Theoretical analysis of diffraction spikes produced by a four vane spider

Spike length vs Intensity

Normalised Intensity Maxima

Airy Disc obstruction ratio								Spike	
Σ=0		Σ=0.2		Σ=0.33		Σ=0.4			
kR		kR		kR		kR		kR	
0	$I_{0=}1$	0	$I_{0=}1$	0	$I_{0=}1$	0	$I_{0=}1$	0	$I_{0=}1$
1.64π	$I_1=1/57$	1.63π	$I_1=1/33$	1.61π	$I_1=1/19$	1.58π	$I_1=1/14$	1.43π	$I_1=1/22$
2.68π	$I_2=1/240$	2.69π	$I_2=1/668$	2.74π	$I_2=1/730$	2.77π	$I_2=1/299$	2.46π	$I_2=1/62$
3.70π	$I_3=1/625$	3.68π	$I_3=1/269$	3.64π	$I_3=1/480$	3.66π	$I_3=1/1475$	3.47π	$I_3=1/121$
4.71π	$I_4=1/1284$							4.48π	$I_4=1/200$
5.72π	$I_5=1/2288$							5.48π	$I_5=1/299$
								6.48π	$I_6=1/417$
k=πD/λ[EFL]								7.49π	$I_7=1/555$

Maxima intensity along the spike fall off less rapidly than the Airy disc rings, e.g. for an obstruction ratio Σ=0.2 the third maximum along the spike has twice the normallised intensity than the third ring.

Spike length is independent of vane width. Intensity is proportional to square of relative width (thickness/aperture). Apparent length of spike proportional to aperture and square of relative width, hence square of vane thickness for a given aperture.

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contrast factor γ = eef/[1-eef] eef=encircled energy function

obstruction ratio Σ	w=0	relative vane width w w=0.01	w=0.02	w=0.04
		contrast factor γ		
0	5.17	4.45	3.90	3.05
0.1	4.51	3.95	3.60	2.85
0.2	3.23	2.95	2.75	2.30
0.3	2.15	1.95	1.85	1.70
0.4	1.41	1.25	1.20	1.10

Contrast factor more marked when obstruction ratio $\Sigma \leq 0.25$.
Where $\Sigma \geq 0.3$ width of vanes has little effect on contrast factor.

What Everhart & Kantorski's findings reveal is that spider vane thickness is of crucial significance in reflectors with small central obstructions intended for high contrast performance. It makes sense to use a wire strut spider for such a telescope. When the telescope has a short focal length and an obstruction ratio of 1/3, spider vane thickness has little additional deliterious effect on contrast. If for instance a Newtonian has an $f/4$ primary and a 1/3 c.o. the spider vanes can be made from 16SWG steel strip, or even thicker.