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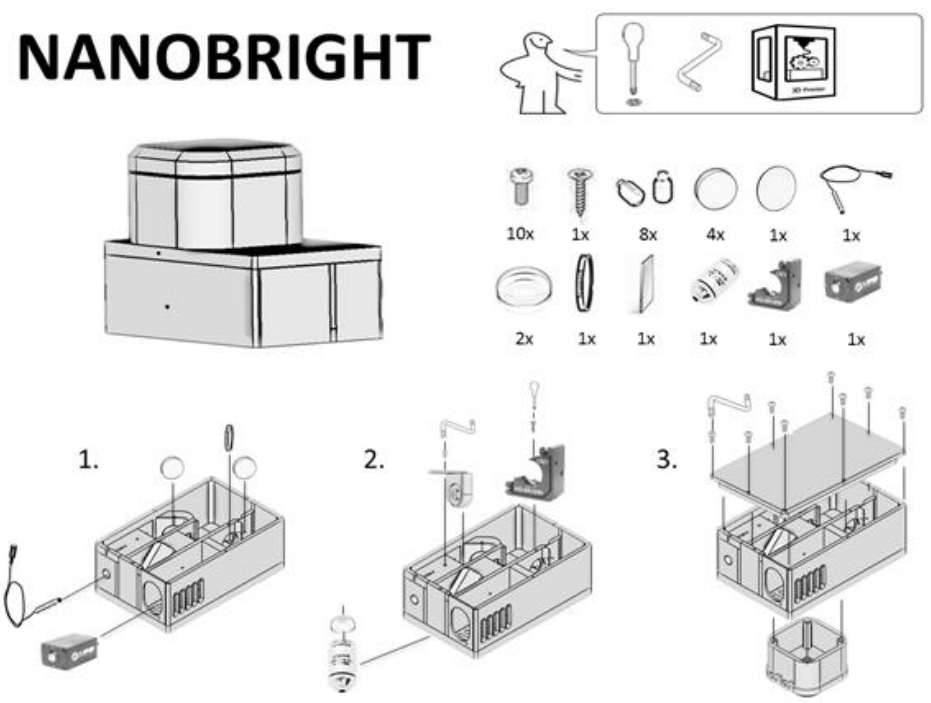
3D printing the new generation of super-resolution microscopes



Single molecule assays have, by definition, the ultimate sensitivity and represent the next frontier in biological analysis and diagnostics. Single molecule spectroscopy or imaging techniques are used extensively in biophysical laboratories; however, have remained a specialist field. These instruments are expensive, require dedicated dark rooms and large optical tables to minimise vibrations, and extensive training is needed for the collection and analysis of high-quality data sets. Many groups are developing their own high-end instruments, acquisition hardware and software, but the blueprints of these setups are too complex for replication by other groups. For these reasons, these exciting technological developments have not spread to many laboratories and have not entered industrial settings or classrooms to expose students to single-molecule techniques.

In order to make the technique more accessible and more affordable for academic laboratories, diagnostic purposes in the field and education, we designed a simplified single molecule confocal system requiring minimal assembly and useable by non-specialists.

During his 6 months internship, Arnaud Bauer, an engineer from Ecole Centrale, developed the NanoBright - a single molecule confocal system built from a 3D printed scaffold. This compact, plug-and-play device performs single photon counting and fluorescence correlation spectroscopy (FCS) experiments in a simple format, and is widely applicable the detection of single fluorophores, protein oligomers, liposomes or bacteria. The power of single-molecule detection was demonstrated by detecting single α-synuclein fibrils, a protein associated to Parkinson's disease, with an improved sensitivity of >100,000-fold over bulk measurements.

Recent breakthroughs in single molecule fluorescence super-resolution imaging have provided exquisite details into many biological processes in living cells. **We are now looking for new interns to develop the new generation of super-resolution microscopes, starting after January 2020.**

Contacts:

Yann GAMBIN y.gambin@unsw.edu.au
Emma SIERECKI e.sierecki@unsw.edu.au