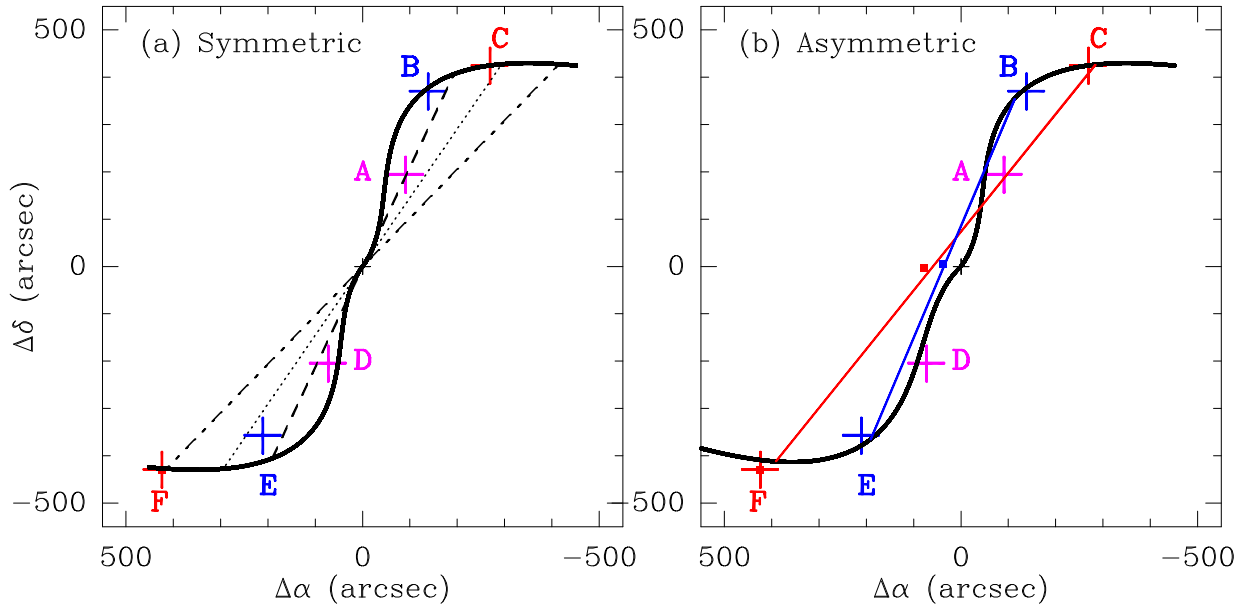

Fig. 3. Distribution of groups of HH knots around PV Cep. The three groups towards the north-west are labelled A, B, and C, and the three groups toward the south-east are D, E, and F. The positions are taken from Gómez et al. (1997). (a) Model based on a symmetric precessing jet following Gómez et al. (1997) with the parameters given in the text (solid black line). Lines joining the expected positions along the jet at times 6000, 7000, and 8000 yr are shown. (b) Model based on an asymmetric precessing jet with the parameters given in the text (solid black line). Lines joining the expected positions along the jet at 4900 and 6900 yr are shown. They intercept the positions of the bisectors of the B-E and C-F pairs (shown as blue and red squares).

with the measured bisectors of the B-E and C-F pairs (Figure 3b).

The model shown in Figure 3b certainly represents an oversimplification of the true structure of the jet in PV Cep, and is clearly not unique. It does demonstrate, however, that a slightly asymmetric jet can provide a better description of the structure of the flow than a symmetric one, and could readily explain the bisector results of GA2004 with no need for a large stellar velocity. It would be interesting to investigate more realistic numerical models of bipolar jets encountering asymmetric surroundings. In particular, it would be useful to know in what domain of the parameter space they can produce bisector results similar to those found in PV Cep by GA2004.

It is worth mentioning that the gas immediately south of PV Cep appears to be significantly denser than the gas immediately north of it (Arce & Goodman 2002a,b). Thus, one might expect the southern lobe to be slower than the northern lobe and not the other way around, as our asymmetric model would suggest. The distribution of the gas surrounding PV Cep, however, is likely to be quite asymmetric. For instance, knot C (to the north) is known to entrain a massive molecular gas shell, whereas no entrained gas is associated with its southern counterpart knot F (Arce & Goodman 2002a,b). This suggests that, on large scales, the density of molecular material north of PV Cep might be higher that south of it. This is reversed compared to the density distribution in the immediate surroundings of PV Cep.

In addition to their bisector results, GA2004 mention two pieces of evidence supporting the idea that PV Cep might be a runaway star. The first one is the existence of a tail of red-shifted gas located to the east of PV Cep. The second is the wiggling of the southern jet seen at small scales. These two effects have not been reported in other outflow systems, and it is unclear if they have a direct relation to the asymmetry of the jet in PV Cep. It certainly would be worthwhile to search for these effects in other outflow systems (symmetric or not) and to investigate numerically in what kind of situation they would tend to develop.

6. CONCLUSIONS

Comparing two VLA observations separated by 10.5 years, we have measured the proper motion of the young star PV Cep. This measurement shows that PV Cep is essentially stationary with respect to its surroundings, and is not a fast-moving runaway