
The Spin Vector

In spite of its esoteric name, the spin vector is simple. It will be the key to managing wedge orientations without actually having to think about them.

There is a spin vector associated with each of our four classes of non-random crystal orientations:

Plate orientations Recall that a hexagonal prismatic crystal is in plate orientation when face 1 is horizontal and on top (Figure 6.1). Thus the crystal is in plate orientation if \mathbf{N}_1 , the outward normal vector to face 1, is vertical (and pointing up rather than down). The vector \mathbf{N}_1 is the spin vector for plate orientations. It is a vector which is fixed in the crystal and which characterizes plate orientations: The crystal is in plate orientation exactly when the spin vector is vertical.

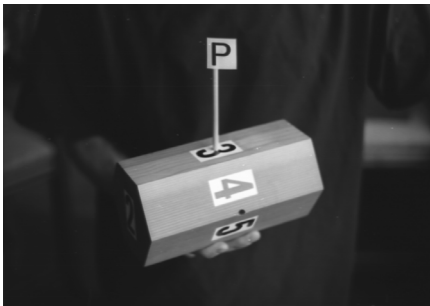
The spin vector is illustrated with a wooden crystal model in Figure 13.1. The spin vector is the dowel, inserted in face 1. The crystal model is in plate orientation when the dowel points up.

Parry orientations A crystal is in Parry orientation when face 3 is horizontal and on top. Thus the crystal is in Parry orientation when \mathbf{N}_3 , the normal vector to face 3, is vertical. The vector \mathbf{N}_3 is the spin vector for Parry orientations. It is a vector which is fixed in the crystal and which characterizes Parry orientations: The crystal is in Parry orientation exactly when the spin vector is vertical.

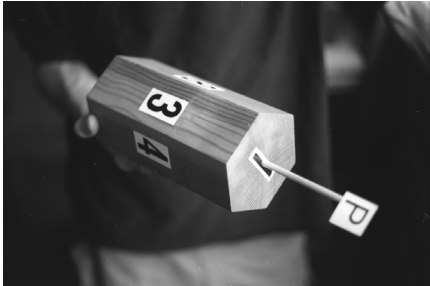
Column orientations A crystal is in column orientation when the crystal axis is horizontal, that is, when the vector \mathbf{N}_1 is horizontal. The vector \mathbf{N}_1 is the spin vector for column orientations. It is the same as the spin vector for plate orientations, but for column orientations the spin vector is horizontal, whereas



Wooden crystal model in plate orientation. The spin vector \mathbf{P} (the dowel) is \mathbf{N}_1 , the normal vector to face 1. In plate orientation the spin vector is vertical.



Crystal model in Parry orientation. The spin vector is \mathbf{N}_3 and is vertical.



Crystal model in column orientation. The spin vector is \mathbf{N}_1 and is horizontal



Crystal model in Lowitz orientation. The spin vector is $\mathbf{N}_1 \times \mathbf{N}_3$ and is horizontal.

FIGURE 13.1 Compare these photographs with Figure 6.1.

TABLE 13.1 Crystal orientation classes and spin vector.

Crystal orientation class	Spin vector \mathbf{P}	Direction of \mathbf{P}
plate orientations	\mathbf{N}_1	vertical
Parry orientations	\mathbf{N}_3	vertical
column orientations	\mathbf{N}_1	horizontal
Lowitz orientations	$\mathbf{N}_1 \times \mathbf{N}_3$	horizontal

for plate orientations it is vertical. That is, the crystal is in column orientation exactly when the spin vector is horizontal.

Lowitz orientations Lowitz orientations are rare, and we mention them here mainly to illustrate further the concept of spin vector. A crystal is in Lowitz orientation when $\mathbf{N}_1 \times \mathbf{N}_3$ (a vector parallel to face 1 and face 3) is horizontal. Hence the spin vector for Lowitz orientations is $\mathbf{N}_1 \times \mathbf{N}_3$, and the crystal is in Lowitz orientation exactly when the spin vector is horizontal.

Thus for each of the above four classes of crystal orientations there is a vector \mathbf{P} —the *spin vector*—which is fixed in the crystal and which characterizes the class of orientations: A crystal has the orientation in question exactly when the spin vector is vertical (plate and Parry orientations) or horizontal (column and Lowitz orientations).

Contact arcs and non-contact arcs

We said that the spin vector \mathbf{P} is always horizontal or always vertical. Refraction arcs that arise in crystal orientations with \mathbf{P} horizontal are called *contact arcs*, those that arise in crystal orientations with \mathbf{P} vertical are called *non-contact arcs*. The middle diagram in Figure 5.5 can be thought of as showing the distribution of the spin vector for a contact arc, and the left-hand diagram as showing the same for a non-contact arc. In Figure 12.1 halos associated with the first and second rows—plate arcs and Parry arcs—are non-contact arcs, and those associated with the third and fourth rows—column arcs and Lowitz arcs—are contact arcs. The terminology of contact and non-contact has to do with whether the arc normally makes contact with the associated circular halo (Chapters 14 and 16).

Contact arcs behave quite differently from non-contact arcs. More importantly: In spite of our initial impression of chaos, all contact arcs behave alike, and all non-contact arcs behave alike. In the next chapter we will look at the non-contact arcs, then in Chapter 16 the contact arcs.