Angle Resolved Surface Plasmon Resonance

Laser and Spectroscopy

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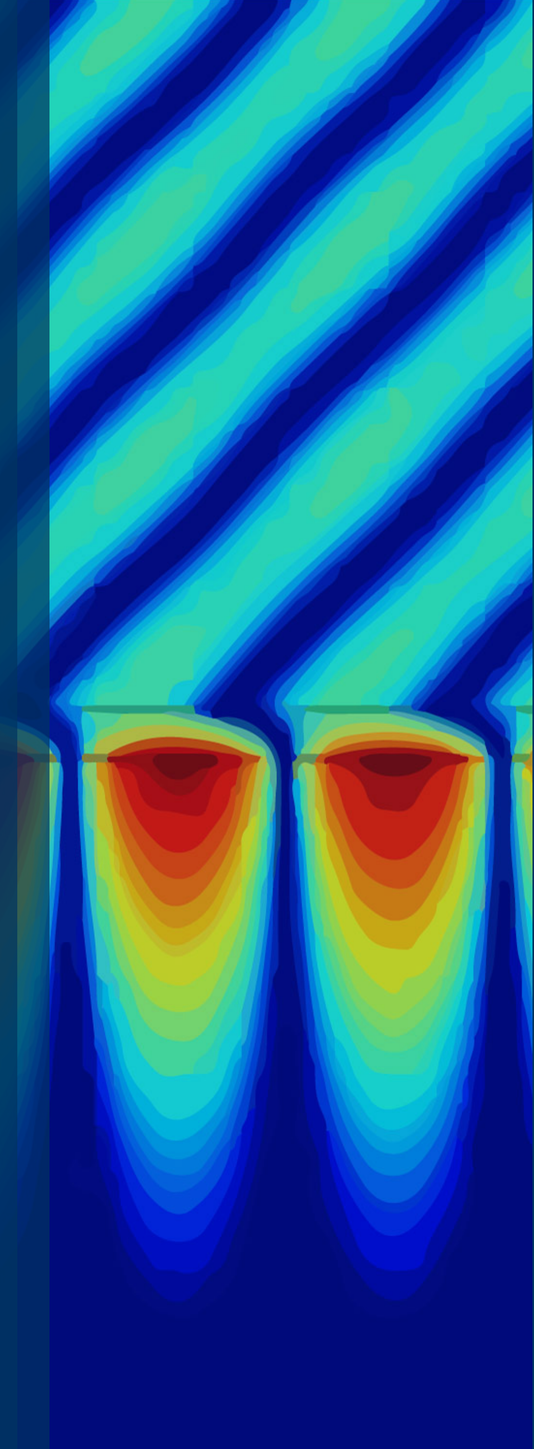
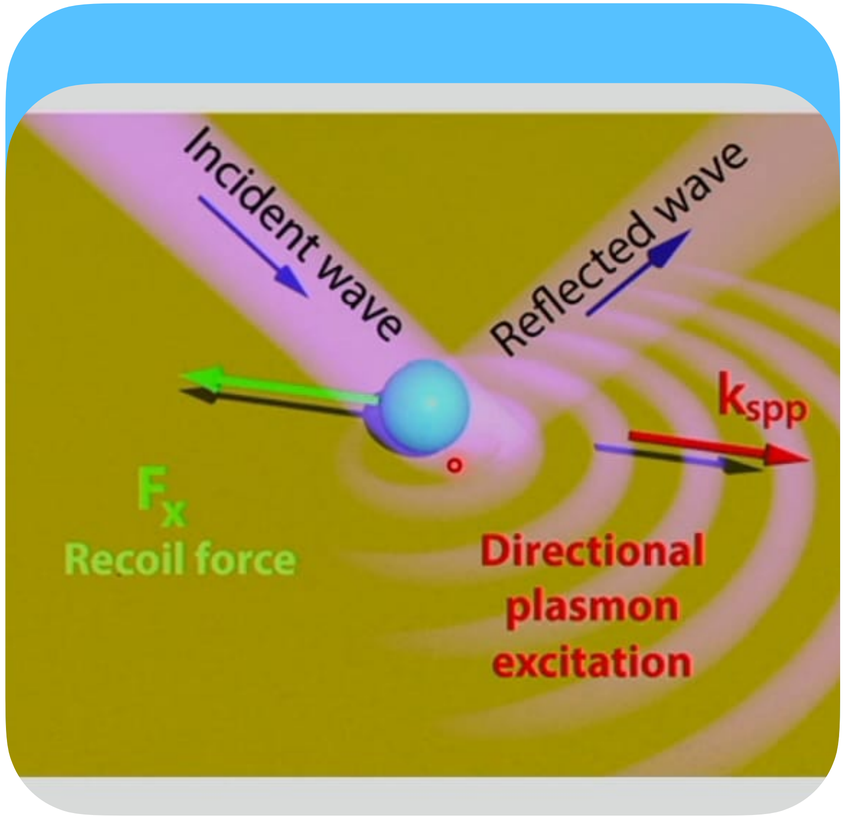


Introduction

Surface Plasmon Resonance (SPR) is an optical phenomenon that occurs when **light interacts with free electrons on a metal surface**, typically **gold** or **silver**, at a **metal-dielectric interface** (like metal and air or metal and glass).

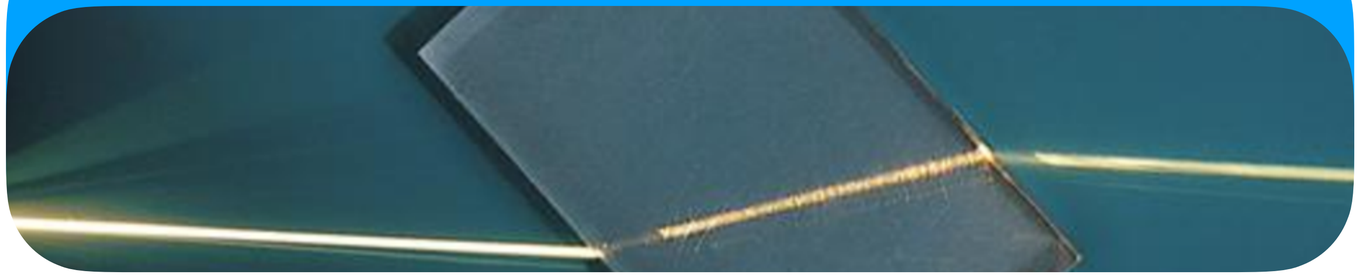
When light hits the metal surface at a specific angle, **it causes electrons on the metal surface to oscillate collectively**—these are called **surface plasmons**.



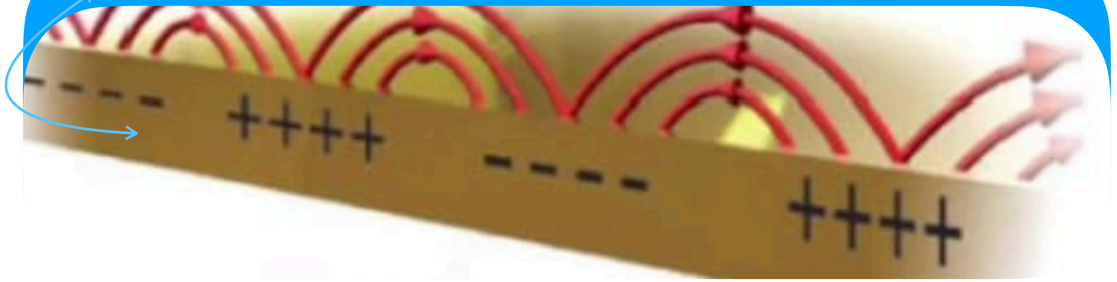
Importance

SPR can **detect molecule binding events**, like when :

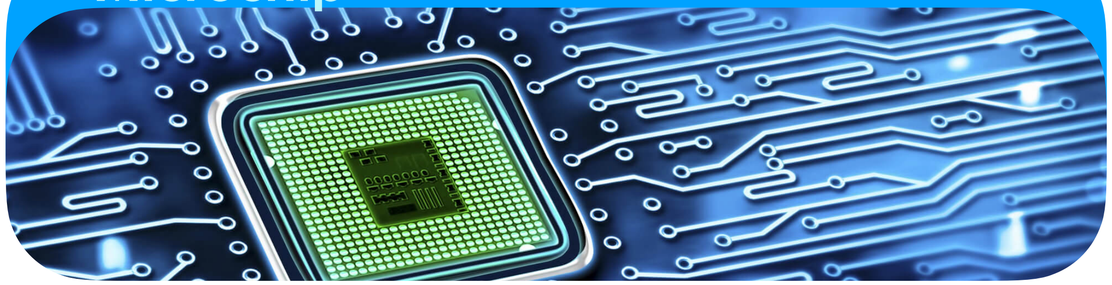
Change in Refractive Index, and SPR angle shift



Gold Film

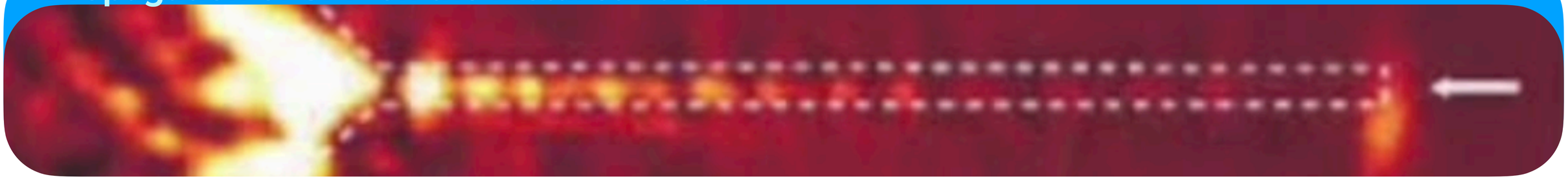


Microchip



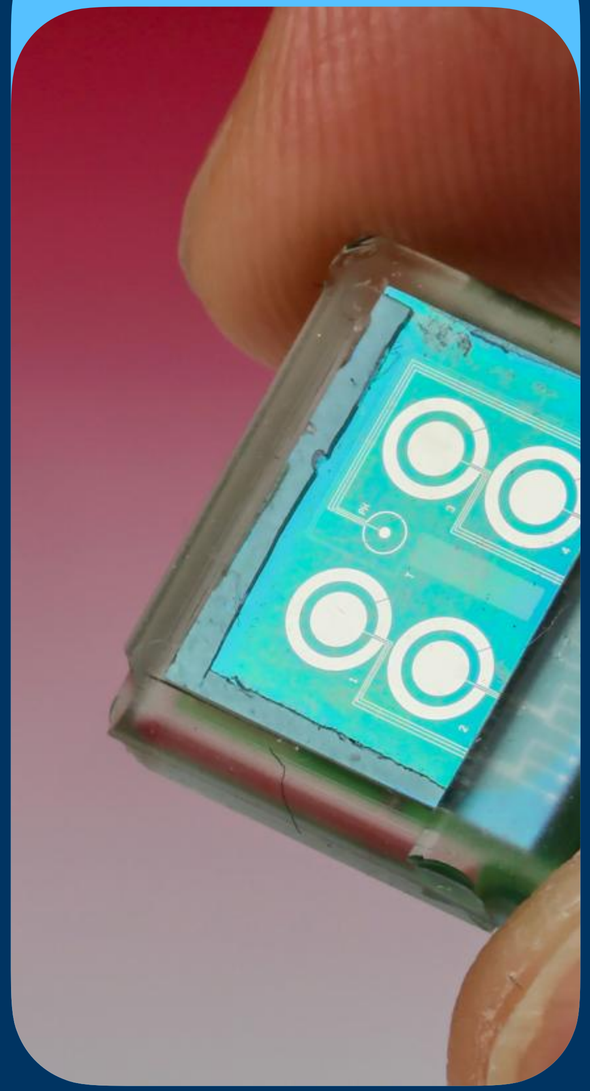
A target molecule (antigen) bonds to it

Propagation of SPP on the metal surface



Applications

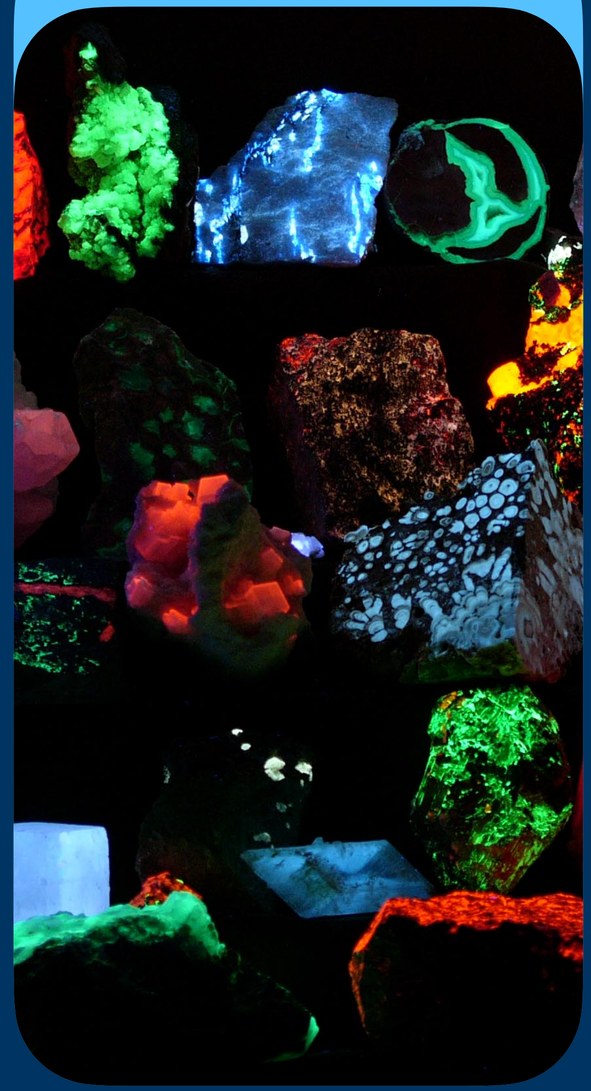
Biosensors



Drug Discovery

Env. Sensing

Label-free Detection



Comparison between different propagation systems

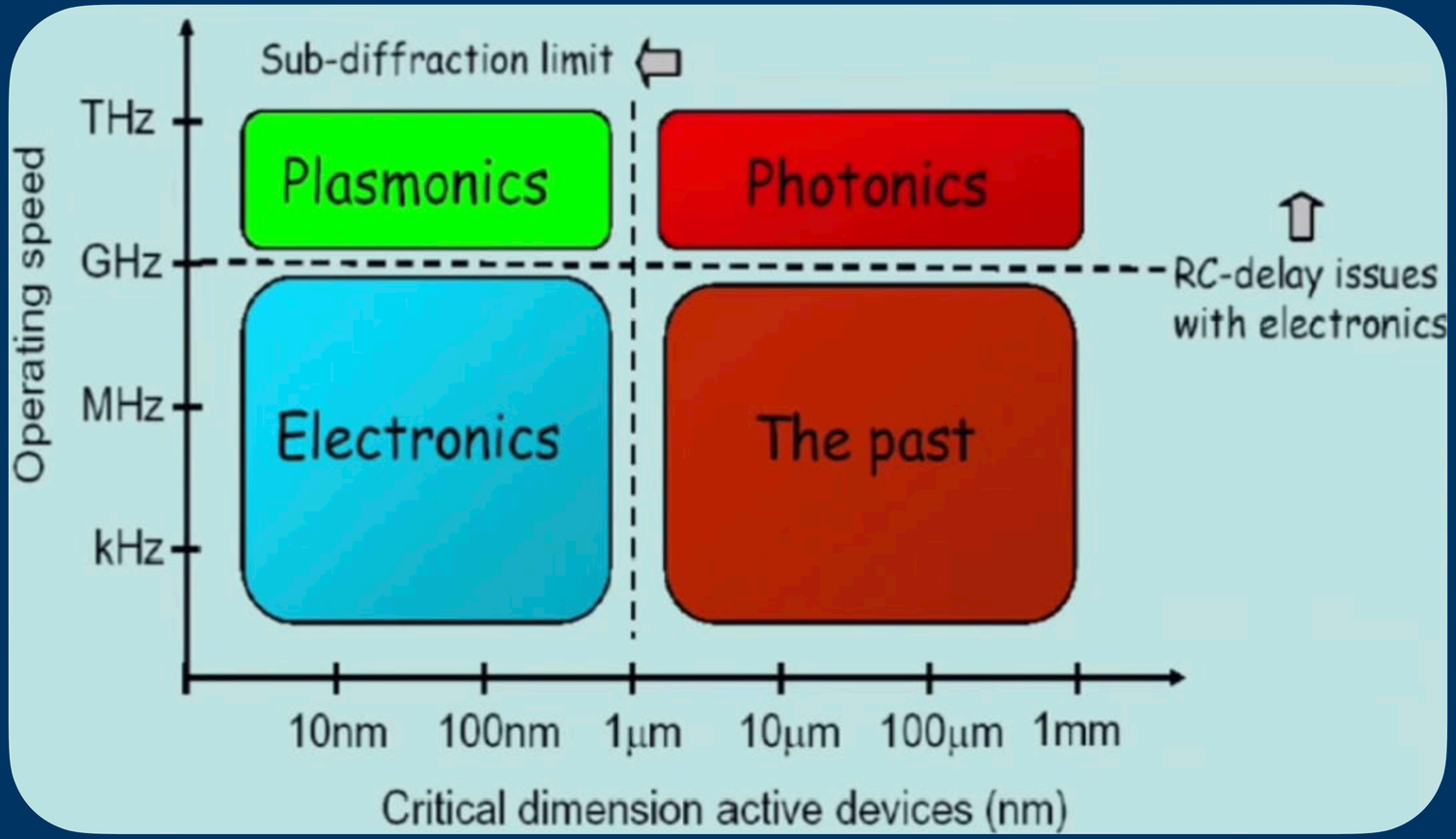
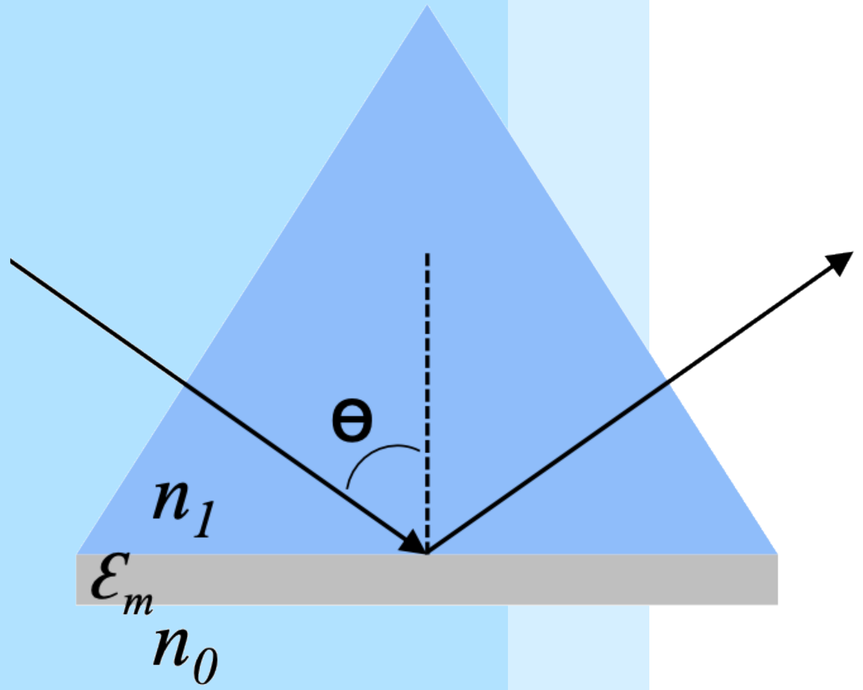


Figure: Geometry for SPP propagation at a single interface between a metal and a dielectric.

Conditions :

- A **p-polarized light** (light with electric field parallel to the incident plane) is used.
- The light hits a **thin metal layer** (often gold) coated on a transparent surface (like a prism).
- At a **specific incident angle**, energy from the light is transferred to the electrons, exciting surface plasmons.
- This causes a **sharp dip in the reflected light intensity**—this dip is called **Surface Plasmon Resonance.**



Experimental Setup

The **Kretschmann configuration** is an experimental setup used to **excite Surface Plasmon Polaritons (SPPs)** using light. It allows **efficient coupling** of light into **surface plasmons** at a **metal-dielectric interface**.

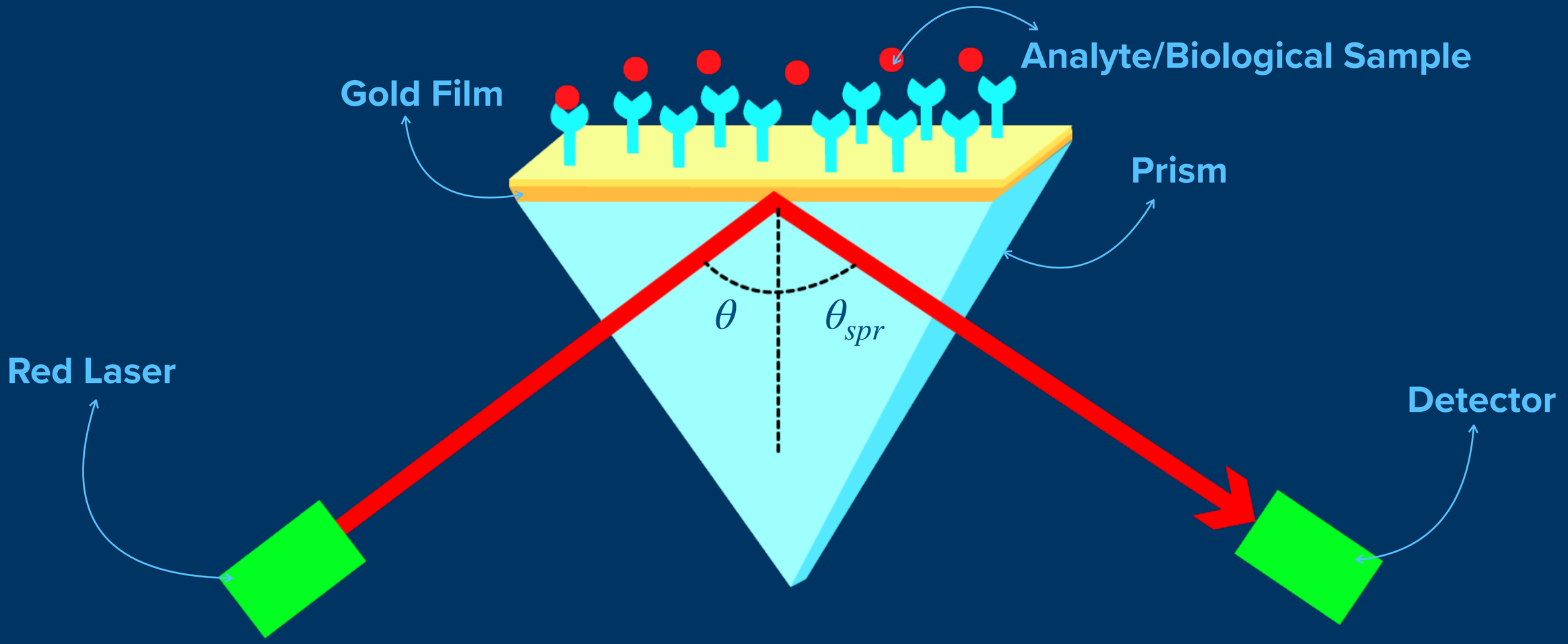
HIGH REFRACTIVE INDEX PRISM WITH THIN GOLD COATING

P-POLARISED LASER BEAM

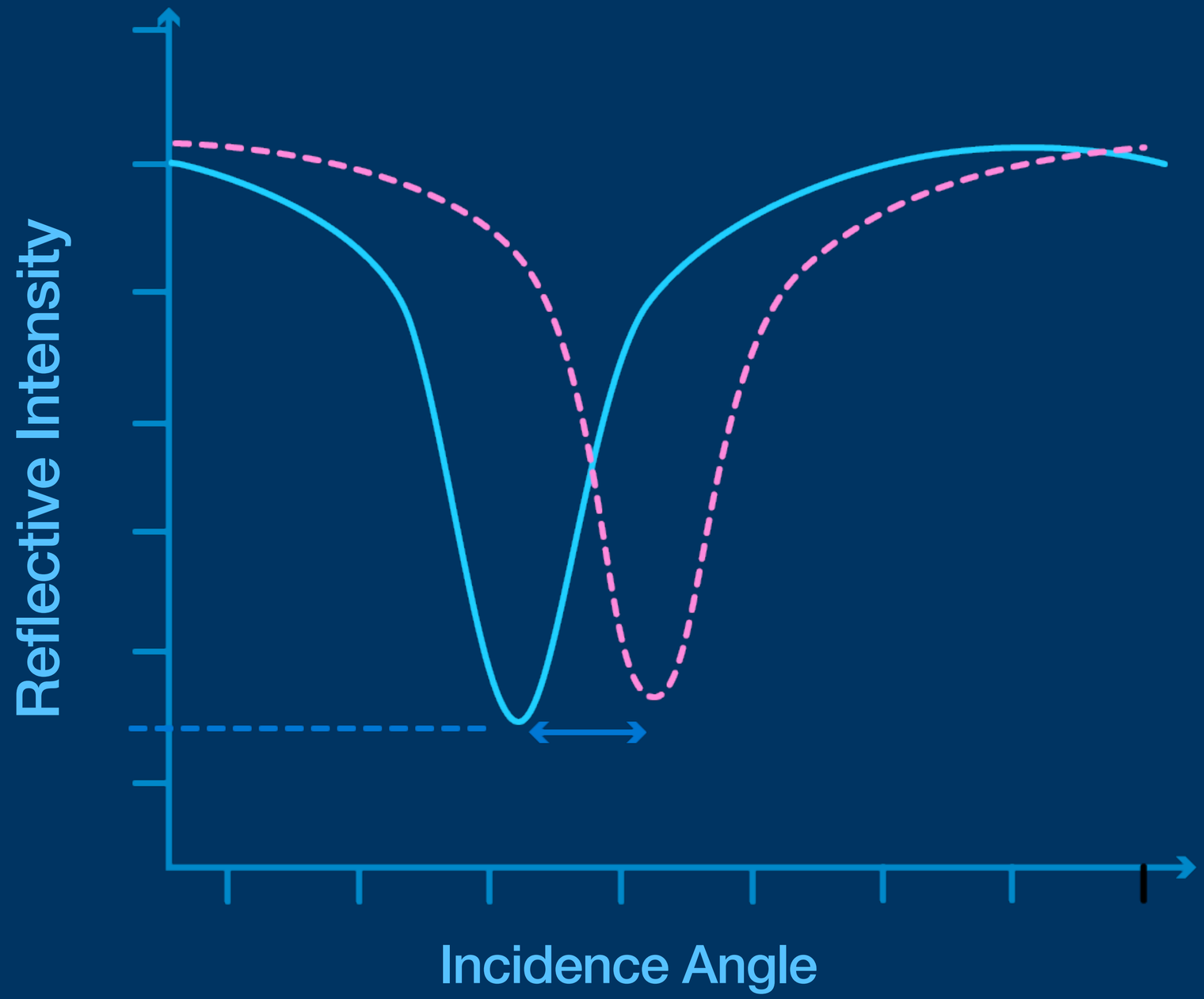
TOTAL INTERNAL REFLECTION

SURFACE PLASMON EXCITATION & SPR DIP

Kretschmann Configuration

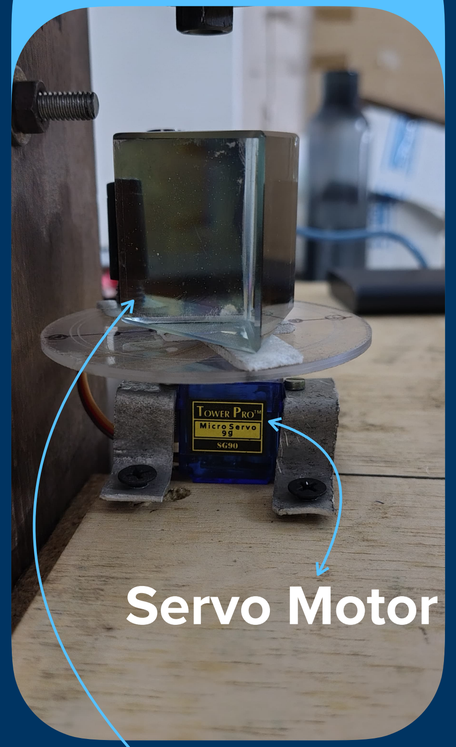


Intensity Dip
At Resonance Angle

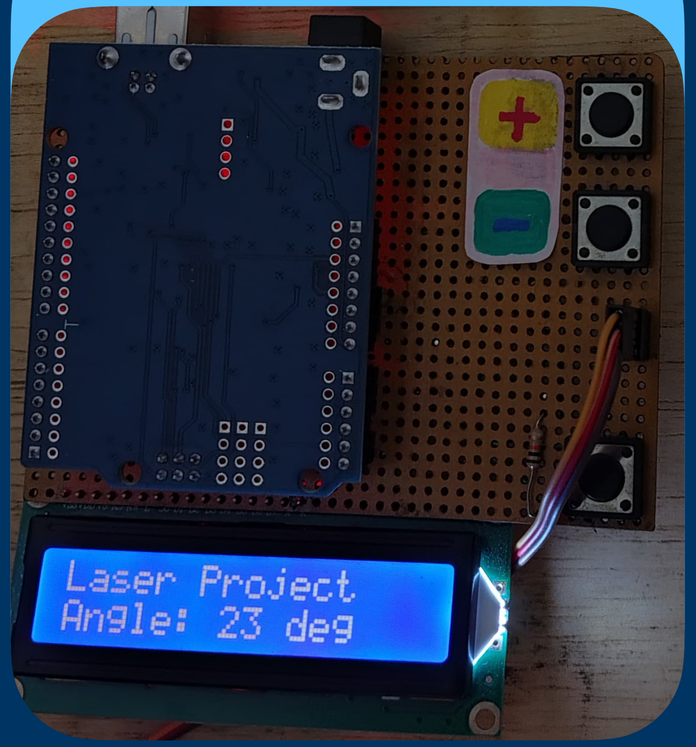


APPARATUS COMPONENTS

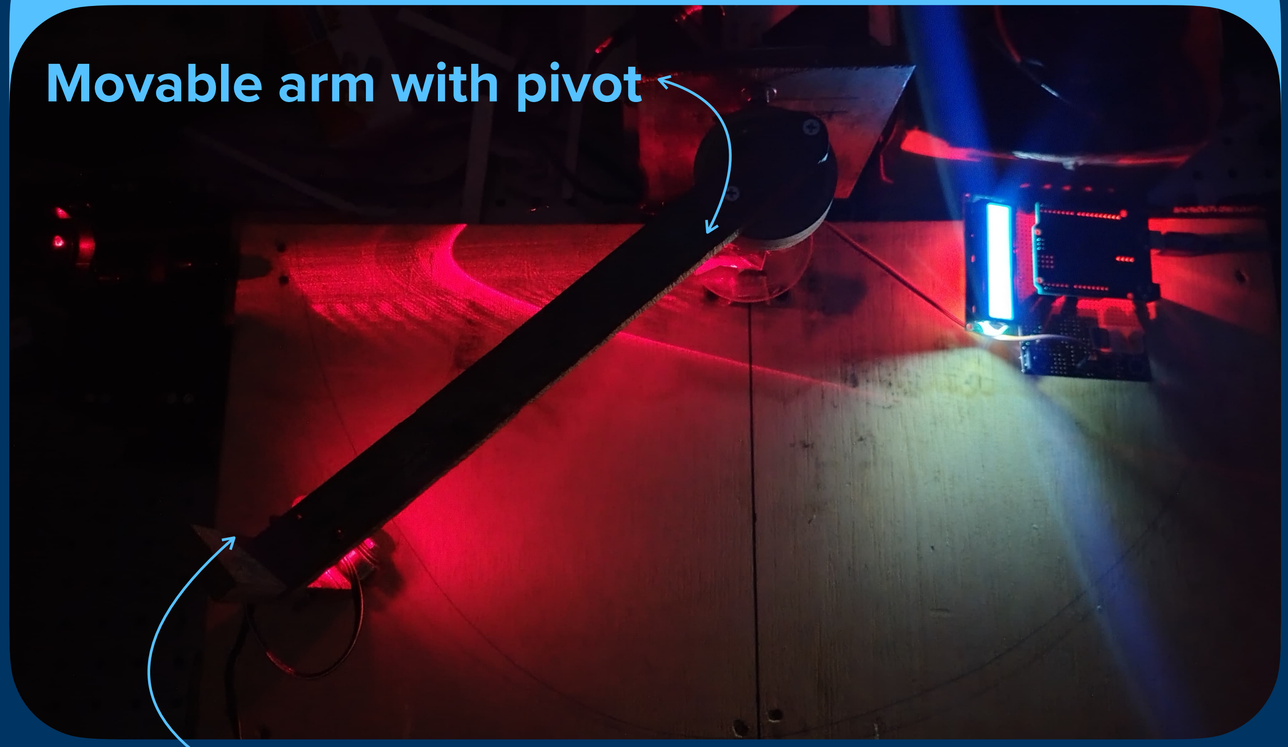
Prism



Arduino Setup

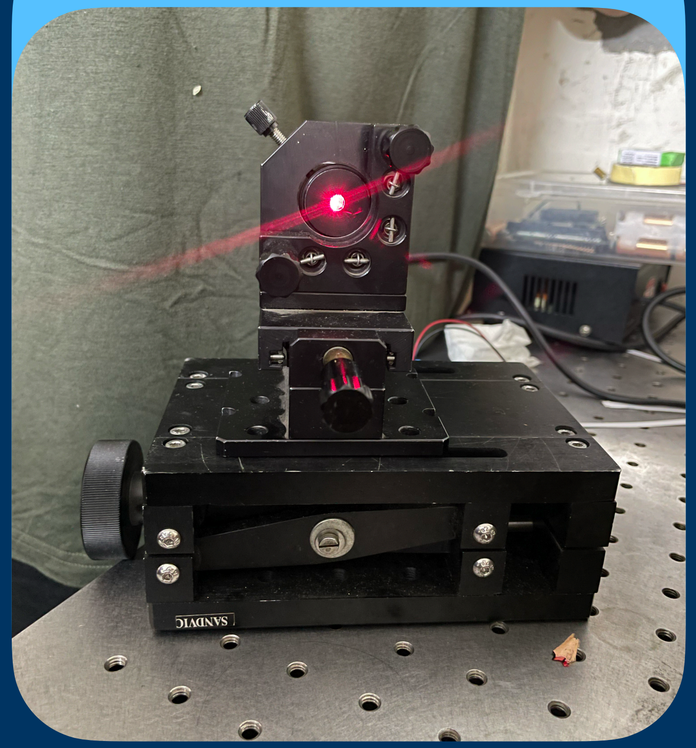


Setup under observation



APPARATUS COMPONENTS

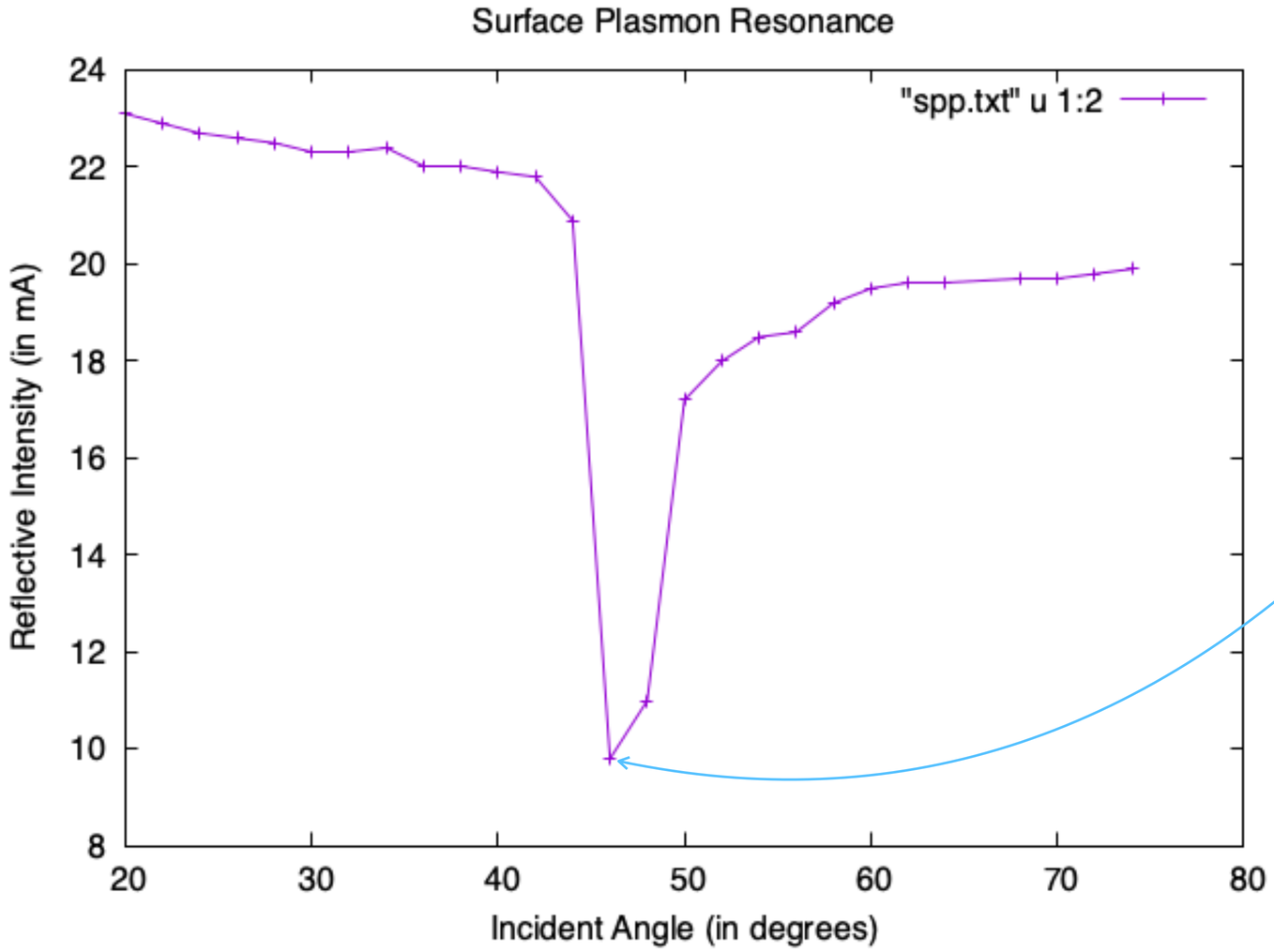
Red Laser



Setup under observation

Observation & Result

Incident angle v/s reflective intensity were plotted using the observed data in gnuplot



Resonance Angle ~ 46°

Conclusion

- DEMONSTRATED THE SURFACE PLASMON POLARITON
- OBSERVED SPR AS A SHARP DIP IN REFLECTIVE INTENSITY
- COST EFFECTIVE ARDUINO SETUP
- REAL TIME ANGLE MONITORING

Future Scope

MULTI WAVELENGTH LASER INTEGRATION

DIFFERENT METAL COATING

ANGULAR RESOLUTION UPGRADE

PORTABLE SPR DEVICE SETUP

References

- Krenn & Aussenegg, Physik Journal 1 (2002)
- M.L. Juan , et. Al., Nat. Photon 5 (2001)
- M.L. Brogerssma and V.M. Shalaev, Science 328 (2010)

THANK YOU