Fast-timing techniques developement
With help of the EAGLE-EYE multi-detector setup

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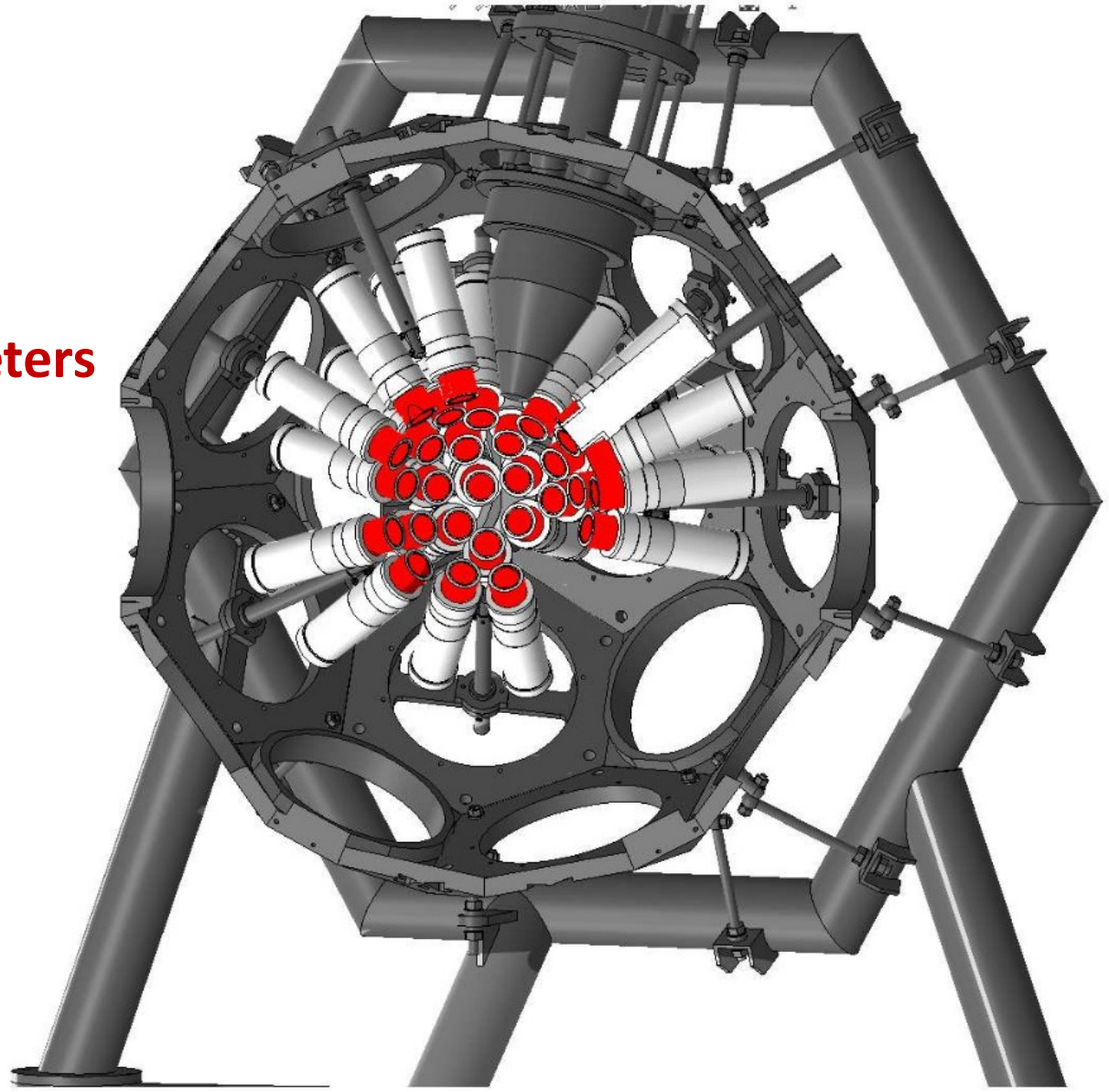
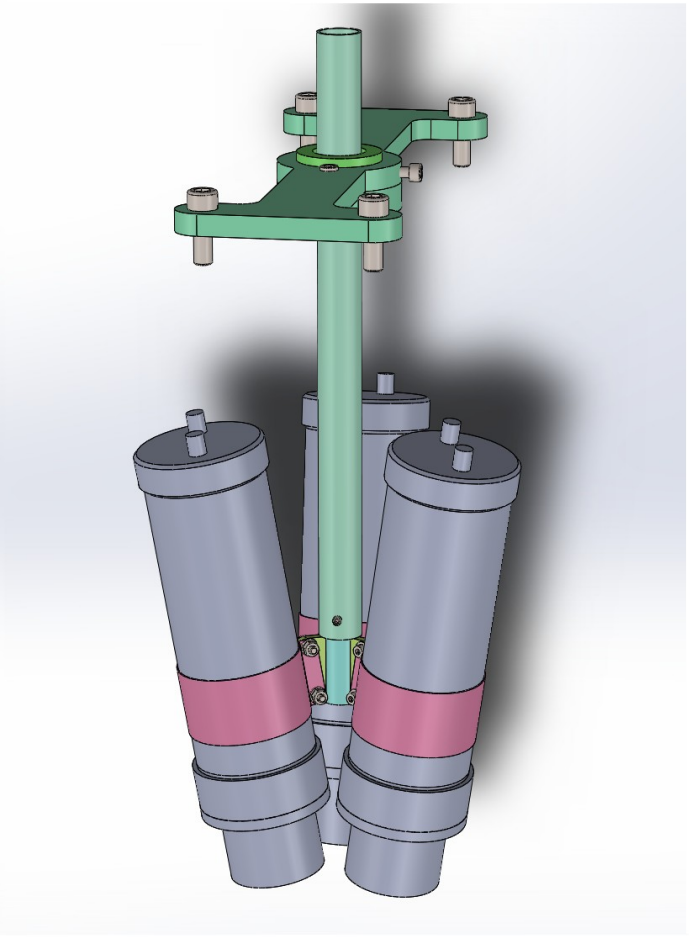
NCBJ
10.12.2019

New approach: Fast-Timing
EAGLE-EYE setup @ HIL

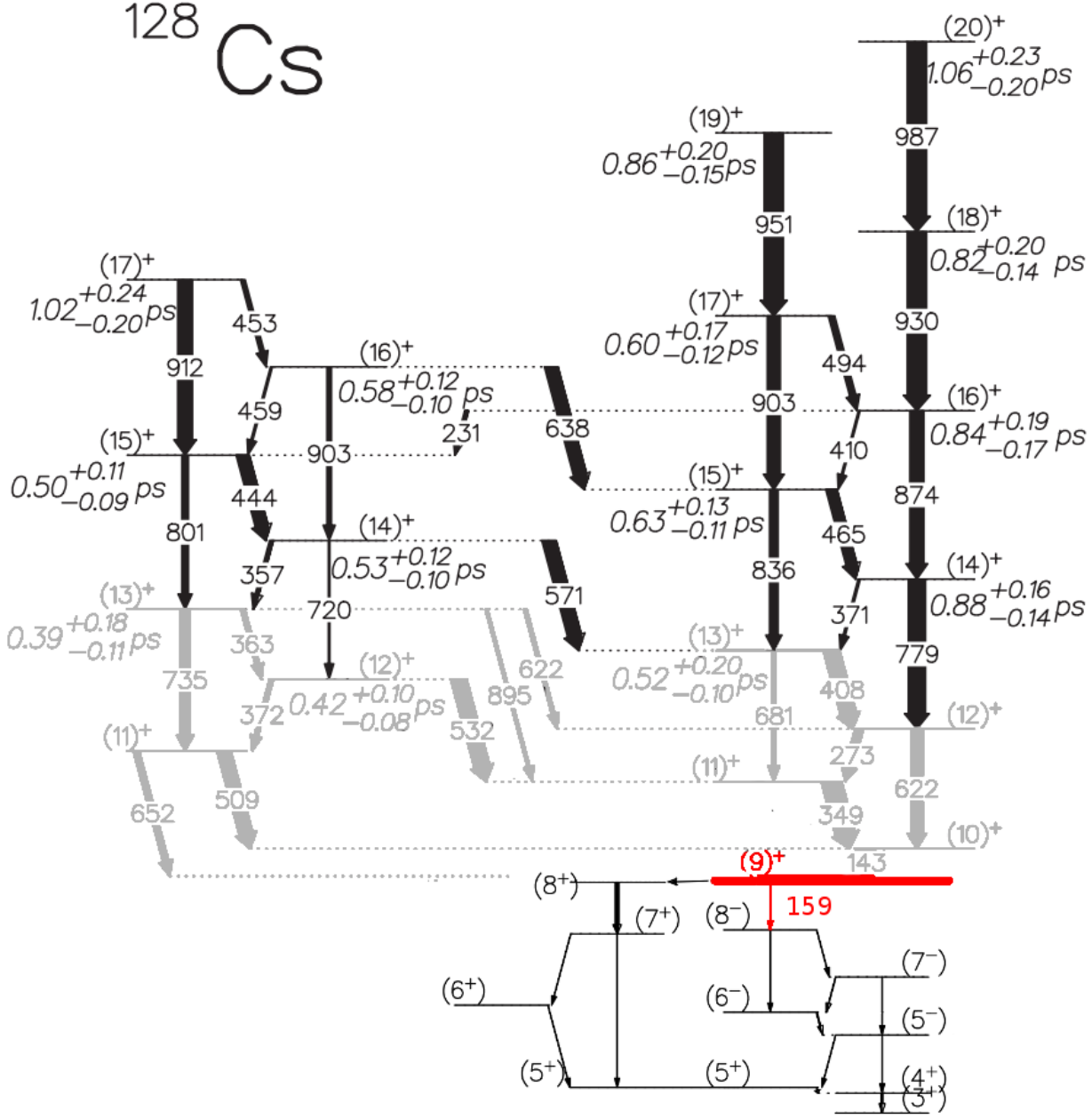
24 LaBr3 detectors
(FATIMA collaboration)

16 HPGe ACS spectrometers
(GAMMAPOOL)






9
25
T01



128Cs isotope used for

-testing new experimental techniques

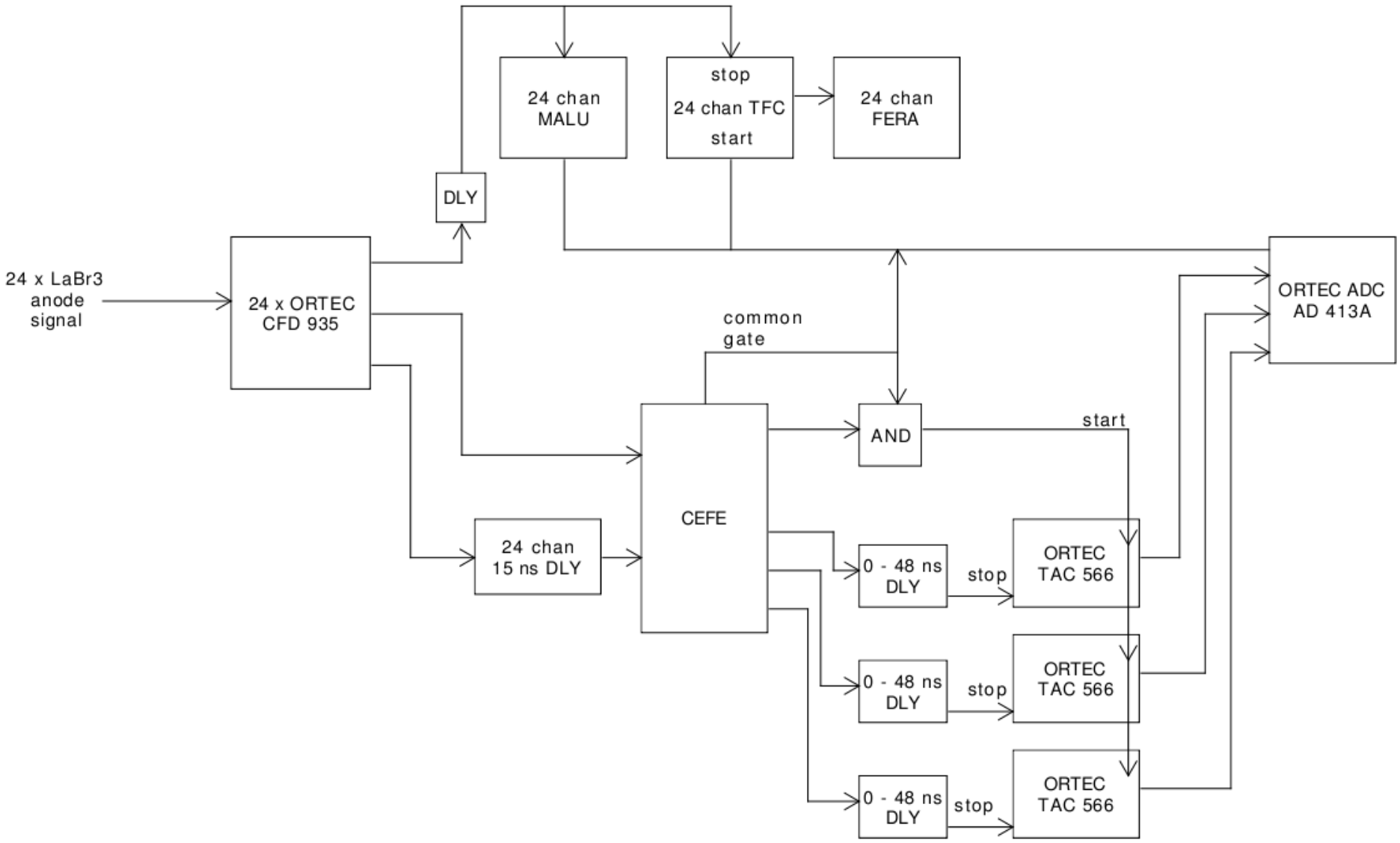
-New DAQ design

Experiments performed
In beam of U200p cyclotron
At Heavy Ion Laboratory UW

EAGLE-EYE

Unique (first world-wide)
DAQ design with logic signal multiplexer
To avoid :
(24 * 23)/2 = 276 different detector pairs
276 fast timing clocks (one for each pair)
276 * ORTEC TAC UNITS= 276 * 40 kzł = 11.04 Mzł
COST

Alows to use only one TAC (40 kzł) in basic mode for all
276 crystal pairs


24 chan
MALU
stop
24 chan TFC
start
24 chan
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DLY
24 x LaBr3
anode
signal
24 x ORTEC
CFD 935
common
gate
ORTEC ADC
AD 413A
AND
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CEFE
24 chan
15 ns DLY
0 - 48 ns
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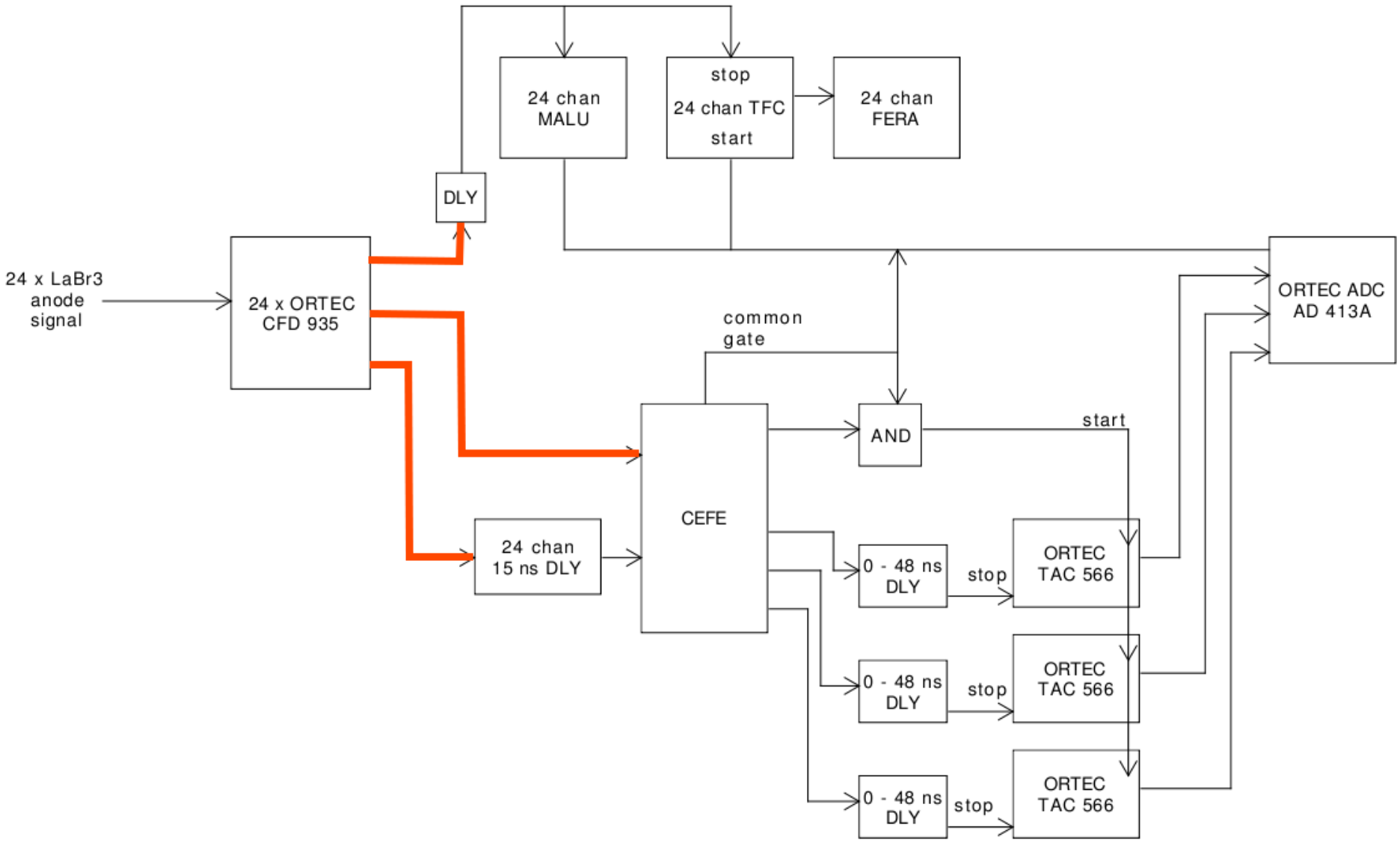
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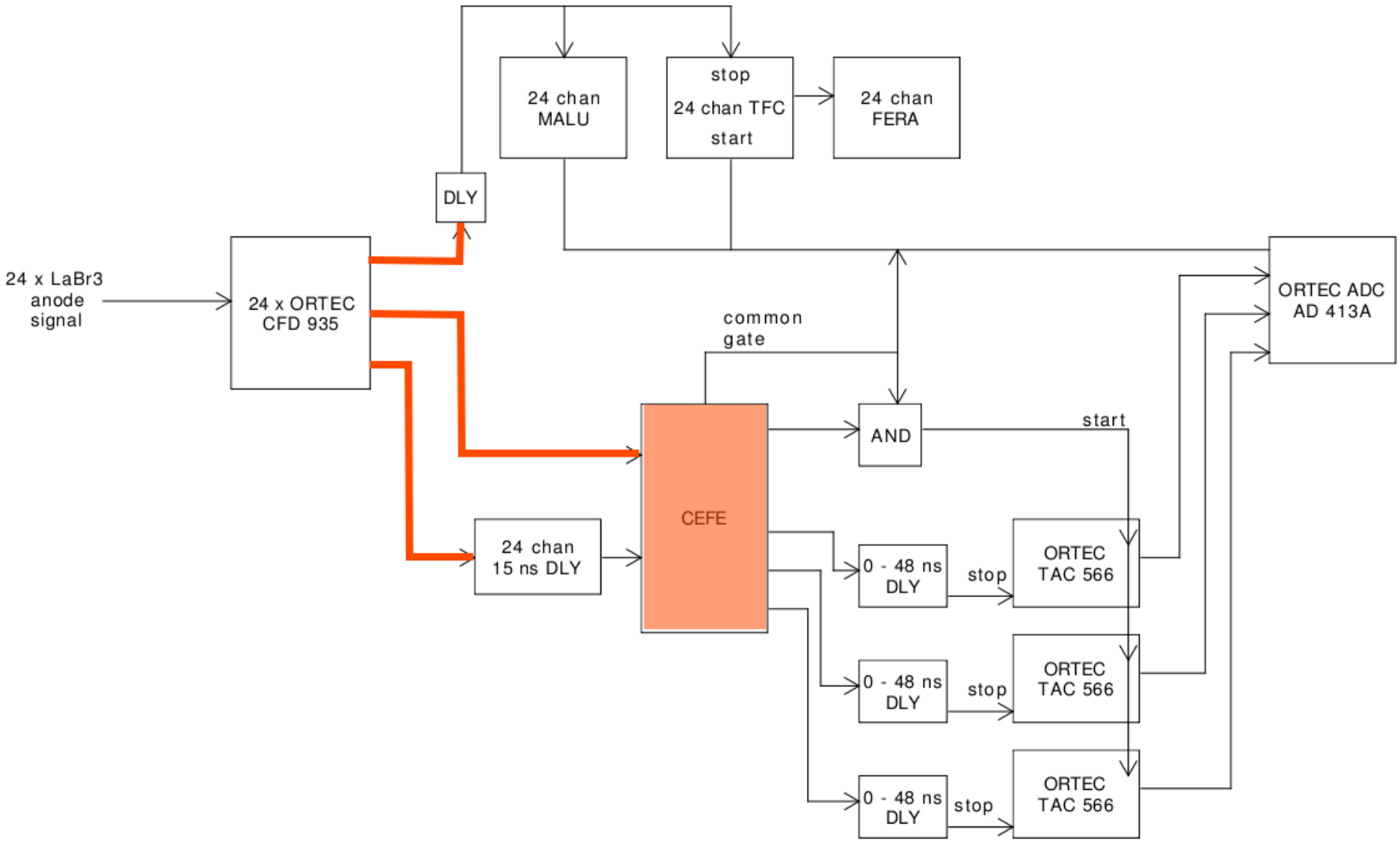
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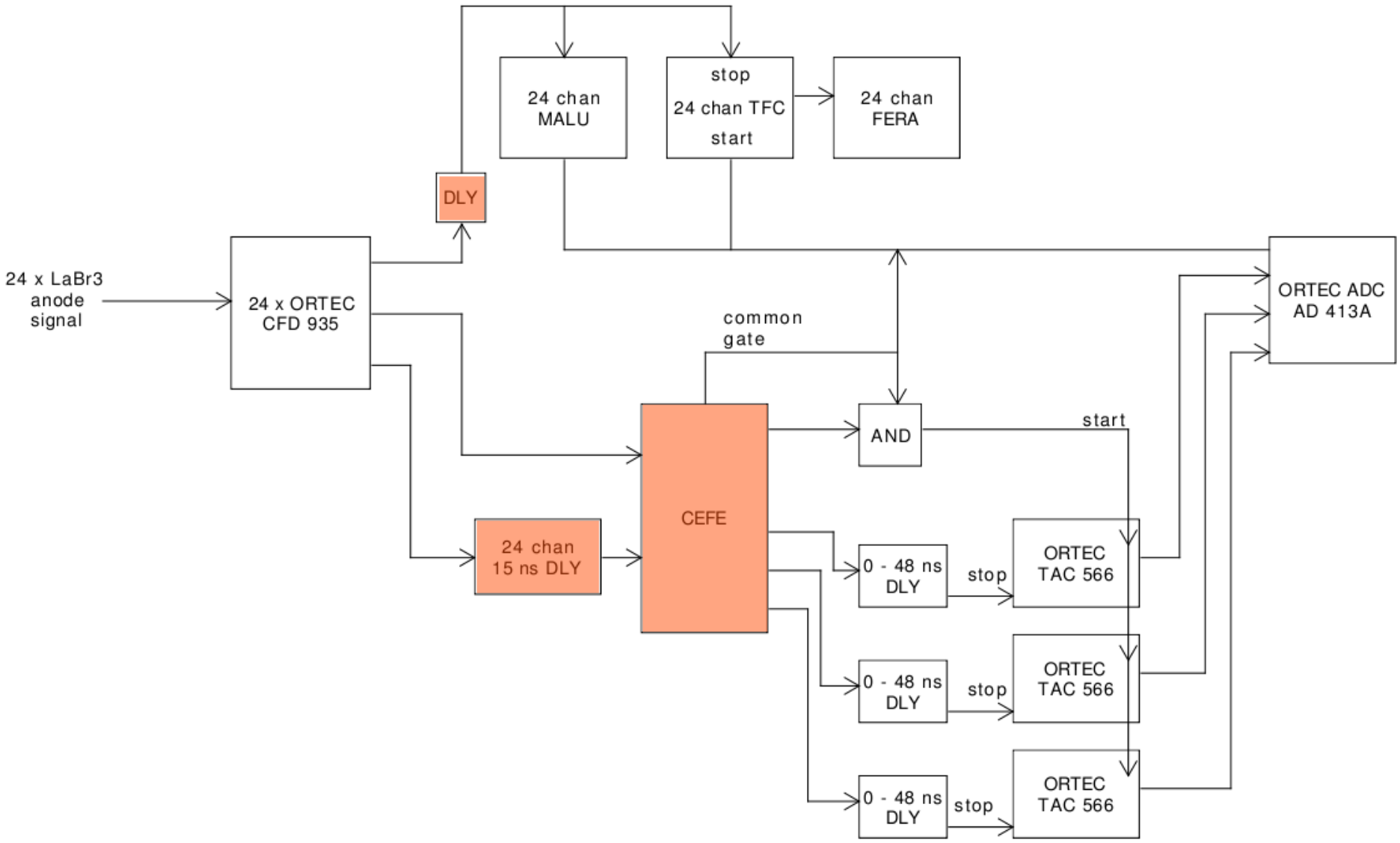
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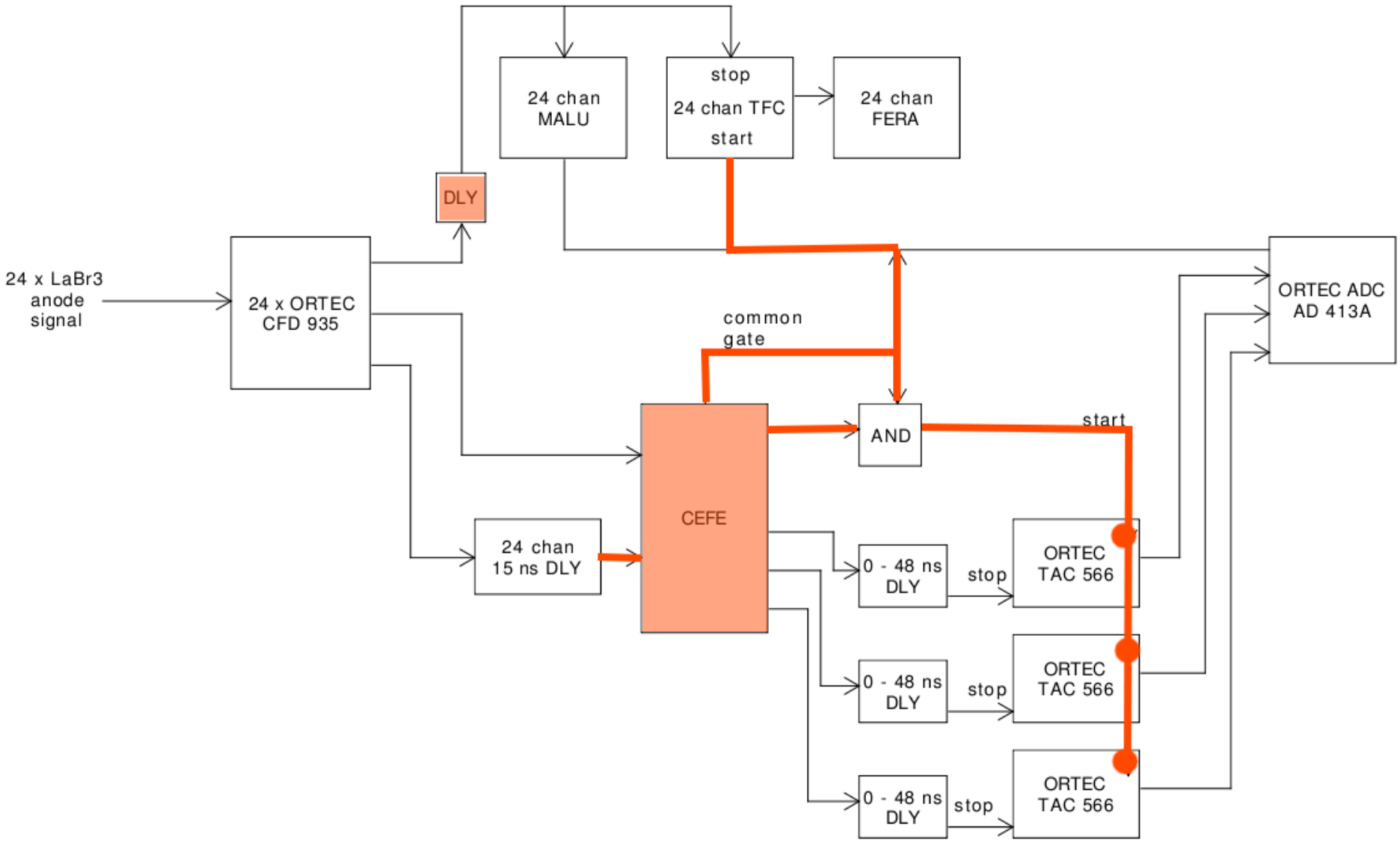
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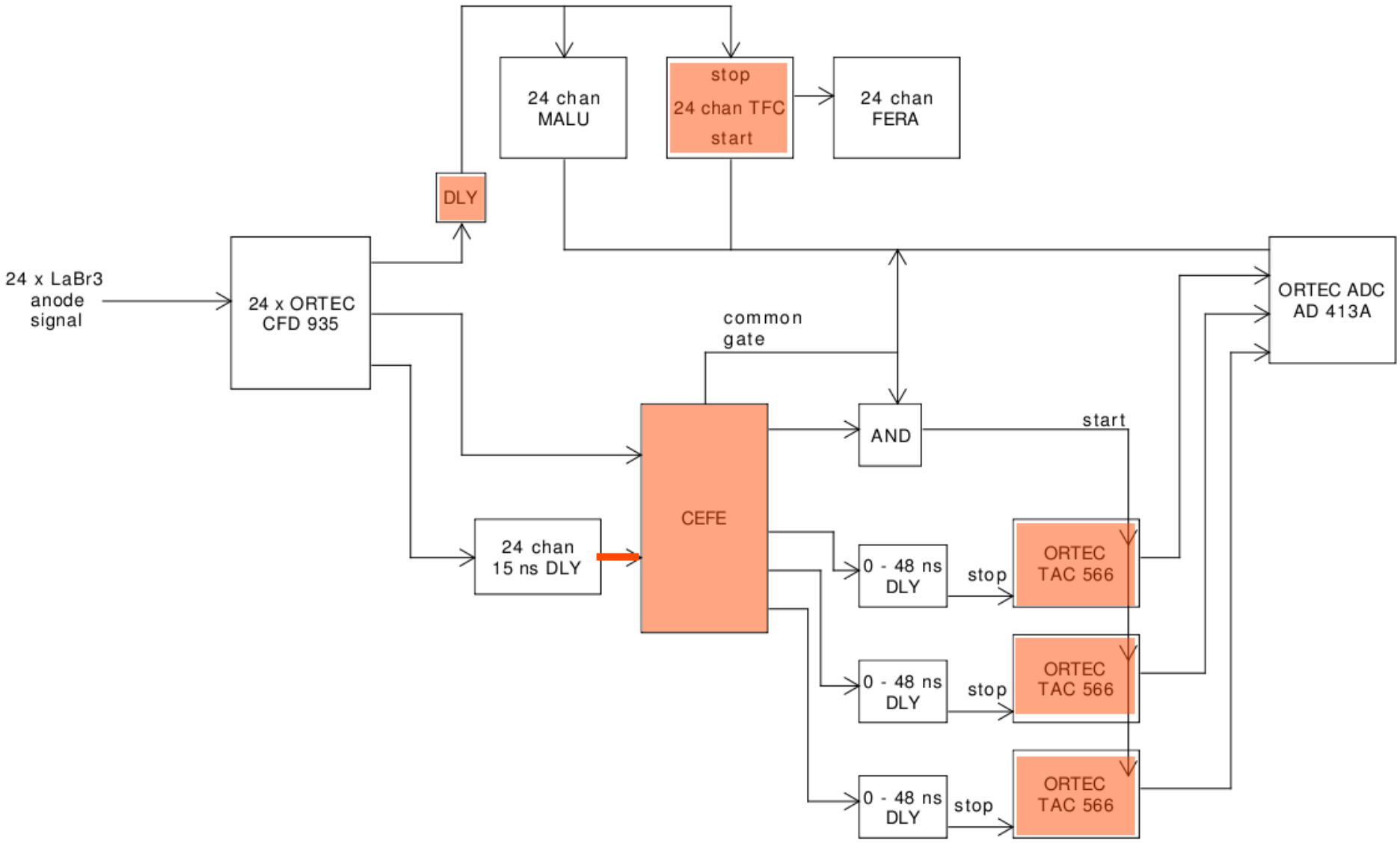
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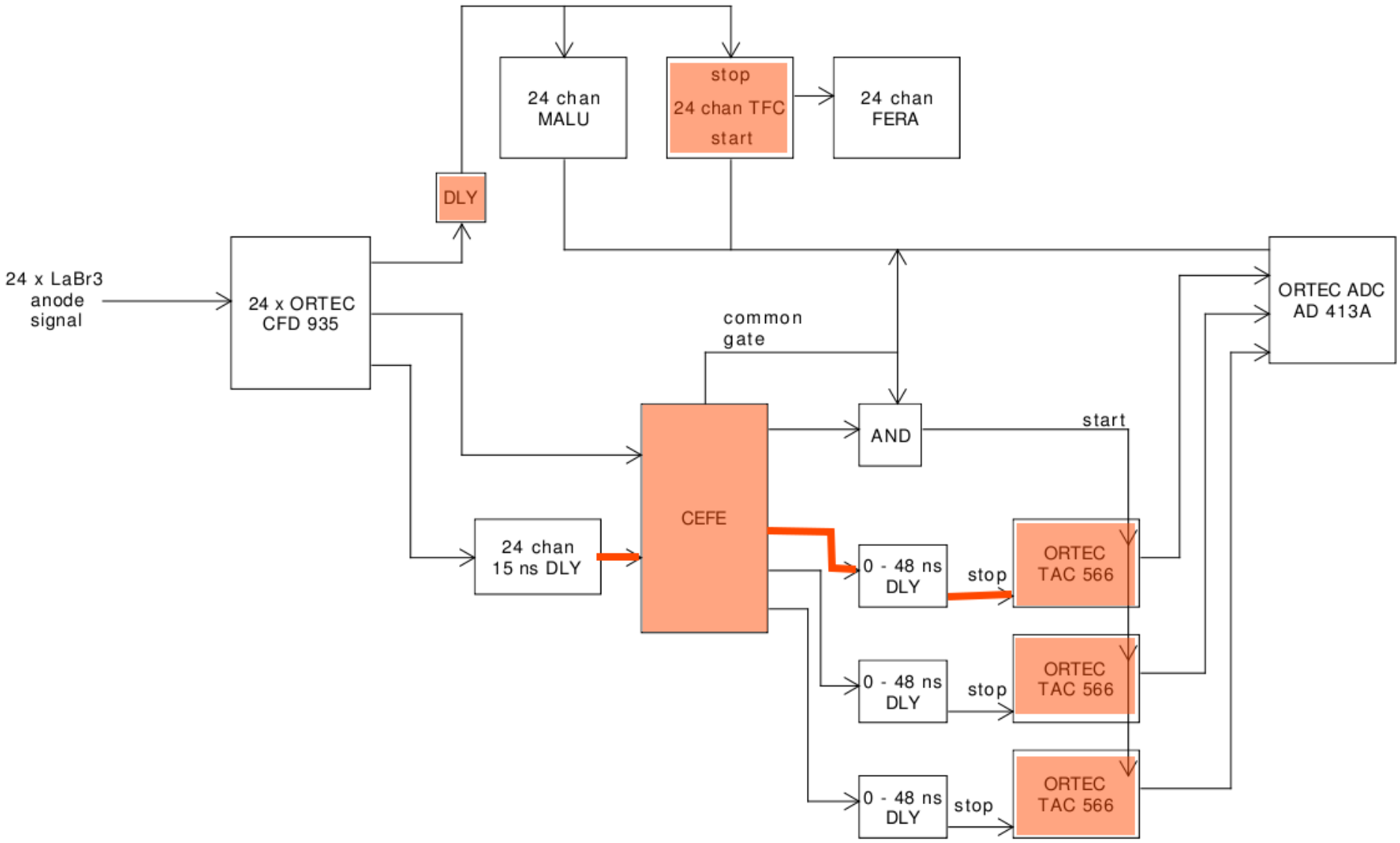
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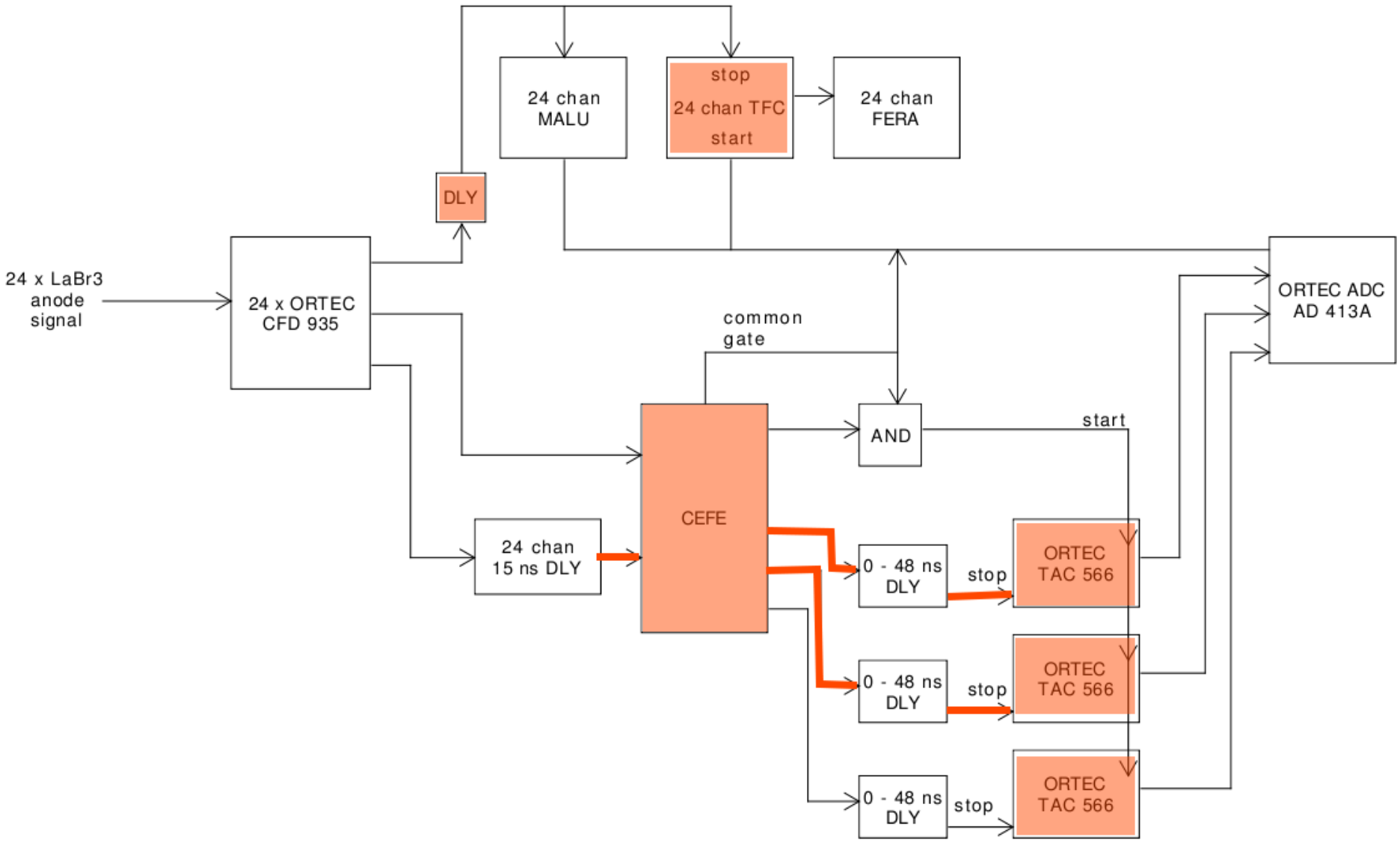
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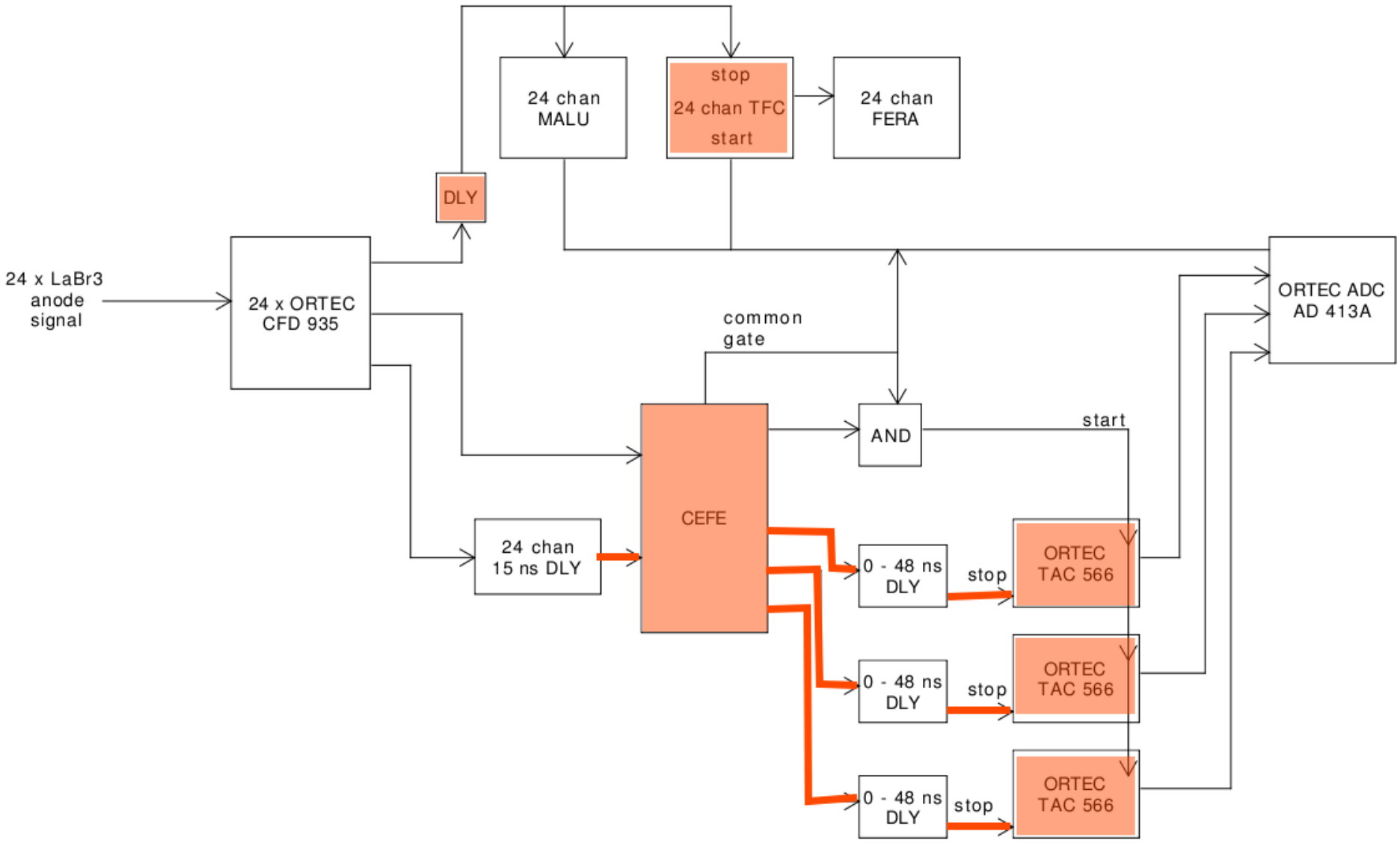
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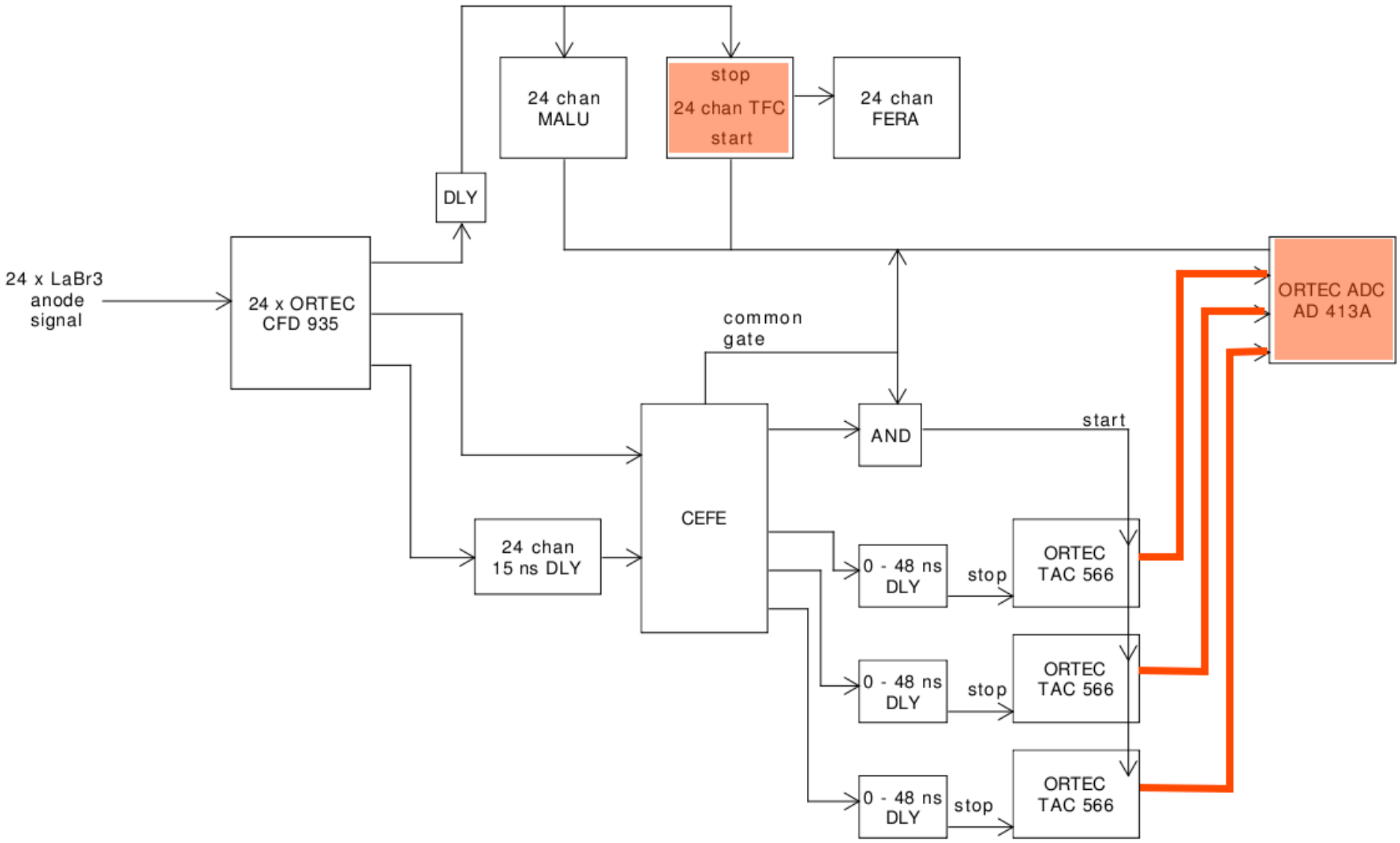
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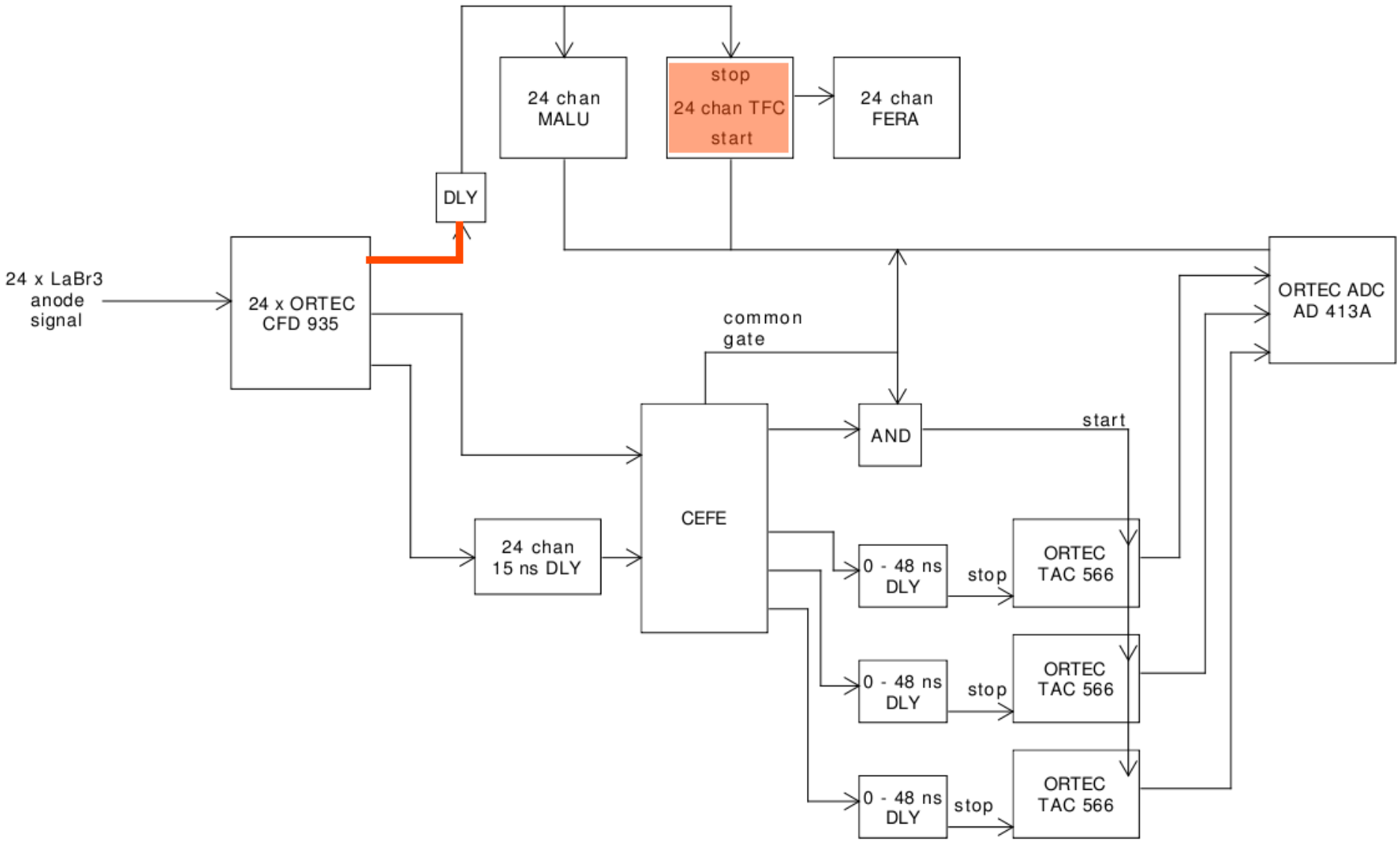
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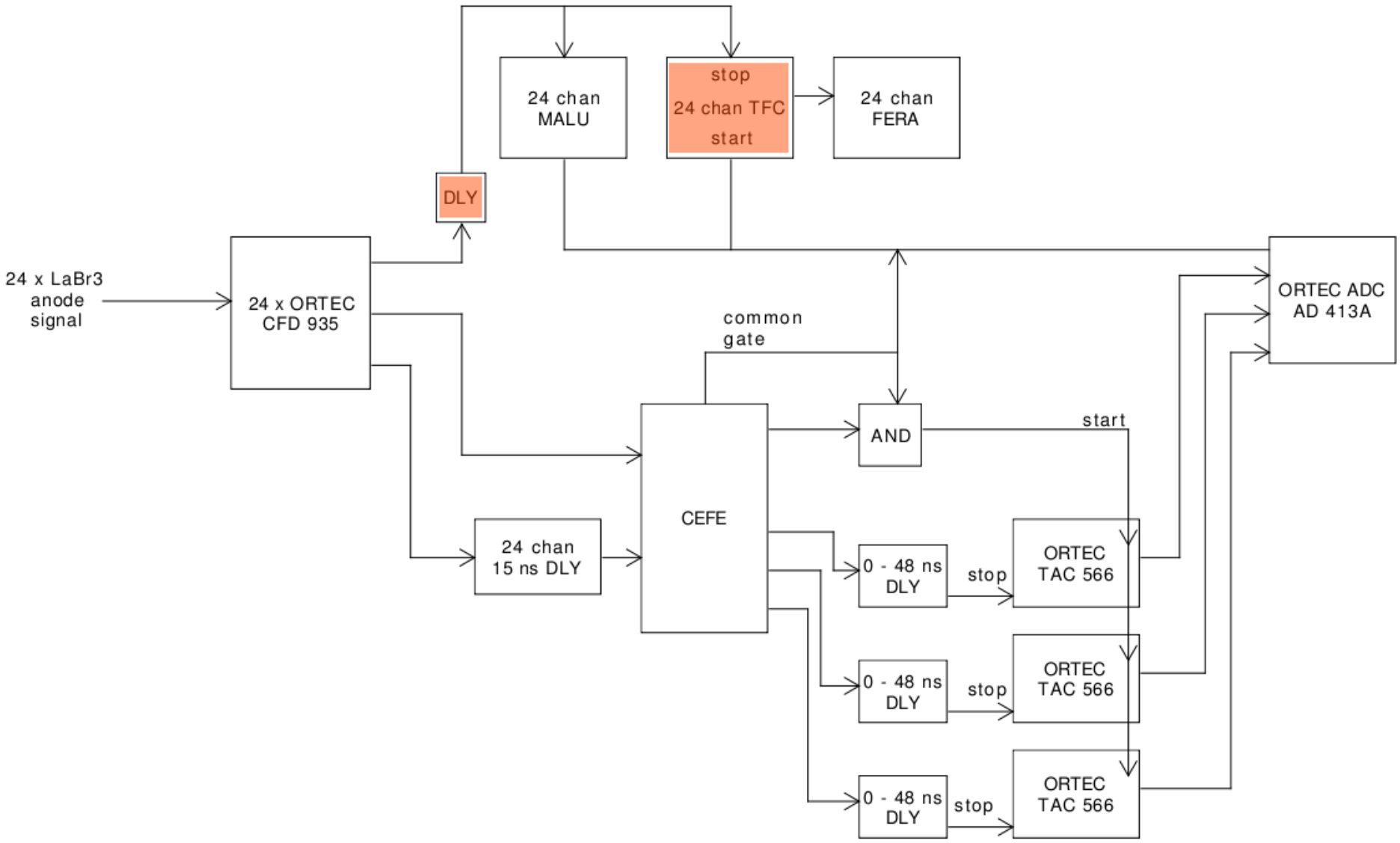
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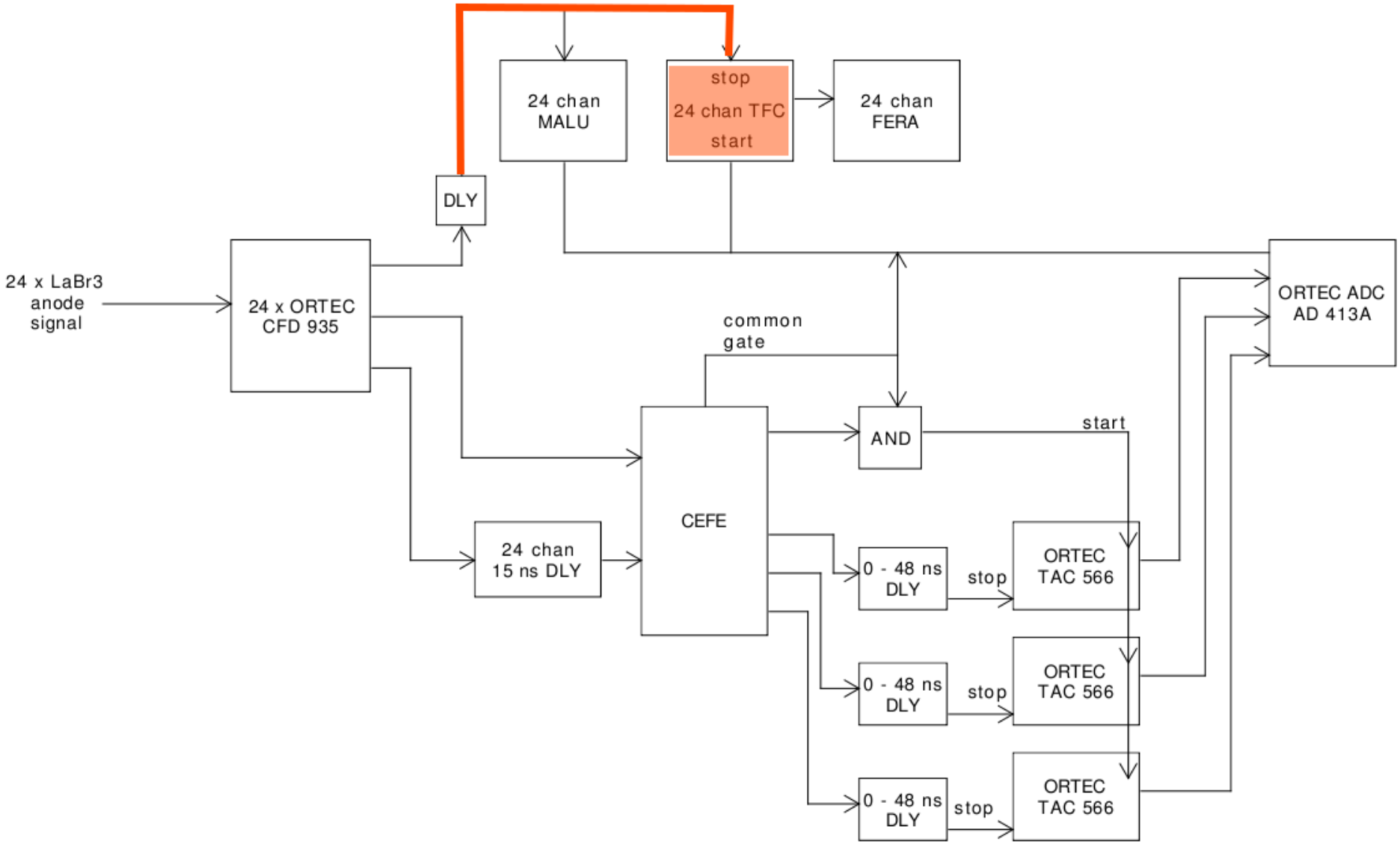
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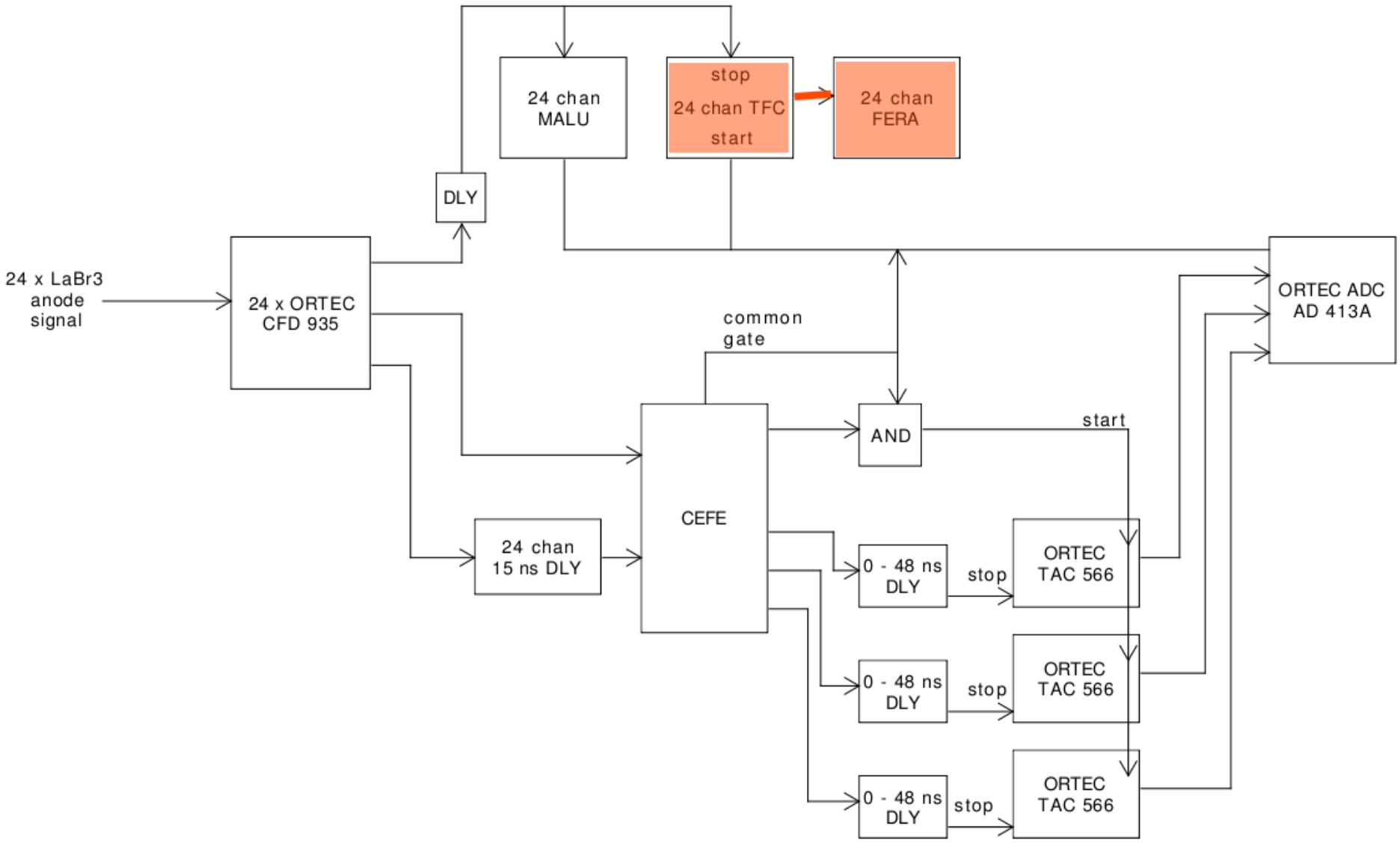
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DLY
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ORTEC
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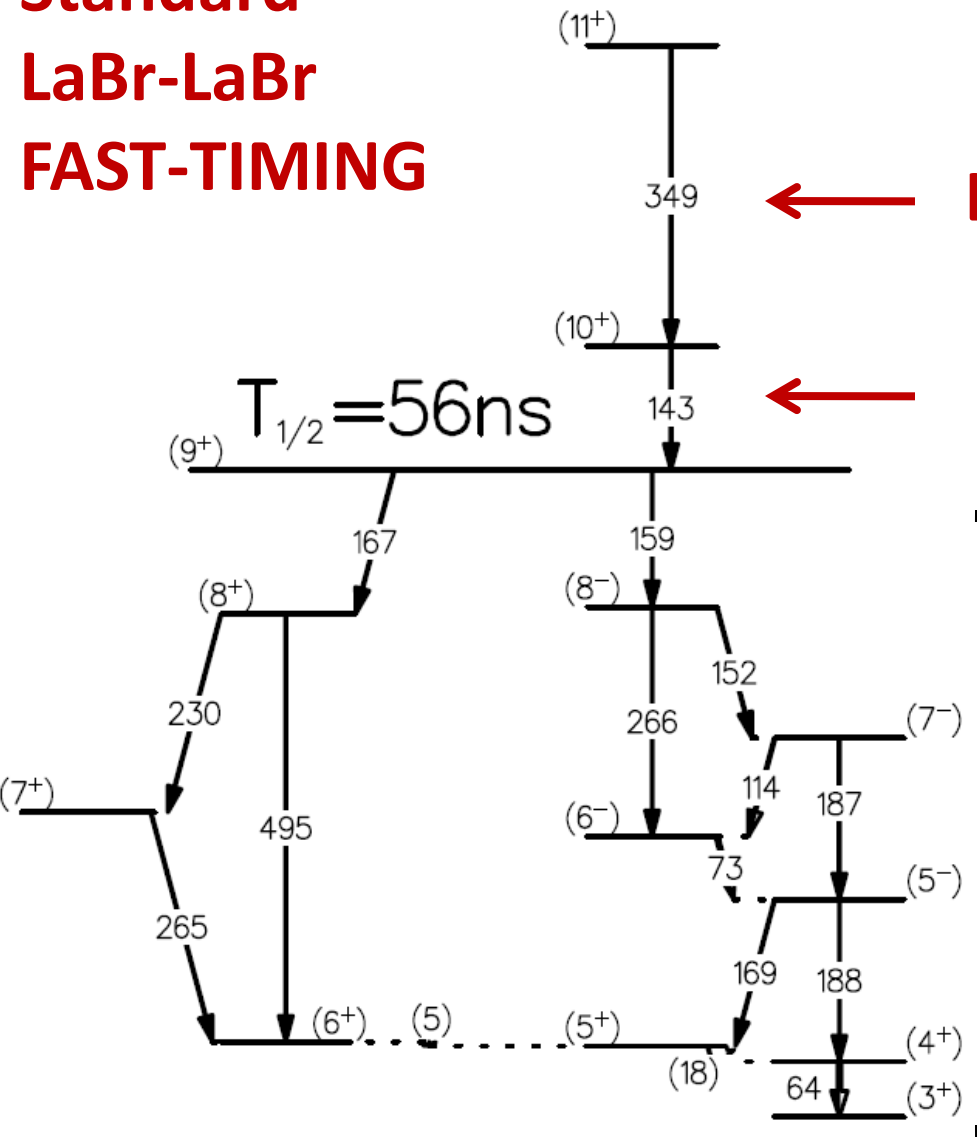
Several Fast-Timing techniques available

Standard
LaBr-LaBr
FAST-TIMING

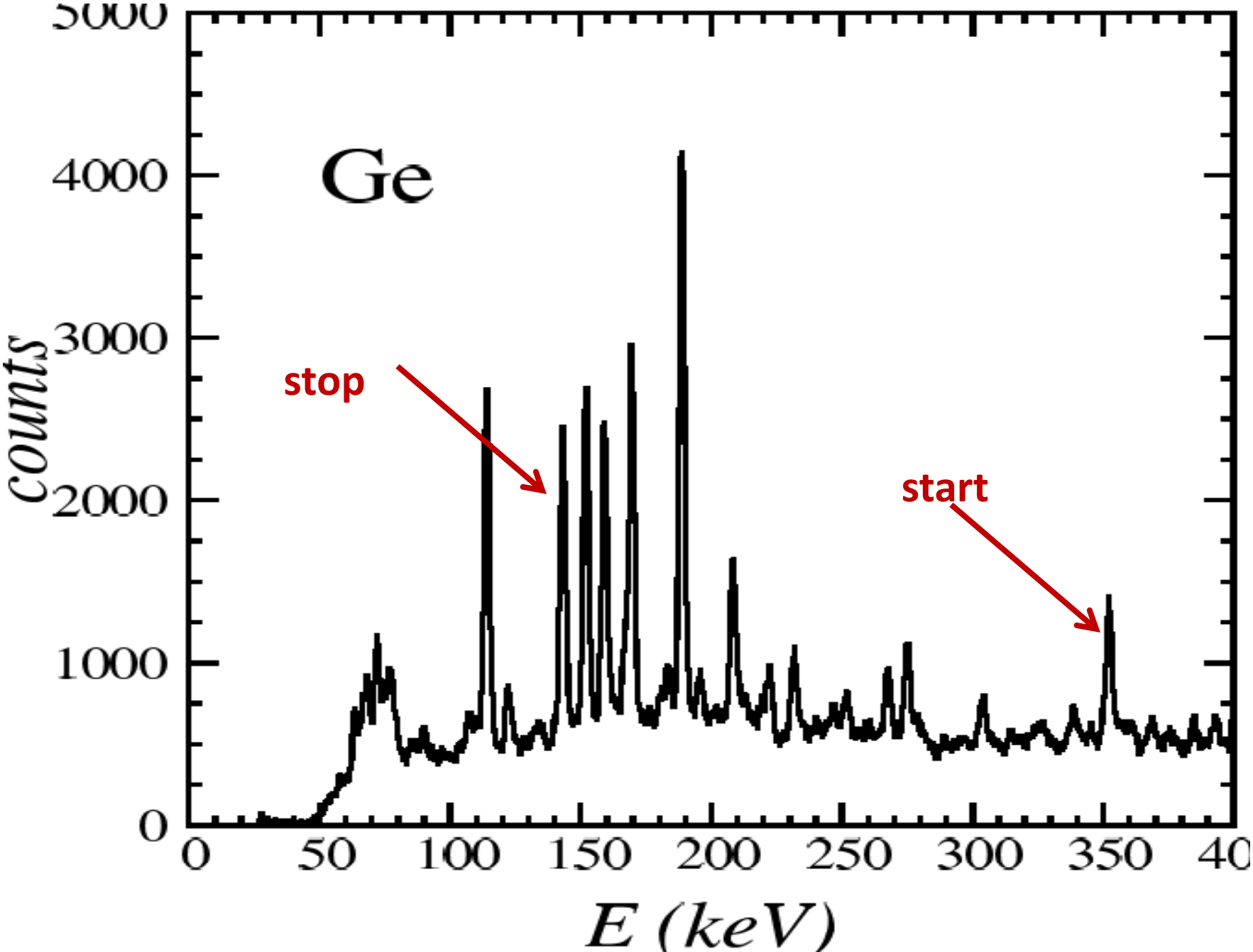
~ 100ps



LaBr (start) signal

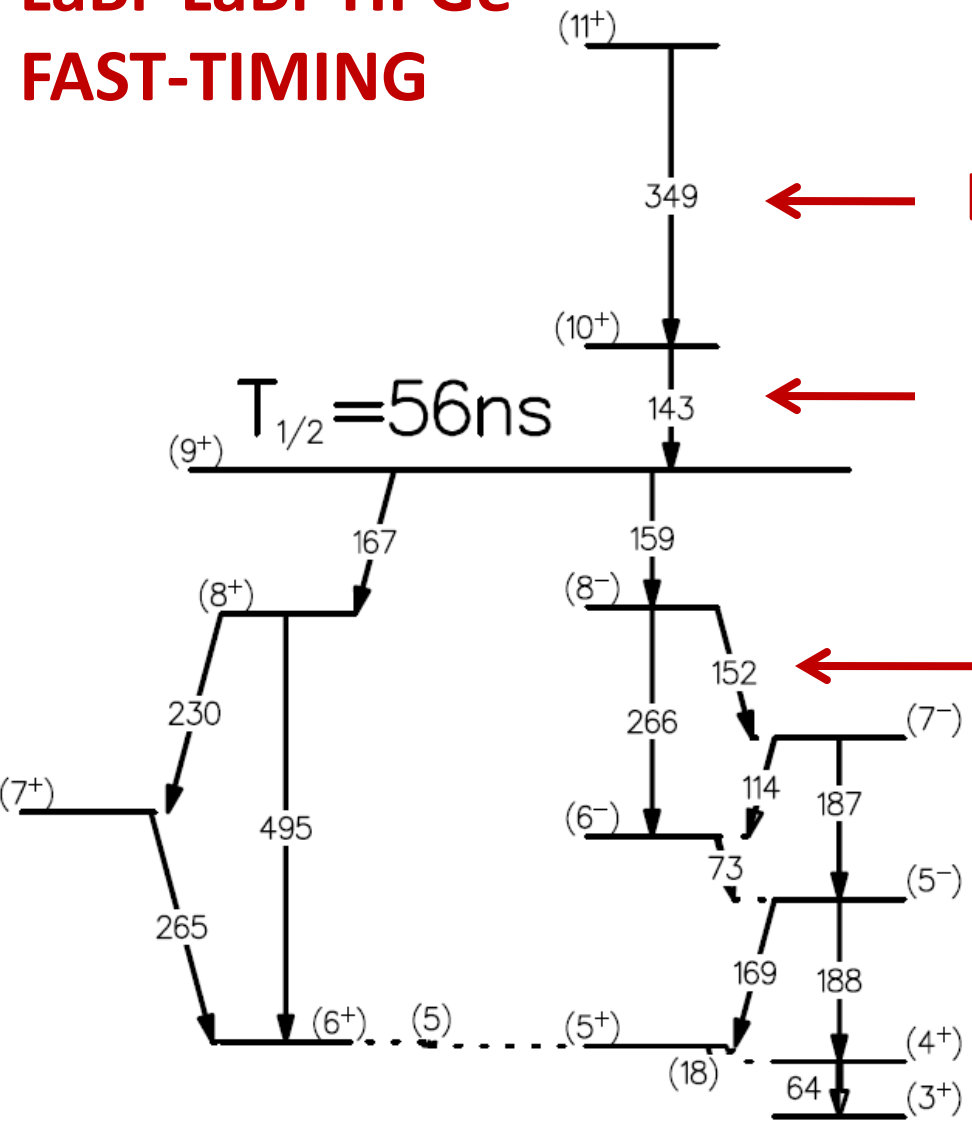
LaBr (stop) signal

~ 50000ps
Long-time
background


Ge
stop
start
counts
E (keV)
0
1000
2000
3000
4000
0
50
100
150
200
250
300
350

LaBr-LaBr-HPGe FAST-TIMING

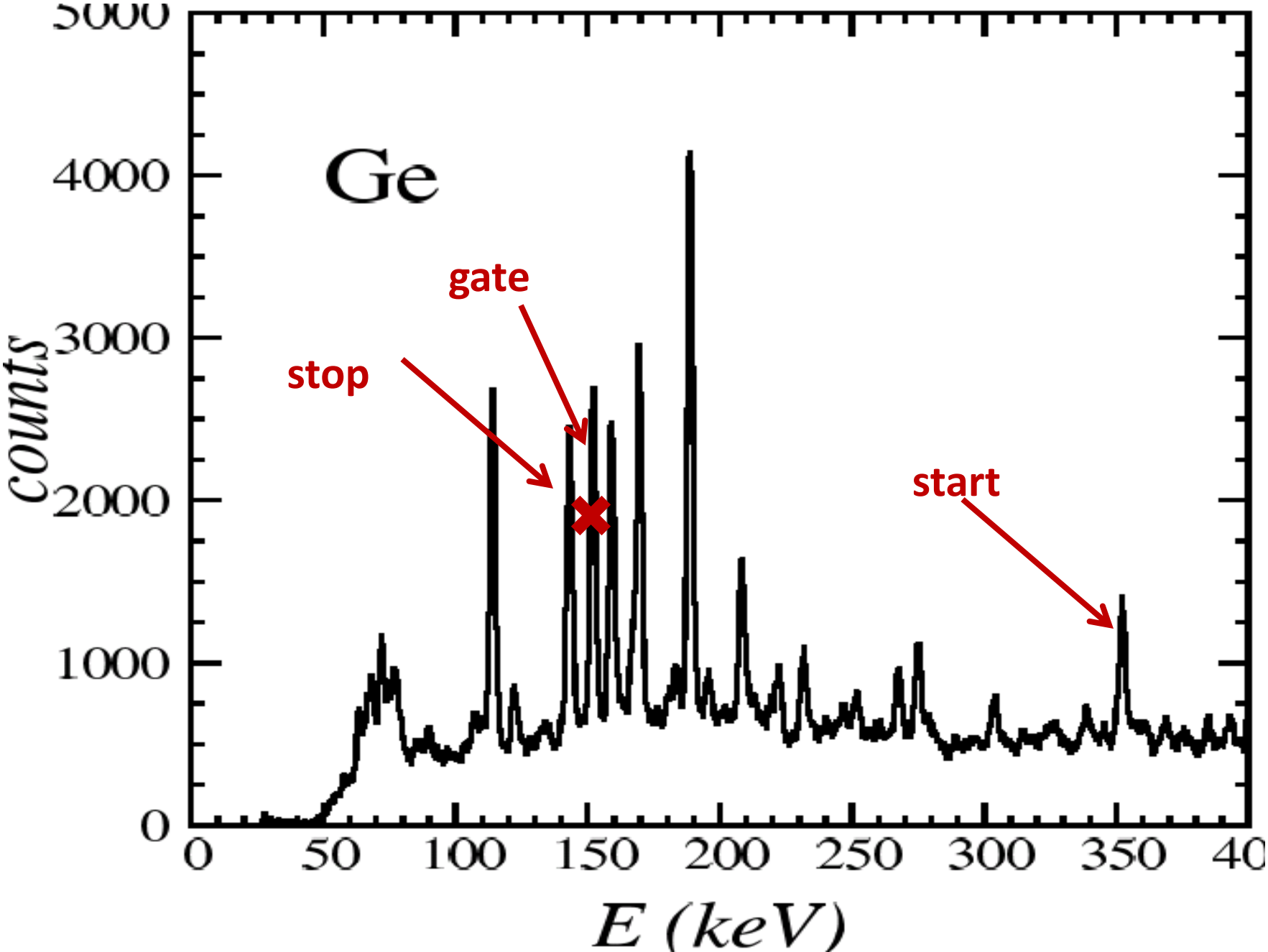
~ 100ps time spectrum



LaBr (start) signal

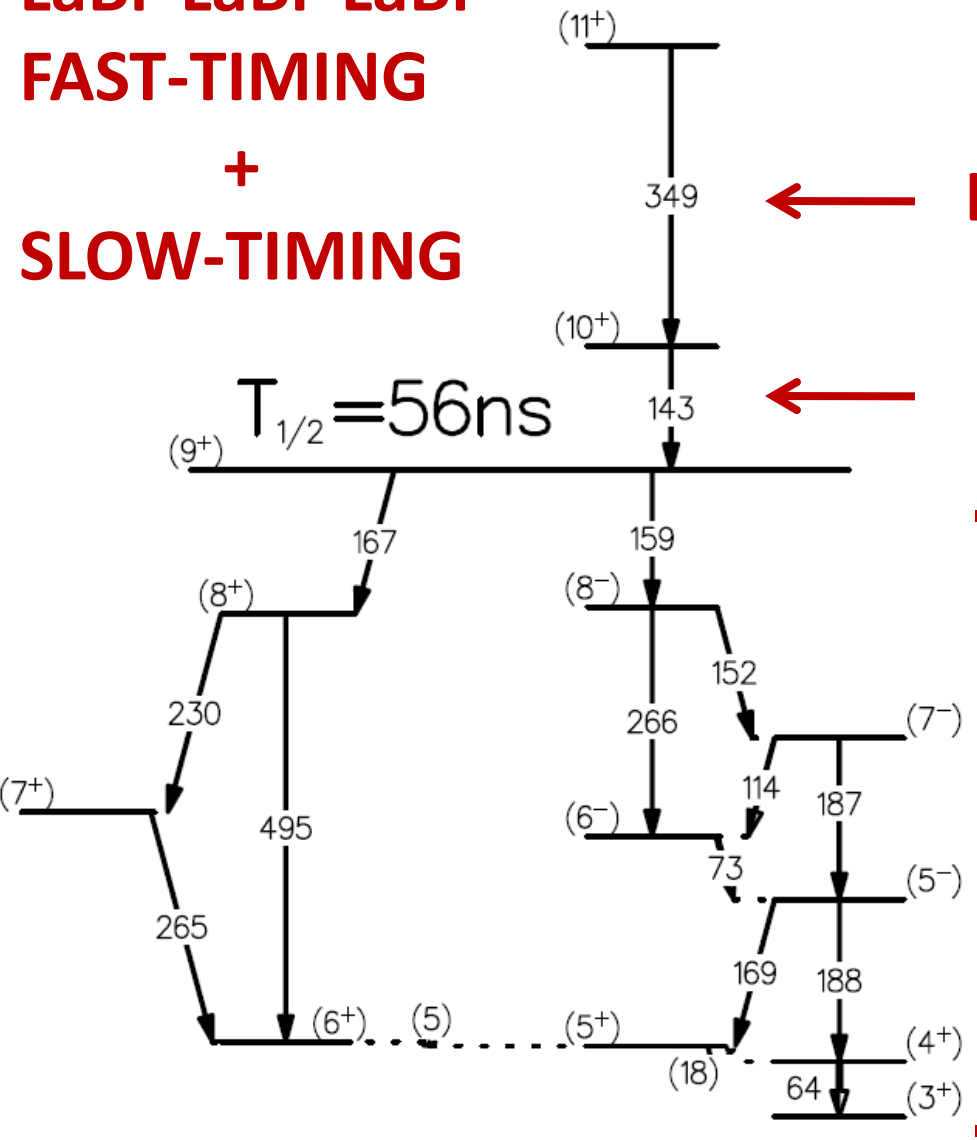
LaBr (stop) signal

HPGe gate


Ge
gate
stop
start
counts
E (keV)
0
1000
2000
3000
4000
0
50
100
150
200
250
300
350

LaBr-LaBr-LaBr
FAST-TIMING
+
SLOW-TIMING

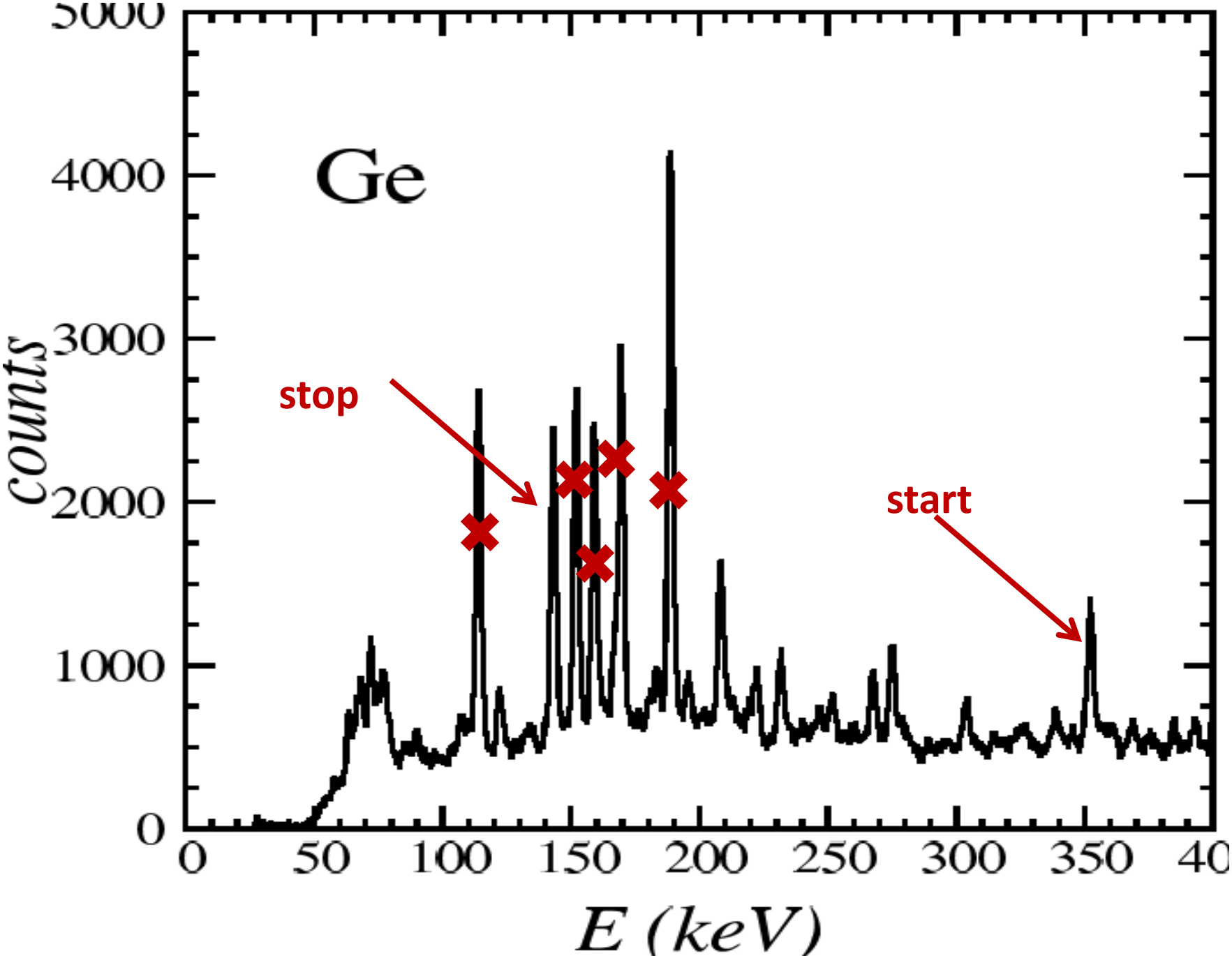
~ 100ps
time spectrum



LaBr (start) signal

LaBr (stop) signal

LaBr delayed coincidences


Ge
stop
start
counts
E (keV)
0
1000
2000
3000
4000
5000
0
50
100
150
200
250
300
350
40

ISSUES STILL TO RESOLVE

1) PRD curve, walk-curve
   widely used formulae not valid!

Nuclear Instruments and Methods in Physics Research A 684 (2012) 36–45

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Nuclear Instruments and Methods in Physics Research A

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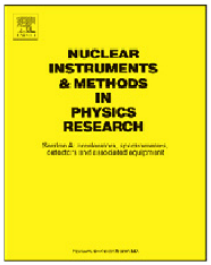
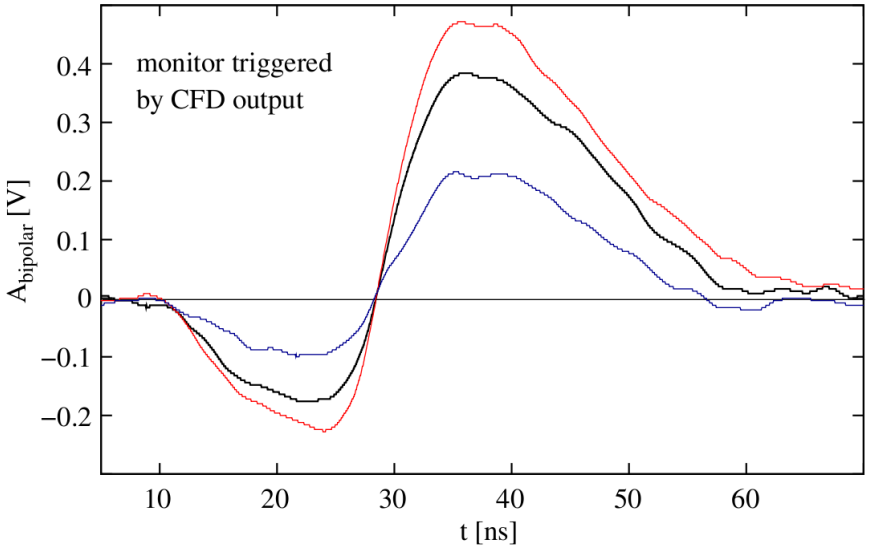
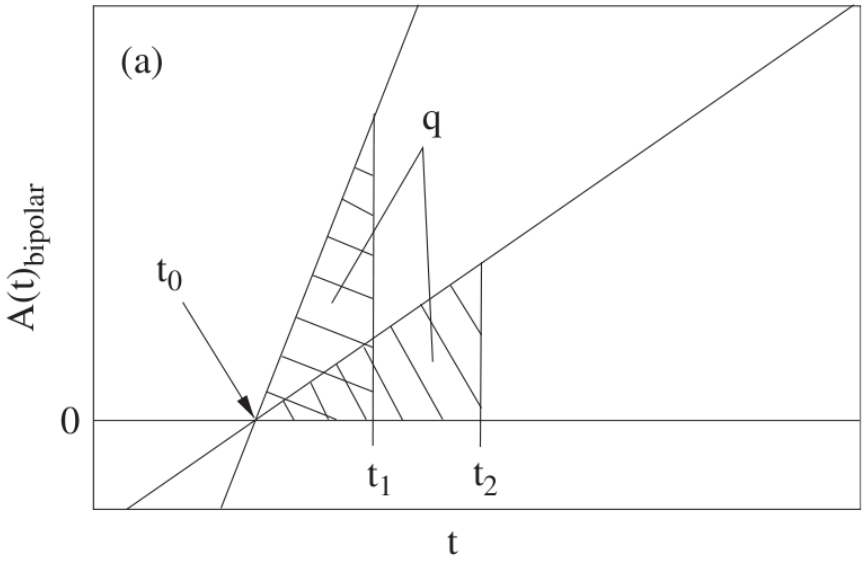


The time-walk of analog constant fraction discriminators using very fast scintillator detectors with linear and non-linear energy response

J.-M. Régis *, M. Rudigier, J. Jolie, A. Blazhev, C. Fransen, G. Pascovici, N. Warr

Institut für Kernphysik der Universität zu Köln, Zülpicher Str. 77, 50937 Köln, Germany

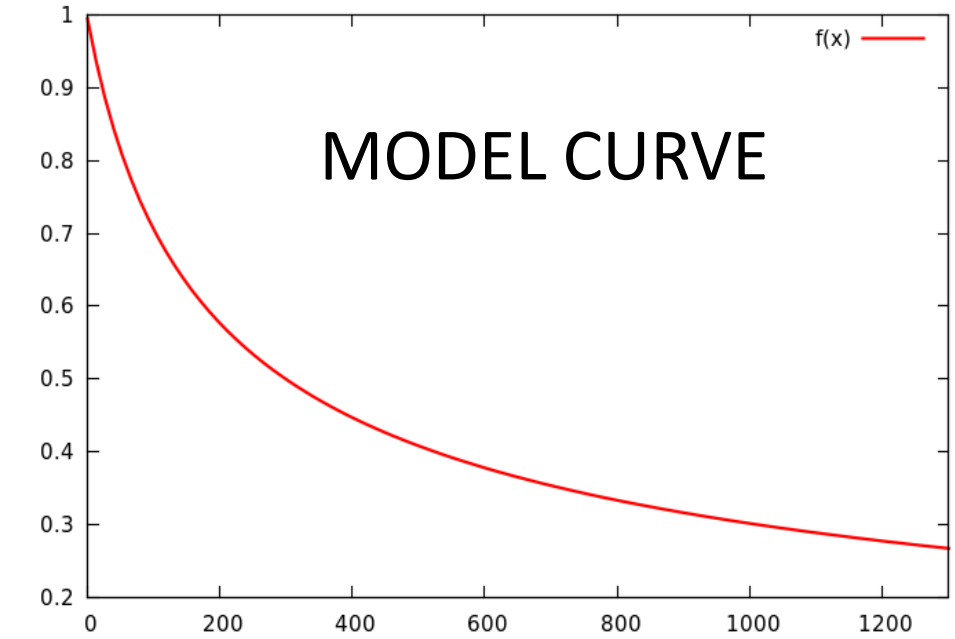




According to Eqs. (5) and (6), the energy dependent time-walk due to charge sensitivity of the zero crossover comparator can be expressed as

$$\Delta T_E = a/\sqrt{E+b} \qquad (10)$$

SEPARATE EXPERIMENT PERFORMED TO VERIFY THE F-T METHOD BASICS



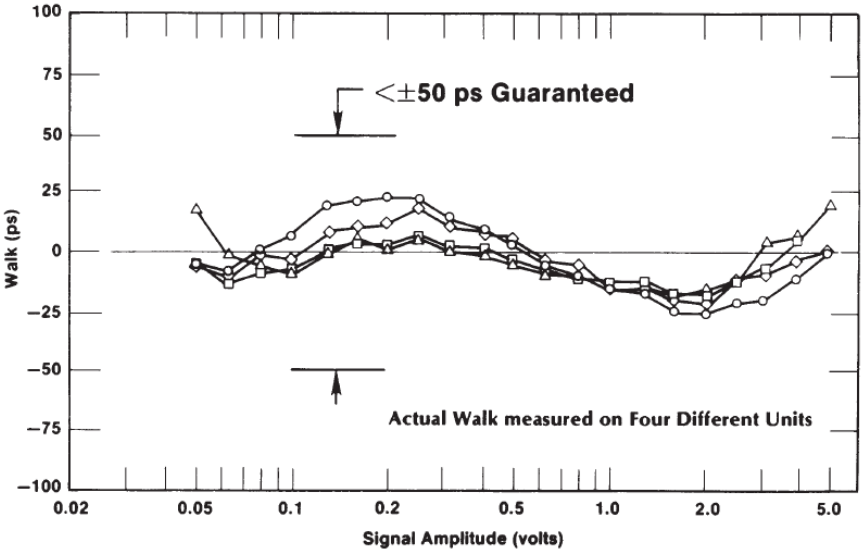
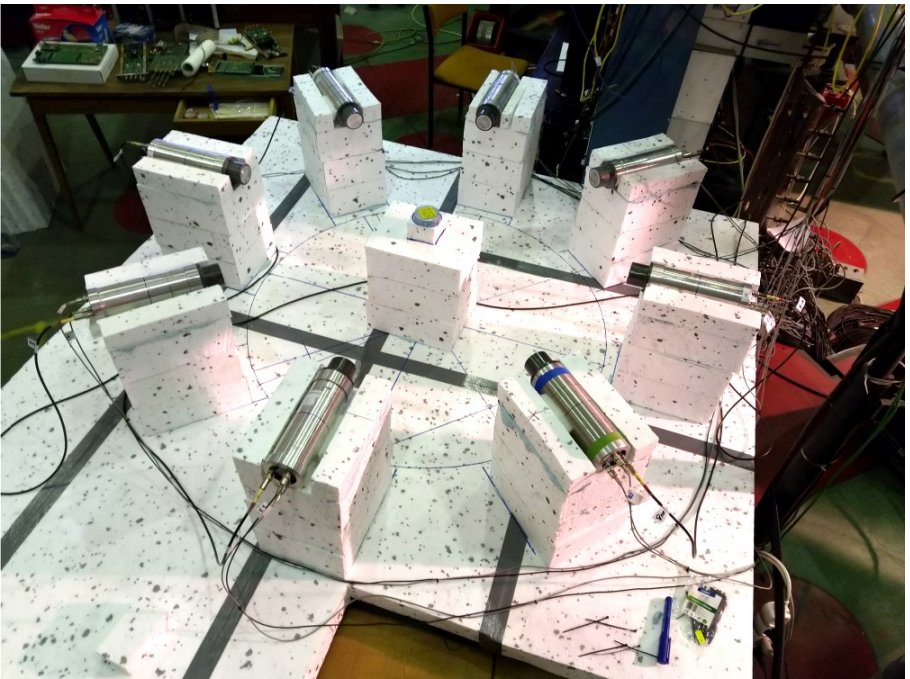
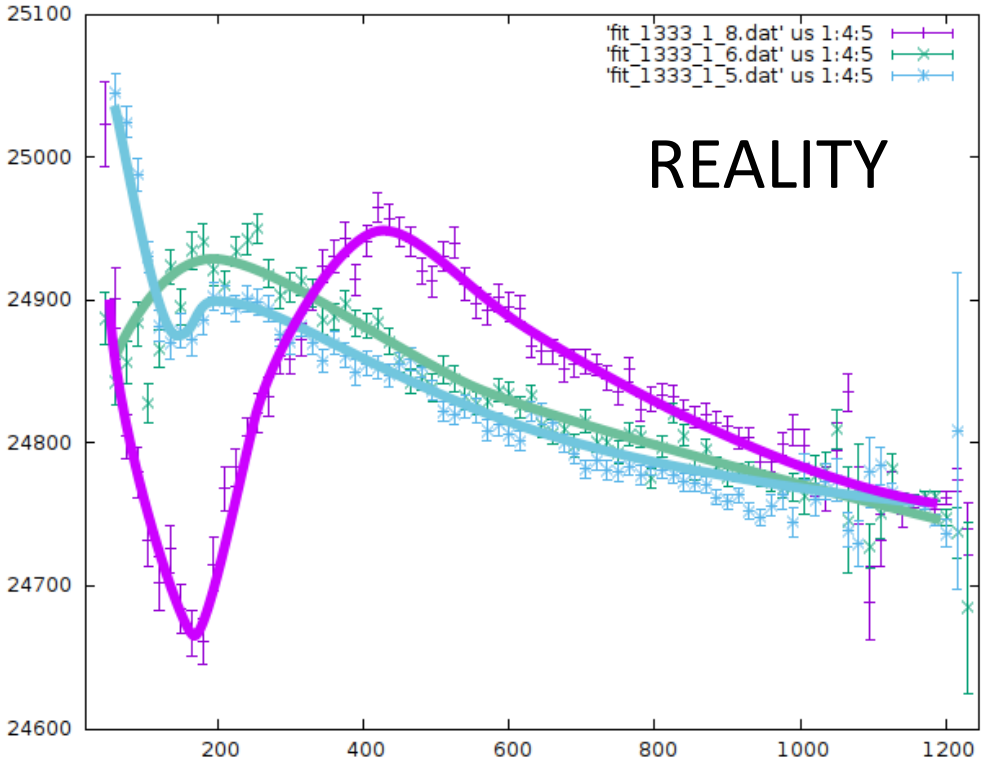


Fig. 1. Actual Walk Measured on Four Different Units.
See Walk Specification for Measurement Conditions.





ISSUES STILL TO RESOLVE

2) Methods to deal with Compton scattering

Nuclear Instruments and Methods in Physics Research A 811 (2016) 42–48

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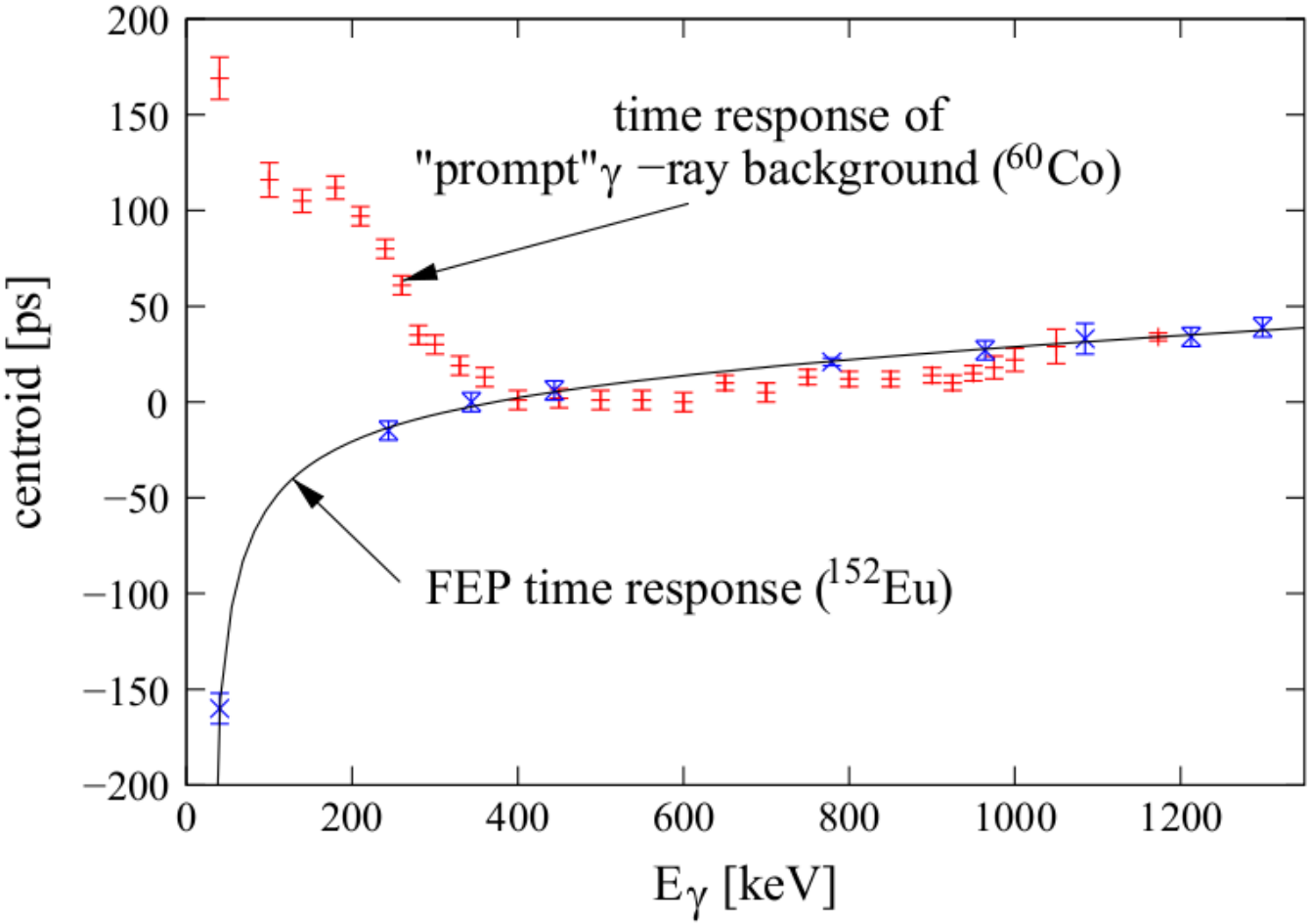
journal homepage: www.elsevier.com/locate/nima

On the time response of background obtained in γ-ray spectroscopy experiments using $LaBr_3(Ce)$ detectors with different shielding

J.-M. Régis *, M. Dannhoff, J. Jolie, C. Müller-Gatermann, N. Saed-Samii

Institut für Kernphysik der Universität zu Köln, Zülpicher Str. 77, 50937 Köln, Germany



the FEP time response. This indicates for single-interaction Compton events creating the Compton background compared to multiple interactions in the creation of the FEP, in agreement with the observations made in Refs. [13,24].

ISSUES STILL TO RESOLVE

3) Are the detectors position sensitive?

Team students workshop in collaboration with Faculty of Physics UW
Participation of 5 Students

Unique method for measurement of low energy 214keV event coming form interaction in subsequent layers of the crystal using 60Co without collimators!

Results: LaBrs can strongly be position sensitive!

detektory	d [cm]	λ [cm]	w [cm]	s [cm]	w - s [cm]
8 - 7	38.26	1.362	33.87 ± 0.37	40.98	-7.11 ± 0.37
8 - 6	70.71	1.362	63.91 ± 0.65	73.43	-9.52 ± 0.65
8 - 5	92.35	1.362	86.61 ± 0.35	95.07	-8.46 ± 0.35
8 - 4	100.00	1.362	95.93 ± 0.46	102.72	-6.79 ± 0.46

Collaboration:

E. Grodner[1], M. Kowalczyk[2] , J. Srebrny[2] , T. Abraham[2] , M. Brunet[3] , T. Cap[1] , S. Lalkovski[4] , T. Marchlewski[2] , S. Mianowski[1] , C. Mihai[5] , R. Mihai[5] , S. Pascu[5] , M. Rudigier[3] , M. Saxena[2] , Zh. Toneva[4] , A. Tucholski[2] , A. Turturica[5]

1) National Centre for Nuclear Research, Poland

2) Heavy Ion Laboratory, University of Warsaw, Poland

3) Department of Physics, University of Surrey, UK

4) Department of Nuclear Engineering, Faculty of Physics, Soa University "St. Kl. Ohridski", Soa 1164, Bulgaria.

5) IFIN-HH, Bucharest, Romania