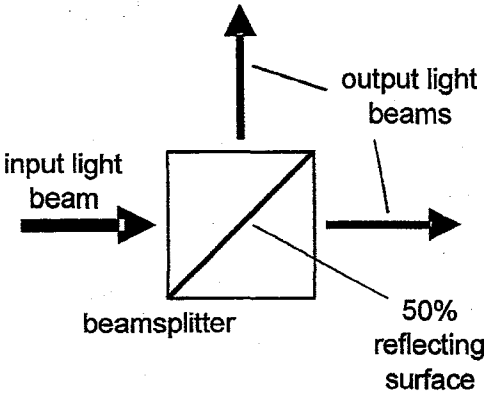
EE Ph.D. Qualifying Exam, January 2007 Question

David Miller

Backwards Beamsplitters

Note: if you finish the questions on this sheet, subsequent questions will be asked.

A mirror with 50% reflectivity can be used as a beamsplitter, turning one light beam into two, as shown in the figure. (A beamsplitter is often made in the shape of a cube of glass, with the reflecting surface in the middle of the cube, as sketched in the figure.)



Starter question (not part of the graded exam):

What happens if we shine the input light beam onto the bottom face of the beamsplitter, instead of the left face?

Question:

Can we run this beamsplitter backwards, using it to *combine* the power of two input light beams into one? (For example, we could have input light beams incident on the top and right faces, and want to combine them to give an output light beam only from the left face.) You may presume that the two light beams to be combined are monochromatic light beams (i.e., one color or frequency) of exactly the same frequency.

If we can combine them, what determines whether the combined beam comes out of the left face or out of the bottom face?