Potential applications of MTCA at synchrotron beamlines

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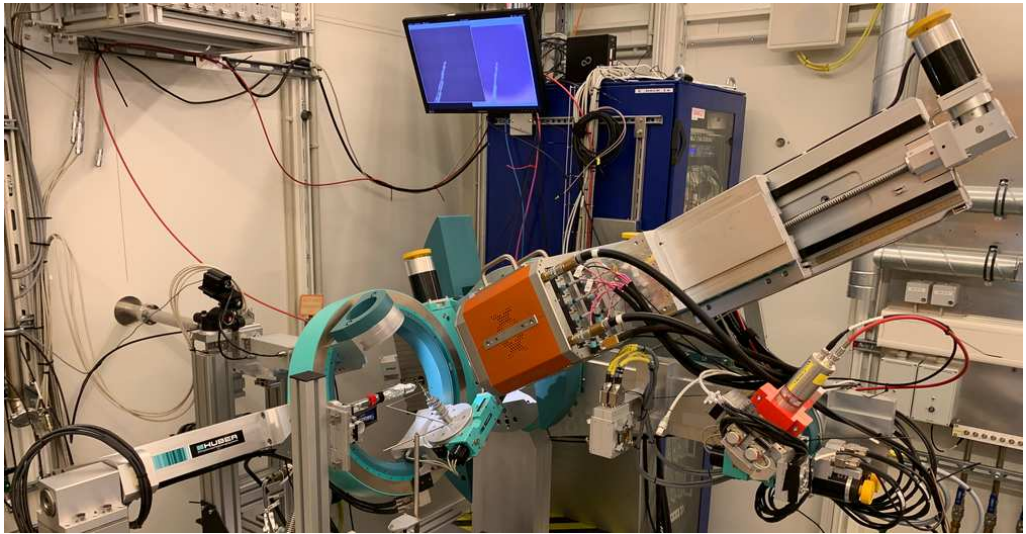
Outline

- Introduction
- Possible applications of MTCA
- A MTCA based motion controller
- Gamma spectroscopy with the SIS8300KU

P24 under construction (in early 2017)

Four circle diffractometer in EH2



Ionisation chamber readout

FMB Oxford AHQ1855

- Beam position monitor
- needs HV
- provides 2 current signals (nA range)

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FMB Oxford AHQ1855

- Beam position monitor
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Keithley 427 (or similar)

- old, expensive
- needs additional hardware (HV supply, ADC)

Ionisation chamber readout

FMB Oxford AHQ1855

- Beam position monitor
- needs HV
- provides 2 current signals (nA range)

HV-PANDA

- 4 channel HV source
- easy to use, python based GUI

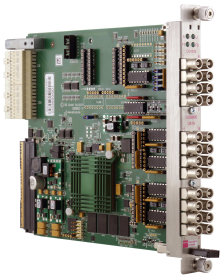
PICO-8
8 channel 1MSPS, 20bit

- MSK firmware framework
- Newer version with ZYNC UltraScale+ FPGA

Scintillation detector readout

e.g. $CeBr_3$ detector

- Single photon counting
- needs HV
- provides pulses

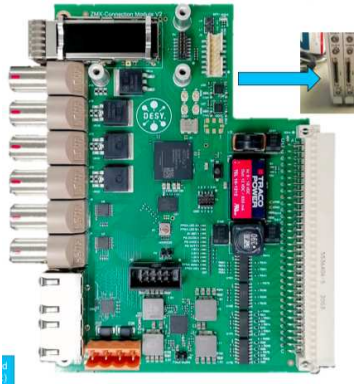


SIS8800 multi channel scaler

- 16 channels on front panel
- 16 channels via RTM (discriminator RTM)
- Synchronization with other devices via MLVDS
- BSP from Struck

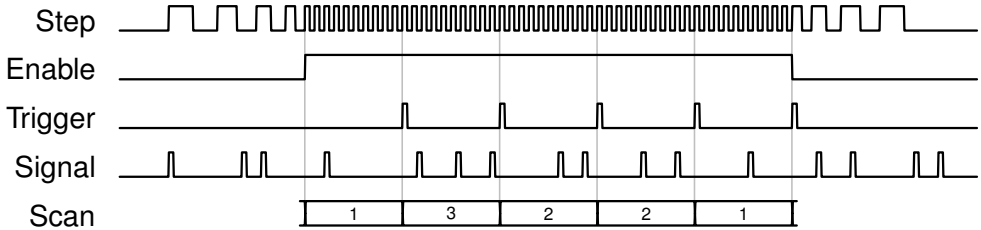
New motion controller

MTCA.4 based motion controller for 16 axes:



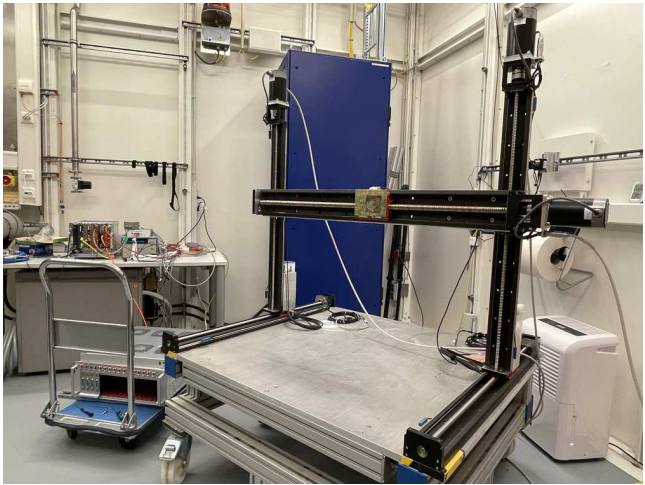
DESY-ITT funded project in collaboration with MSK, open source firmware based on FWK (N. Radakovic, M. Fenner, M. Randall, C. Gümüs et al.)

Continuous scans



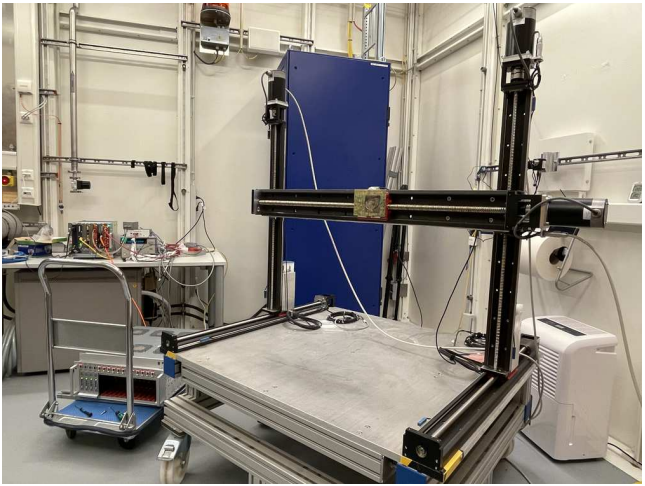
- Motor steps are used for synchronization
- Enable and Trigger signals are distributed via MLVDS
- Synchronization with other devices is possible (e.g. LAMBDA, . . .)
- Will be supported by spec (`flyscan`)

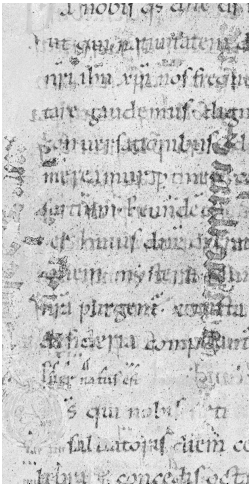
New motion controller — test at P24



Motors can be moved from spec, first user experiment planned for 2024. . .

New motion controller — test at P24





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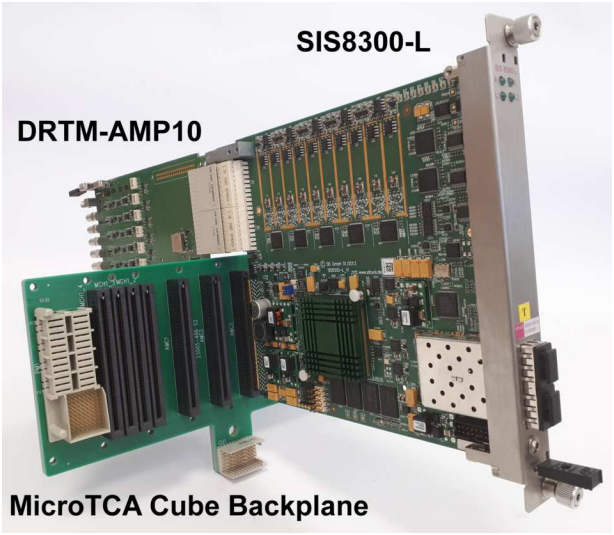
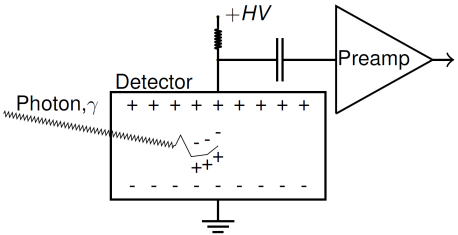
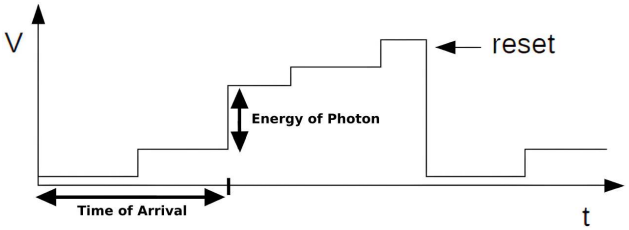
The Struck SIS8300-KU digitizer



- MTCA.4 based
- 10 Channels 125MS/s
- 4x PCEe Gen3
- XCKU040-1FFVA1156C Kintex Ultrascale FPGA
- 2GByte DDR4 Memory

Energy dispersive X-ray detectors





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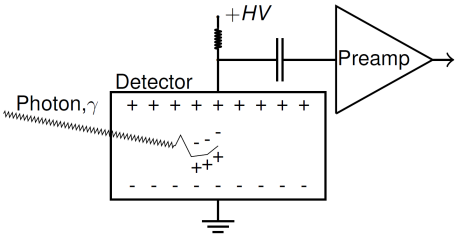

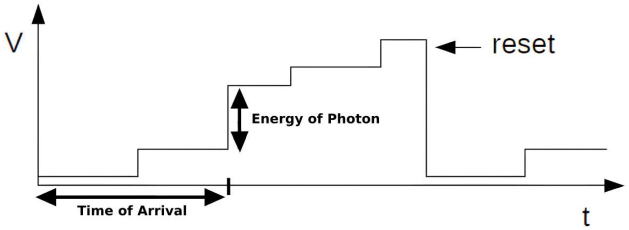

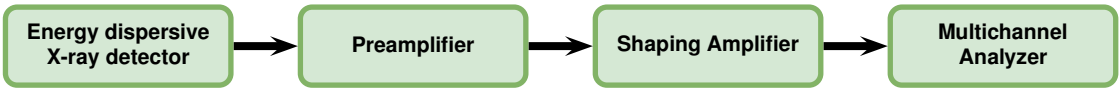

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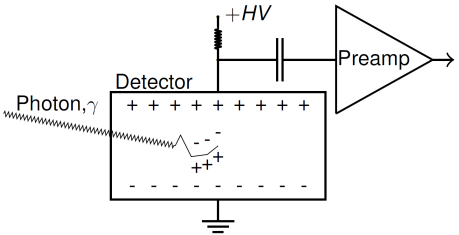
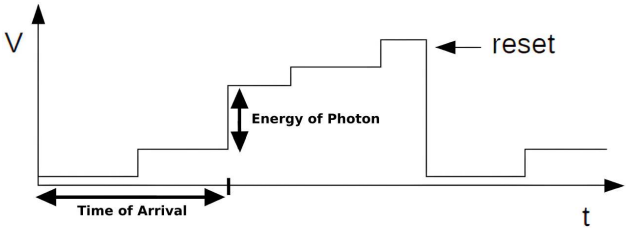
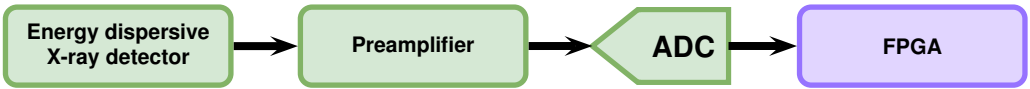
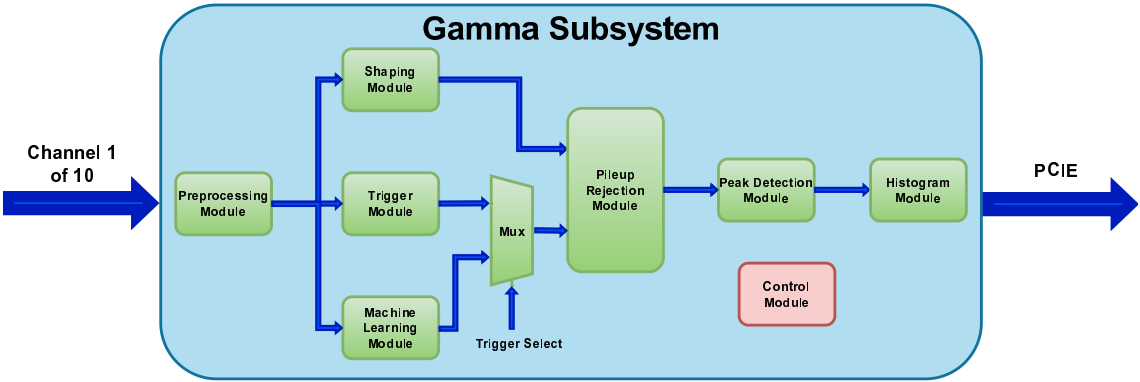






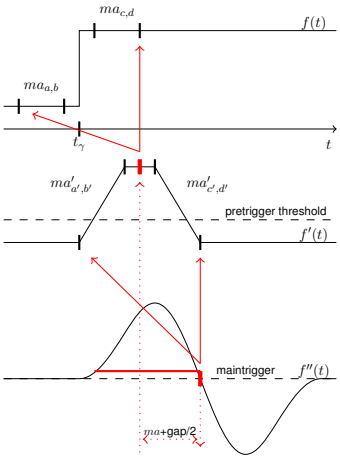
PhD thesis Sarmad Adeel

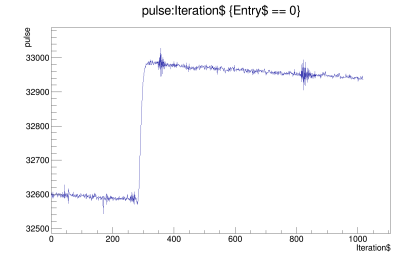
The Gamma firmware

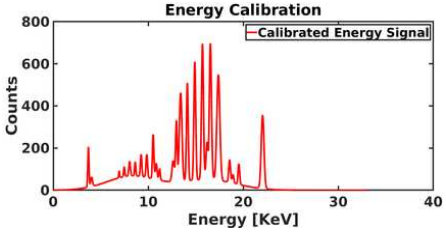


Based on the DESY-MSK firmware framework.

Simple trapezoidal shaping



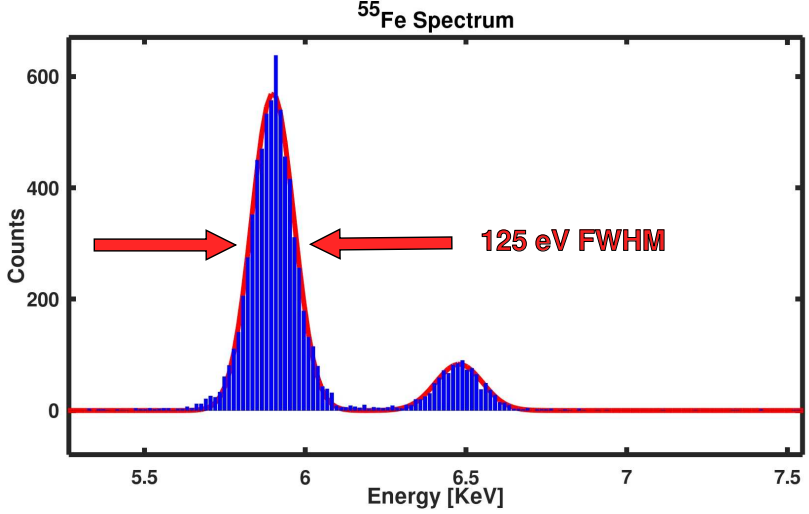




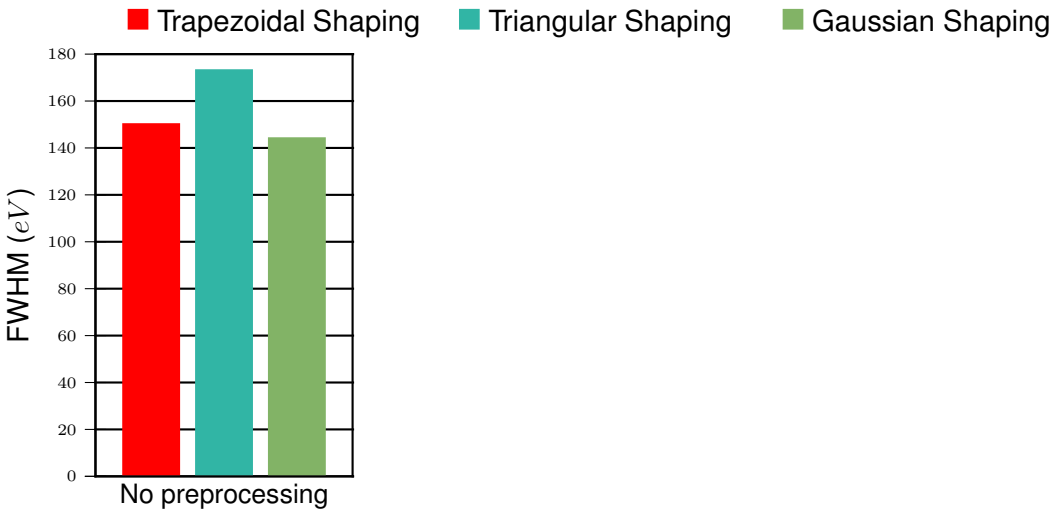
Spectrum from NIST SRM 610

Simple trapezoidal shaping - Results

Trapezoidal shaping with 400ns peak time, 100ns gap time

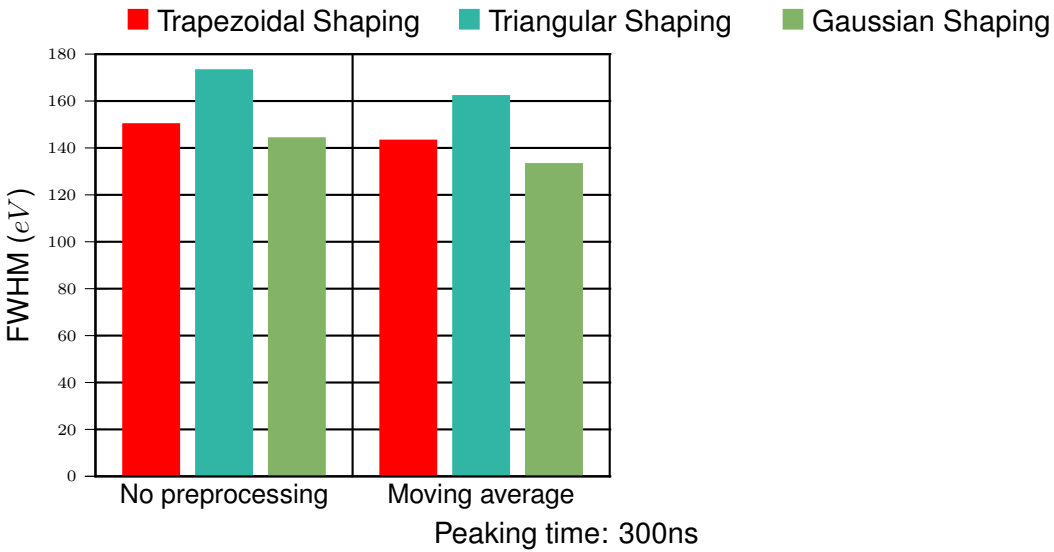


Other shaping methods



Peaking time: 300ns

Other shaping methods



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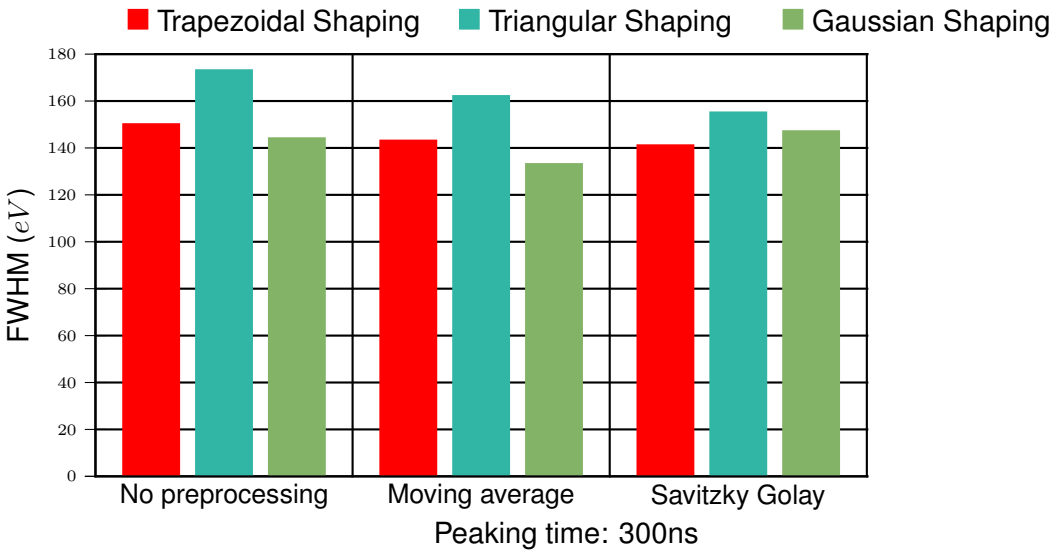

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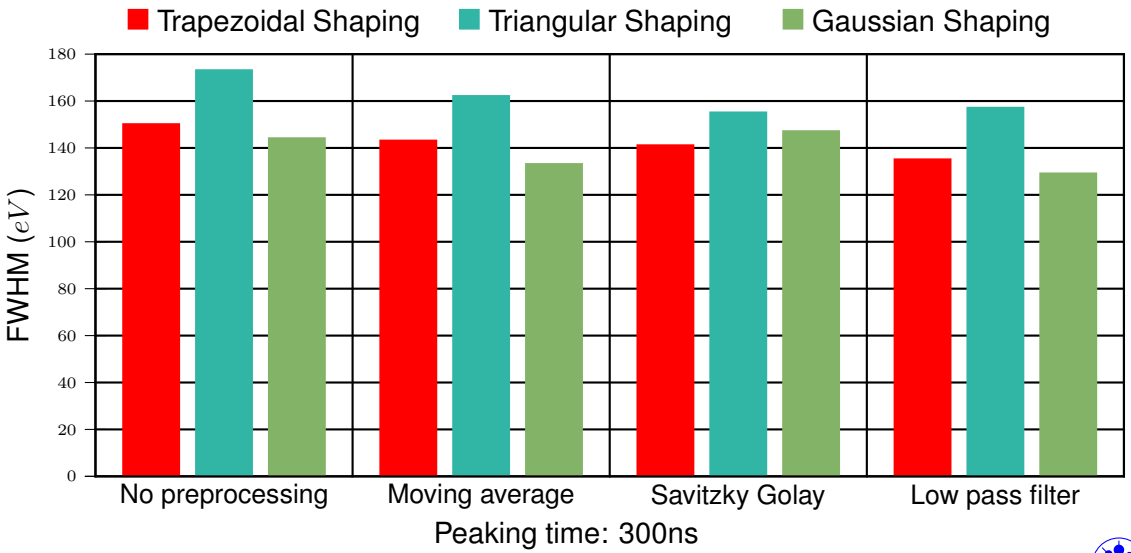

Thank you for your attention!