Status of the Photosensor Testing Facility at TRIUMF

Tom Feusels

University of British Columbia

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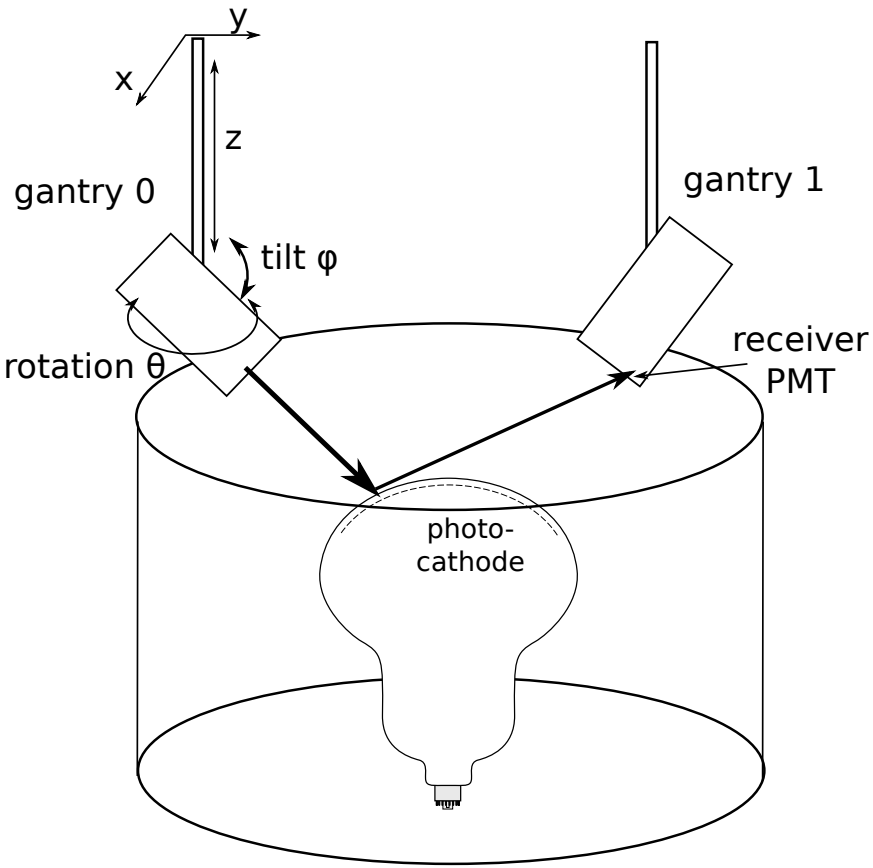
Objectives

Characterize and study optical properties of PMTs under consideration for HK and near detector.

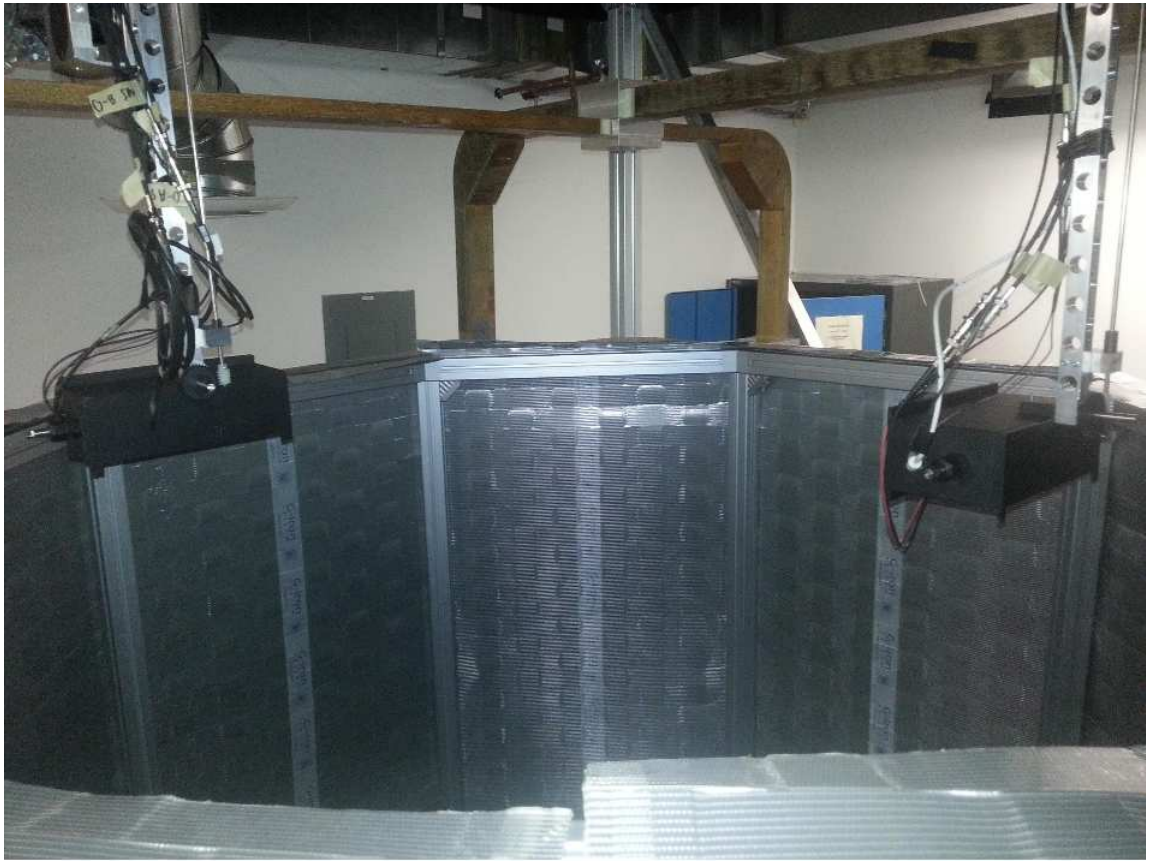
- Measure PMT acceptance.
- Map reflectivity of PMT: important for reconstruction algorithms.
- Magnetic compensation R&D possible: study field requirements and alternatives to active compensation.
- ...

Mechanical system



- 5 stepping motors for each of two manipulator arms (gantries) $\Rightarrow$ 5D (x,y,z, rotation, tilt)
- Waterproof optical box with laser, monitor and receiver PMT attached to the head of the gantry arm.
- Optical box also contains USB powered board with 3-axis magnetometer, accelerometer and gyroscope (*Phidget*).

Mechanical system



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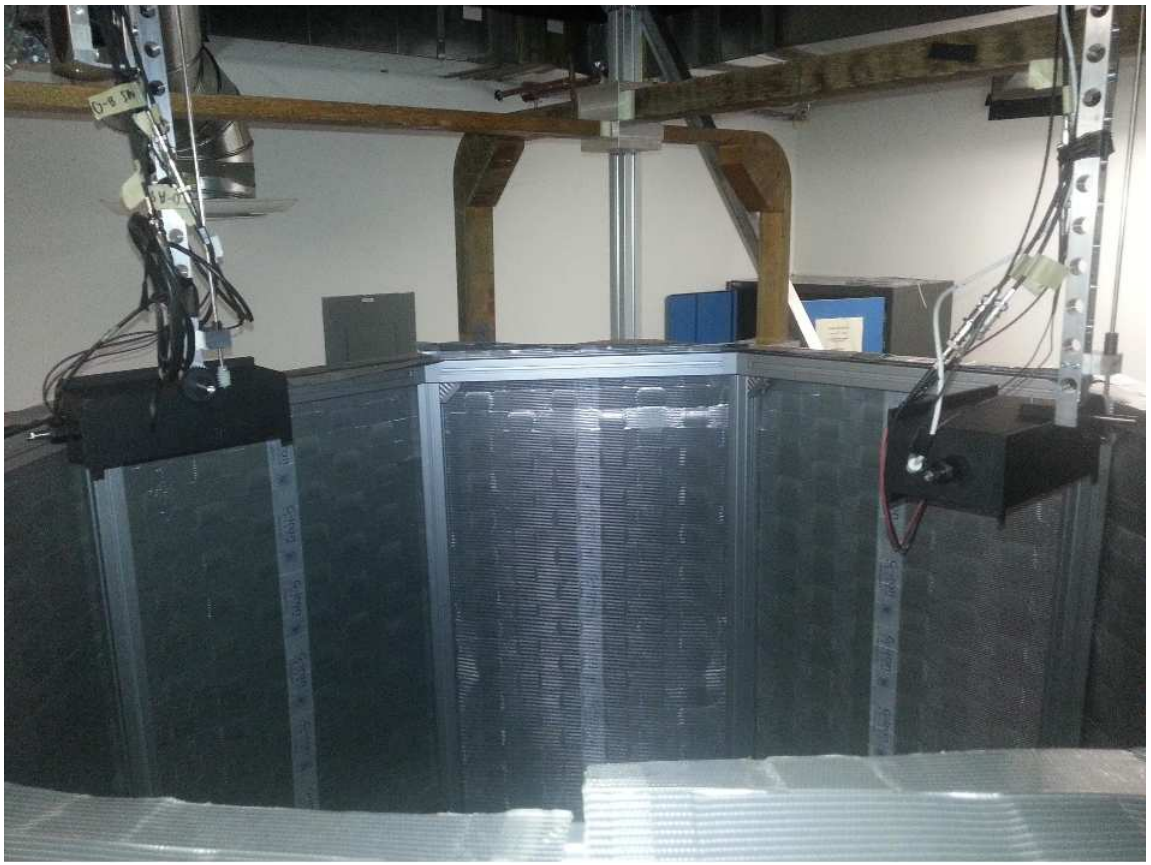
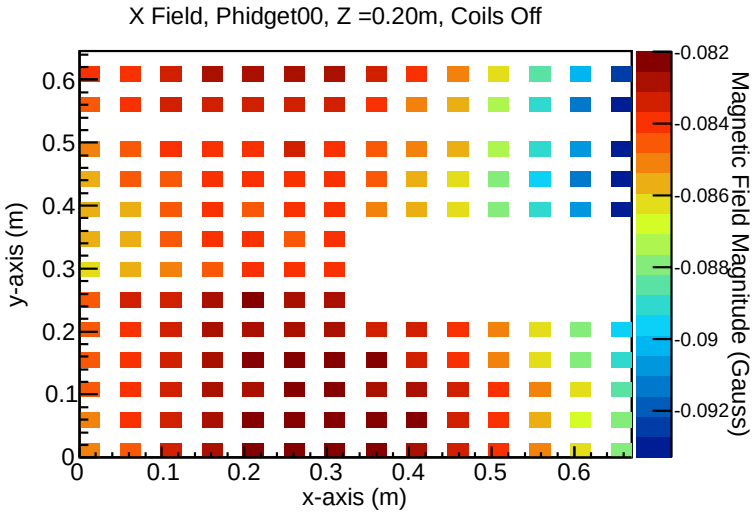


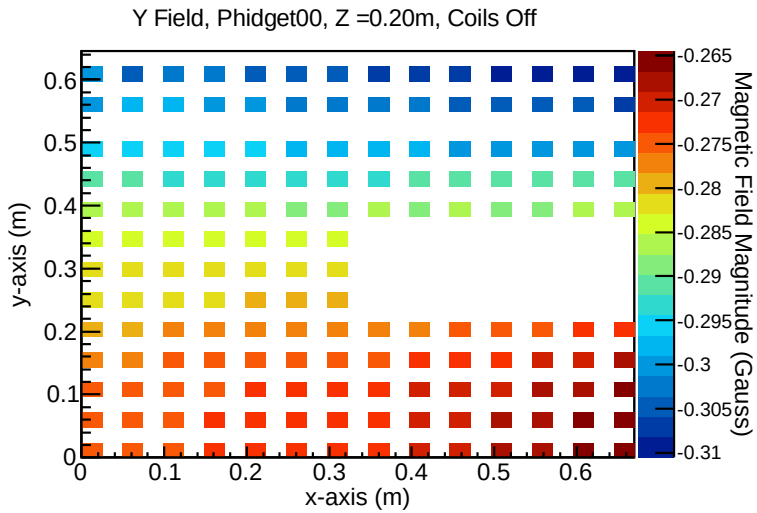
- DAQ through MIDAS: steering and readout of the motors, sensors, voltages and PMTs.
- Collision avoidance for gantry heads implemented in software
  $\Rightarrow$ automated scan sequences.
- Repeatability to 1 mm for position, velocity and acceleration

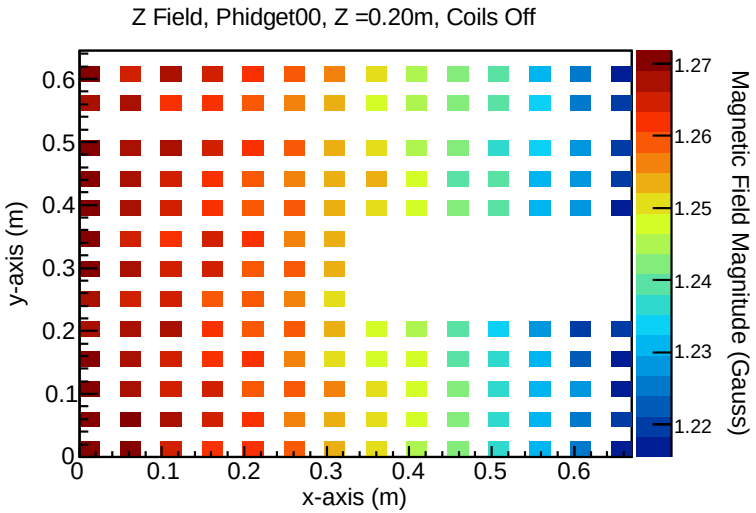
Magnetic field compensation

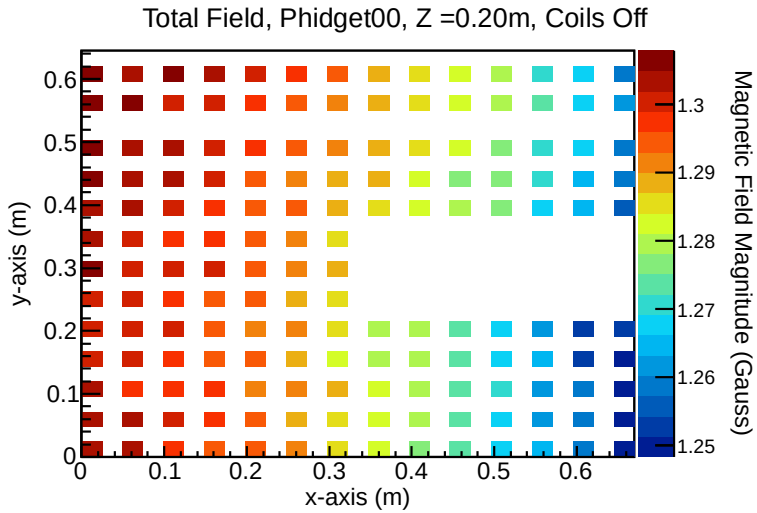
- In addition to the Earth magnetic field, presence of additional magnetic fields (eg. from TRIUMF Cyclotron).
- Active cancellation with Helmholtz coil, passive cancellation with two layer of g-iron.
- Field scans with phidgets mounted on gantry arms.
- Calibration of offsets in magnetometer on phidget using accurate Gaussmeter (up to 0.1mG).

Magnetic field scans: no g-iron, coil OFF



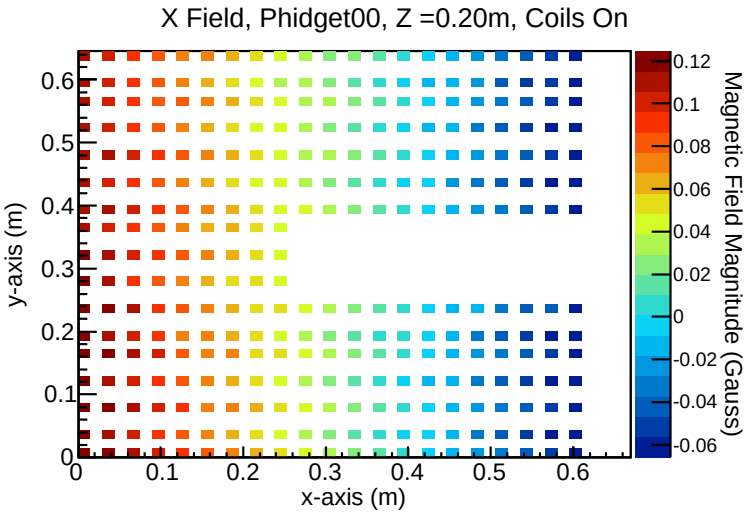


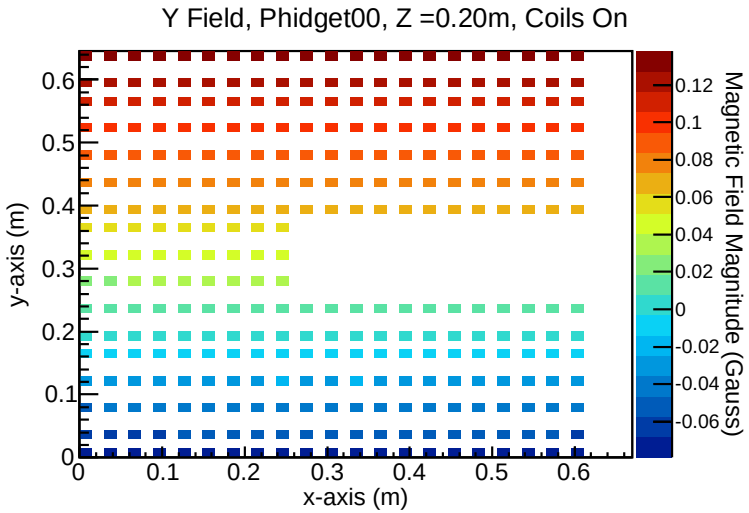


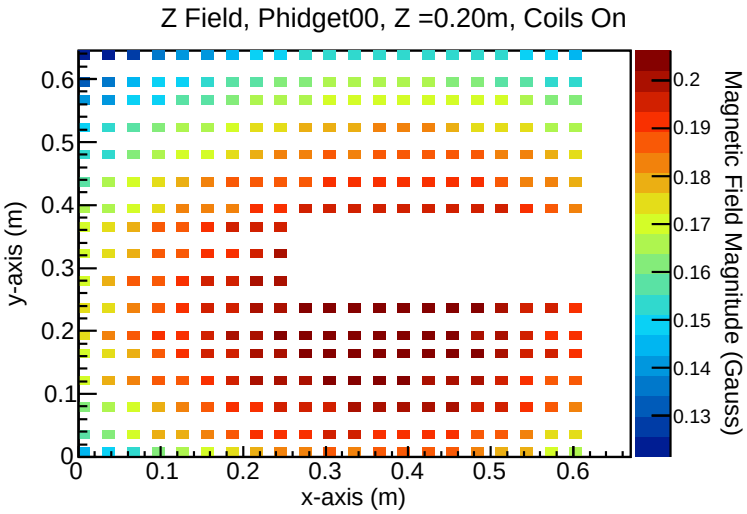


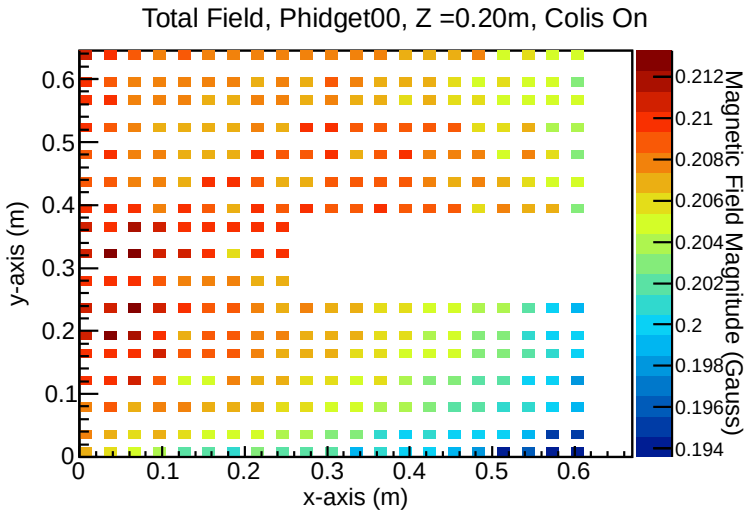
$\Rightarrow$ Need to reduce total magnetic fields of 1.3 G for optimal PMT performance.

Magnetic field scans: g-iron, coil ON



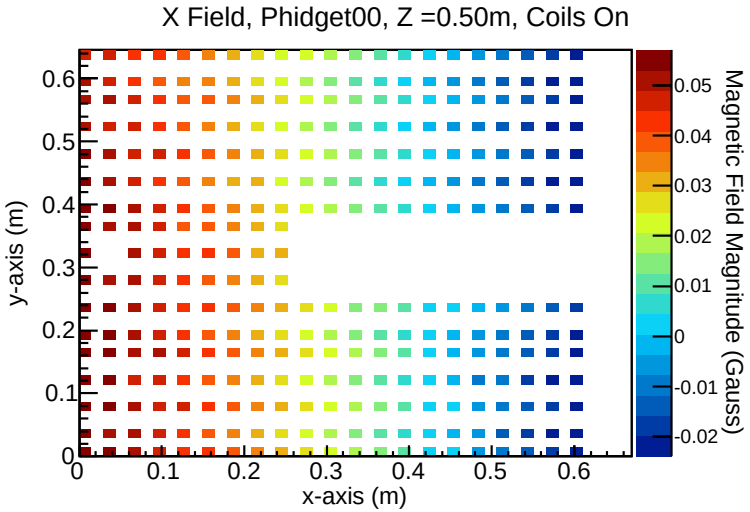


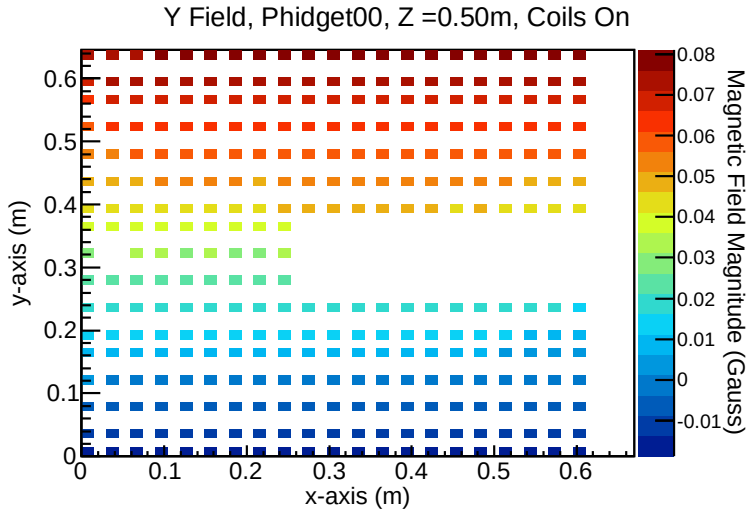


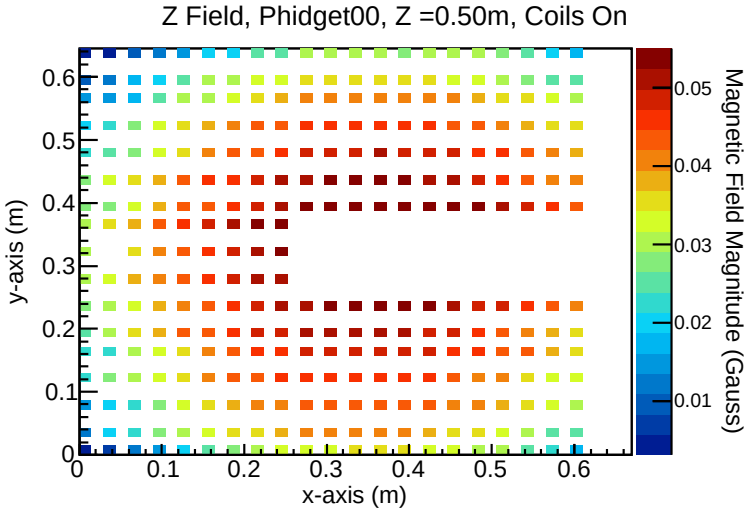


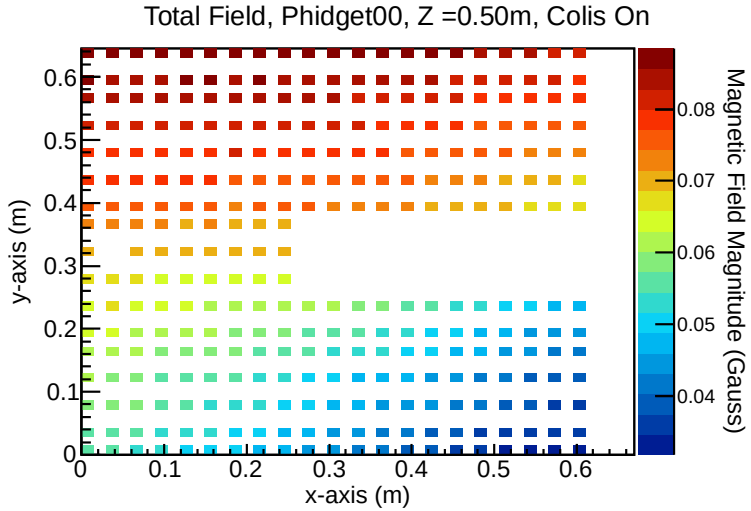
⇒ Large reduction of magnetic field with both Helmholtz coil and two layers of g-iron.

Magnetic field scans: g-iron, coil ON, lowest z





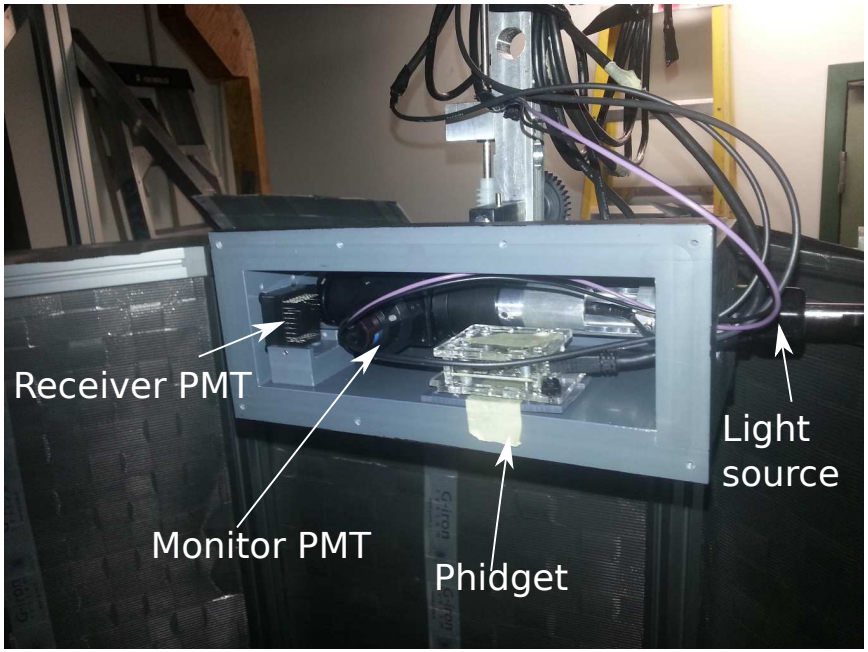


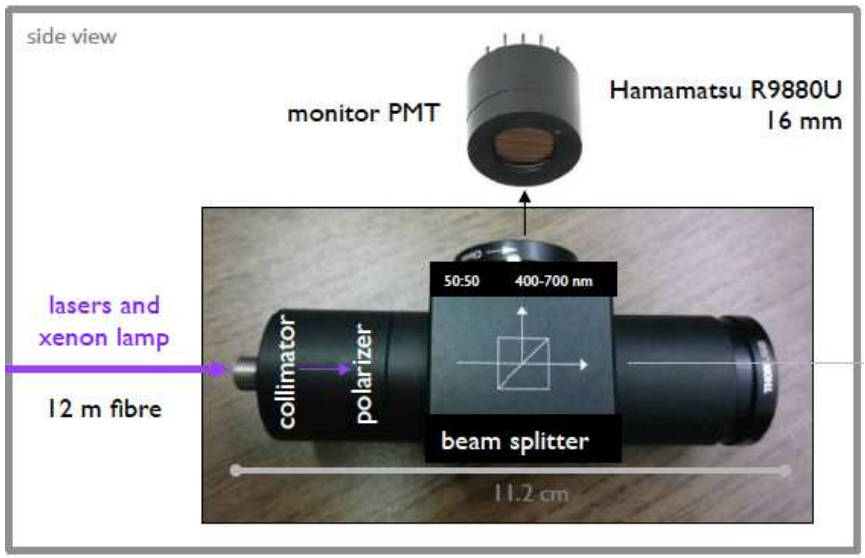


$\Rightarrow$ Total field in the center at lowest Z $<$ 70mG with small gradient in the center

$\Rightarrow$ For fields $<$ 10mG we need to improve the phidget calibration and retune the coil current.

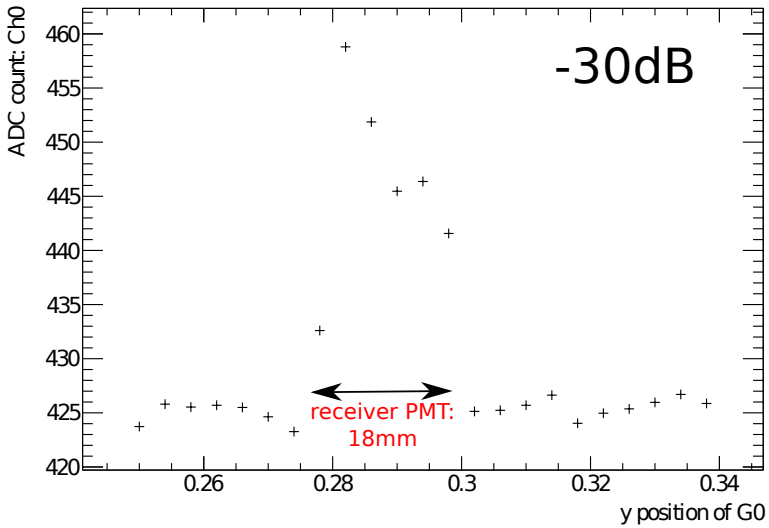
Optical system

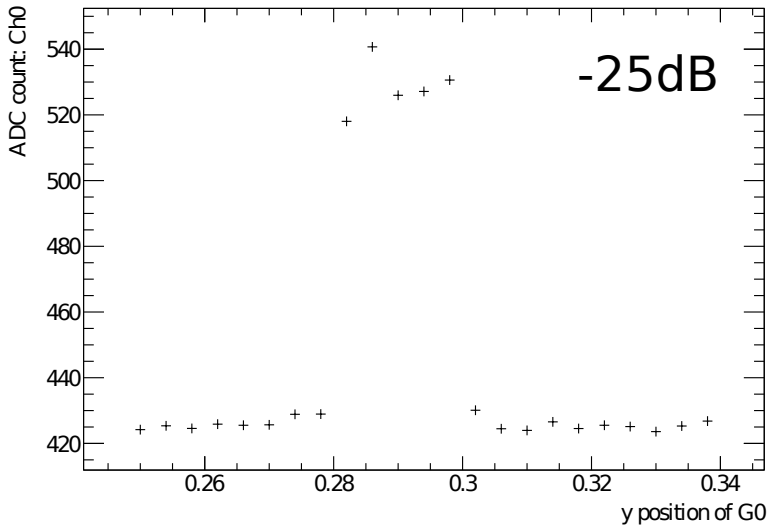


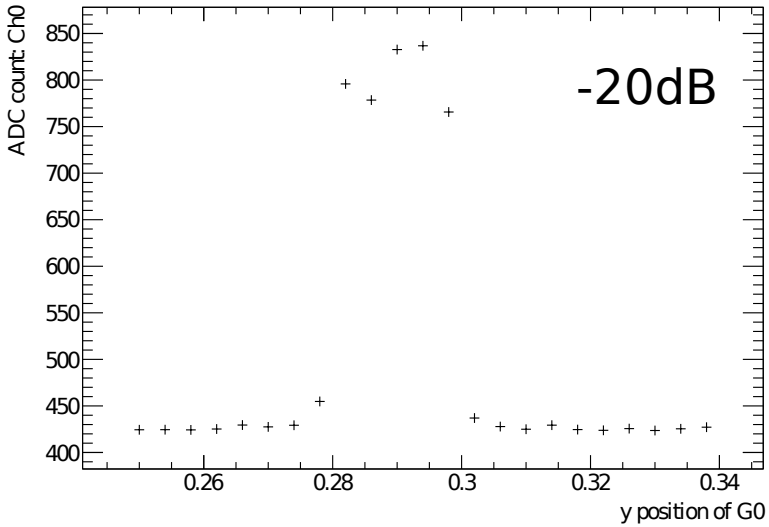


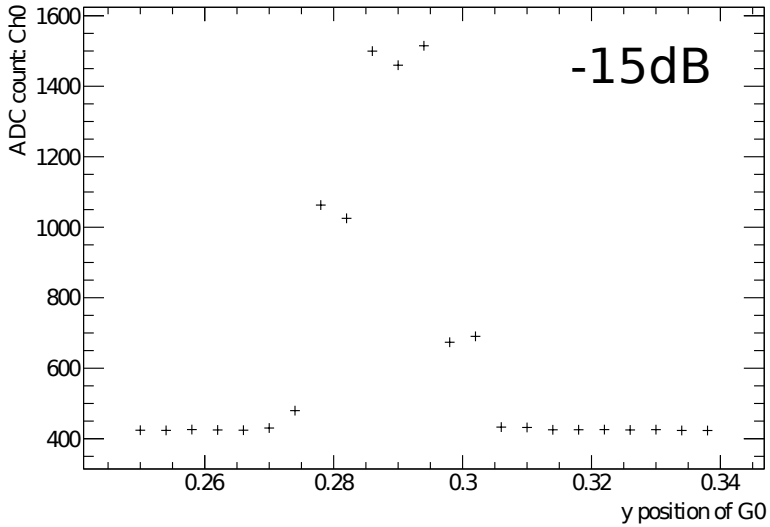
- Light sources: 405nm pulsed laser and Xe lamp with filters.
- Connected through fiber to optical boxes.
- Collimator, polarizer, beam splitter.
- Monitor PMT and receiver PMT.

Test scan: move receiver PMT past fixed laser







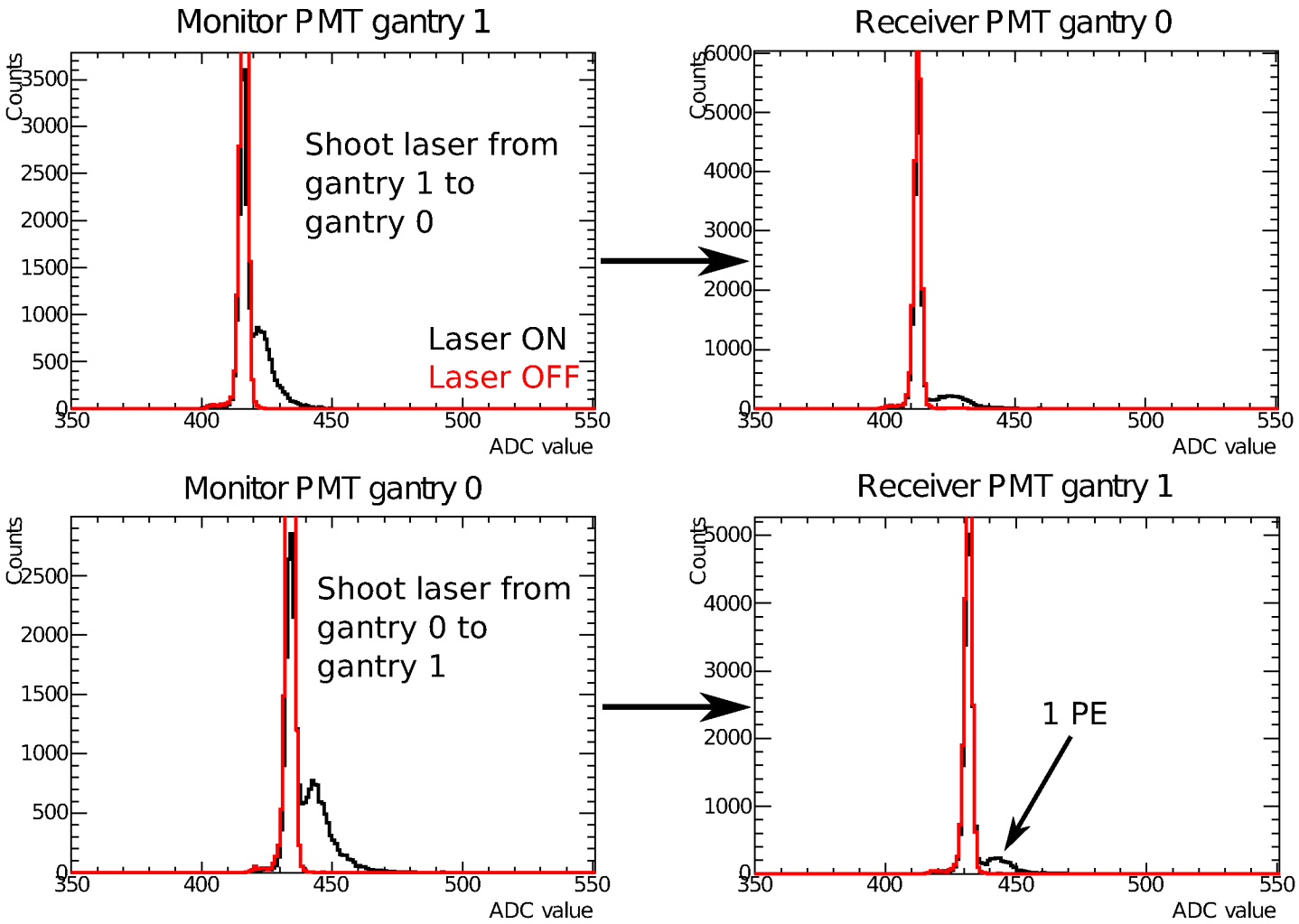


18 mm receiver PMT in gantry0 detects light from laser with different attenuation when passing.

Light tightness

- Created an inner area in the PTF room with two layers of dark curtains in U-shape.
- Walls and floor painted black.

First test: 1 PE measurements with and without laser

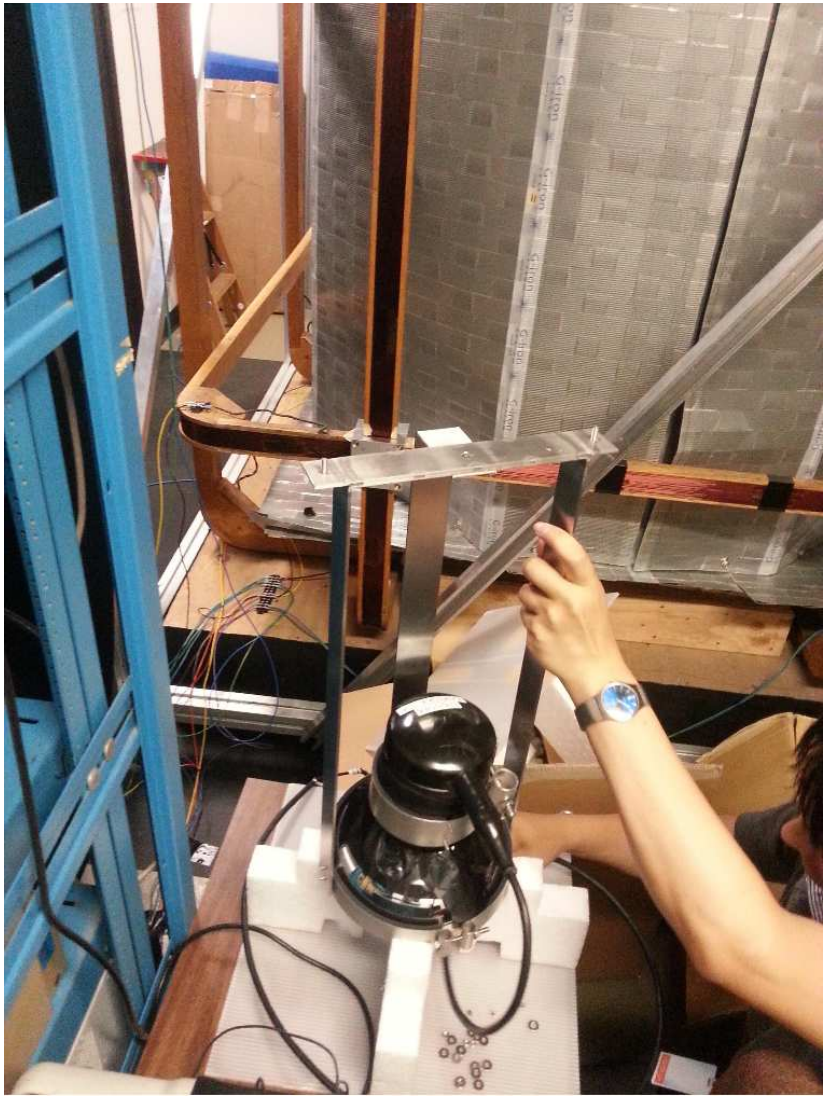


Only pedestal peak visible in receiver and monitor PMTs when laser is off
$\Rightarrow$ No light pollution inside curtain area when main lights in PTF are off.

Water system

Pump and filter system is being assembled and will be tested soon.

First tests with 8inch HPD



- First PMT (8inch HPD) arrived earlier this week.
- Mounted, installed and tested in PTF on July 18 with Nishimura-san and Okajima-san.

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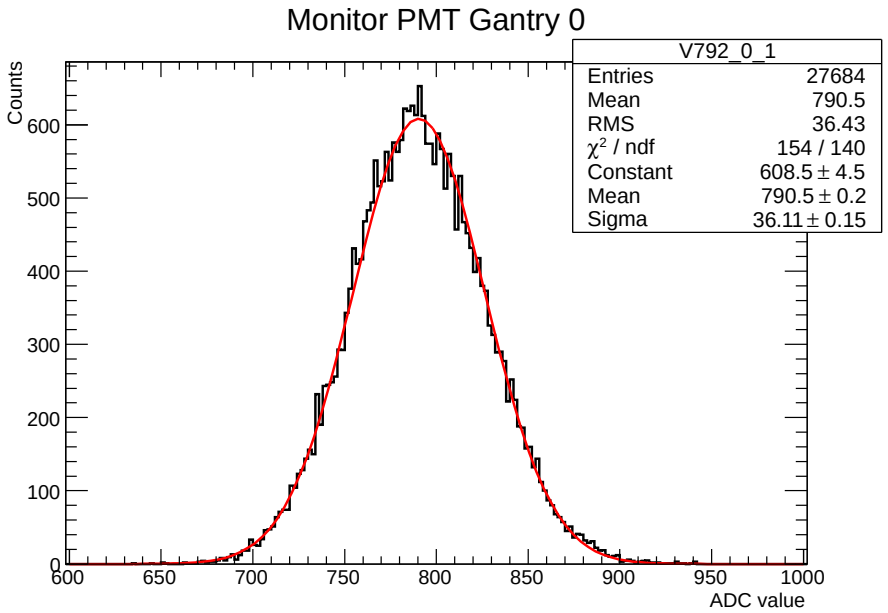

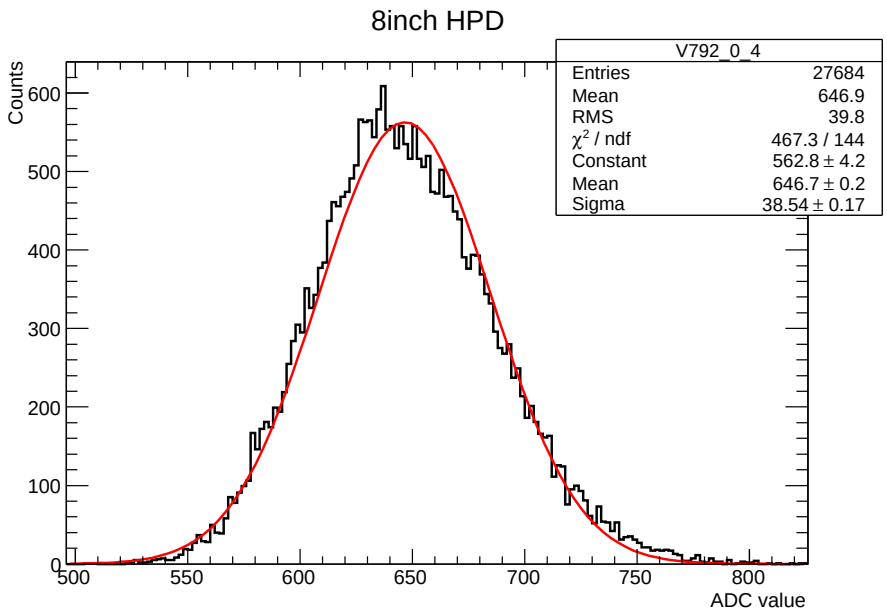

- HPD works and sees laser light from gantry 0!
- Further tests ongoing..
- Preparation for first measurements in air.

Summary

- Mechanical two gantry system works great!
- Optical system with laser, monitor and receiver PMTs in place and tested.
- Field scans show field cancellation already possible below 100mG, but should be improved with better sensor calibration.
- No light pollution inside curtain area of PTF when main lights off.
- Water system being assembled.
- First tests with 8inch HPD look good.

THANKS

UBC and TRIUMF:
Sophie Berkman, Ben Krupicz, Patrick de Perio, Wayne Faszer, Tom Feusels, Akira Konaka, Harish Kugel, Thomas Lindner, James Linqiao Liu, Philip Lu, Andy Miller, David Morris, Corina Nantais, Carl Reithmeier, Fabrice Retière, Mark Scott, Nils Smit-Anseeuw, Hiro Tanaka, Shimpei Tobayama, Peter Vincent, Michael Wilking, Stan Yen, Aaron Zimmer