# Wavelength Dependence of the Fano Effect

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The spin polarization of photoelectrons emitted by unpolarized cesium atoms exposed to circularly polarized light has been measured at wavelengths between 2300 and 3200 Å. At certain wavelengths 100% polarization has been obtained. Slight deviations from theory have been observed. Irradiation of a broad mercury spectrum resulted in (81± 3)% polarization with a current of $0.3 \times 10^{-10}$ A.

One of the topics of atomic physics where there have been very recent advances is the Fano effect[1-3]: Photoelectrons emitted by alkali atoms exposed to circularly polarized light are highly spin polarized if the wavelength of the light falls within a broad spectral band around the minimum of the photoabsorption cross section. This polarization is due to the influence of spin-orbit interaction on photoionization.

In an earlier experiment the existence of spin polarization has been verified by photoionization of cesium atoms using circularly polarized but unfiltered light of a mercury arc lamp.[2] It is the purpose of the present Letter to report the first measurements of photoelectron polarization along the wavelength spectrum.

The general layout of the apparatus is like that described in Ref. 2, though certain parts have been considerably improved.[4] So an efficient extraction system[5] for the photoelectrons has been used and the mercury lamp has been replaced by an uv monochromator combined with a xenon arc lamp.

The experimental results together with the theoretical curve are shown in Fig. 1. In agreement with Fano's predictions, a polarization of 100%, i.e., a completely polarized electron beam, was experimentally obtained at certain wavelengths. At shorter wavelengths we found deviations from the theoretical curve which are not surprising, since the experimental data available to Fano allowed him to make only a semiquantitative estimate of the wavelength scale. The present experimental data yield more accurate information on the influence of spin-orbit interaction on photoionization in a similar way as discussed by Baum, Lubell, and Raith.[3] These authors measured the difference of the ion intensities produced by photoionization of polarized alkali atoms by means of right- and left-hand circularly polarized light, respectively. This quantity, which is closely related to the spin polarization measured in the present work, shows similar deviations from theory.

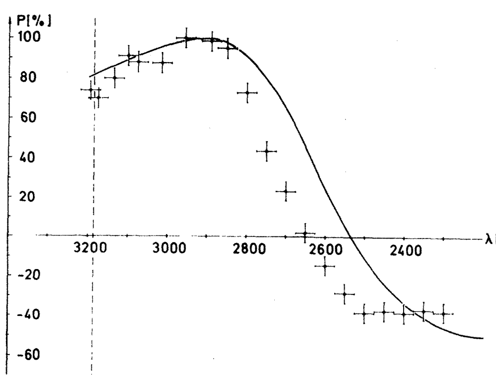


FIG. 1. Wavelength dependence of the photoelectron polarization. Solid line, theoretical values (Fano); the dashed line indicates the ionization threshold.

Irradiation of the unfiltered spectrum of the mercury lamp HBO 200 as described in Ref. 2, but with the improved extraction system, resulted in an average polarization of $(81 \pm 3)\%$[6] with currents of $0.3 \times 10^{-10}$ A. The present apparatus, though not conceived as a source of polarized electrons, has therefore the same efficiency as the well-known sources based on photoionization of polarized atomic beams.

A detailed account of the present work is given elsewhere.[4]

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[1]U. Fano, Phys. Rev. 178, 131 (1969).

[2]J. Kessler and J. Lorenz, Phys. Rev. Lett. 24, 87 (1970).

[3]G. Baum, M. S. Lubell, and W. Raith, Phys. Rev. Lett. 25, 267 (1970).

[4]U. Heinzmann, J. Kessler, and J. Lorenz, to be published.

[5]We gratefully acknowledge the helpful advice of Dr. K. Jost.

[6]The average spin polarization to be expected was $P = 80\%$, considering that the light polarization varied between 95 and 98% over the irradiated spectrum.