Reflectivity Equation

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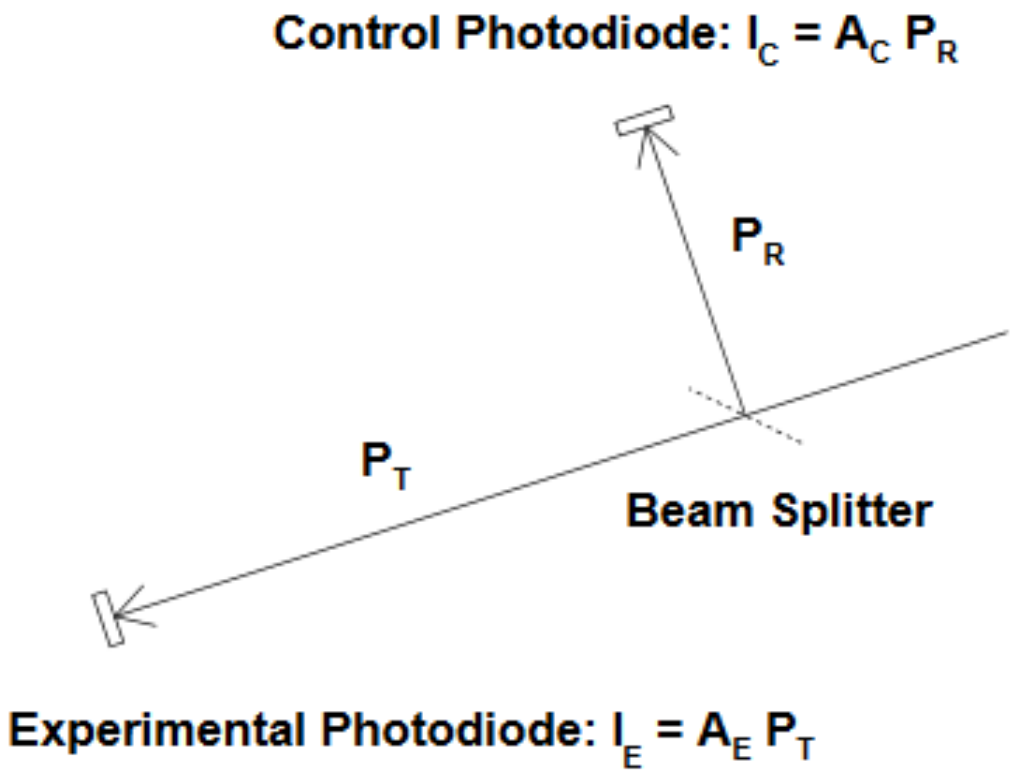
Reflectivity

- Optical test measures reflectivity of mirrors.
- RICH mirror test setup:
  - Monochromator
  - Two photodiodes
  - Beam splitter
  - Dark box
  - Two computers

Calibration Measurement



Control Photodiode

- Power reflected by beam splitter to control disk $P_R = R_S P_I$
  - R_S is reflectivity of 6mm splitter coating.
  - P_I is incident optical power.
- Current measured in control photodiode is $I_C = A_C R_S P_I$
  - A_C is responsivity of control photodiode.
  - Responsivity measures input-output gain of system.
    - Amps of photocurrent generated per Watt of power.

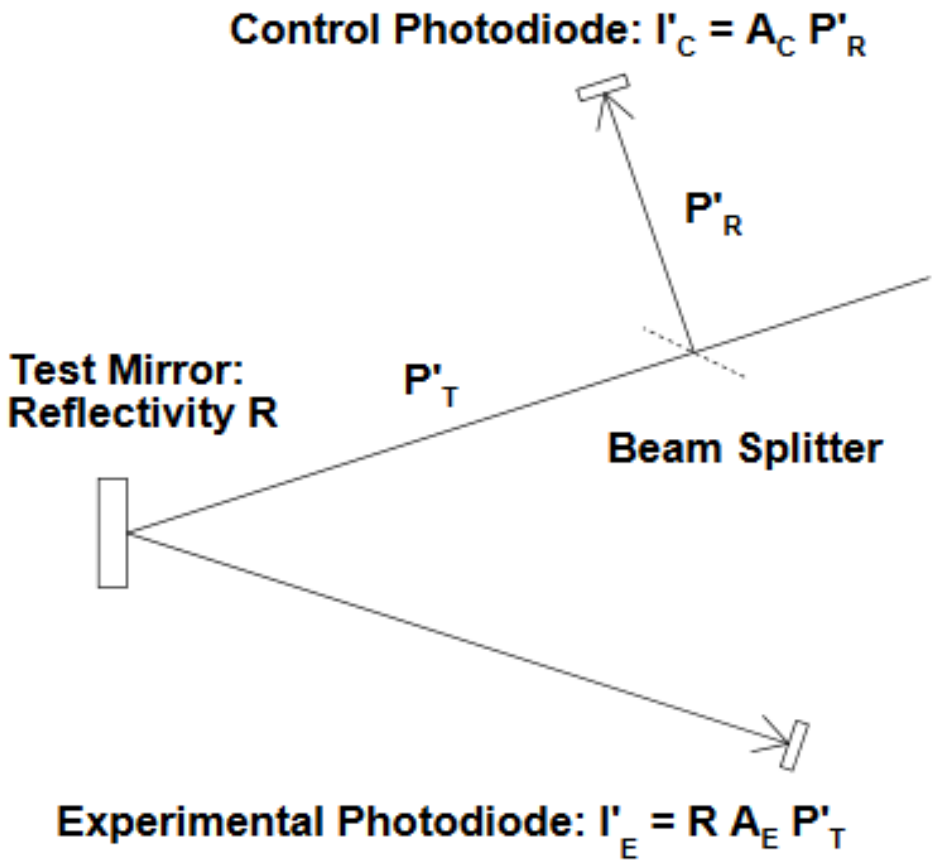
Experimental Photodiode

- Power transmitted through beam splitter $P_T = T_S P_I$
  - T_S is transmission of beam splitter coating.
  - P_I is incident optical power.
- Current measured in experimental photodiode is $I_E = A_E T_S P_I$
  - A_E is responsivity of experimental photodiode.

Ratio Equation

- Ratio of currents $\frac{I_E}{I_C} = \frac{A_E T_S P_I}{\mathrm{A_C R_S} P_I}$
  - Incident power cancels from ratio.
  - $\frac{I_E}{I_C} = \frac{A_E T_S}{\mathrm{A_C R_S}}$
  - Without control photodiode, reflectivity is dependent on P_I, which can vary.

Reflectivity Measurement



Reflectivity Equation

- Current measured in control photodiode $I_C' = A_C R_S P_I'$
  - A_C is responsivity of control photodiode.
- Current measured in experimental photodiode $I_E' = R(A_E T_S P_I')$
  - A_E is responsivity of experimental photodiode.
- Ratio of currents $\frac{I_E'}{I_C'} = R(\frac{A_E T_S P_I'}{\mathrm{A_C R_S} P_I'})$
  - Incident power cancels from ratio.
  - $\frac{I_E'}{I_C'} = R(\frac{A_E T_S}{\mathrm{A_C R_S}})$

Reflectivity Equation

- From calibration, $\frac{I_E}{I_C} = \frac{A_E T_S}{\mathrm{A_C R_S}}$
- From reflection, $\frac{I'_E}{I'_C} = R(\frac{A_E T_S}{\mathrm{A_C R_S}})$
- $\frac{T_S}{R_S}$ is constant due to intrinsic properties of beam splitter.
- $\frac{A_E}{A_C}$ is constant if same photodiodes are used for “control” and “experiment”.
- Reflectivity equation $R = (\frac{I'_E}{I'_C})/(\frac{I_E}{I_C})$

Thank You