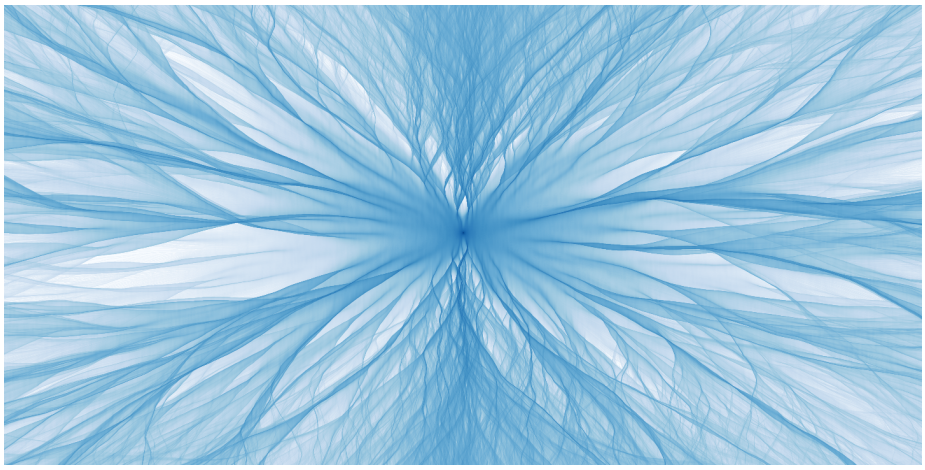
Branched flows in anisotropic random media

Ragnar Fleischmann, Max Planck Institute for Dynamics and Self-Organization, Göttingen



Example of a branched flow in an anisotropic medium with anisotropy $\mathcal{A} = 1/\sqrt{6}$.

Even very small fluctuations in the ocean depth can randomly focus tsunami waves. This leads to an order of magnitude variations in the energy flux density emitted in random directions, with severe implications for the predictability of tsunamis [1]. This is an example of a *branched flow*: When waves propagate through weakly scattering but correlated, disordered environments they are randomly focused into pronounced branch-like structures. This phenomenon has been studied in a range of systems including the sound propagation in the ocean, electron transport in two-dimensional electron gases, microwave transmission through random arrangements of scatterers and the dynamics of wind-driven ocean waves. In contrast to these systems, which are well characterized as isotropic random media, the structures in the ocean floor topography that scatter tsunami waves show a pronounced anisotropy. This motivated us to study the influence of anisotropy on the natural focusing events in branched flows. We found a strong and non-intuitive dependence of the intensity fluctuations on the propagation angle. Furthermore does the mean intensity of the flow show an intricate structure linked to angle dependent anomalous velocity diffusion [2].

[1] H. Degueldre, J. J. Metzger, T. Geisel, and R. Fleischmann, "Random focusing of tsunami waves", Nature Phys. **12**, 259262 (2016).

[2] H. Degueldre, J. J. Metzger, E. Schultheis, and R. Fleischmann, "Channeling of Branched Flow in Weakly Scattering Anisotropic Media," Phys. Rev. Lett. **118**, 024301 (2017).