On looking out the window

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In March I was in Cork for the annual conference of the ISTA and stayed in the Rochestown Park Hotel. The room I was in faced approximately East and overlooked the N25 and the flyover (F) for Rinnaskiddy. With the help of Google Earth the distance is found to be 350 metres (Fig. 1).

Fig 1

There were net curtains on the windows (as well as heavy ones). The daytime view form the window is shown in Fig. 2. The flyover is on the extreme right; the bridge in the middle corresponds with B in Fig. 1.

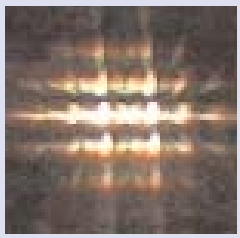

Fig. 2


Fig. 3

At night the view of the flyover was different (Fig. 3).

Fig 4

Fig 5



The fixed light above the flyover showed a single diffraction pattern with little obvious dispersion (Fig. 3, 4). The paired lights of the approaching cars showed overlapping patterns and obvious dispersion (Fig. 5). On the left the red tail-lights of a car show no dispersion.

Between the car headlights the overlapping first order spectra produce a 'white double patch' because the two spectra are in opposite directions. In the overlapping spectra immediately above this centre patch the 'greens' from each side seem to coincide. Let us assume that the wavelength (λ) of 'green' is 530 nm.

What was the spacing in the curtain mesh (d)?
In order to use the usual diffraction relationship ($n\lambda = d\sin\theta$) we need to identify the variables. Because we are dealing just with the first order spectrum $n = 1$. The sine of the angle (which for small angles is almost the same as the tangent of the angle) is the ratio of two distances: 1. the apparent distance from the light source to the green part of the first order spectrum, which turns out to be **half** the distance between the headlights on the car, and 2. the distance from the car to the curtain (350 m).
I have checked the distance between the headlights on a few cars and they ranged from 1.0 m to 1.25 m; 1.10 m would seem to be a typical distance. Half this distance is 0.55 m.

Since $n\lambda = d\sin\theta$
$d = n\lambda / \sin\theta$
$= 1.\ (530 \times 10^{-9})(350)/(0.55)$
$= 3.4 \times 10^{-4}$ m
or 0.34 mm