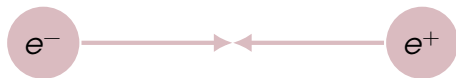
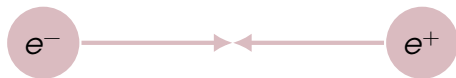


See Shen Xiaoyan's talk on Thursday 9h45:
Recent Results from BESIII





Fixed beam energy:
e.g. $E(e^+) = E(e^-) = \frac{1}{2} \text{mass}(J/\psi)$

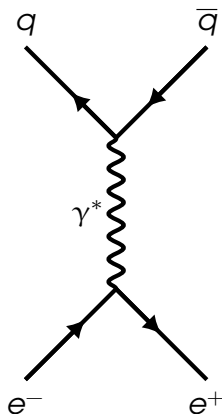


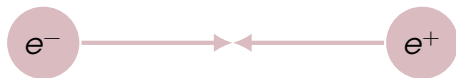
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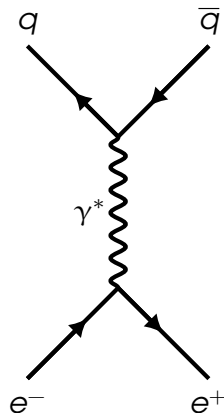


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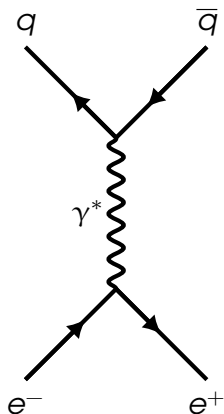


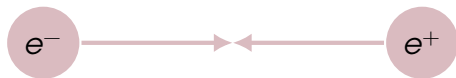
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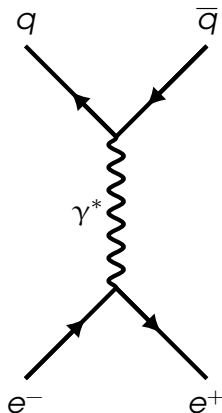


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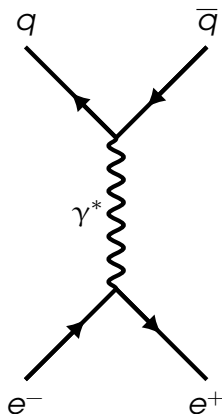


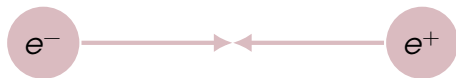
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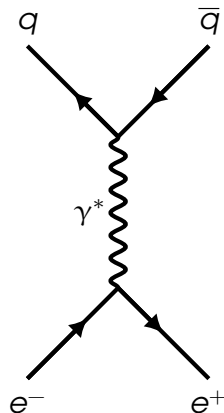


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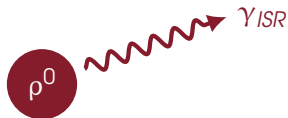




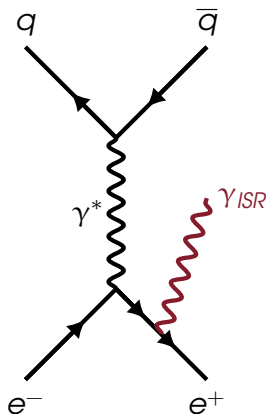
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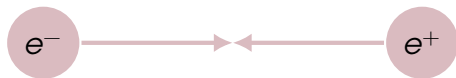
Initial state radiation (ISR): γ^* carries $\sqrt{s'} < \sqrt{s}$



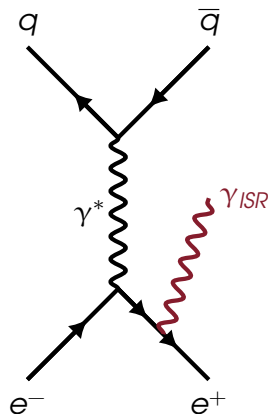
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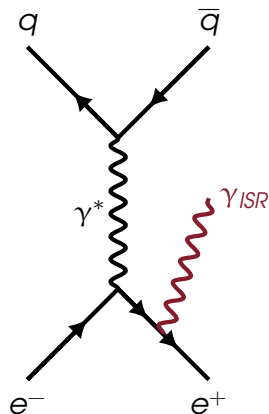
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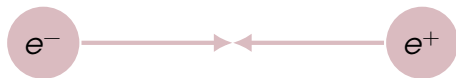
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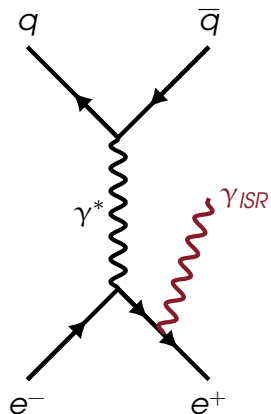
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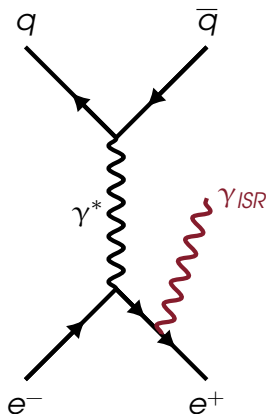
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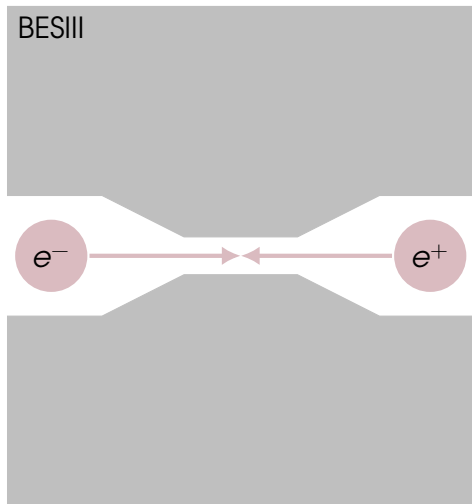


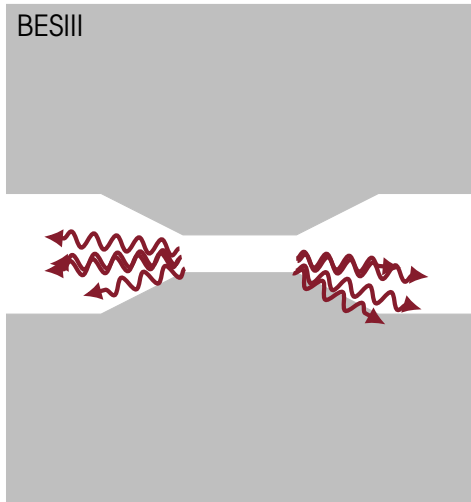
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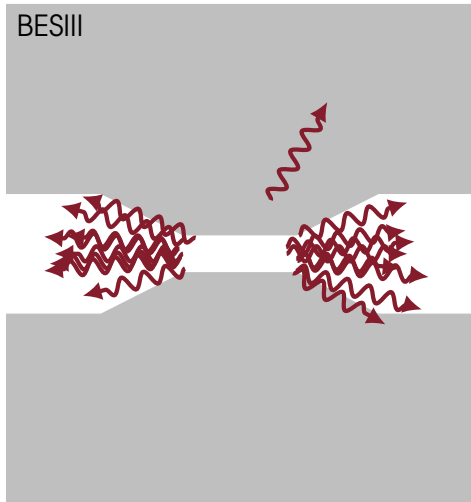


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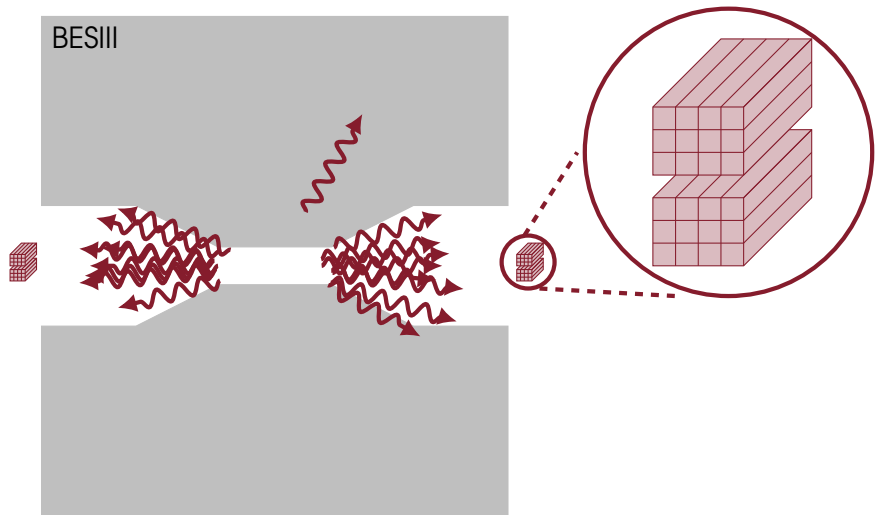




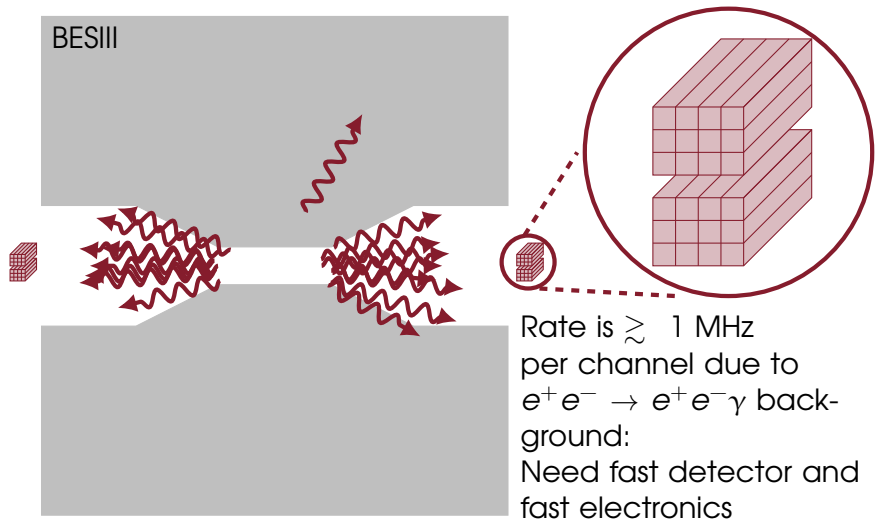




Leonard Koch (JLU Gießen): The Crystal Zero Degree Detector at BESIII



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JGU Mainz:

Achim Denig, Peter Drexler,
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Christoph Redmer

Uppsala Universitet:

Tord Johansson, Pawel
Marciniewski

JLU Gießen:

Leonard Koch, Wolfgang Kühn,
Sören Lange, Yutie Liang


THE CRYSTAL ZERO DEGREE DETECTOR AT BESIII

Achim Denig¹, Peter Drexler¹, Brice Garillon¹, Tord Johansson²,
 Leonard Koch³, Wolfgang Kühn³, Sören Lange³, Werner Lauth¹,
 Yutie Liang³, Pawel Marciniewski³, Christoph Redmer¹

¹Johannes Gutenberg Universität Mainz
²Uppsala Universität
³Justus-Liebig-Universität Gießen

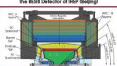
Motivation

Initial State Radiation (ISR) in e^+e^- Colliders




- emission of a real photon before annihilation of the e^+e^- pair
- ISR lowers \sqrt{s} to an effective $\sqrt{s'} = \sqrt{s} \sqrt{1 - 2x}$
- 3-dimensional measurement in whole range of $\sqrt{s'}$ while \sqrt{s} is constant
- well suited technique for extraction of threshold resonances, ρ waves, etc.
- distribution of IR photons strongly peaked in forward/backward direction (outside acceptance of BESIII)
- within two dedicated small subdetectors of $\theta = 0^\circ$ and $\theta = 180^\circ$

The BESIII Detector of IRP (Setup)



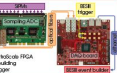
The Crystal Zero Degree Detector (cZDD)

Detector



- each detector consists of two arrays of crystals
- Gap reduces contamination from $e^+e^- \rightarrow \gamma^*e^+e^-$ pairs to 1%
- 1 MHz per channel
- 1000 ns lifetime
- short radiation length $X_0 = 1.15$ cm
- Full distribution across time to 40 ns
- High light yield (0.5 - 30% relative to NaI)
- SiCon Photomultiplier (SiPM)

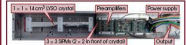
Data Acquisition (DAQ)



- Sampling ADC (SiCon)
- developed for INEXA SiC
- 144 channels, 12 bit resolution
- 100 MHz sampling rate
- two Xilinx Kintex 7 FPGAs: trigger extraction, data reduction
- DAQ-board (SiCon)
- silicon development board equipped with Xilinx Max 100klogic FPGA
- code building, automatic building
- Coordination with BESIII Trigger
- BESIII event builder

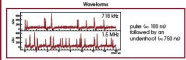
Prototype Beam Test of MAME in Nov. '17

cZDD Prototype Grade 1.0



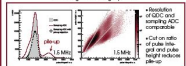
1 x 1 x 1 mm³ cZDD crystal
 3 x 3 SiPM x 2 in front of crystal

Waveforms




7.10 ns
 pulse in 100 ns followed by an underburst (to 750 ns)

Pulse Integration - Charge Spectra



- Resolution of ADC and sampling ADC comparable
- Cut on ratio of pulse height and pulse height reduces pile-up

Setup



Prototype detector
 1000 ns beamline treated dump for rate determination, 2 sets - 14 MHz

DAQ board

- Sampling ADC + DAQ-board
- ADC for comparison

Conclusion & Outlook

- IR detection of very small angles requires a fast detector and real-time data processing
- successful test of cZDD prototype in a high-rate environment with full DAQ chain
- well-tuned algorithm for pile-up recovery needed for pile-up rejection under development

Many thanks to Johannes Müller for his valuable design of the ADC! | To visit successfully, go to [BESIII] or [cZDD] on the development page

