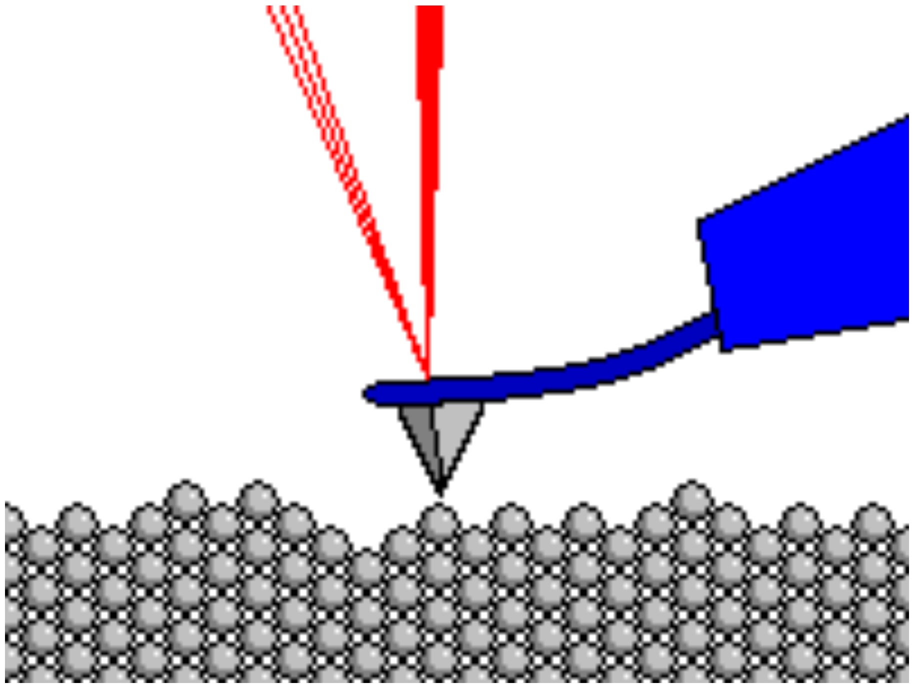


It is a very-high-resolution type of scanning probe microscopy (SPM), with demonstrated resolution on the order of fractions of a nanometer, more than 1000 times better than the optical diffraction limit

The tip touches the surface atoms.



OPERATION MODES

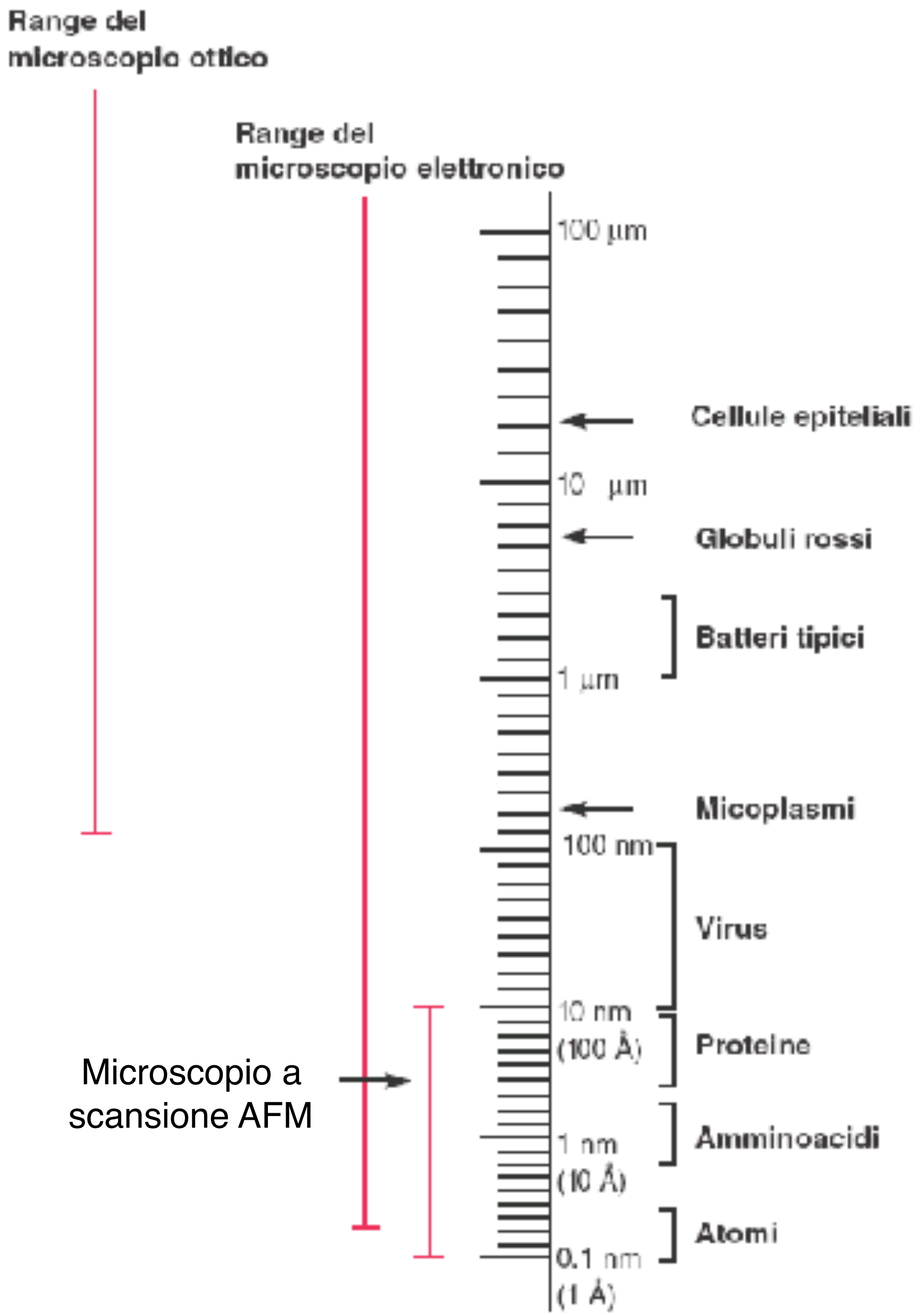


- ***Contact mode***. The tip touches the surface of the sample: the resolution is better but the contact may damage the top.

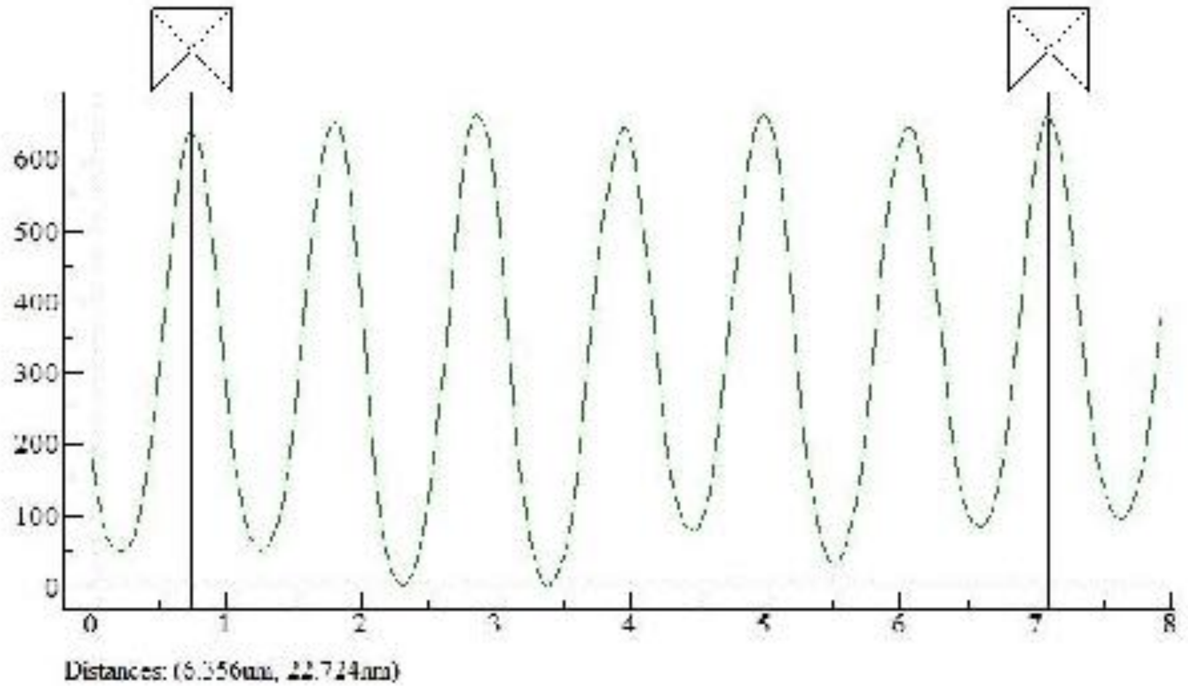
- ***No- contact mode***. The tip doesn't touch the surface: the resolution is worse but the sample remains undamaged.

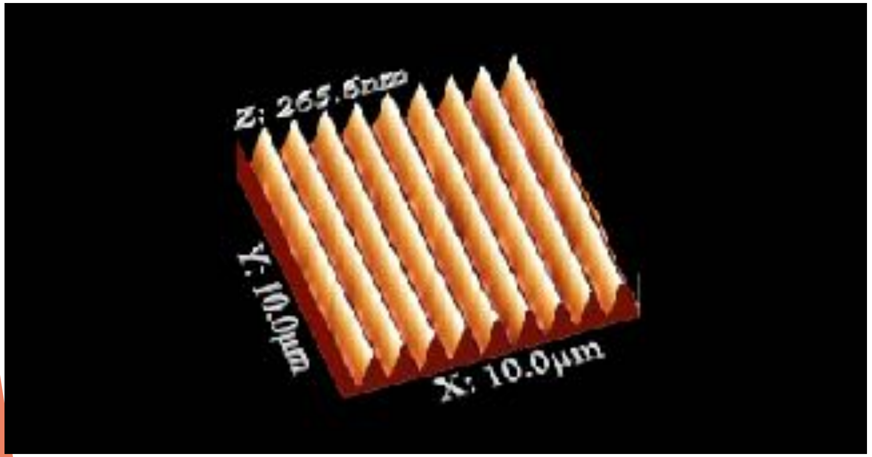
- ***Tapping mode***. The tip oscillates on the surface: the resolution is high but the acquisition is slow.

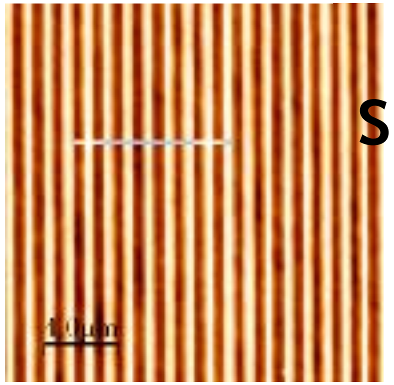
Resolution ranges of different microscopic techniques



CHARACTERIZATION OF GRATING



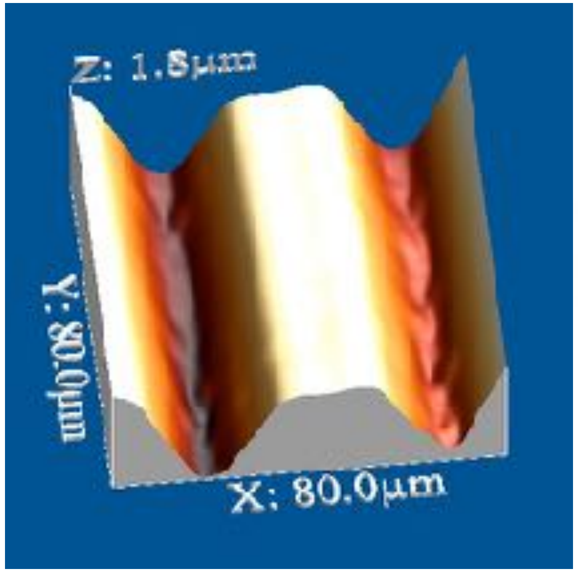


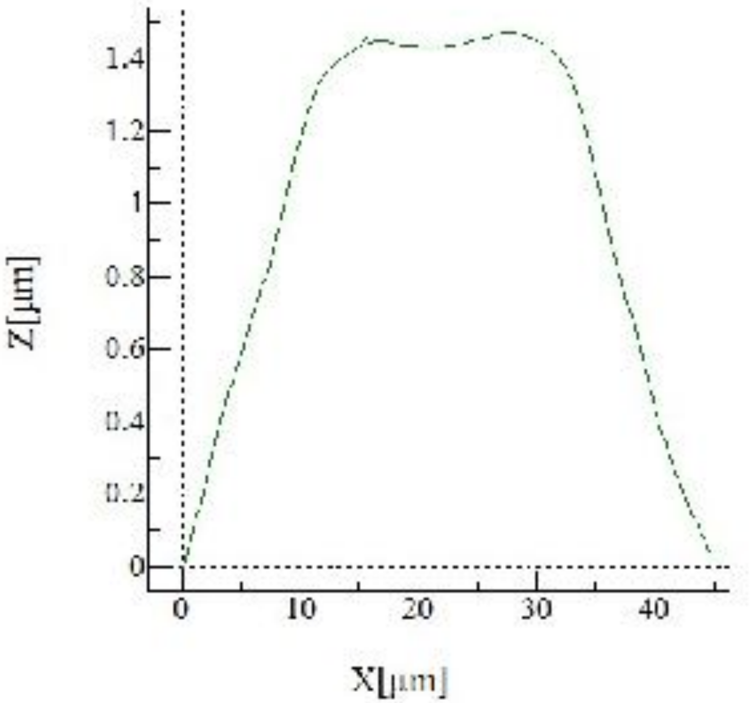


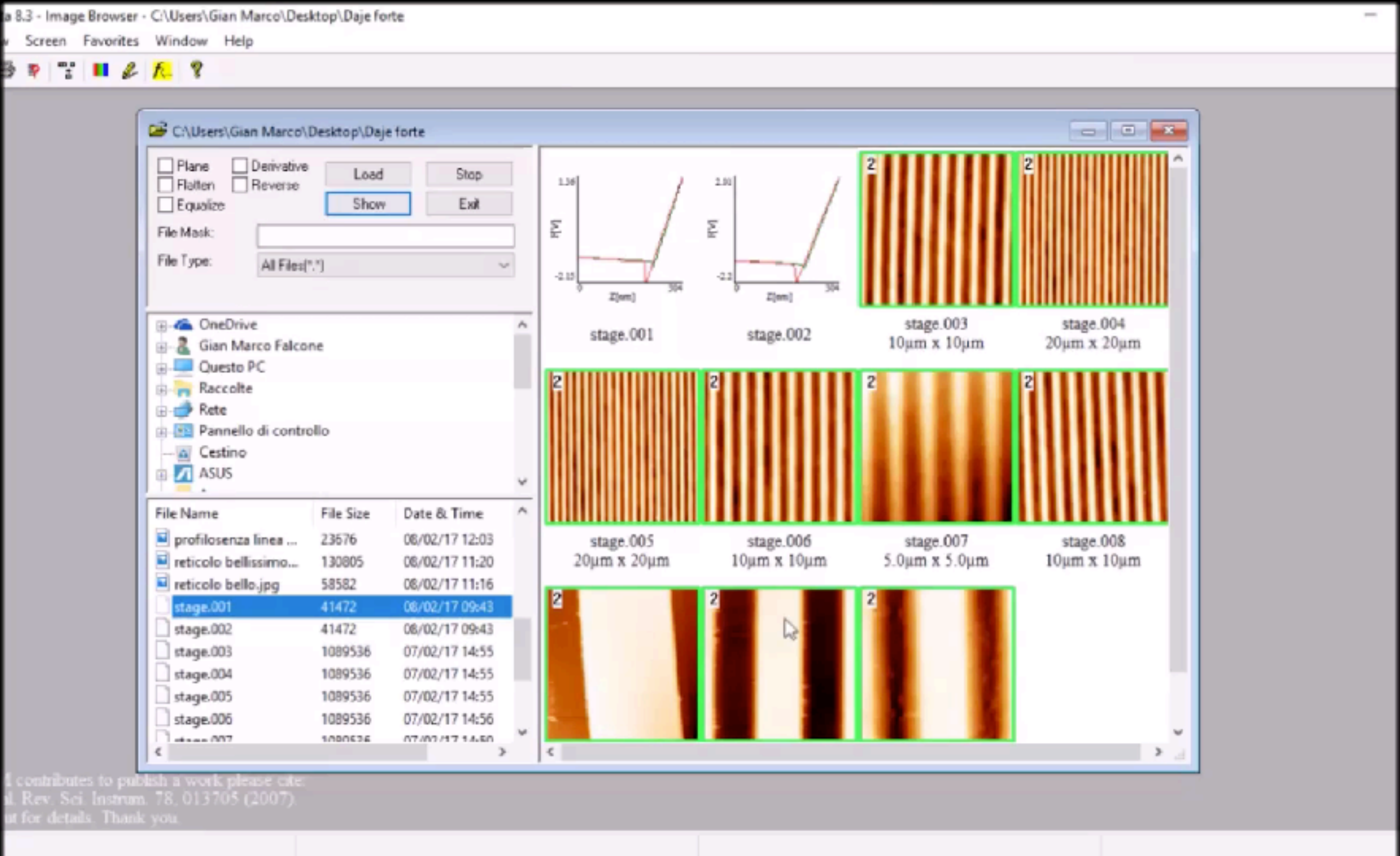
We use the AFM to observe the grating at atomic level. Doing that, we can measure the grating's step. To analize datas we use a specific program, which can produce pictures of the samples in 2D, 3D or their profiles.

CHANNEL WAVEGUIDE

We have characterized the channel waveguide through AFM with contact mode. After this measure we have developed the images with WSxM . This program uses an universal language to process images acquired by any microscopes.






a 8.3 - Image Browser - C:\Users\Gian Marco\Desktop\Daje forte
Screen
Favorites
Window
Help
C:\Users\Gian Marco\Desktop\Daje forte
Plane
Flatten
Equalize
Derivative
Reverse
Load
Stop
Show
Exit
File Mask:
File Type:
All Files(*.*)
OneDrive
Gian Marco Falcone
Questo PC
Raccolte
Rete
Pannello di controllo
Cestino
ASUS
File Name
File Size
Date & Time
profilosenza linea ... 23676 08/02/17 12:03
reticolo bellissimo... 130805 08/02/17 11:20
reticolo bello.jpg 58582 08/02/17 11:16
stage.001 41472 08/02/17 09:43
stage.002 41472 08/02/17 09:43
stage.003 1089536 07/02/17 14:55
stage.004 1089536 07/02/17 14:55
stage.005 1089536 07/02/17 14:55
stage.006 1089536 07/02/17 14:56
stage.001
stage.002
stage.003
10µm x 10µm
stage.004
20µm x 20µm
stage.005
20µm x 20µm
stage.006
10µm x 10µm
stage.007
5.0µm x 5.0µm
stage.008
10µm x 10µm
contributes to publish a work please cite:
l. Rev. Sci. Instrum. 78, 013705 (2007).
ut for details. Thank you.

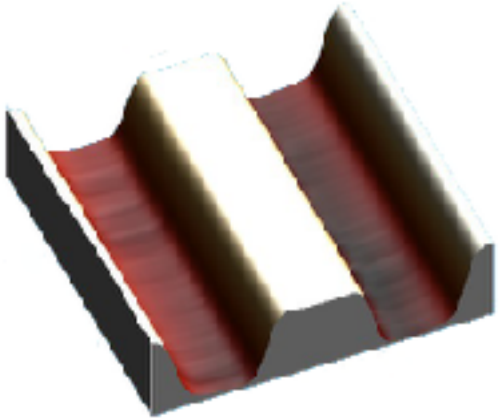
LIGHT COUPLED INTO THE CHANNEL WAVEGUIDE

the question is: How can we insert the light into the channel waveguide?

To insert the light we need to focus all the light on the entrance of the channel waveguide

LIGHT COUPLED INTO THE CHANNEL WAVEGUIDE

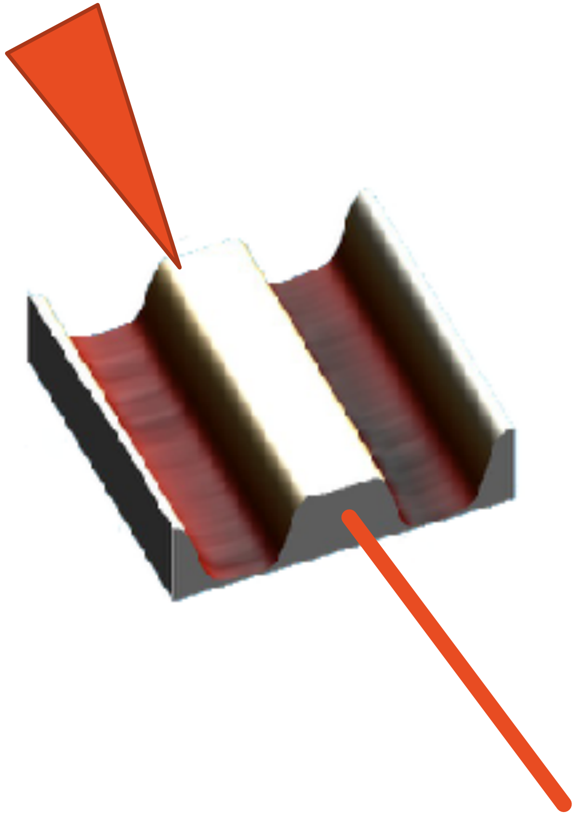
the question is: How can we insert the light into the channel waveguide?


Channel Waveguide (AFM)

To insert the light we need to focus all the light on the entrance of the channel waveguide

LIGHT COUPLED INTO THE CHANNEL WAVEGUIDE

the question is: How can we insert the light into the channel waveguide?

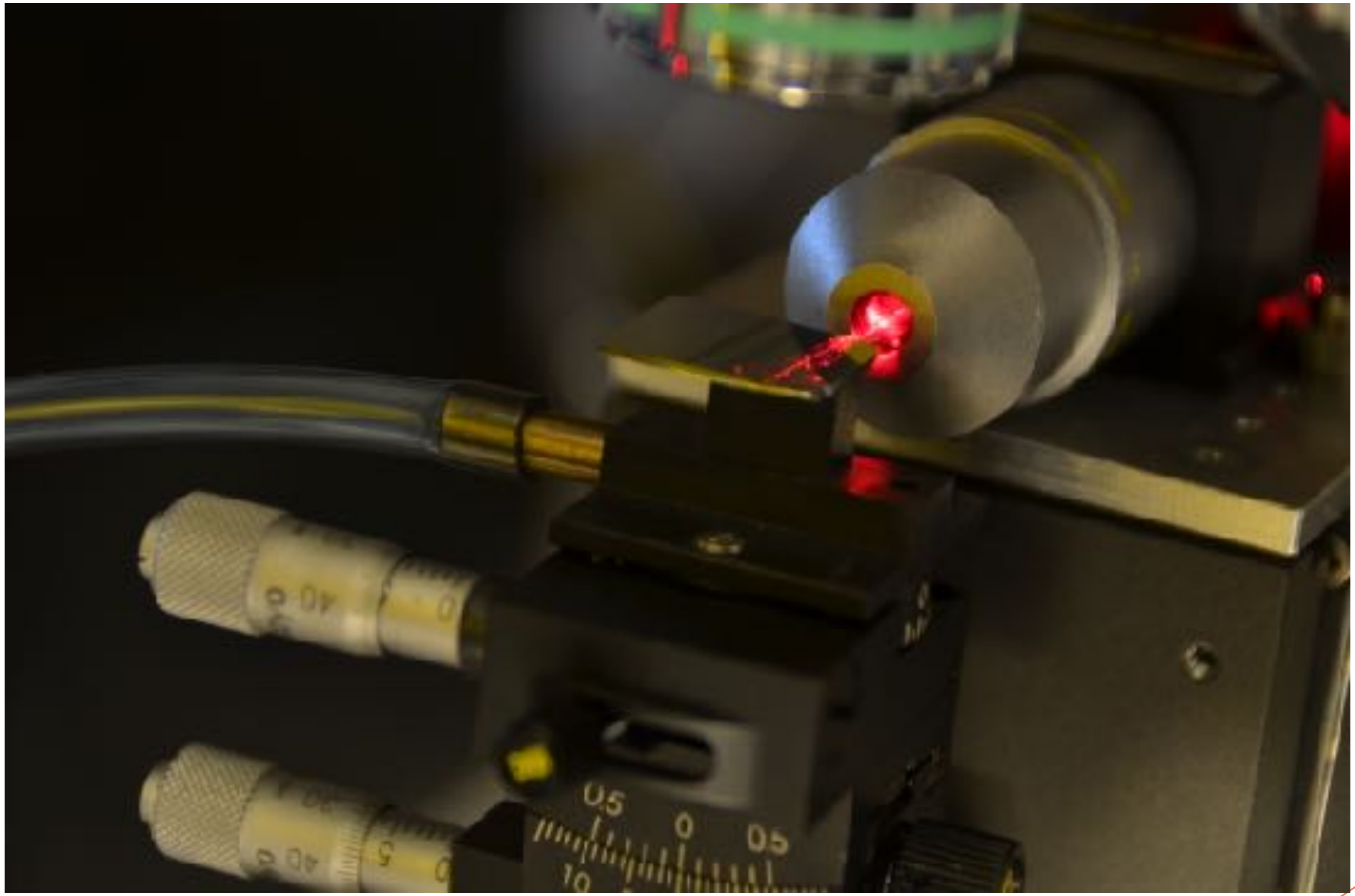


To insert the light we need to focus all the light on the entrance of the channel waveguide

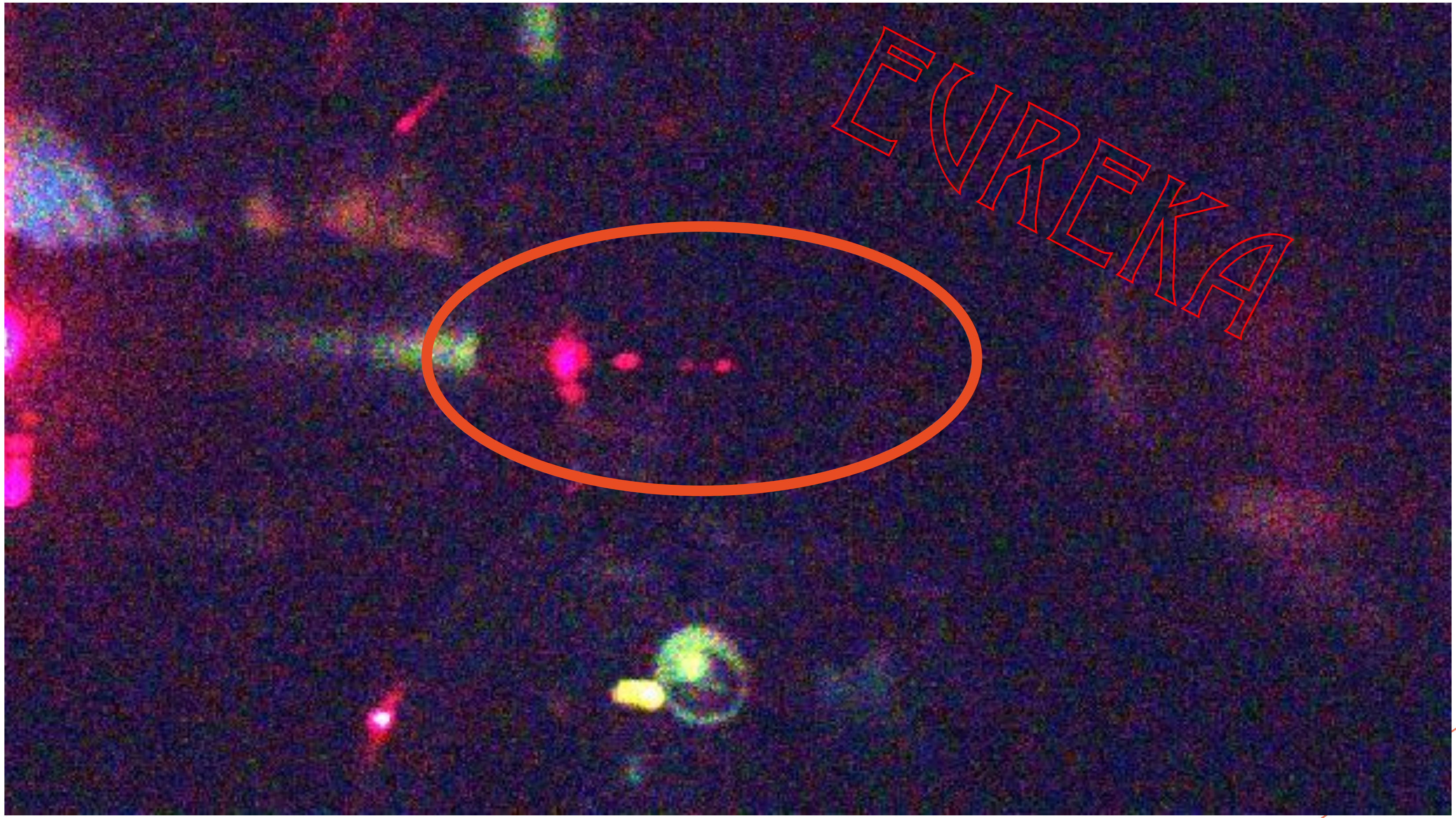
Thanks to a lens system that converge the light of a laser in a little spot (50μm)

Thanks to a lens system that converge the light of a laser in a little spot ($50 \mu m$)

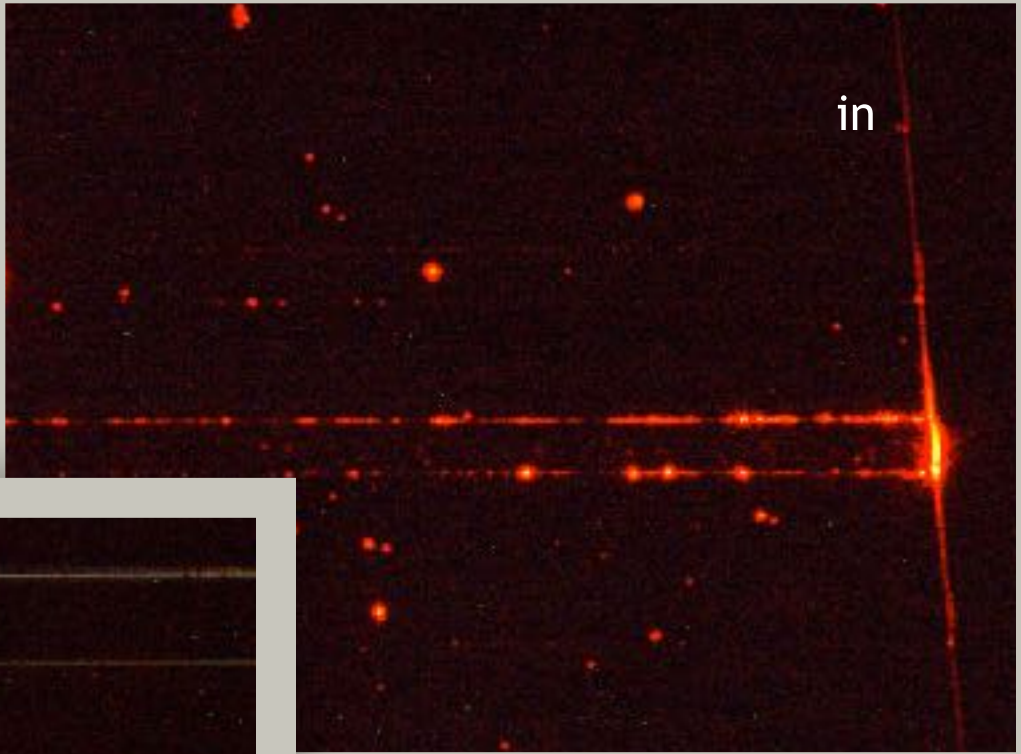
Thanks to a lens system that converge the light of a laser in a little spot ($50\mu m$)

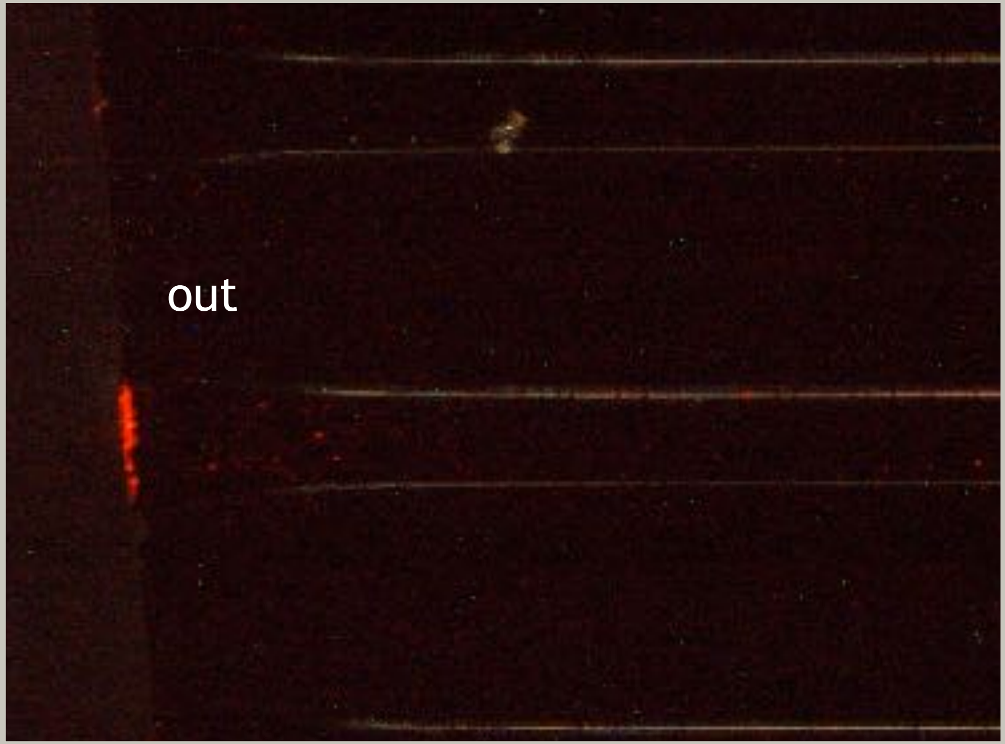


Thanks to a lens system that converge the light of a laser in a little spot (50μm)



we had seen that the light could go trough the waveguide





THE END

CREDITS

PROF. PROSPOSITO PAOLO
PROF. DE MATTEIS FABIO
PROF.ESSA SGARLATA ANNA
PROF. PLACIDI ERNESTO

STARRING:
BIZZONI ALESSANDRA
DE IULIS ANDREA
FALCONE GIAN MARCO
LUGARINI CHIARA
MALIZIA GIOVANNI
PAOLETTI SIMONE
PASSI ALESSANDRO
PRESAGHI CLAUDIO
SAMBUCCO FEDERICO