

Student Concepts of Quantization and the Photon

David B. May,
Gordon J. Aubrecht, II,
Thomas J. Kassebaum

Department of Physics,
Ohio State University
Columbus, Ohio

James H. Stith
American Institute of Physics,
College Park, Maryland

Supported by NSF GER 9553460
and NSF DUE 9653145

SOS/AAPT, Dayton, Ohio, 4/24/99

Objectives

- **To identify the preconceptions about quantization that students bring to the introductory physics course**
- ➔ **To determine the extent to which these conceptions exist within the student population**
- **To determine if and to what extent these preconceptions adversely impact upon the student's ability to understand contemporary physics concepts.**

Creating Survey Items

Item content:

- **from interview transcripts.**

Item format:

- **Multiple Choice?**
- **Likert Scale?**
- **Combination.**

Number of items.

- **Not a problem.**

The Survey

on quantization and the photon

Four items are multiple choice.

Three multiple choice items have a confidence indicator, the fourth is open-ended.

Forty-two items are currently being tested by use of a Likert scale response, which also includes a “don’t know” option.

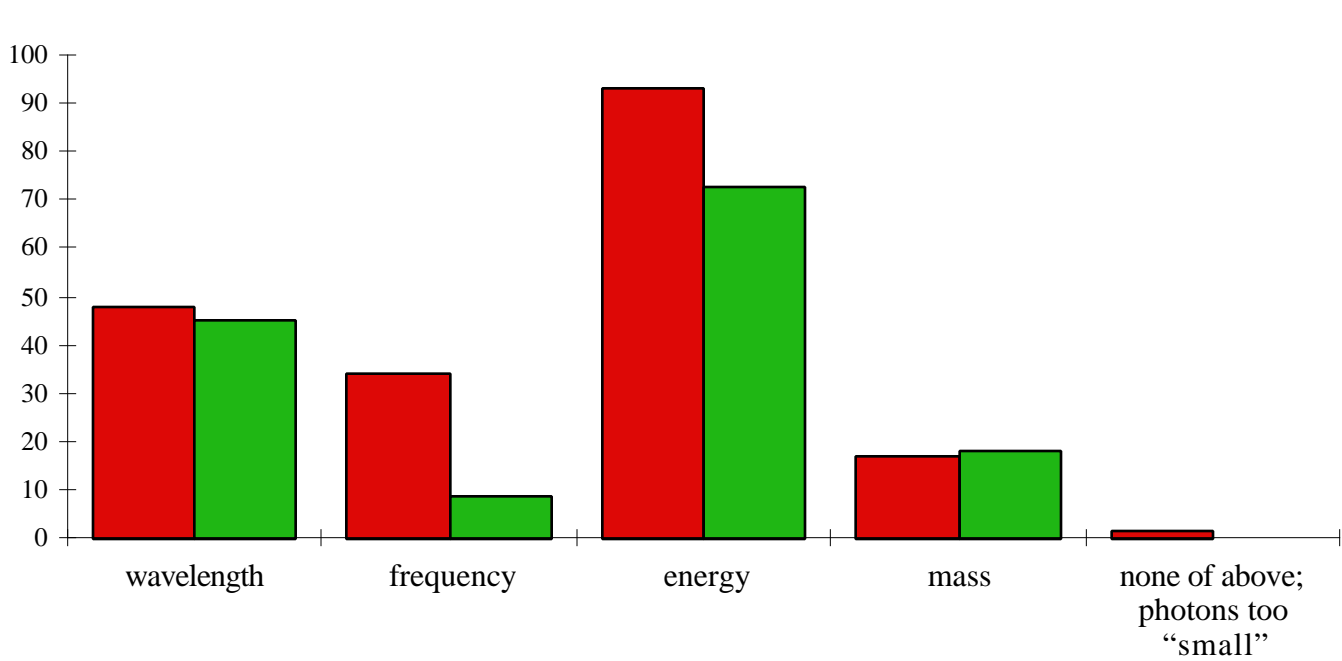
What we've found from the first version of the survey:

N = 58 engineering students

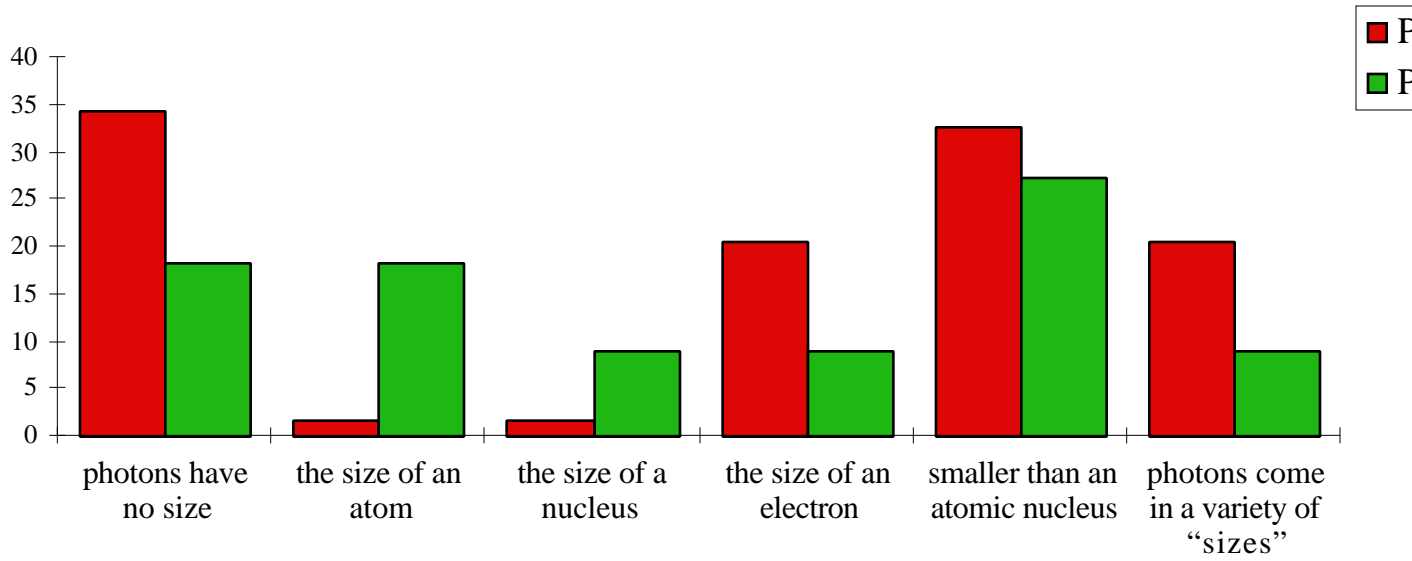
N = 11 Physics By Inquiry students

- **Students in the nonengineering courses more frequently give an answer when the questions are in multiple choice format, even if they lack confidence in their answers, than if they can choose “don't know” as an option.**
- **Many introductory students have heard the word photon, but few have a clear mental image of one.**
- **Few introductory students have heard the word quantization at all.**

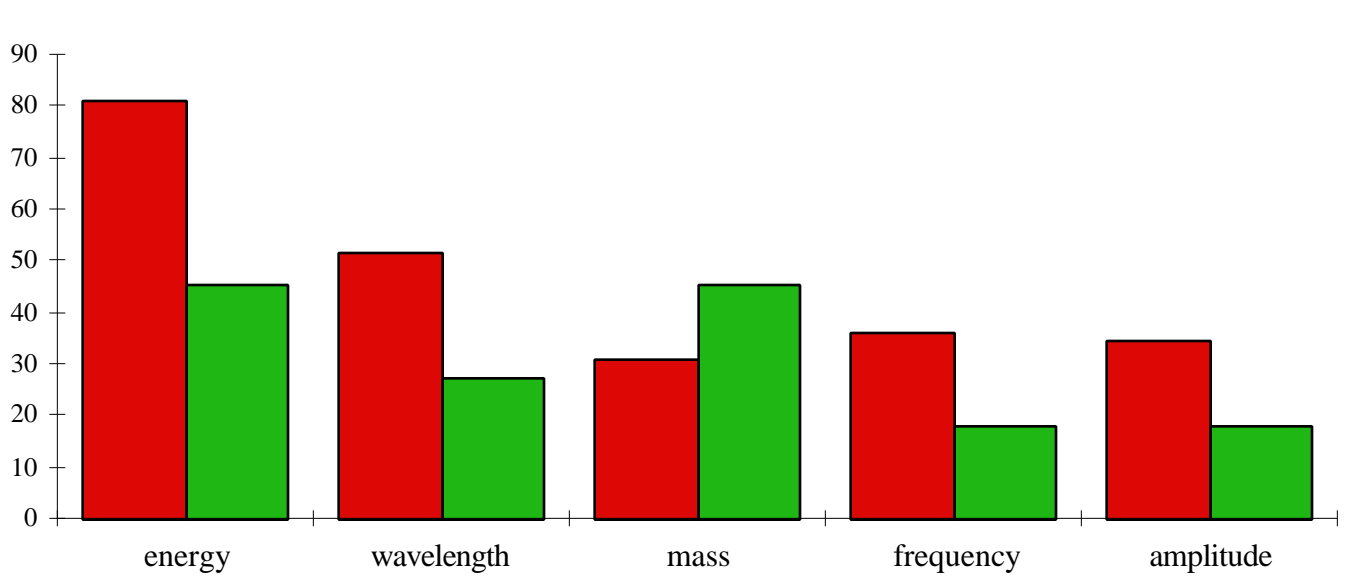
Which of the following physical characteristics do you MOST FREQUENTLY use to describe a photon?



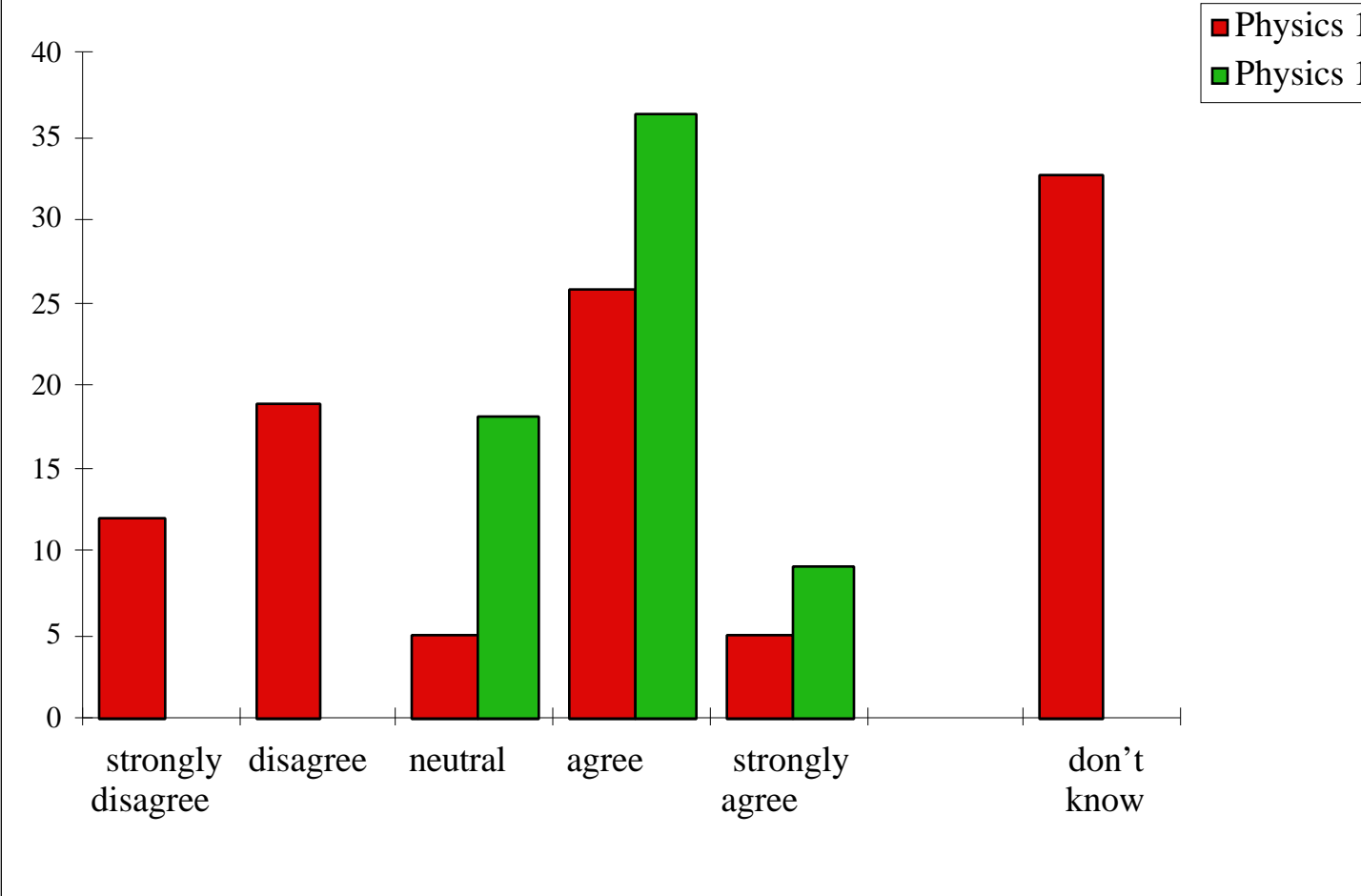
Which of the following BEST describes the size of the photon



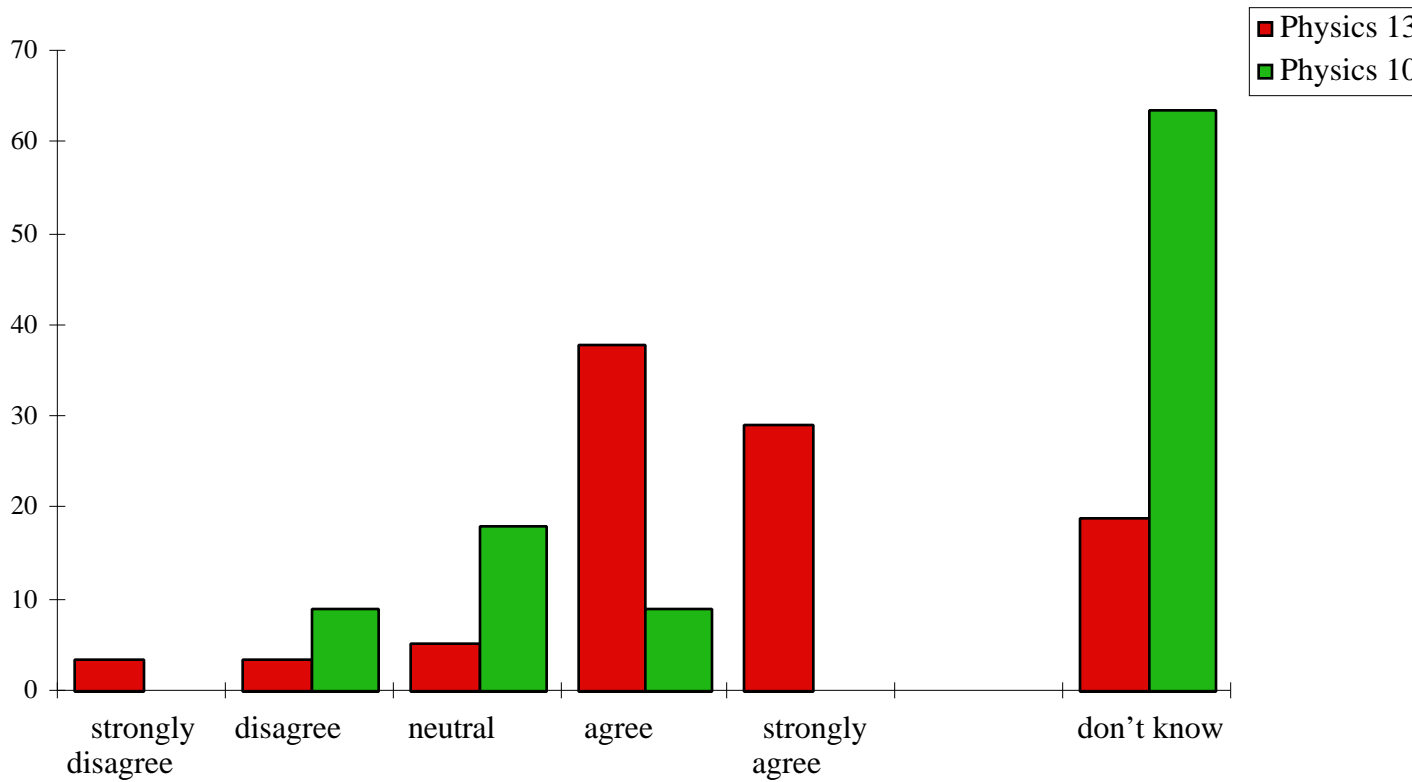
What has to do with the size of the photon?



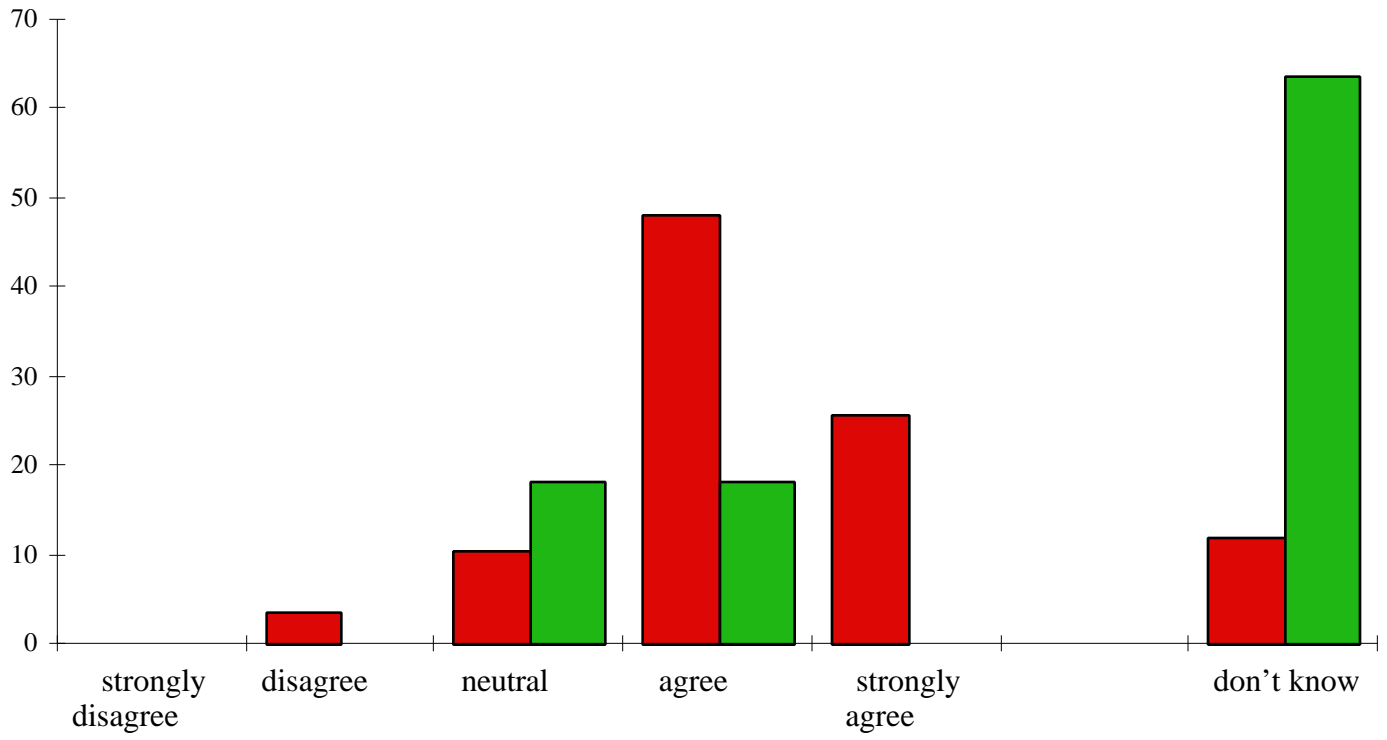
Microwave ovens give off gamma ray photons.



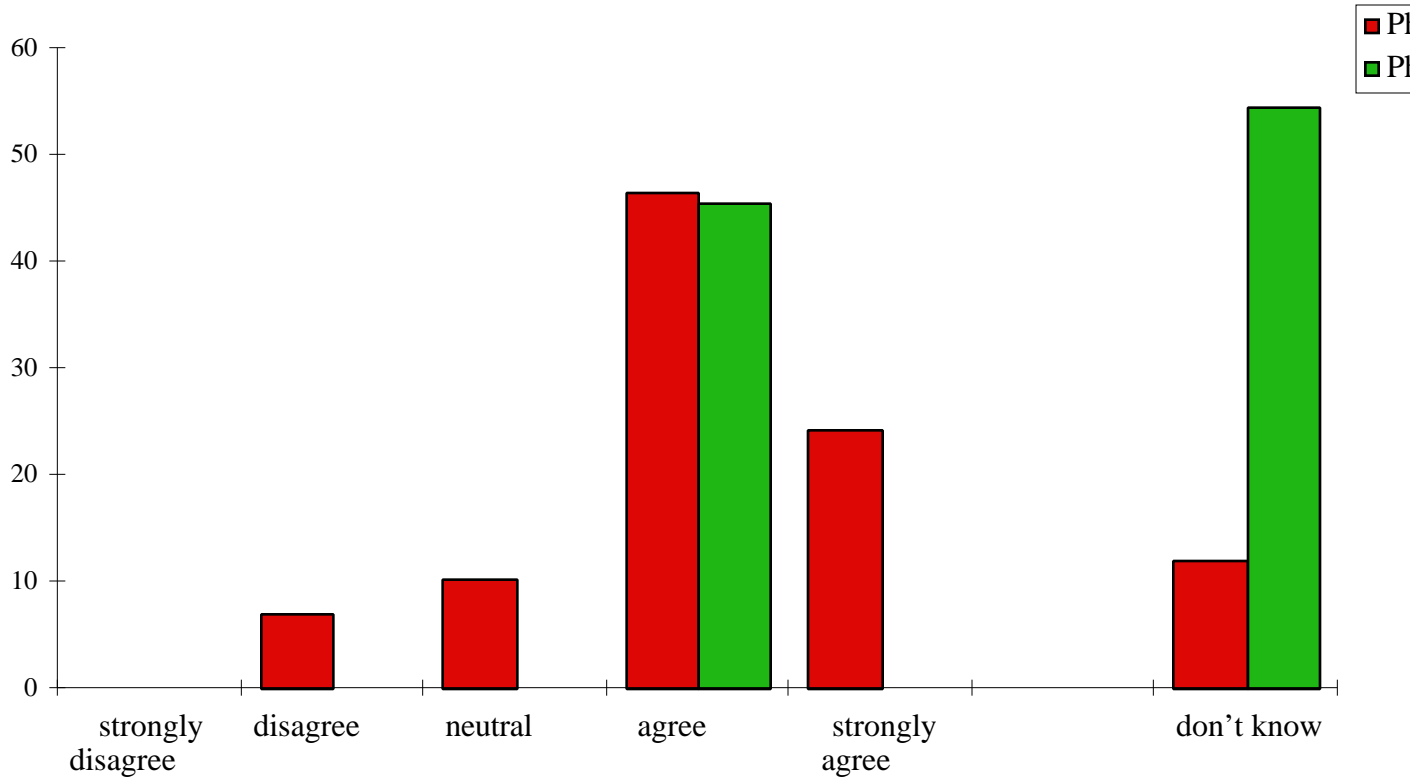
Electrons emit a photon as they go from excited to ground state.



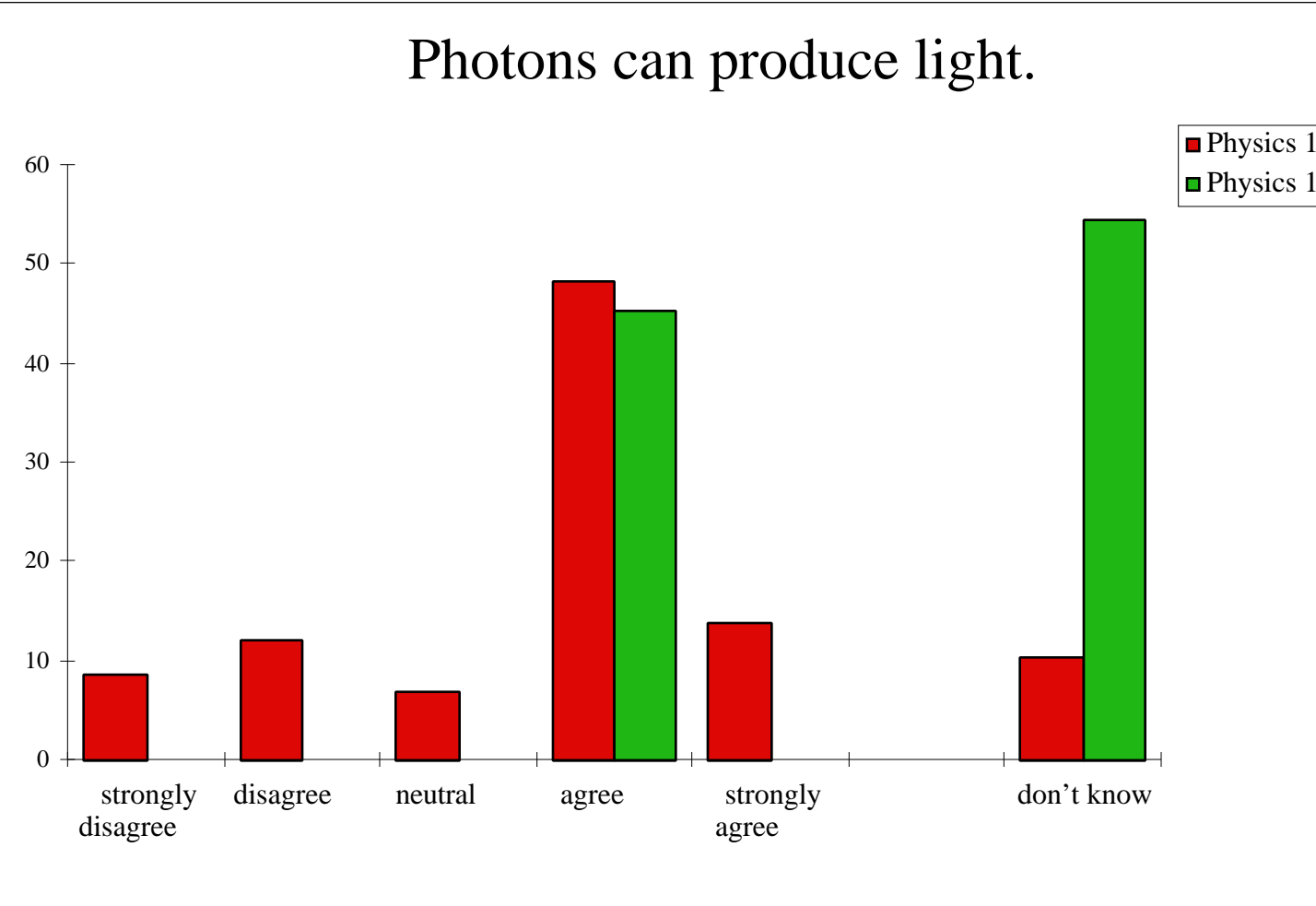
When electrons change atomic energy levels, photons are absorbed/emitted.



Photons result when electrons flow through a bulb's filament.



Photons can produce light.



Photon isn't real, just a way of thinking about light/

