

## The “sixth sense:” How do we sense electric fields?

October 12th, 2015 @ 10:46 am by [Andy Fell](#)

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A variety of animals are able to sense and react to electric fields, and living human cells will move along an electric field, for example in wound healing. Now a team lead by Min Zhao at the UC Davis [Institute for Regenerative Cures](#) has found the first actual “sensor mechanism” that allows a living cell to detect an electric field. The work is published Oct. 9 in the journal [Nature Communications](#).

“We believe there are several types of sensing mechanisms, and none of them are known. We now provide experimental evidence to suggest one which has not been even hypothesized before, a two-molecule sensing mechanism,” Zhao said.

Zhao and colleagues have been studying these “electric senses” in cells from both larger animals ([fish skin cells](#), human cell lines) and in the soil-dwelling amoeba *Dictyostelium*. By knocking out some genes in *Dictyostelium*, they previously identified some of the genes and proteins that [allow the amoeba to move in a certain direction when exposed to an electric field](#).

In the new work, carried out in a human cell line, they found that two elements, a protein called Kir4.2 (made by gene *KCNJ15*) and molecules within the cell called polyamines, were needed for signaling to occur. Kir4.2 is a potassium channel – it forms a pore through the cell membrane that allows potassium ions to enter the cell. Such ion channels are often involved in transmitting signals into cells. Polyamines are molecules within the cell that carry a positive charge.

Zhao and colleagues found that when the cells were in an electric field, the positively-charged polyamines tend to accumulate at the side of the cell near the negative electrode. The polyamines bind to the Kir4.2 potassium channel, and regulate its activity.


He cautioned that they do not yet have definitive evidence of how “switching” of the potassium channel by polyamines translates into directional movement by the cell.

Contributors to the paper are: Ken-ichi Nakajima, Kan Zhu, Yao-Hui Sun, Yoshihiro Izumiya, Bence Hegyi, Qunli Zeng, Christopher Murphy, J. Victor Small, Ye Chen-Izu, and Josef Penninger, with affiliations at the UC Davis Departments of Dermatology, Ophthalmology, Pharmacology, Biochemistry and Molecular Medicine, and the UC Davis School of Veterinary Medicine; Zhejiang University, Hanzhou, China; and the Institute of Molecular Biotechnology of the Austrian Academy of Sciences, Vienna, Austria.

The work was supported by grants from the National Institutes of Health, NSF, American Cancer Society, American Heart Association, Research to Prevent Blindness Inc., and the University of California.

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