

# Microscopy Status and Development Plans

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# Resources at Naples & LNGS

- Napoli:
  - Mic6 – plasmon analysis, ~1 min/event -> ~1500 ev./day
  - Mic4 – color camera used for R&D
  - Mic2, mic3 & mic5 are used for fast scanning (all upgraded)
  - Mic1 – not in use, **waiting for walls repair**
  - **Need a new camera and a frame-gabber** to assemble another microscope for preselection
- LNGS:
  - 1 microscope for preselection (almost ready), 7 g/y
- Total:
  - 1 mic for preselection = 1500 ev./day =  $5 \times 10^5$  ev./y
  - 1 mic for plasmon = 7 g/y
  - 1 mic for R&D

# Possible Optimizations for Plasmon

- Denoise frames = 8 -> 1 (**numerical denoising**)
  - 32 s/event -> 14 s/event
- LC time = 20 ms -> 1 ms (Pockels Cell)
  - 14 s/event -> 11 s/event
- Exposure time = 10 ms -> 2 ms (with stronger illumination)
  - 11 s/event -> 9 s/event
- Settling time = 50 ms -> 1 ms (with piezo Z-stage)
  - 9 s/event -> 8 s/event



# Ongoing R&Ds

- Color camera for multi-wavelength plasmon
- Large area virtual source (4-LED illumination)
- 3D SR microscope for multi-wavelength plasmon
- Holographic microscopy

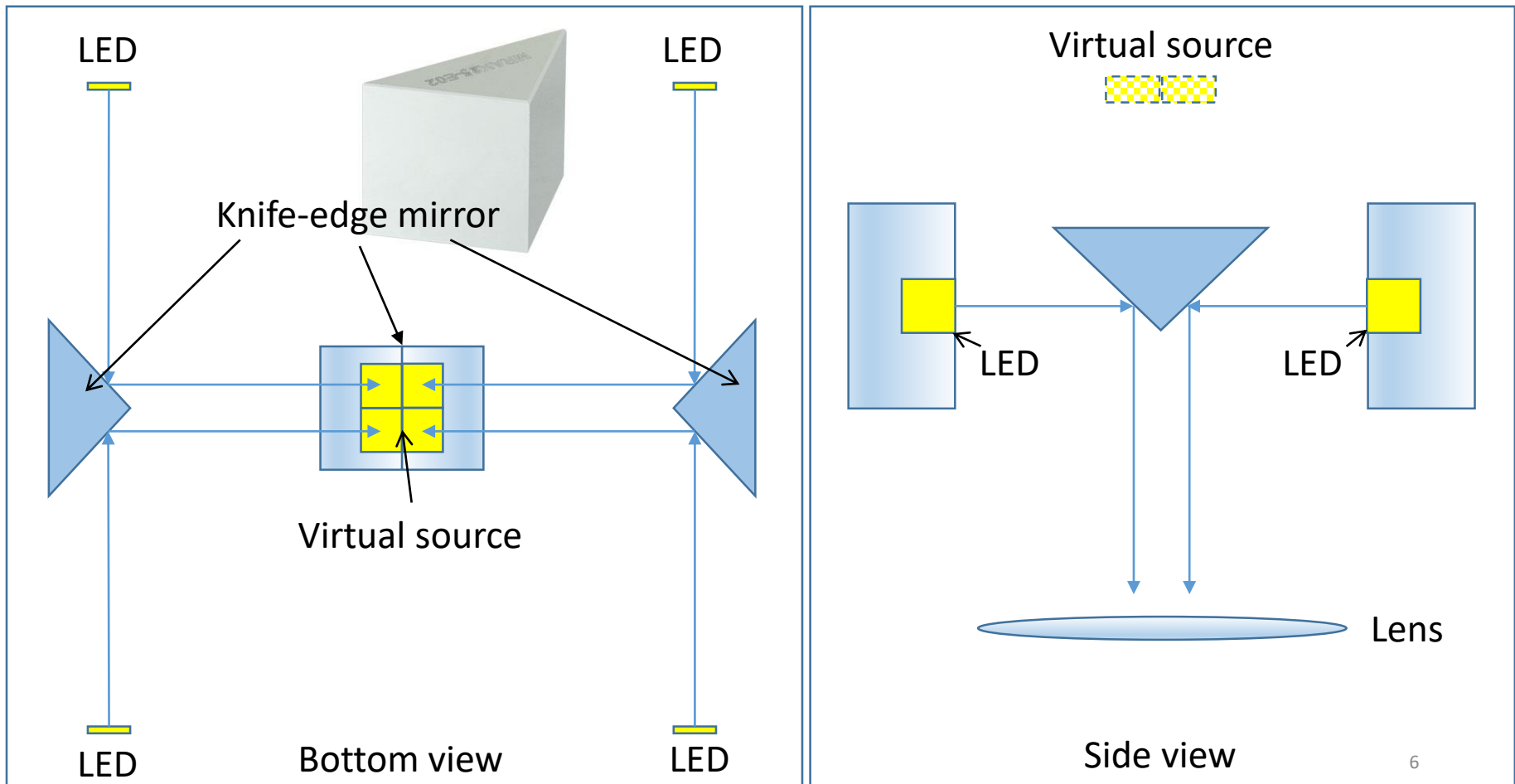
# Color camera

- Actual status:
  - Implemented camera driver
  - Slow CPU debayering
  - Color corrections
- Automatization steps:
  - Fast GPU debayer library – to be tested - 1-2 days
  - Extension of the display module – 2-3 days
  - Extension of the processing module – 1 week
  - Extension of the .obx format - 3-4 days
  - .obx->DMRoot converter upgrade – 2-3 days
- Estimated time: ~3 weeks

# Large-area virtual source

Idea:

- Put virtual images of several LEDs closely together to form a large-area virtual source
- Concentrate the virtual source into the field of view

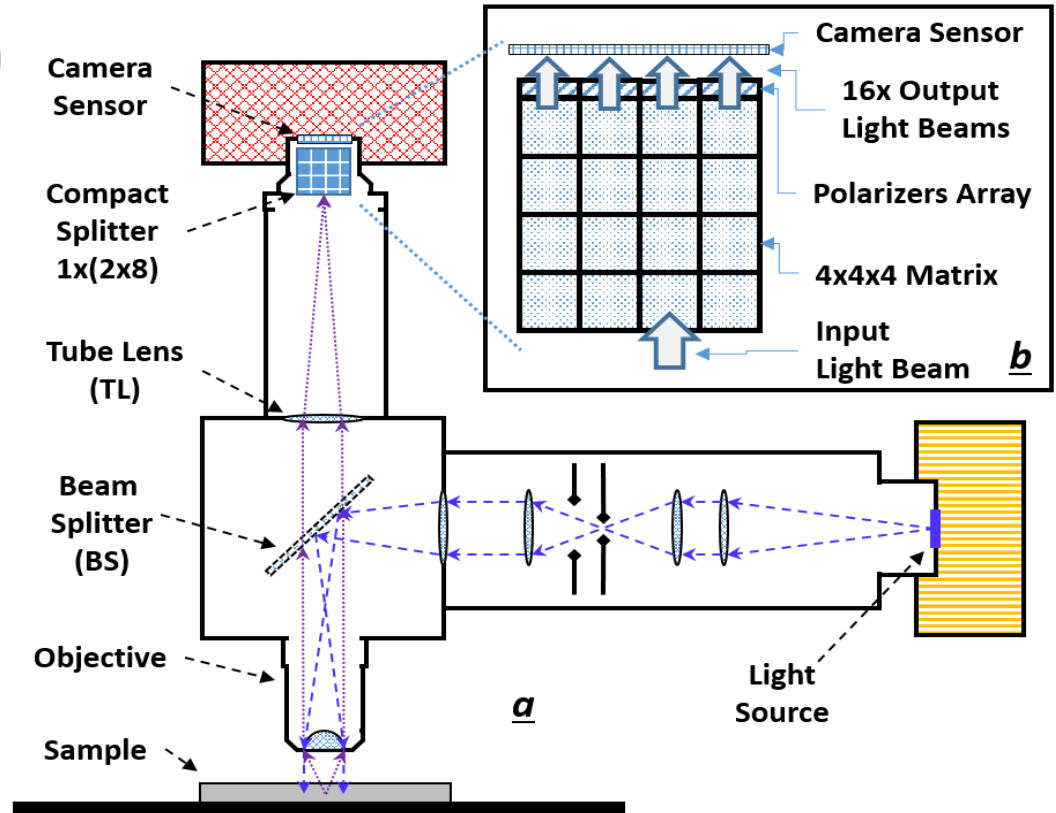


# Large-area virtual source

- Review the layout design – 1 day
- Calculate lens strength – 1 day
- Order components from Thorlabs – 1 month?
- Design and produce missing components – 1-2 weeks?
- Implement control module for digital power source – 1 week
- LASSO extension for multiple power sources – 1 week
- Assemble and test – 1 week
  
- Estimated time: 5-6 weeks

# 3D Super-Resolution Microscope

- ✓ New 3D nanometric readout design is based on beam-splitting
- ✓ Splitted imaging beams (same FoV) pass through static polarization filters with predefined polarization angles
- ✓ Registered with a single wide-sensor colour video camera.
- ✓ Synchronized images => insensitive to vibrations => better accuracy
- ✓ Z reconstruction is tricky

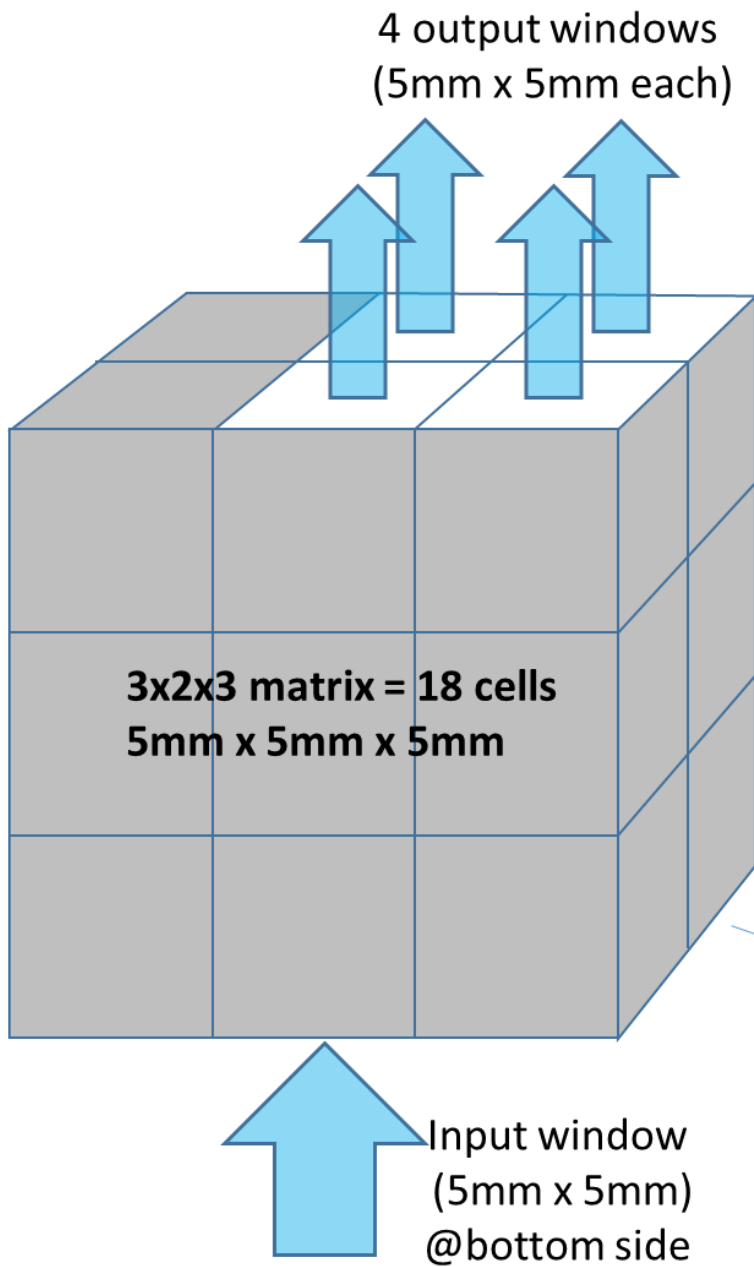


**8 polarizations × 2 focal planes with a single shot!**

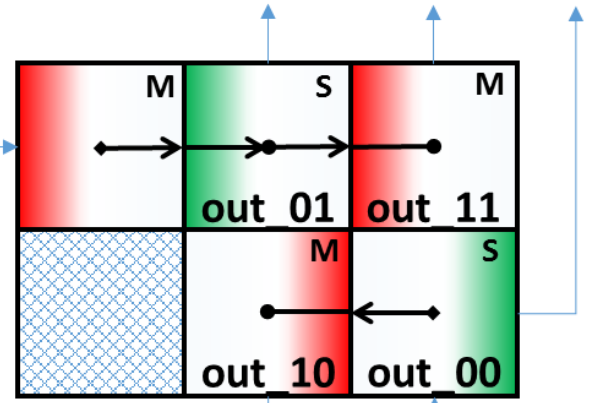


# 3D Super-Resolution Microscope

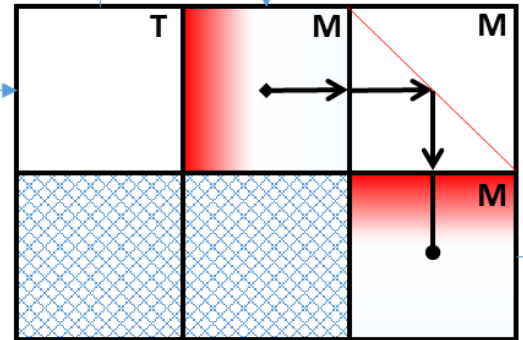
- Current status:
  - Bought 25M color camera
  - Bought 1xBS, 8xPM, 8xTP
- Future plan:
  - Figure out the technology for the CS production
  - Order missing components
  - Produce the reduced CS (3xBS, 10xPM, 12xTP)
  - Test and prove the CS design
  - Implement Z reconstruction with 2 parallel planes
  - Order missing components
  - Produce the complete CS (15xBS, 21xPM, 43xTP)
  - Extend LASSO to use new components
- Estimated time: >6 months



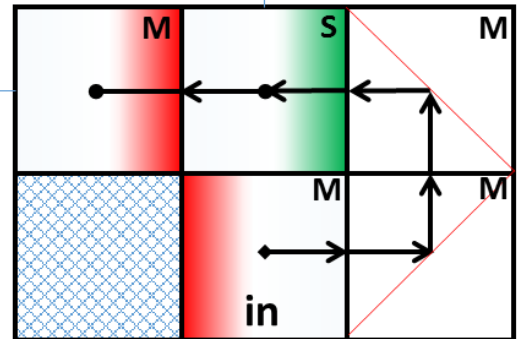
Level 3



Level 2



Level 1



# Holographic microscopy

- Tested with NIT and NPs – **grains too small**
- Tested with OPERA-like – **fog too high**
- Test with the low fog sample - 1 week
- Analyze the results – 1-4 weeks?
- Decide if the concept works

