

## Vacuum Photo Tetrodes for PANDA?



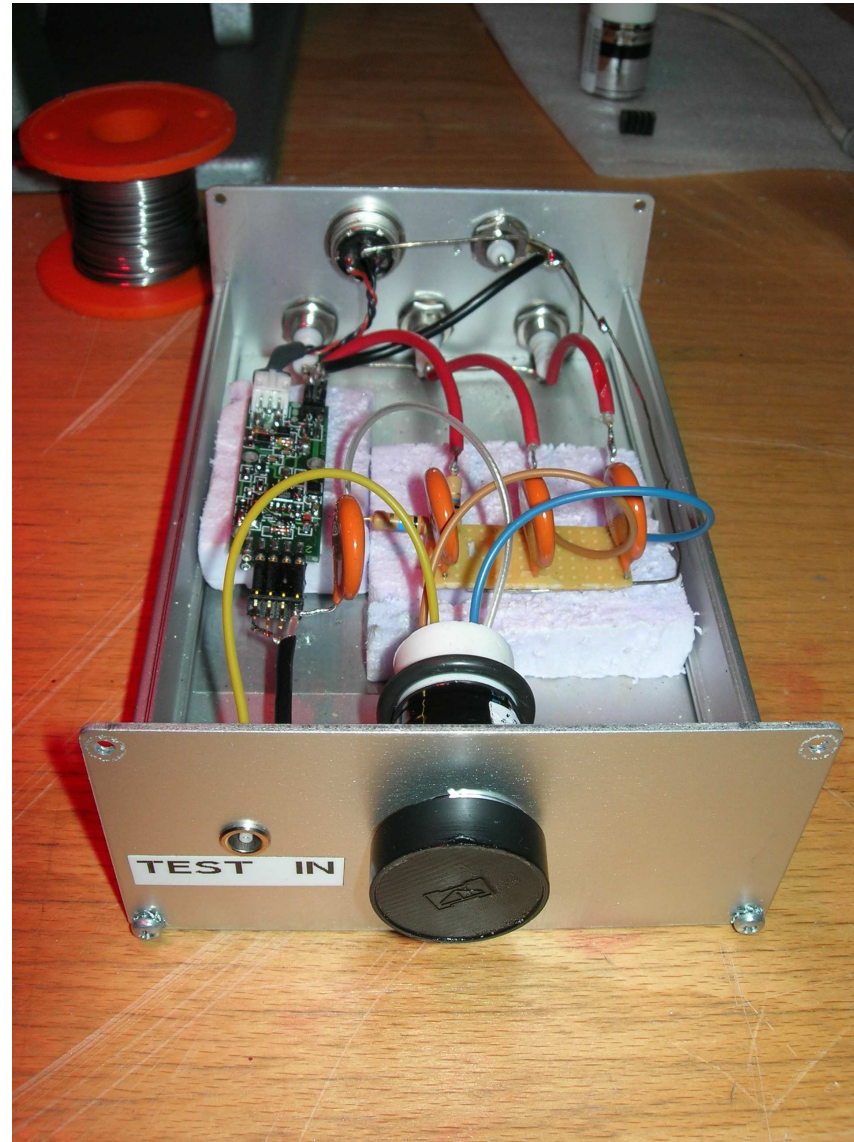
Thomas Held

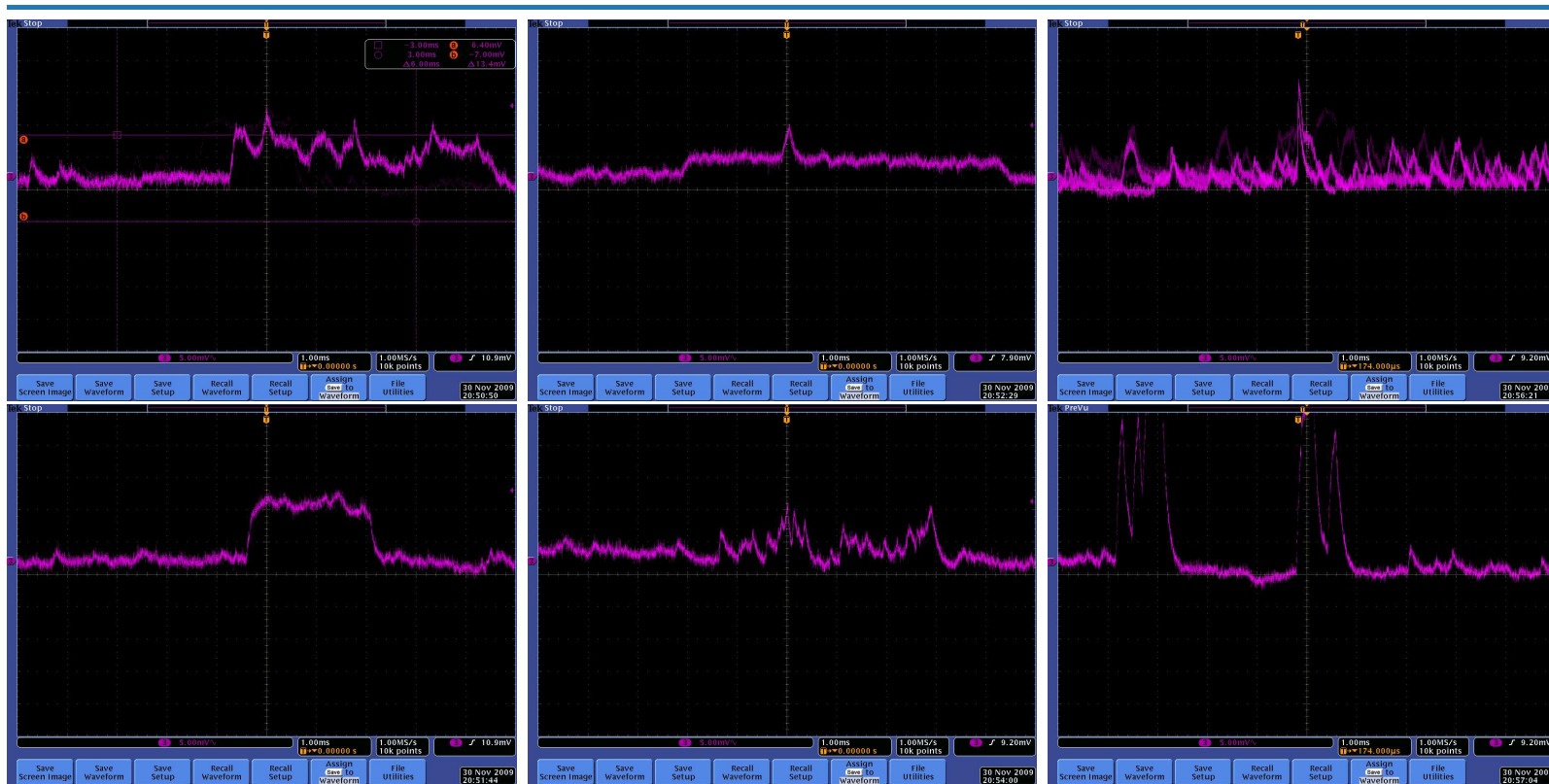
Institut für Experimentalphysik I

Ruhr-Universität Bochum

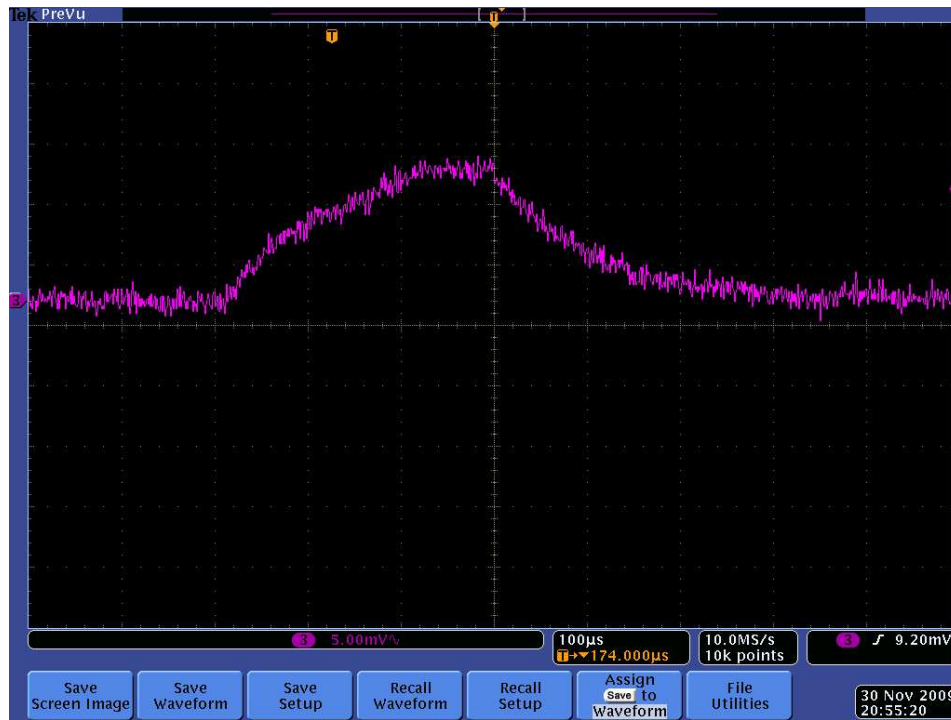
- **Manufacturer: RIE, Petersburg, Russia**
- **4-electrode systems (photo cathode, 2 dynodes, anode)**
- **Arrangement of electrodes?**
- **Dimension: length 45.5 mm, diameter 21.5 mm, silicon base with wires**
- **Supply voltage 1200 V  
( $D_1$ : +500 V,  $D_2$ : +1000 V, if cathode grounded)**
- **Quantum efficiency  $P=0.14\text{...}0.20$  % (stated by RIE)**
- **Gain  $G=24\text{...}45$  (stated by RIE)**
- **Dark current  $I_D=1\text{...}10$  nA (stated by RIE)**
- **(Hamamatsu R2148MOD:  $P=0.23$ ,  $G=8$ ,  $I_D=0.1$  nA)**
- **Radiation hard up to at least 1.5 kGy (stated by RIE)**
- **Magnetic field strength tolerance (?)**
- **First 10 pieces recently arrived at Bochum (2 at Basel)**

- VPTT read out by Basel VPT preamp
- Additional (external) coupling capacitor to cope with higher supply voltage
- Separate HV supplies for dynodes and anode
- External filter circuits



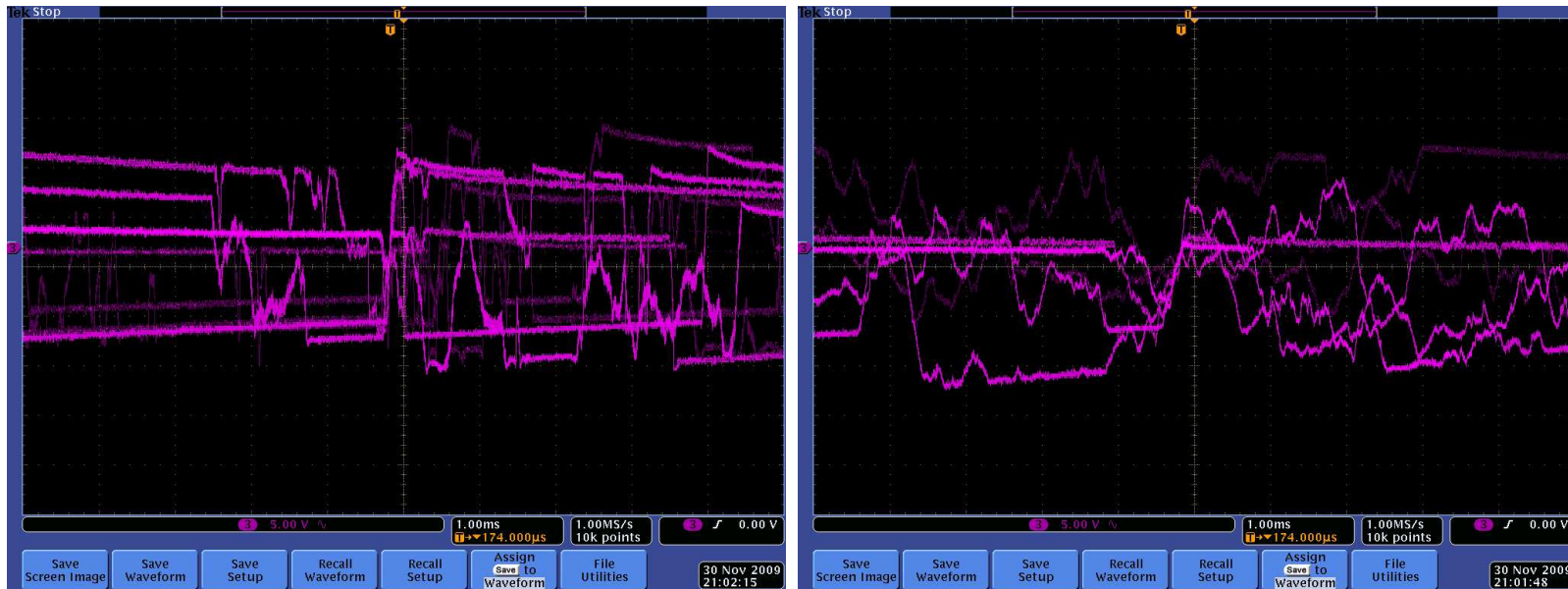


- All plots: Preamp output signals, vertical scaling 5 mV/div
- Sometimes (tube related?) several hundred millivolts amplitude!
- 'Activity' spans from occasional signals to explosions of bursts
- 'Fireworks' show up/vanish spontaneous, almost immediately after supply of HV or hours later, generally last several hours

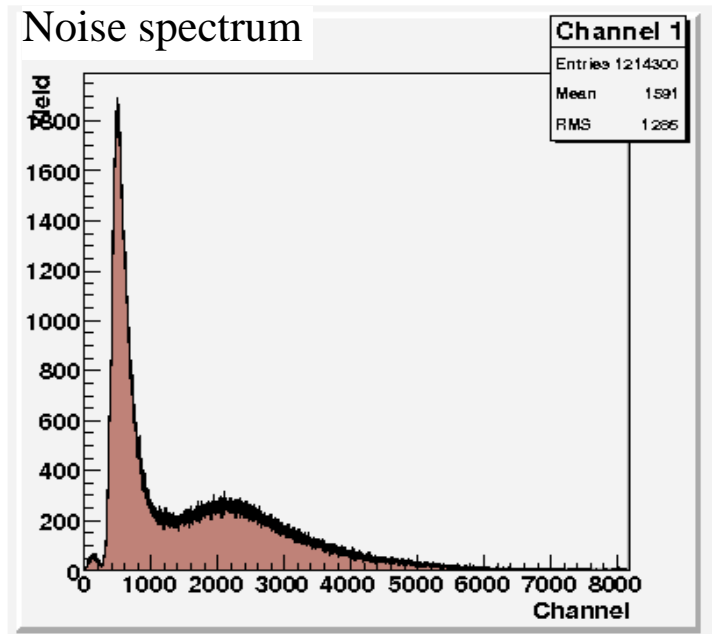


- Most (all?) of the structures may be described as combinations of 'capacitor charge-discharge'-like curves...!?
- Definitely tube effect!
  - ▷ tried different/removed filter circuits
  - ▷ tried different preamps (Basel (w/o filter circuit), commercial)
  - ▷ tried different HV power supplies



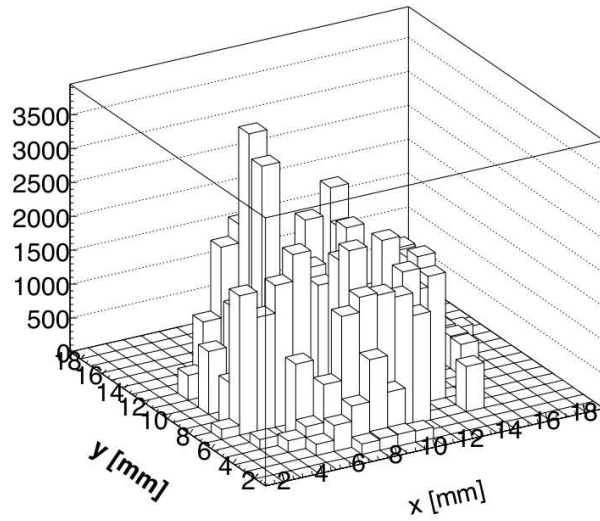


- Switching off HV on ( $D_1?$ ),  $D_2$  or A causes even higher amplitude structures
- Vertical scaling: 5 V per division!
- Preamp killing procedure!

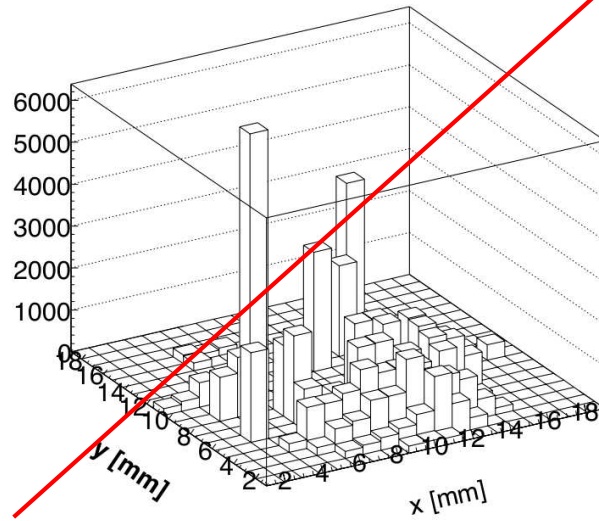


- Unlike VPTs clear noise signals triggerable (about 1...2 Hz)
- P\*G ranking:
  - ▷ 7, 10, 3, 8, 4, 9, 5, 2, 1 (measurement)
  - ▷ 10, 2, 9, 3, 8, 5, 7, 6, 1, 4 (RIE)
- Discrepancy may be caused by different light source (DC vs. pulser, spectrum?)
- Very high microphony (even fans in readout rack affect baseline!)

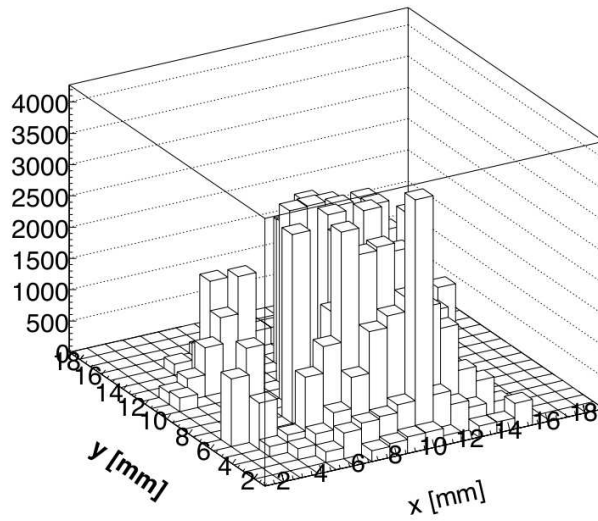
tube #0002



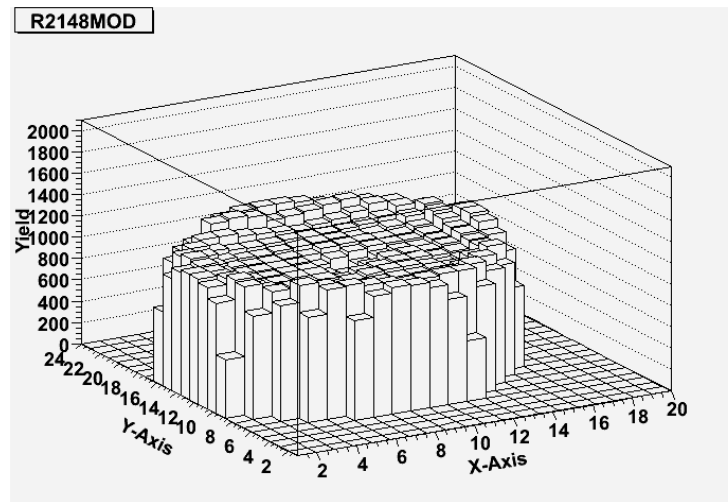
tube #0006



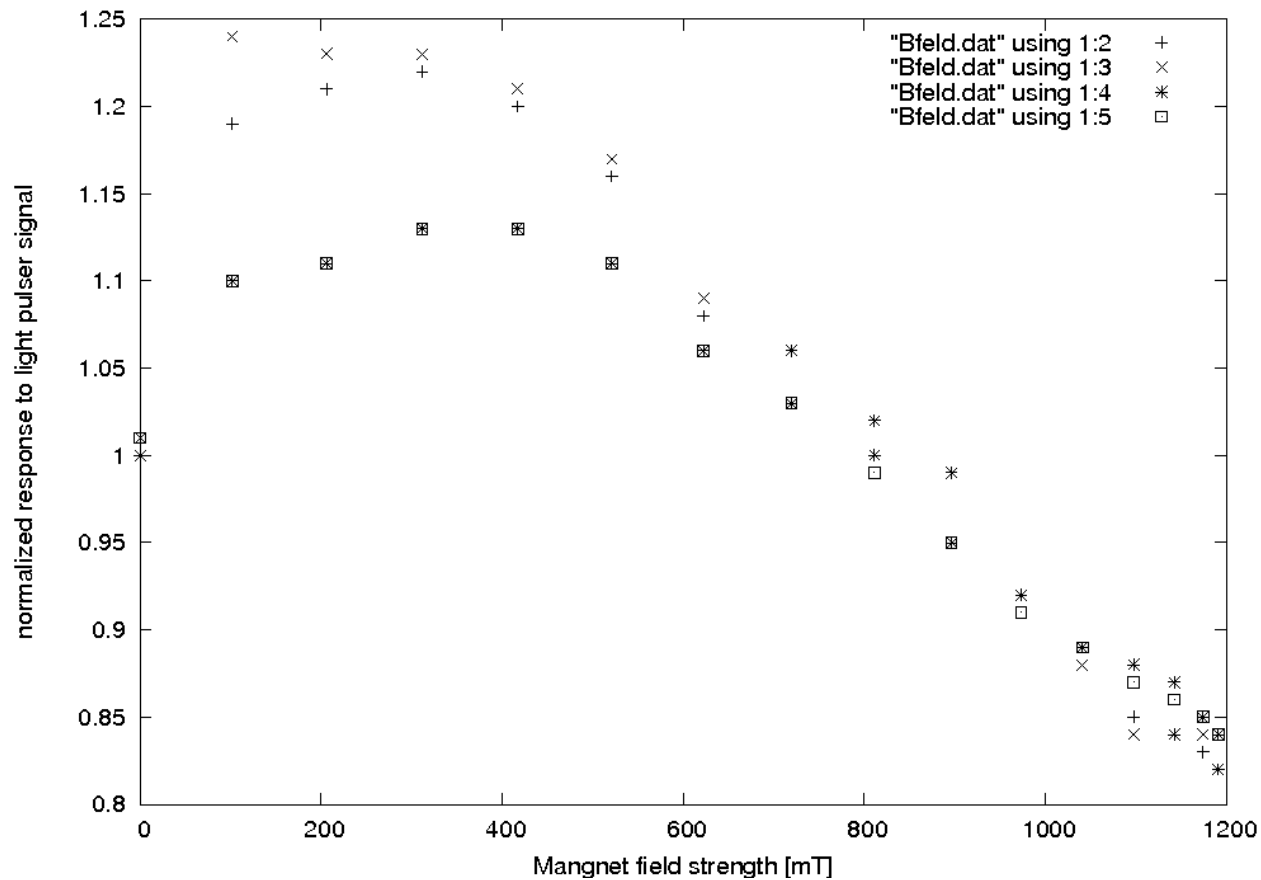
tube #0010



Hamamatsu VPT







- B-field variation 0...1.2 T (maximum field at VPTTs in endcap)
- VPTT orientation to B-Field: 0 and 17° (maximum VPTT angle)
- Gain variation of -15% to +25%
- (Hamamatsu VPTs: 0°: -1%, 17°: -10%)

- We are just in the process of measuring the first delivered VPTTs from RIE
- Need to understand and prevent 'fireworks' effects
- Check with RIE about P\*G measurement
- Separate gain measurements
- Dark current measurements
- Variation of voltages, voltage distribution (Basel?)
- More B-field measurements (different angles)