**Qu3D – Quantum 3D imaging at high speed and high resolution**

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**Goal**
Design and implement quantum plenoptic cameras: novel correlation plenoptic imaging (CPI) devices exploiting both momentum-position and photon-number correlations to enable the typical refocusing and ultra-fast, scanning-free, 3D imaging capability of plenoptic devices, but with dramatically enhanced performance:
- diffraction-limited resolution, unattainable in standard plenoptic cameras;
- an unprecedented large depth of focus (DOF), even 10 times larger than in standard imaging;
- ultra-low noise, aiming at sub-shot noise performance.

**Main challenge of CPI:**
Large number of frames required ($10^3-10^4$) → long acquisition (10 s - 10 min), data trasferring (1-30 min), and elaboration (10 hours for retrieving the 3D image and/or refocusing a 2D image) time.

**The solution of Qu3D:**

** ✓ Hardware speed-up:**
- Ultra-fast sensors (EPFL): SwissSPAD2 (100 kHz, 512x512, 16 um pitch, PDE 50% @ 532nm, 100 cps dark counts)
- Ultra-fast computing: (PKH): Parallel computing platforms (GPU,...) + PCI-express streaming interface

** ✓ Software speed-up:**
- Quantum tomography (UPO)
- Compressive sensing & machine learning (INFN & PKH)

** ✓ Correlation plenoptic imaging (INFN)**

** ✓ Super-resolution:**
Quantum Fisher information inspired measuring protocols (UPO & INFN)

**Qu3D outputs**
- Single-lens plenoptic camera, based on a chaotic light source, for 3D imaging at 100 Hz
- Plenoptic device for 3D imaging of low absorption samples at 10 Hz, at the shot-noise limit or below @ high resolution (diffraction-limited or sub-Rayleigh), with 10 times larger DOF than standard imaging.

Ready to play a transformational role in technology and society (biomedical and clinical imaging, space imaging, security and industrial inspection, ...)

**References**

**Qu3D website:** under construction
*Kick-off meeting:* Apr-May 2020 @ PKH
*Workshops:* M18 @ EPFL + M30 @ UPOL
*Training school:* M33 @ INFN
*Final meeting:* M36 @ INFN