

Measuring Velocity of Pellet Using Vernier Photogate

A pellet fired from an airgun flies through the detection beam of a photogate. The velocity of the pellet can be determined from the known length of the pellet and the times when the beam was interrupted and restored.

What you need

- data logger [LabQuest 2](#) or [LabQuest Mini](#) interface
- photogate [Vernier VPG-BTD](#)
- airgun and pellets
- towel, blanket or other fabric for capturing pellets
- calliper

Safety

In this experiment is required to ensure safety. The barrel of the airgun must be always pointed towards the area in which the fired pellet cannot (even unwillingly) cause any damage. Do not forget this rule, even during loading.

For capturing the flying pellet safely, a common towel folded in half and placed on a box like is shown in the picture has proven practical. Aim approximately in the centre of the towel. Even in this case this area is considered potentially dangerous, so make sure that there are no people or showcases etc. in the shooting direction.



Preparation

1. Measure the pellet length using a calliper.
2. Connect the photogate to your computer via LabQuest 2 or LabQuest Mini.
3. On the computer, launch the Logger Lite or Logger Pro programme.
4. Set the switch of the internal and external mode of the photogate to the lower position (= the source of the infrared beam is exposed), as indicated by the arrow in the figure.



Execution

1. Start the measurement.
2. Load the airgun.
3. Position the barrel the way it is shown in the figure above so that the pellet crosses the beam of the photogate. Do not forget to pay attention to safety throughout the experiment. Place the pellet catcher made according to the instruction above in the shooting range behind the photogate.
4. Shoot and stop the measurement.
5. The times of the change of the photogate state are automatically entered into the table. The time difference corresponds to the time when the beam was interrupted by the flying pellet.

	Time (s)	Gate state
1	4.714726	1
2	4.714759	0

If the pellet is significantly narrowed (as shown in the figure), in some measurements four changes of the photogate status occur instead of two. In this case, use the difference between the first and fourth measured time.

	Time (s)	Gate state
1	2.689973	1
2	2.689979	0
3	2.689992	1
4	2.690005	0
5		



6. Based on the knowledge of the length of the pellet and the time of the beam interruption, calculate the velocity of the pellet.

PHYSICS

Methodology



Notes for teachers

In this case the typical velocity of the pellet shot from the airgun was about 160 m/s. The particular values will vary according to the type of the airgun and the type of the pellet