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The Current Helicity Parameter H_c is More Sensitive than α_{best} to Faraday Rotation

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Observations have indicated that the net helicity sign of active regions is predominantly negative in the northern hemisphere and positive in the southern (see Table 1). From Table 1, we find that the hemispheric sign rule of helicity parameter $\alpha_{\rm best}$ does not change with another solar cycle; but the helicity parameter $H_{\rm c}$ seems to show a weak opposite hemispheric preference for Huairou data in the solar cycle 23 and no preference for Mees data. How to explain such a phenomenon? We think one reason may be from the action of Faraday rotation. Faraday rotation will cause a counterclockwise rotation of the azimuth for a positive polarity field and vice versa. During the cycle 22, the polarity of leading sunspots is dominantly negative in the northern hemisphere and positive in the southern. The effect of Faraday rotation, which is determined mostly by a leading polarity sunspot, has a positive contribution to the percentage of current helicity signs in active regions and leads to the increase of the strength of the hemispheric sign rule. In the cycle 23, the polarity of most leading sunspots is positive in the northern hemisphere and Faraday rotation will decrease the percentage of current helicity signs. Consequently, the strength of the hemispheric rule should be weakened. On the other hand, $H_{\rm c}$ is more susceptible to Faraday rotation than $\alpha_{\rm best}$ because it is mainly related to the areas where the line-of-sight field is strong. Therefore, if the effect of Faraday rotation is not completely removed in our observations, the hemispheric sign rule showed is weak in the cycle 23 than in the cycle 22 (for $\alpha_{\rm best}$), even opposite (for $H_{\rm c}$).

Table 1. Hemispheric distribution of current helicity sign in solar cycles 22 and 23.

Reference	Cycle	Hemisph.	$\alpha_{\rm best}$ Negative	$\alpha_{\rm best}$ Positive	$H_{\rm c}$ Negative	$H_{\rm c}$ Positive	No. Obs.	Data Source
Pevtsov et al. 1995	22	North	25(76%)		. . .		33	Mees
		South		25(69%)		. . .	36	
Bao & Zhang 1998	22	North	152(76%)		168(84%)		199	Huairou
		South		159(71%)		177(79%)	223	
Bao et al. 2000	23	North	26(59%)		14(32%)		44	Huairou
		South		28(65%)		21(49%)	43	
Pevtsov et al. 2001	23	North	88(63%)		70(50%)		140	Mees
		South		86(70%)		70(57%)	123	

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