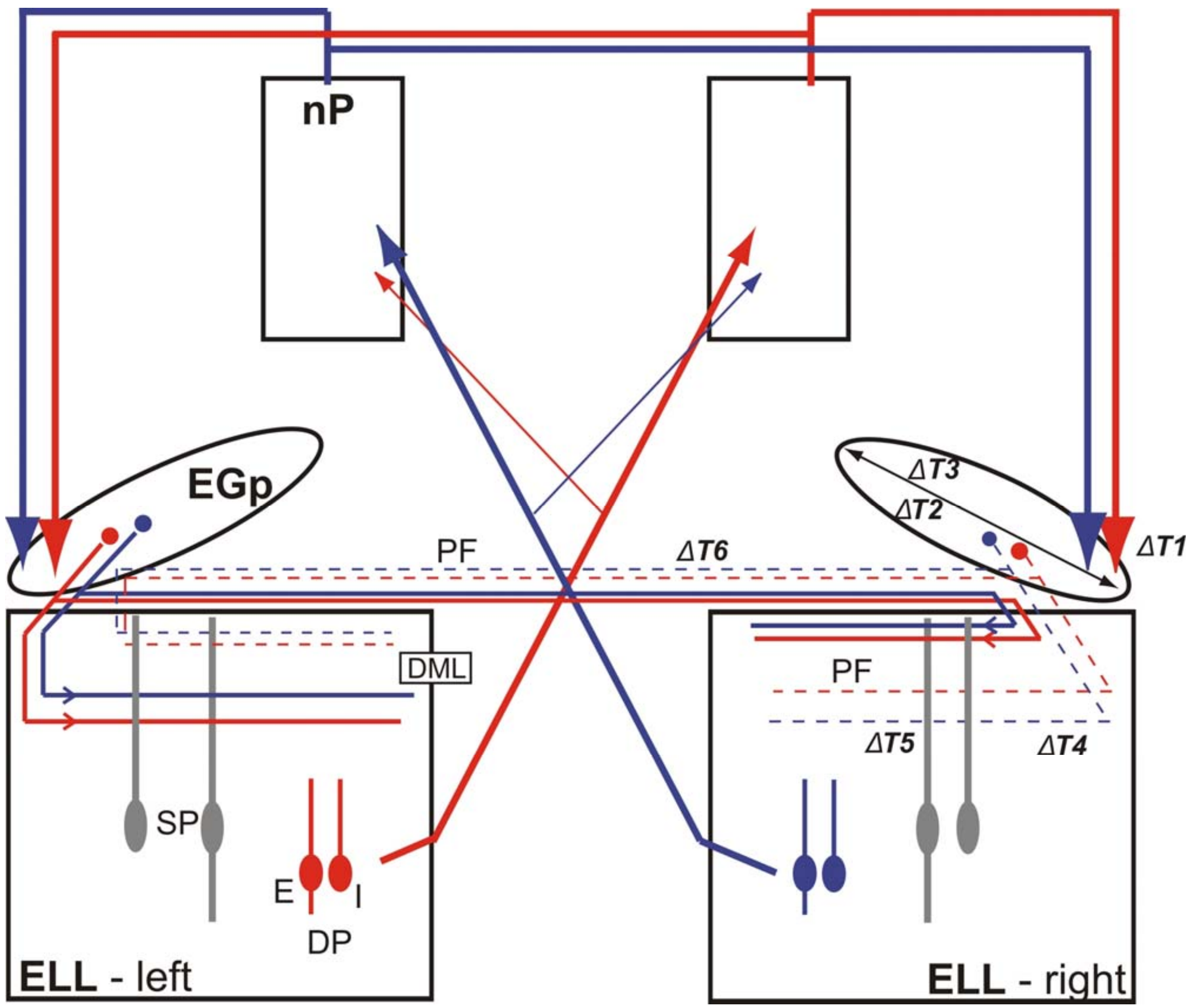

Figure 2011A: Schematic diagram of indirect feedback pathway to ELL and associated conduction and synaptic delays.

For clarity neither the electrosensory lateral line (ELL) maps nor the intermediate class of pyramidal cell are included (Maler, 2007). Superficial (S) and deep (D) pyramidal cells receive direct input from P-unit electroreceptors; the E type pyramidal cells respond to increases in stimulus amplitude. A second type of pyramidal cell, the I type, responds to decreases in amplitude (Maler et al., 1981; Saunders and Bastian, 1984; Maler, 2007**).** The deep cells are not plastic and are the source of the feedback pathway to ELL under study in this paper (Bastian et al., 2004); these cells and their efferent pathways are colored red in the left ELL and blue in the right ELL. The superficial cells project only to the midbrain torus semicircularis (not shown; Carr and Maler, 1986); they are plastic and receive massive feedback via their apical dendrites (Bastian et al., 2004). Deep pyramidal cells project mainly to the contralateral nucleus praeminentialis (nP, thick red and blue lines and arrows) with a small ipsilateral projection as well as projecting to the midbrain torus semicircularis, which is not indicated in this figure (Carr and Maler, 1986). Several cell types within nP project bilaterally (roughly equal weight for ipsi and contralateral projections) to a mass of caudally situated cerebellar granule cells- the eminential granularis posterior (EGp; Sas and Maler, 1987). We assume in these diagrams that the deep E and I-cells pathways are kept separate through nP and EGp but that EGp granule cell parallel fibers can then make synaptic contacts on both E and I type superficial pyramidal cells. Further studies will be required to validate this assumption which is important inasmuch as granule cells cannot fire throughout the stimulus cycle.

Thus the EGp receives roughly equal input from both ipsilateral and contralateral deep pyramidal cells (E and I type). The latency of this input (measured in EGp) was estimated to range from ~5-12 ms (ΔT1) (Middleton and Maler, unpublished observations- these values were obtained for recordings reported in Middleton et al., 2006); the mean latency was 9.3 ms, slightly higher than that reported for one type of nP neuron (5.7 ms, multipolar cells; Bastian and Bratton, 1990). The synaptic delay of mossy fiber input to granule cells of the rat cerebellum is approximately 2 ms (Saviane and Silver, 2006); we take this to be the delay for input to EGp granule cells (ΔT2). The EGp projects bilaterally to the dorsal molecular layer (DML) of the ELL; the ipsilateral projection terminates in the ventral half of the DML while the contralateral projection ends in its dorsal half (Sas and Maler, 1987). The EGp extends about 1200 μm; this and the other lengths reported below were estimated from the *A. leptorhynchus* atlas of Maler et al. (1991). The EGp granule cells must therefore traverse up to this distance before entering the ELL. The conduction velocity of parallel fibers in the mormyrid cerebellum has been estimated to be 0.1 m/s (Roberts and Bell, 2000). This gives a delay of up to 12 ms (ΔT3) for PFs to reach the lateral edge of the ispilateral DML. From this location PFs must traverse ~800 μm to reach the middle of the centro-lateral segment leading to a delay of ~8 ms (ΔT4). The EPSPs evoked by PF stimulation peak with a latency of ~6.5 ms (Berman and Maler, 1998b) and we take this as the synaptic delay, ΔT5. Therefore the total feedback delay for contralateral and ipsilateral electrosensory input to reach the DML via the ipsilateral EGp ranges from ~21 to 41 ms.

The EGp granule cells also project to the contralateral ELL via a commissure within the medial caudal cerebellum (Sas and Maler, 1987); the commissural fibers must traverse up to an extra ~3200 μm giving an extra delay of ~32 ms (ΔT6). Therefore the total feedback delay for contralateral and ipsilateral electrosensory input to reach the DML via the contralateral EGp can be as long as 73 ms.

In summary electrosensory feedback delays via the parallel fiber input to the ELL molecular layer can range from ~20 to 70 ms; the feedback to E-cells can emanate from both E and I type deep pyramidal cells (this also applies to the feedback to I type superficial pyramidal cells).

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