ITM Camera Focuser Control Interface and Calibration

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Background

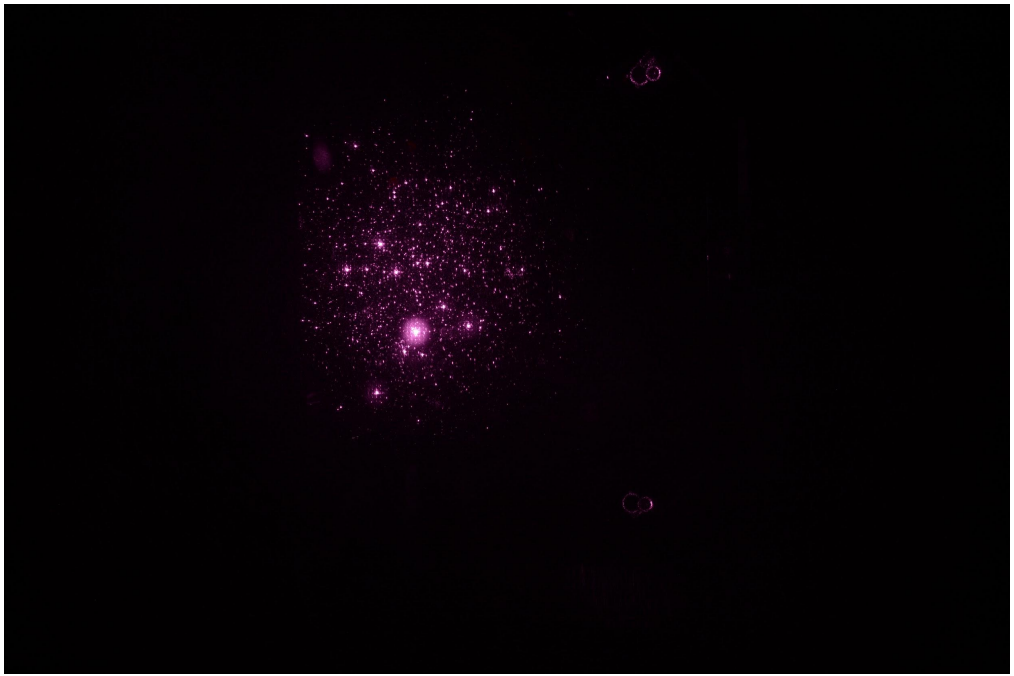
- PCal ETM cameras
  - Nikon D7100 DSLR + Telephoto lens
  - Viewing angle = 9.8°
  - Distance = 5.94 meters

- Locating PCal beams
- Viewing test mass surface

Source: LIGO Document T14005510-v5

Background

- Scattering from ETM when IR resonating in arms



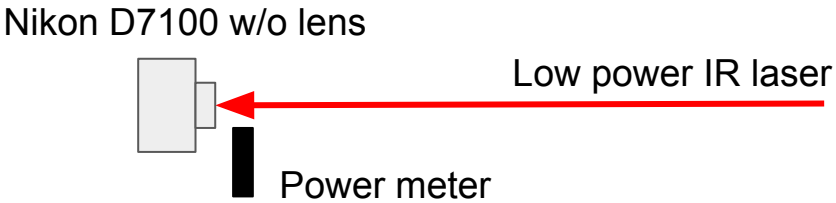
LHO X-end photo from PCal camera (22/11/2015)

Objectives

1. Calibrate cameras to quantify scattering
    - Camera sensor
    - Lens

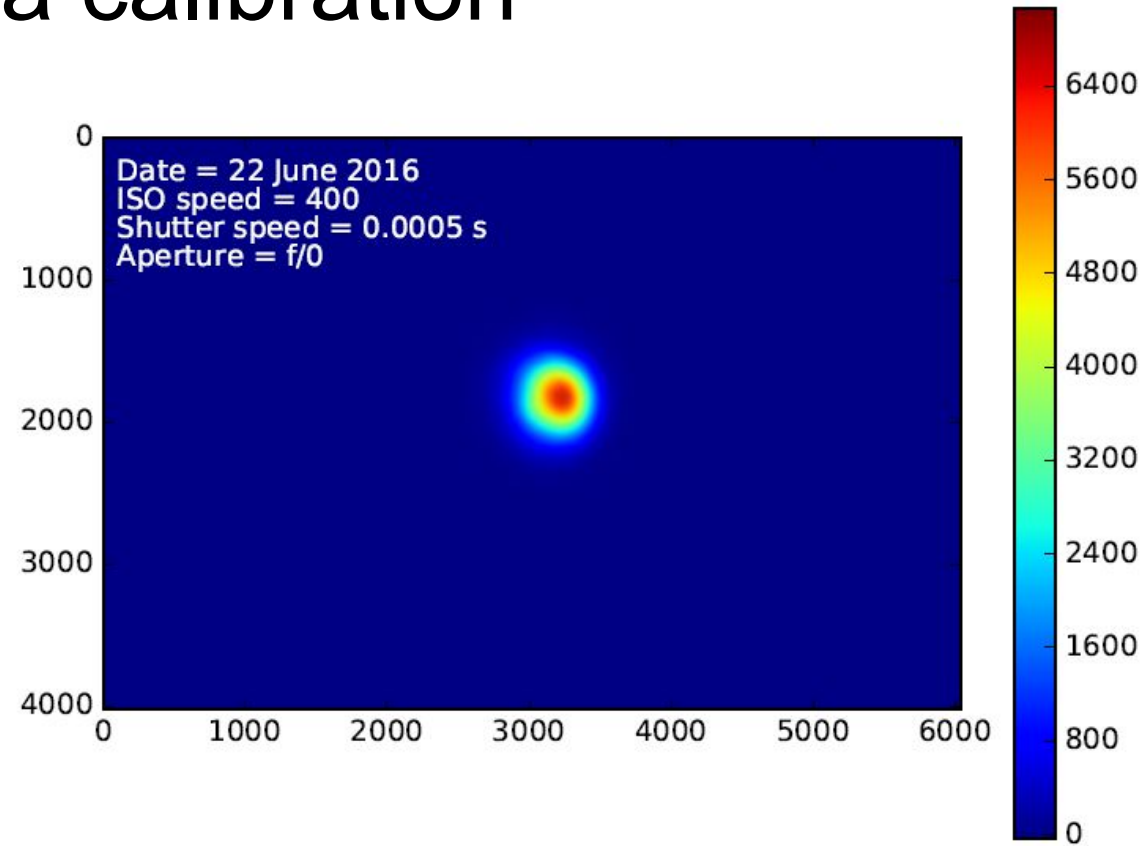
2. Set up similar DSLR cameras for viewing ITMs:
    - Hardware
    - User interface

Camera calibration

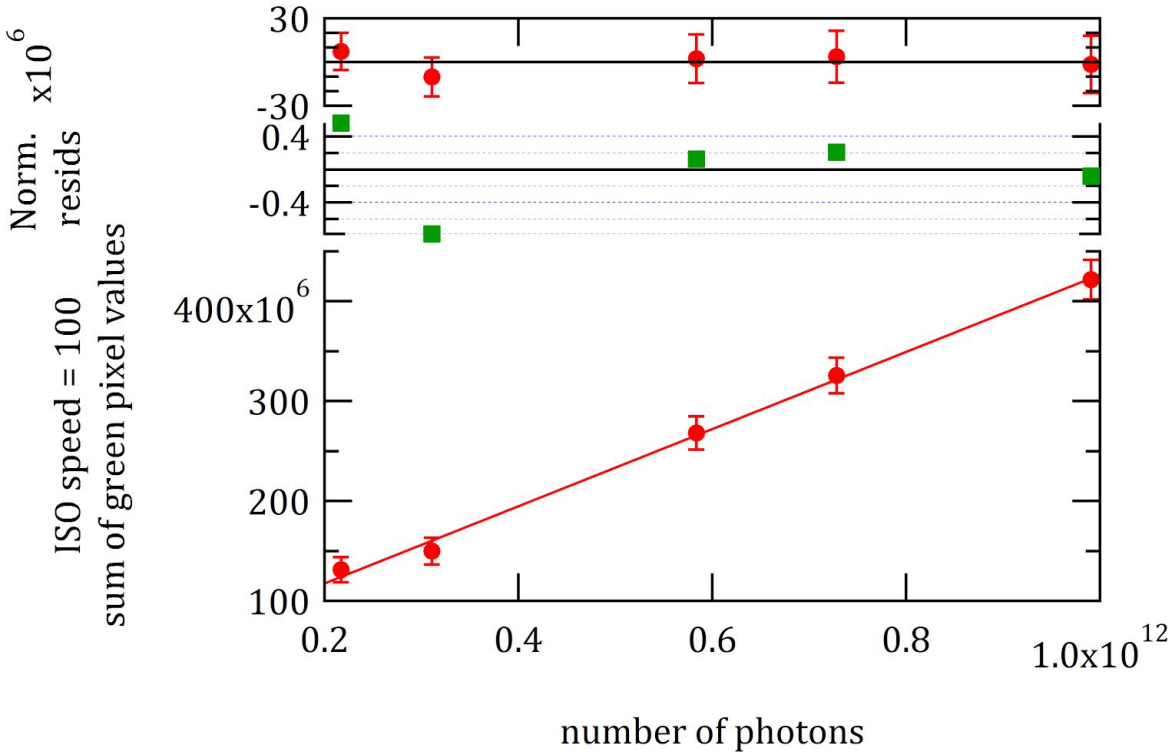


- Determine relationship between pixel values and power incident on camera sensor
- Different settings (ISO, shutter speed)
- Each colour channel R, G, B treated separately

Camera calibration



Camera calibration



Function: a + b*x

Coefficient values ± one standard deviation

a	= 4.0e+07 ± 1.4e+07	(35%)
b	= 0.00039 ± 3.e-05	(6.7%)

ITM cameras

- Different viewport:
  - Viewing angle = 1°
  - Distance = 32.756 m

Source: LIGO Document T14005510-v5

- Celestron 8’’ SCT instead of telephoto lens
- Focus adjustment using stepper motor controlled by Beckhoff module

ITM cameras

- Hardware:
  - Cable connections between stepper motor and Beckhoff controller
- Software:
  - PLC program for position control + position presets
  - Currently: can control motor velocity
  - MEDM screen for use from control room

Further work

- Calibration:
  - Calibrate for losses through the lens and telescope
  - Power meter for input power, camera image for output

- ITM camera:
  - Writing position control loop
  - MEDM screen
  - Documentation