Annual highlights

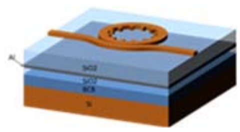
The SPOC Centre started April 1 2015, and was immediately off to a good start. In the spring of 2015, two prestigious postdeadline papers at two of the most important conferences in the field of photonics (OFC’2015 and CLEO’2015, see publication list) were accepted. Both relied on a novel nonlinear optical material, aluminum gallium arsenide (AlGaAs), which allowed for a demonstration of the world’s fastest serial processing chip ever (1.28 Tbit/s data speeds), as well as for generation of optical frequency combs at record-low energy. The fastest chip result was recently nominated in the ongoing competition “Danish research result of the year” for 2015 on videnskab.dk. A frequency comb source offers the unique possibility of feeding a high-capacity multi-channel optical communication system with only the light from a single source and thus save orders of magnitude in energy consumption.

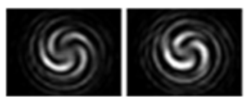
SPOC works on five research flagship themes: FT A. Nonlinear integrated photonics for optical signal processing. FT B. Advanced multiplexing for ultimate capacity. FT C. Advanced coding and information theory. FT D. Integrated frequency combs and light sources. FT E. Quantum fiber optic communications.

In all five flagship themes very good progress has been made. We have hired the first key personnel to support all themes, we have made agreements with our international partners, we have invested in essential new equipment, we have started to build up new expertise, and have made detailed plans.

FT A. Within the first year of SPOC, utilising a nonlinear AlGaAs photonic chip, we demonstrated the fastest serial processing ever. Using optical techniques, we have demonstrated the fastest wireless link in the 300-500 GHz frequency range, as well as a range of novel optical time lens schemes and in particular simultaneous optical regeneration of multiple parallel channels.

FT B. The leader of FT B is also coordinator of the H2020 EU-Japan project SAFARI, where a postdeadline paper at OFC’2015 was accepted, demonstrating 527 km transmission over 36 spatial channels for the first time. This important demonstration shows that these novel fibres are indeed practical and may play a big role in future optical network infrastructure. We have also designed and fabricated a novel orbital angular momentum emitter, which will play a crucial role in our future work.





FT C. We have developed and implemented an advanced coding scheme (‘constellation shaping’) of the transmitted data, enabling the first demonstration of WDM transmission with a reach increase of up to 75%, whilst ensuring an extremely high spectral efficiency.

FT D. We have generated the first AlGaAs-based frequency comb with record-low energy requirement, and have also started our planned work on locking such a comb to an absolute frequency.

FT E. We have developed our first scheme for quantum key distribution (QKD) to create quantum keys for QKD based fiber transmission systems. The scheme is developed to host more than a single quantum bit per symbol (weak coherent pulse), i.e. relying on multi-dimensional quantum keys, in this case using pulse position (time) and optical phase as two independent variables.

All in all, we have managed to build up new capabilities allowing us to pursue record setting so called “hero experiments”. Very recently, in an interplay between FTs A-D, we superseded our own previous world record of the amount of data that can be carried on the light from a single source (no.7 on the Top-20 Engineering Feats of 2014, www.engineerjobs.com), where we reached 43 Tbit/s. Today we can boast 661 Tbit/s on the light from an AlGaAs chip frequency comb generator transmitted on a 30-core optical fibre (to be published)