# Stark polarization spectroscopy in the cathode sheath of a Grimm-type glow discharge in neon

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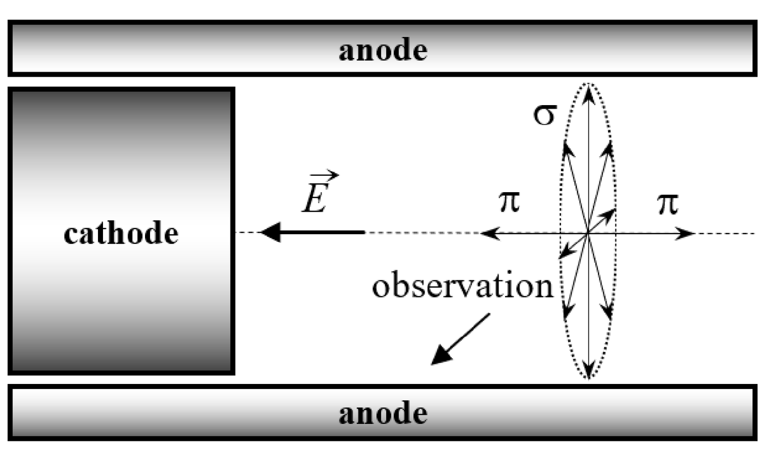
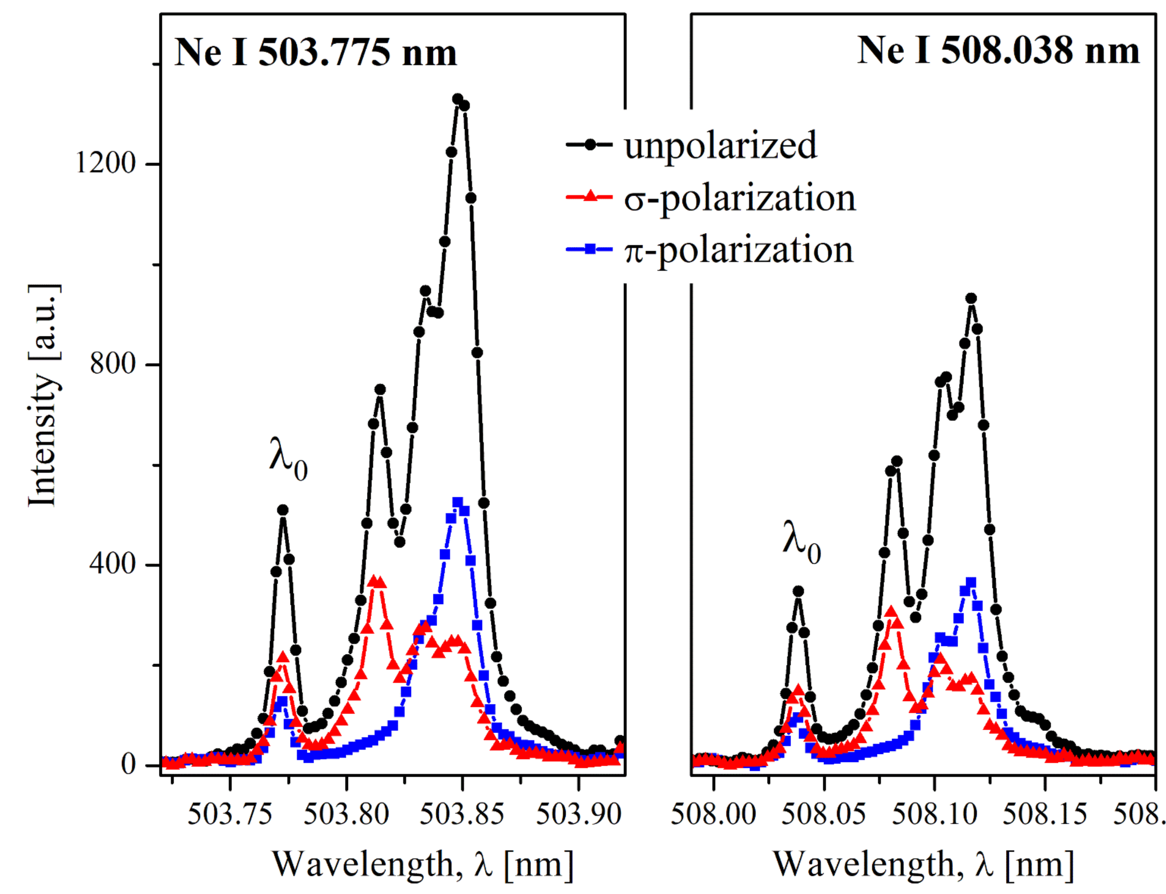
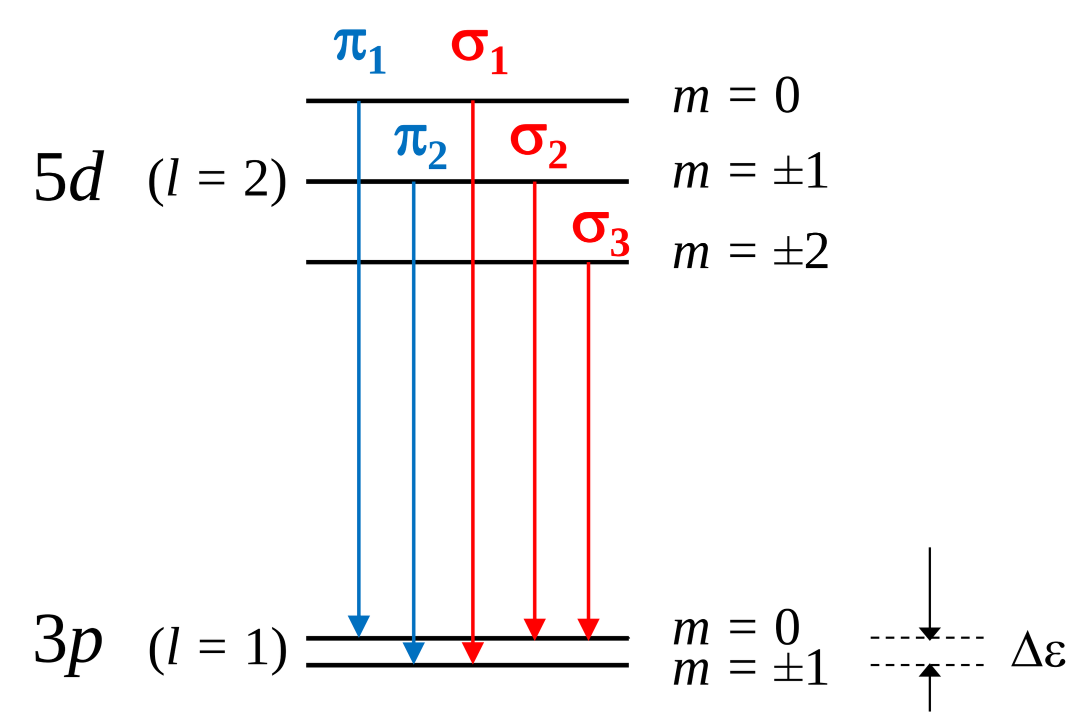
We report on the polarization-dependent excitation of **five** asymmetrically shifted Stark components of neutral neon lines **Ne I 503.775 nm** [5d (7/2) 4 → 3p (5/2) 3] and **Ne I 508.038 nm** [5d (7/2) 3 → 3p (5/2) 2] in the cathode sheath of a Grimm-type DC glow discharge source operating in Ne+0.8%$H_2$ mixture. The Lo-Surdo technique is used in combination with optical emission spectroscopy to study a narrow dark slice of the discharge next to the cathode surface, where an externally applied voltage produces a linearly decreasing electric field.




The central part of the modified Grimm GDS and the schematics of π and σ light polarization. By rotating the linear polarizer axis for 90 degrees, the π or σ polarization is selected.

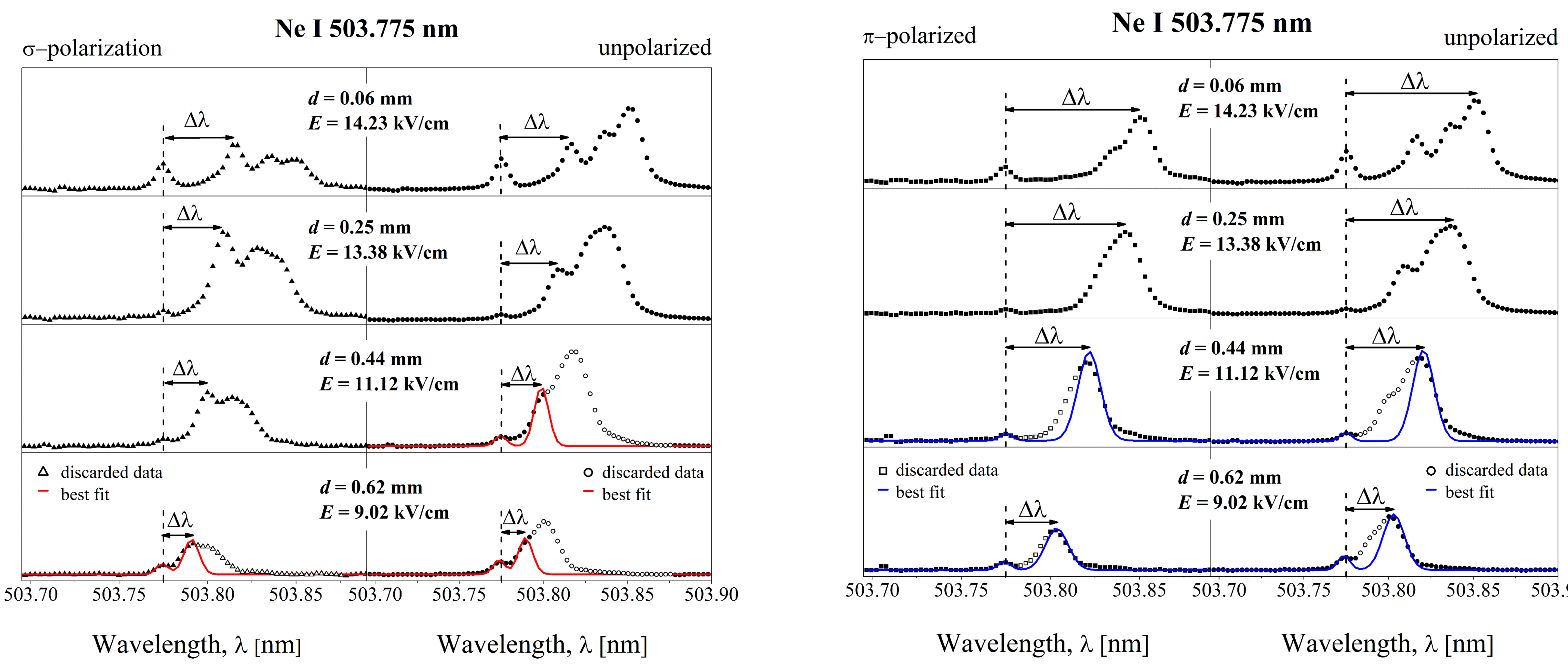



3-component unpolarized profile [1] and polarized profiles with 3 σ and 2 π components, recorded at ~15 kV/cm electric field strength. $\lambda_0$ denotes an unshifted zero-field line.




**Δε ≈ 0** (Ryde [2]): **($\pi_1$, $\sigma_1$) & ($\pi_2$, $\sigma_2$) overlapping**

**Δε = 0** (Windholz [1]): **3-component structure**




Evolution of the σ, π, and unpolarized profiles in the linearly decreasing electric field with the distance from the cathode. The electric field is independently obtained from earlier calibrated Stark shifts of Ne I 507.420 nm line [3]. For fitting at larger distances and smaller fields, the hollow data points are discarded.

The obtained Stark wavenumber shifts Δν ($cm^{-1}$) for strongest polarized components of Ne I lines were fitted to the quadratic function:

$$\Delta\nu = CE^2$$

where $C$ is the line and polarization-specific Stark coefficient, and $E$ (kV/cm) is the electric field strength. This equation is a low-field (up to 15 kV/cm) approximation of analytical expression derived for a wide range of field strengths up to 1000 kV/cm [4].

| Wavelength Ne I [nm] | $C$ [cm/kV$^2$] σ–component | $C$ [cm/kV$^2$] π–component |
|---|---|---|
| 503.775 | -0.00787(5) | -0.01486(9) |
| 508.038 | -0.00827(8) | -0.01501(8) |

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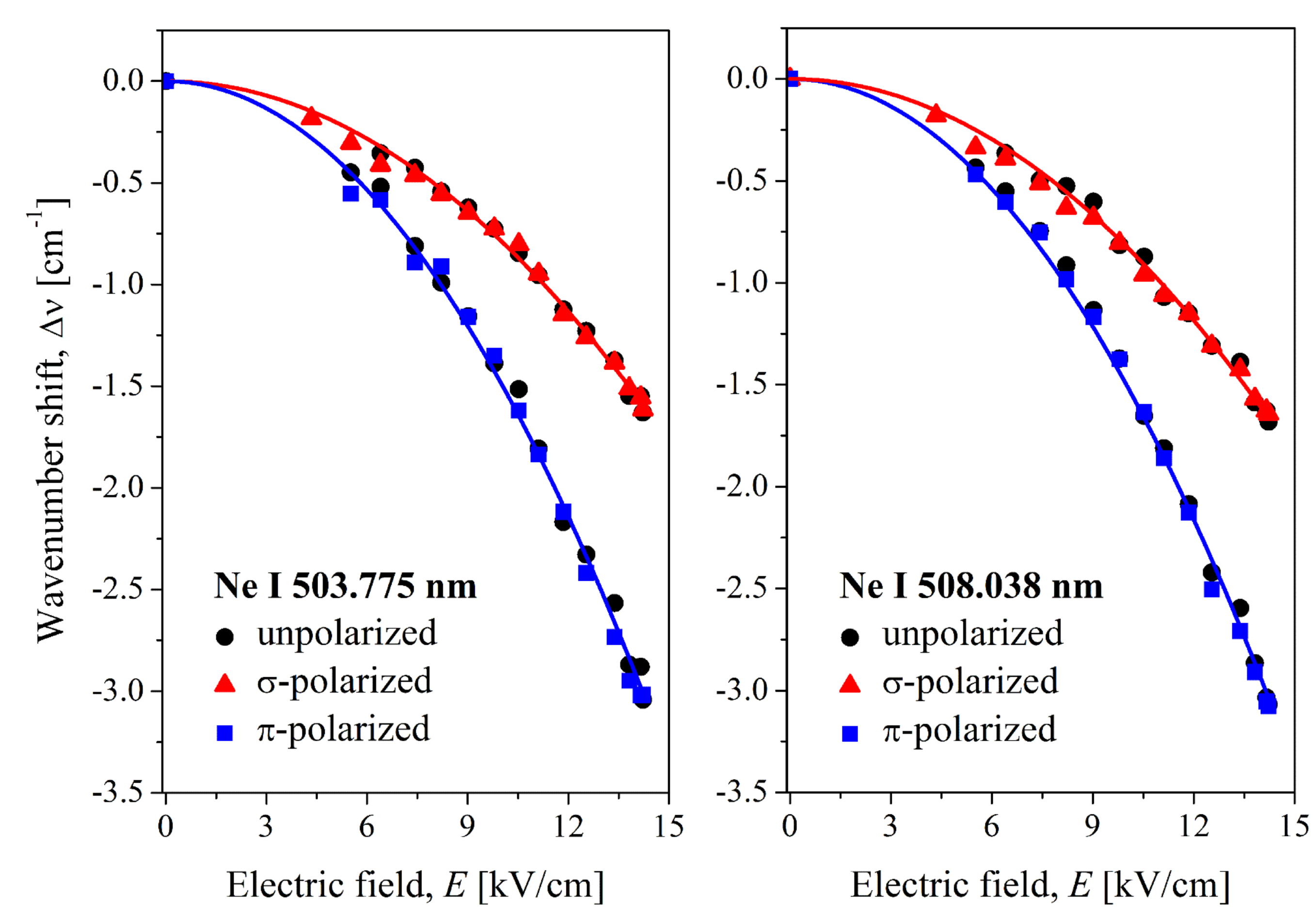


## REFERENCES

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