The BESIII experiment installed in the $e^+e^-$ collider BEPCII at the IHEP of Beijing is taking data in the 2.0 - 4.6 GeV region since 2009. It has a rich physics program and has already collected the world largest samples of $J/\psi$ and $\psi'$. 

**The Zero Degree Detector at BESIII**

**BEPCII:** better segmentation to have a

The first layer has a thinner

Along the

The modules are segmented

**Design features**

- Beam energy: 1.0-2.3 GeV
- Crossing angle: 22 mrad
- Luminosity: $10^{33}$ cm$^{-2}$s$^{-1}$
- Optimum energy: 1.89 GeV
- Energy spread: $5.16 \times 10^{-4}$
- Number of bunches: 93
- Bunch length: 15 mm
- Total current: 0.91 A
- Circumference: 240 m

**Initial State Radiation**

**ISR differential cross section**

\[
\frac{d\sigma}{d\cos(\theta)} = \sigma(\cos(\theta)) \cdot \epsilon(\cos(\theta))
\]

The acceptance at large angle is equivalent to that, almost point-like, in forward-backward direction

A zero-degree radiative photon tagger will suppress most of the background due to misidentified $e^+e^-$'s are produced with high BR's by resonances

**The ZDD calorimeter**

- Each module is a fine sampling lead-scintillating fibers calorimeter (à la KLOE)
- The basic structure consists of an alternating stack of 1 mm fibers layers glued between thin grooved lead foils
- The ratio fiber-lead-glue in the final composite is 48:42:10
- The density is about 5 g/cm$^3$
- The radiation length is $X_0 = 1.6$ cm

**ZDD at the Frascati Beam Test Facility**

- Shower profile across the 4 layers
- Charge distributions with 450 MeV electrons

The signal in coincidence with the scintillator trigger is very well separated from the 2 electron bunches

**ZDD at BESIII**

- Two sections: East and West side
- Each section is made of two, 14x4x6 cm$^3$, modules: upper and lower
- An empty 10 mm-wide slot between upper and lower module suppresses the Bremsstrahlung background

**The ZDD concept and design**

- Angular distributions for ISR and Bremsstrahlung photons
- The slot suppresses about 50% of ISR signal and more than 90% of the Bremsstrahlung

**The ZDD accuracy**

The resolution is

\[
p_1 = 6.8 \% \quad p_2 = 5.2 \%
\]

The final calibration will be done with Bremsstrahlung data at BESIII

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**The BESIII experiment and the ZDD**

- Magnetic yoke
- RPC (68 layers Barrel/Endcaps)
- Sc magnet, 1 Tesla
- TOF (scintillators), 90 ps
- Be beam pipe
- MDC, 120 $\mu$m
- CAEN V792N

The BESIII experiment foresees the installation of two zero-degree detectors, ZDD, to measure the energy and directions of photons produced in ISR processes, along the beam line in the forward and backward direction. The first of these detectors, on the East side, has been recently installed.

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**The ZDD at the Frascati Beam Test Facility**

- Gearbox for movement
- Bundles (2 m)

The light collected by the modules is sent through bundles of clear optical fibers, 2 m long, to 10 Hamamatsu PMTs.

The PMTs are installed in an area with low but not negligible magnetic field.