Karlsruher Institut für Technologie

5th Mini-Workshop on Longitudinal Diagnostics, DESY, 19th-20th November 2015

KALYPSO: KArlsruhe Linear arraY detector for MHz-rePetition rate SpectrOscopy

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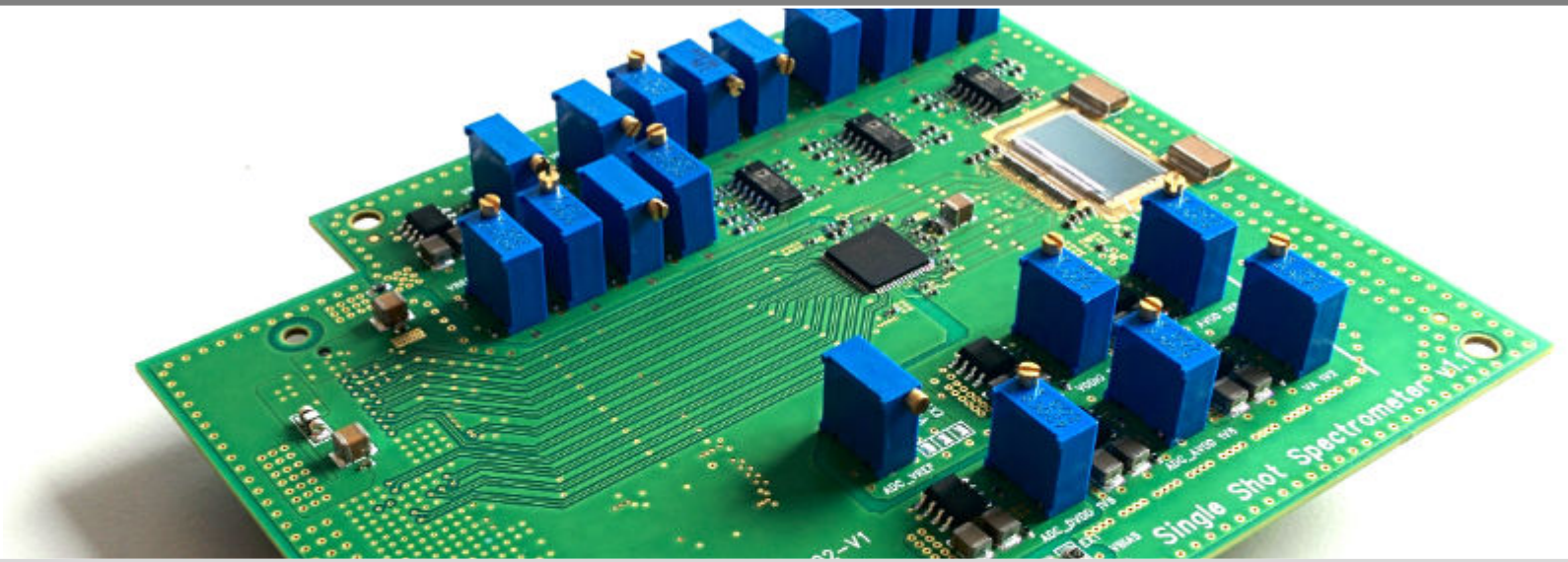
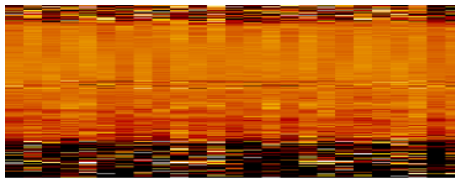
KIT, Institute for Data Processing and Electronics (IPE)

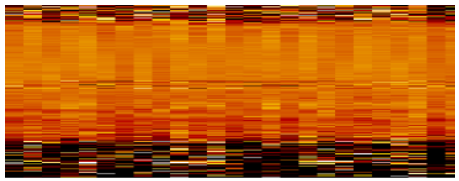


KALYPSO Motivation

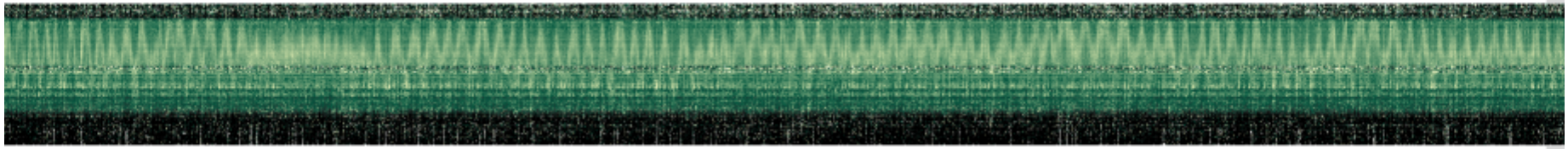


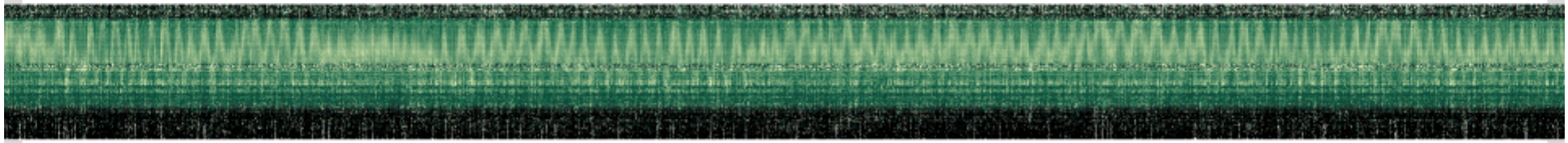
Commercial solutions

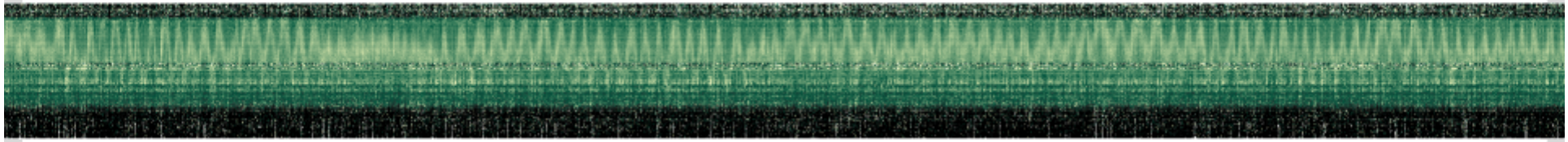
KALYPSO Motivation

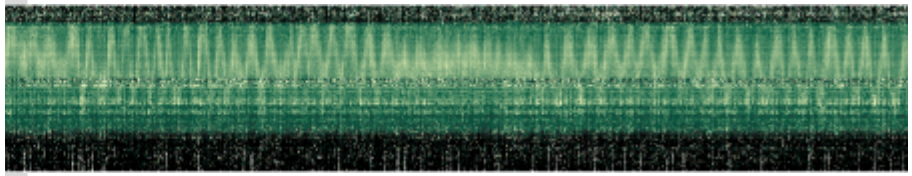


Commercial solutions





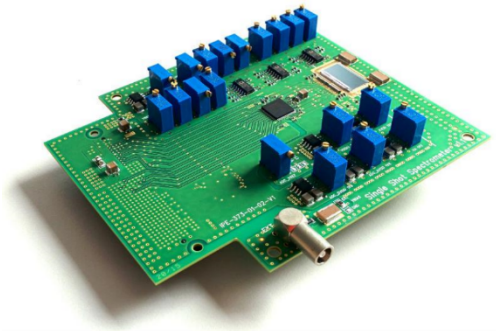




KALYPSO

… limited only by PC memory

KALYPSO v2.0 vs KALYPSO v1.1



2x GOTTHARD v1.4:
- Charge-sensitive amplifier
- 3 different Gain settings
- Inputs: 128
- Outputs: 4 outputs
- Max line-rate= 900 kHz
- Designed by A. Mozzanica (PSI)

InGaAs sensor (Xenics):
- 256 pixels, 50 um pitch

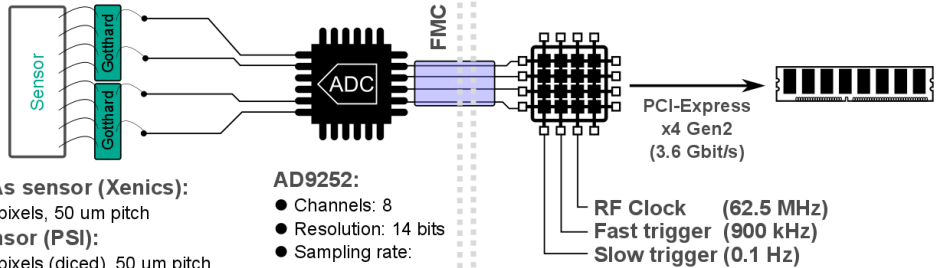
Si sensor (PSI):
- 256 pixels (diced), 50 um pitch

AD9252:
- Channels: 8
- Resolution: 14 bits
- Sampling rate: 50 MSps

KALYPSO detector board

Xilinx ML605:
- FPGA: Virtex6, speedgrade -1
- Connectors: 1 FMC fully populated, 1 partially
- PCI-Express link: x4 Gen2 or x8 Gen1
- KIT-DMA engine for Xilinx PCI-Express Core 2.0 (up to 12/24 Gbit/s)

1 MHz

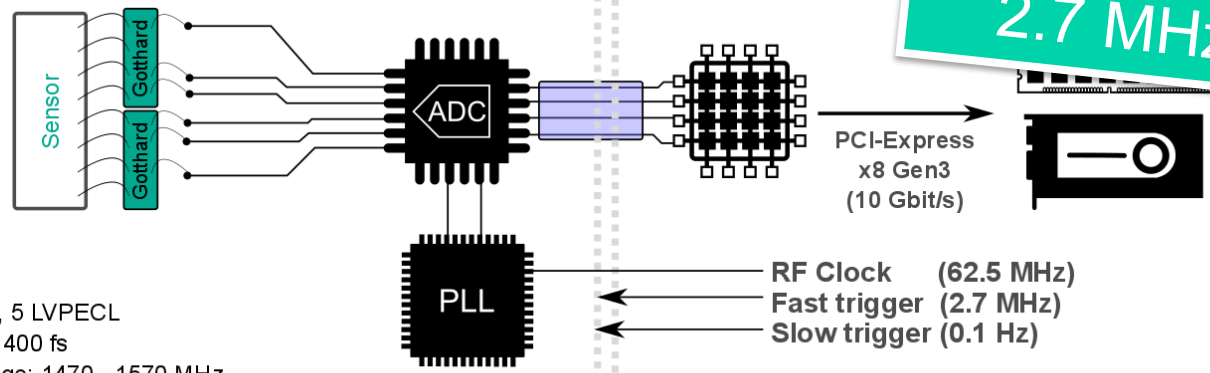


KALYPSO DAQ system at KIT

2x GOTTHARD 'KIT-version':
- 3 different Gain settings
- Inputs: 128
- Outputs: 8 outputs
- Max line-rate: 2.7 MHz
- Designed by A. Mozzanica (PSI)

AD9249:
- Channels: 16
- Resolution: 14 bits
- Sampling rate: 65 MSps

LMK03001C:
- Outputs: 3 LVDS, 5 LVPECL
- VCO RMS Jitter: 400 fs
- VCO Tuning Range: 1470 - 1570 MHz



2.7 MHz

KALYPSO detector board

KALYPSO DAQ system at KIT

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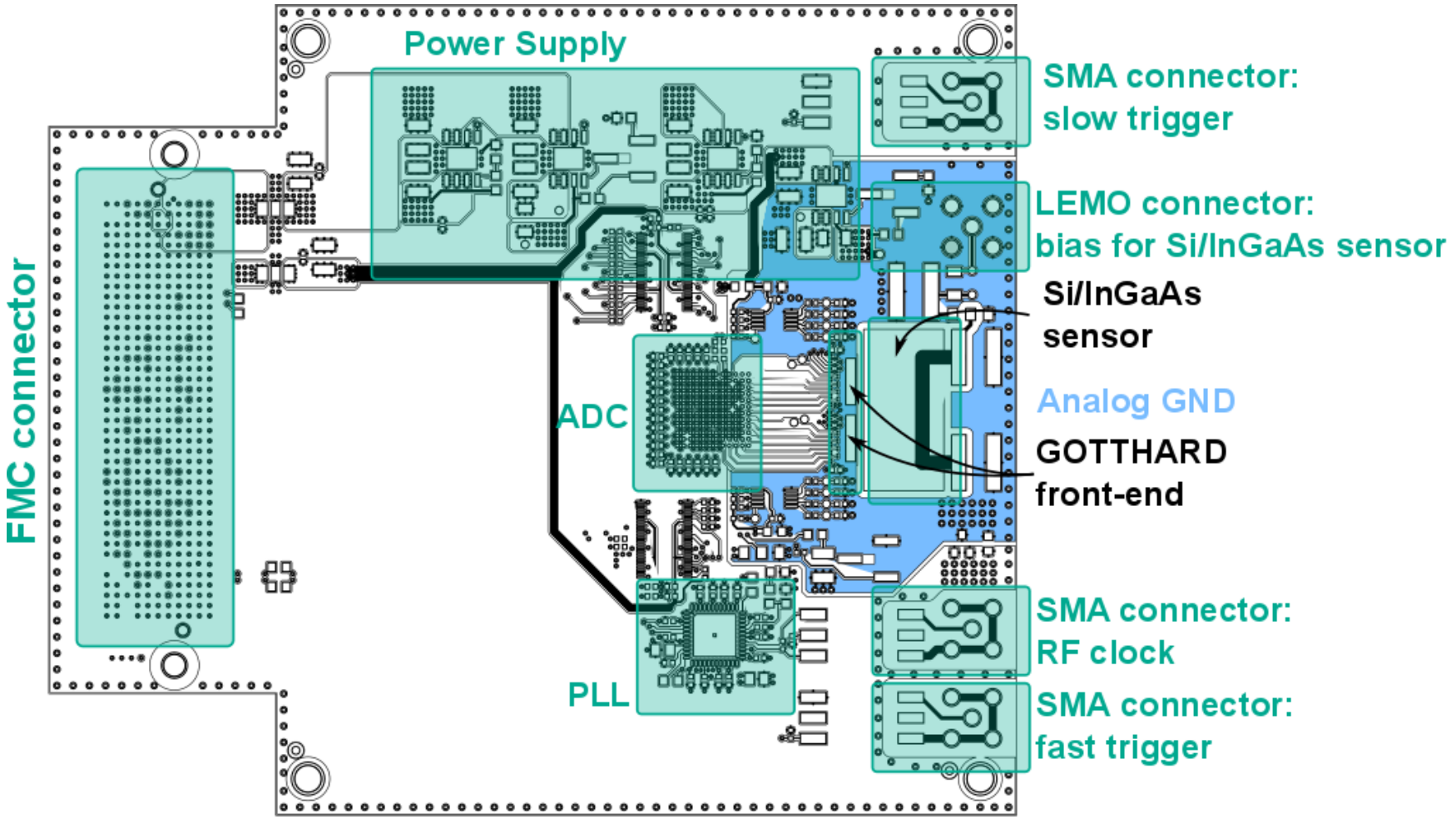
KALYPSO v2.0: preview of PCB layout



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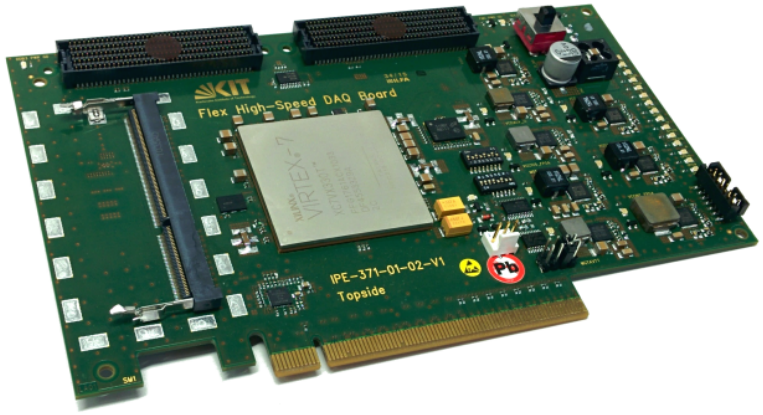
High-performance readout electronics

Hi-Flex: custom FPGA board

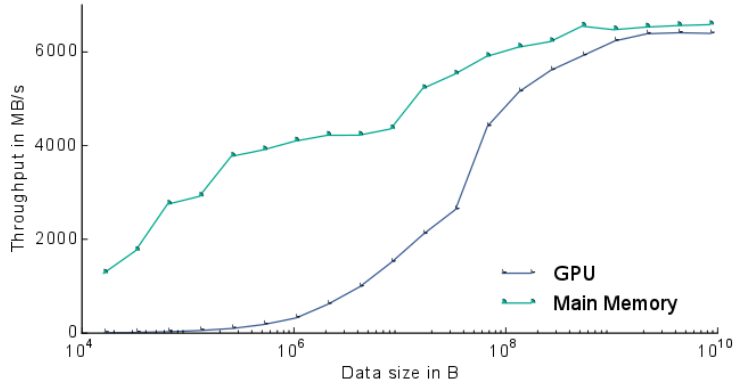


- Virtex 7, Speedgrade -2
- PCI-Express Gen3 x16 Lanes (net data throughput of up to 13 GB/s)
- 2 FMC Connectors, fully populated
- 119 Gbit/s DDR Memory

... currently under test at IPE!

High-throughput readout architecture based on PCI-Express 3.0 and AMD's DirectGMA

The architecture consists of a Direct Memory Access (DMA) engine compatible with the Xilinx PCI-Express 3.0 core, a Linux driver for register access, and high-level software to manage direct memory transfers using AMD's DirectGMA technology.



- Throughput: 6.4 GB/s to GPU memory and 6.6 GB/s to system memory
- Real-time data analysis on GPU based on OpenCL code
- Integration with custom framework for high-performance GPU computing

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