First Measurements of Coherent Smith-Purcell Radiation in the SOLEIL Linac

Nicolas Delerue, Joanna Barros, Stéphane Jenzer, Vitalii Khodnevych[1], Maksym Malovytsia[2],
LAL, Univ. Paris-Sud, CNRS/IN2P3, Université Paris-Saclay, Orsay, France.
Nicolas Hubert, Marie Labat, Synchrotron SOLEIL, Gif-Sur-Yvette, France
[1]also at National Taras Shevchenko University of Kyiv, Kyiv, Ukraine
[2]also at KhNU, Kharkov, Ukraine
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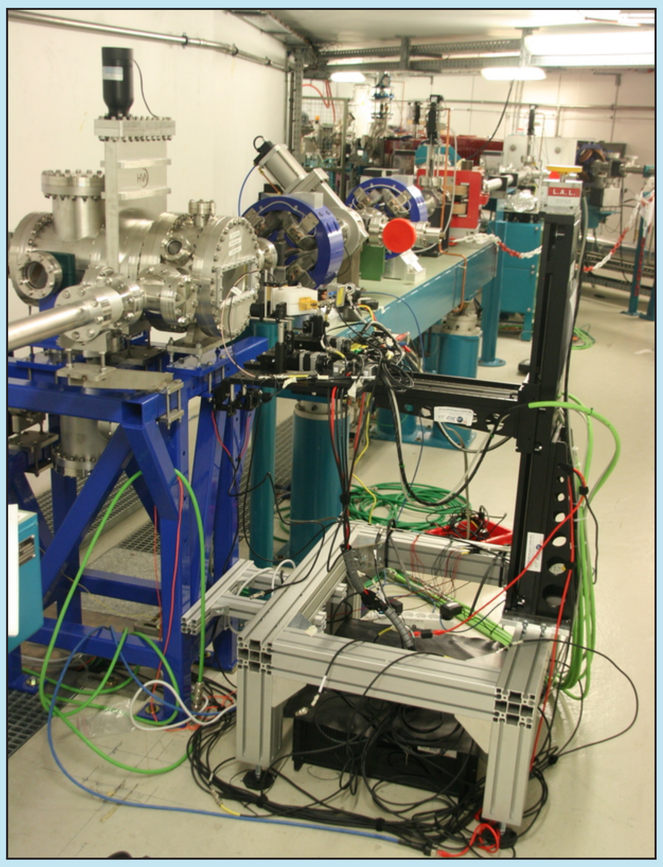
SPESO

Smith-Purcell Experiment at SOleil

Aim: Characterisation of Coherent Smith-Purcell Radiation by 3D scan of CSPR in the SOLEIL Linac.



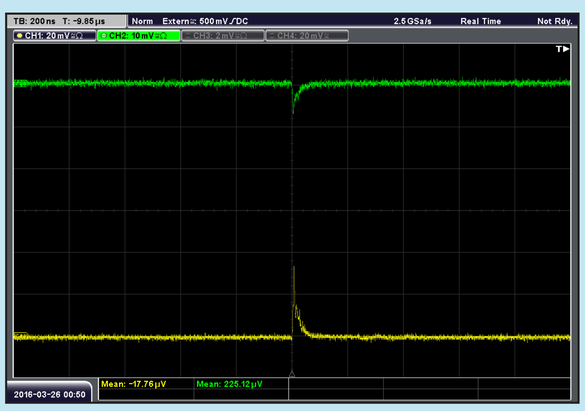
Automated scan using a 5D robot
(3 translations and 2x2 rotations).

Typical bunches:

- In hybride mode : every two minutes with the LPM (4 nC within 104 bunches) and every 6 min with the SPM (0.5 nC in the single bunch).
- In 8 bunches mode : every 90 seconds with the SPM (1 nC within 2 bunches).

Raw data

Typical raw data acquired from scope



Green:
Q-band detector (33-50 GHz - 9.1-6 mm)
Yellow:
Ka-band det. (26.5-40 GHz - 11.3-5 mm)
Schottky diodes

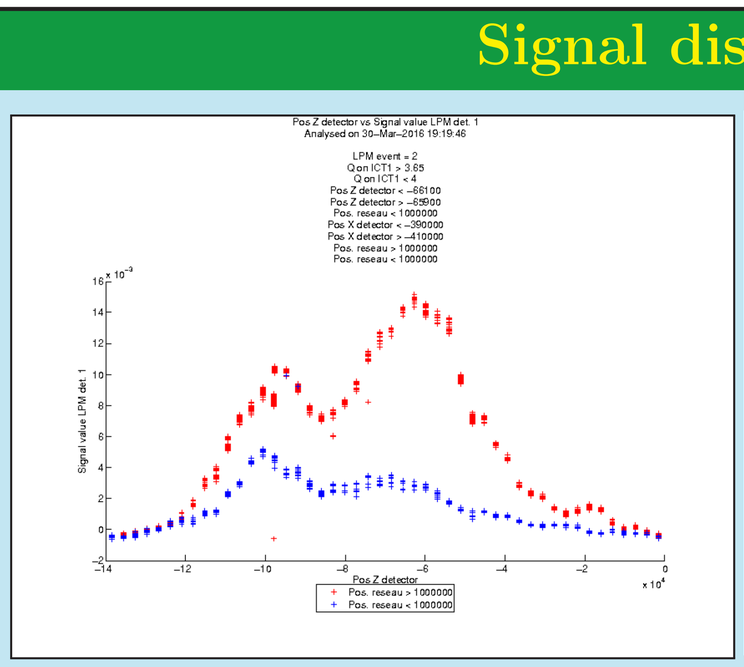
On-line scan data

During operations the position of the detectors is changed every 30 minutes. The grating is retracted after 25 minutes of each cycle.

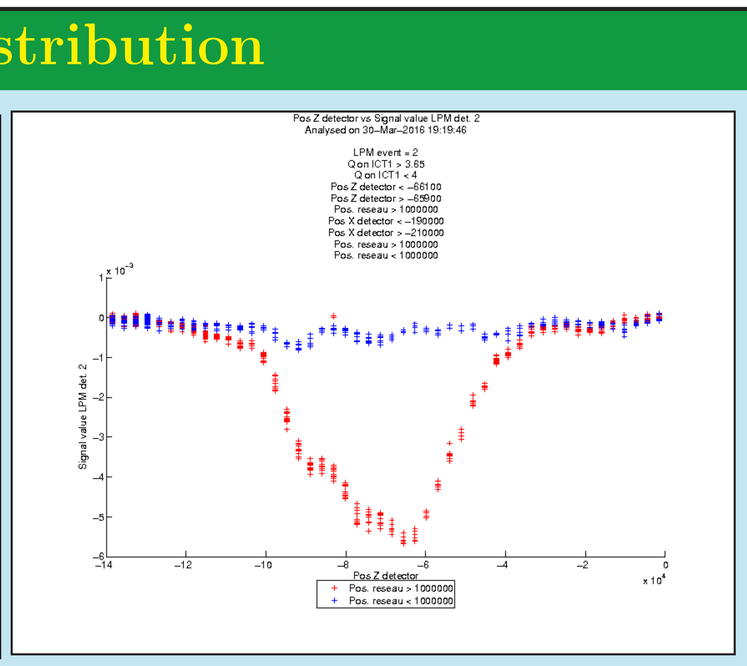
Data quality check:
grating movement

Raw signal from a full day
(Translat. along beam axis)

Signal distribution



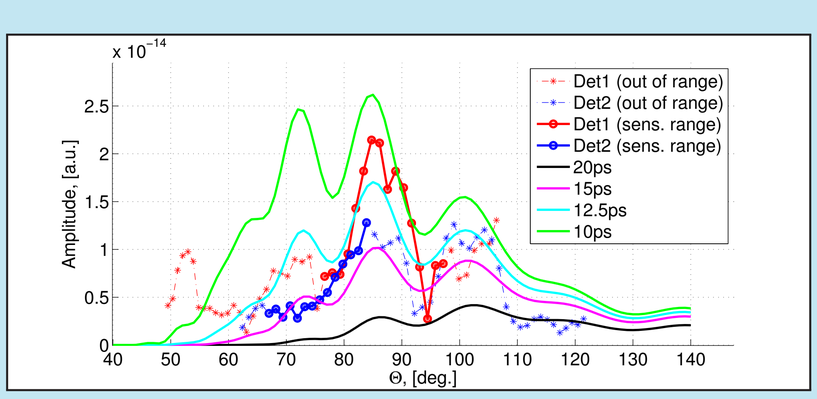
Ka-band detector



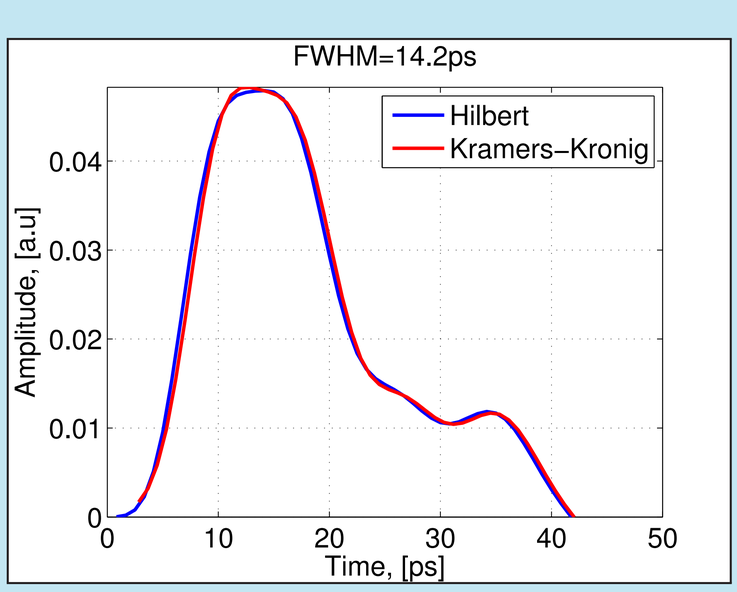
Q-band detector

Profile reconstruction

The data acquired can be used to plot the distribution of the signal versus the angle of observation.
From this distribution the longitudinal profile of the bunch can be reconstructed.



Signal measured vs. observation angle.
Red: Ka band det.; blue: Q-band det.
Solid line: in sensitivity range
Dashed: out of sensitivity range
Comp. to simulations (4 different FWHM)



Reconstructed profile.

Outlook

Longitudinal profile of the SOLEIL linac measured in one mode (LPM, high charge).
SPESO is acquiring data to improve our understanding of Coherent Smith Purcell Radiation!

References

H.L. Andrews, *et al.* Longitudinal profile monitors using Coherent Smith–Purcell Radiation. *NIM A*, 740(0):212 – 215, 2014.
J. H. Brownell, J. Walsh, and G. Doucas. Spontaneous Smith-Purcell radiation described through induced surface currents. *Phys. Rev. E*, 57:1075–1080, Jan 1998.
Nicolas Delerue, Joanna Barros, Oleg Bezshyyko, and Vitalii Khodnevych. Study of Phase Reconstruction Techniques applied to Smith-Purcell Radiation Measurements, ArXiV 1512.01282