Performance of VPTs in magnetic field

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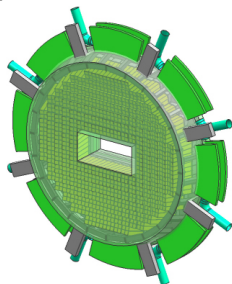**Introduction**
Measurements
Summary and Outlook

Introduction
Magnetic Field Simulation
Setup
Hamamatsu R2148MOD

Introduction

Electromagnetic Calorimeter Forward Endcap

Special needs for photodetectors

▶ sensitive

▶ fast
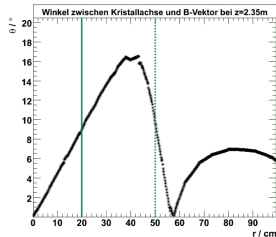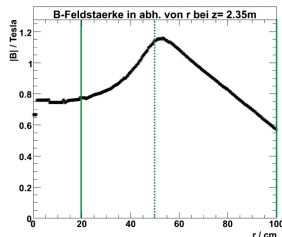
▶ radiation hard

▶ suitable to operate in magnetic fields

because of

▶ magnetic field $\Rightarrow$ no Standard PMTs

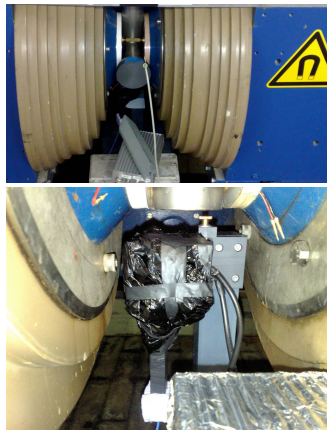▶ high rate 500 kHz $\Rightarrow$ no APDs for innermost crystals

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Magnetic Field Simulation

- ▶ Forward Endcap:
  $z = 2.35$m, $r = 20$cm-100cm

- ▶ High rates: $r = 20$cm-50cm

- ▶ Magnetic field strength:
  0.6 T - 1.2 T

- ▶ Angle between VPT axis and
  B-Vector:
  $\theta = 0° - 17°$

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Setup

- ▶ LED pulser ($f = 5$ kHz)
- ▶ LUXEON1 High-Power LED $\lambda = 455$ nm
- ▶ optical fibre transfers light pulses to VPT
- ▶ preamplifier transmits signal to mainamplifier and afterwards to ADC
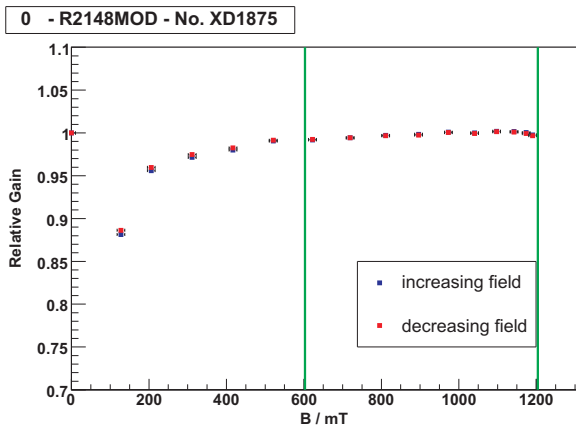- ▶ preamplifier developed in Basel for $\overline{P}$ANDA

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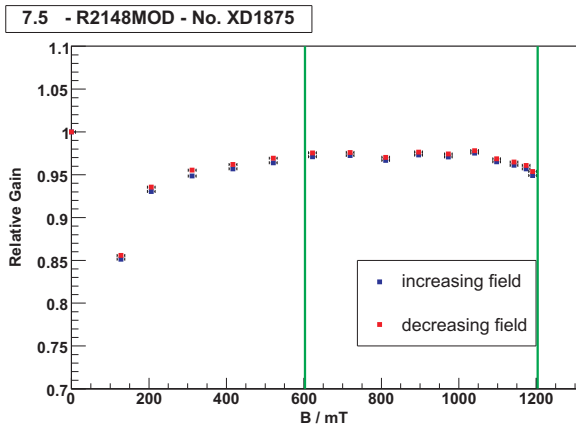**Hamamatsu R2148MOD**

Hamamatsu R2148MOD

Hamamatsu R2148MOD
especially made for $\overline{\mathrm{P}}$ANDA, $\varnothing < 24$ mm

- $\varnothing = 23.7$ mm
  $\ell = 30$ mm
- $U_A = 750$ V
  $U_D = 500$ V
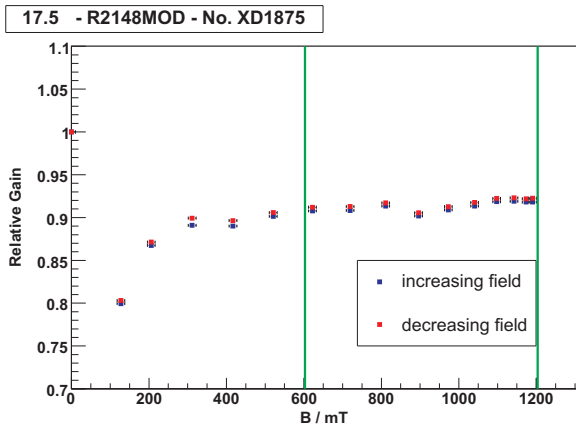- G = 9.3
- QE = 32 %
  (at 420 nm)

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$\theta = 0°$
$\theta = 7.5°$
$\theta = 17.5°$
$B = 1.2T$

0 - R2148MOD - No. XD1875

▶ In the region between 0.6-1.2 T we have a max. loss in gain of 1%

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$\theta = 0°$
$\theta = 7.5°$
$\theta = 17.5°$
$B = 1.2T$

7.5 - R2148MOD - No. XD1875

▶ In the region between 0.6-1.2 T we have a max. loss in gain of 5%

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$\theta = 0°$
$\theta = 7.5°$
$\theta = 17.5°$
$B = 1.2T$

▶ In the region between 0.6-1.2 T we have a max. loss in gain of 10%

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$\theta = 0°$
$\theta = 7.5°$
$\theta = 17.5°$
$B = 1.2T$

angle dependence, B=1.2 T - R2148MOD - No. XD1875
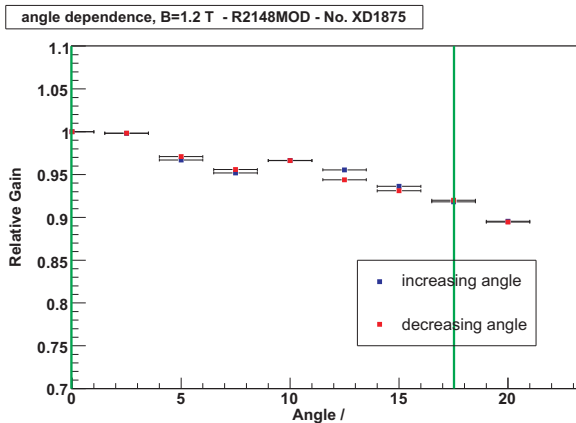
- ▶ B = 1.2 T
- ▶ max. loss in gain of 10%

Summary and Outlook

- ▶ For all VPTs in the endcap we have an acceptable loss in gain of ≤ 10%

- ▶ Order of 10 glass bulb versions from Hamamatsu R2148MOD ⌀24 mm

- ▶ Expecting the Vacuum Photo Tetrode (VPTT) (gain of 20 .. 30), made by RIE in October 2009