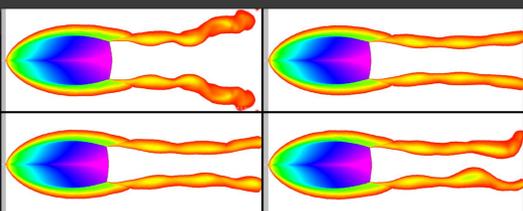


Alexandra Alexandrova

## Problem

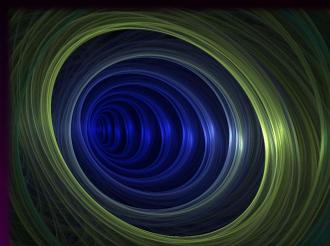
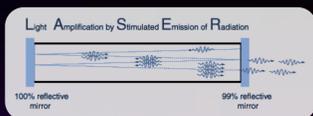


We can create jets of very fast moving gases. These jets are important for a number of accelerator-based applications. Detailed information about the gas jet is important for its optimization and the quality of the beam profile that can be measured with it.

## Solution: Self-Mixing Laser Diode

Which sounds complicated, but it uses some ideas that you may be familiar with...

### Example: Lasers



### Example: Doppler Effect

**DOPPLER EFFECT**

When a star is stationary relative to an observer, the light produced looks the same no matter what direction it is seen from. Our sun is a good example of a star that is not moving much nearer or farther from the Earth.

If stars move either towards or away from our vantage point, however, the motion shifts the way their light looks to us.

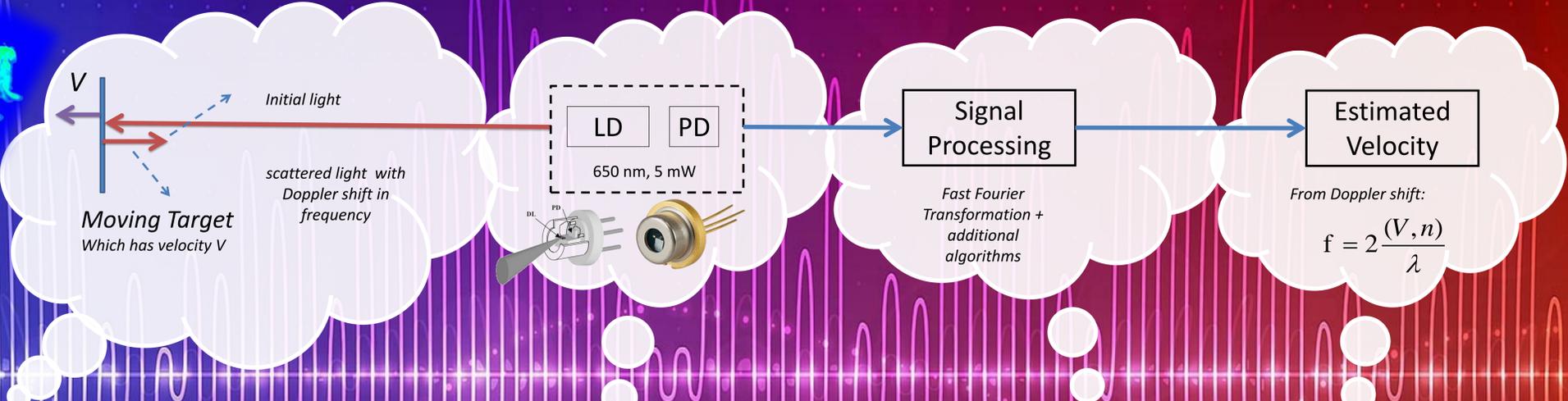
**RED SHIFT**  
When a star moves away from us, it runs away from the light it emits in our direction. This makes the light waves we see expand.

**BLUE SHIFT**  
When a star moves toward us, it starts to catch up to the light it emits in our direction. This makes the light waves we see contract.

Because the wavelengths are shorter than usual, the light shifts toward the blue side of the spectrum. So, a star that exhibits blue shift.

Most shifts can not be seen with the naked eye, but astronomers can measure them to learn whether other stars are advancing or receding.

## Solving the problem needs different areas of your knowledge!



### Physics

- Lasers
- Gas jets
- Light interaction
- Doppler effect
- Waves and Optics
- Thermal Physics
- Interference
- Materials

### Engineering Experiments

- Electronics
- Design

### Computer Programming

- Simulations
- Control software

### Maths

- Equations
- Graphs
- Models

Laser cavity, External cavity, Scattering target, Photo-Diode

A small portion of light is reflected from the target object and re-enters the laser cavity. It is then mixed with the original wave inside the laser.

$V = ??$

Our engineering, programming and mathematical skills are used together with our physics knowledge to calculate the velocity.

## Science!

This poster shows some of the different skills that help scientists make new discoveries. Whether you are interested in physics, computers or maths; we need people just like you to improve the world around us. Don't be shy! We are waiting for young, brilliant and curious people to get involved in Science!

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 289191. Acknowledgment to Chris Edmonds and Lee Devlin