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From single cilia to collective waves in human airway ciliated tissues[1] PIETRO CICUTA, MAURIZIO CHIOCCIOLI, LUIGI FERIANI, NICOLA PELLICCIOTTA, JURIJ KOTAR, University of Cambridge — I will present experimental results on activity of motile cilia on various scales: from waveforms on individual cilia to the synchronised motion in cilia carpets of airway cells. Model synthetic experiments have given us an understanding of how cilia could couple with each other through forces transmitted by the fluid, and thus coordinate to beat into well organized waves (previous work is reviewed in Annu. Rev. Condens. Matter Phys. 7, 1-26 (2016)). Working with live imaging of airway human cells at the different scales, we can now test whether the biological system satisfies the "simple" behavior expected of the fluid flow coupling, or if other factors of mechanical forces transmission need to be accounted for. In general being able to link from the scale of molecular biological activity up to the phenomenology of collective dynamics requires to understand the relevant physical mechanism. This understanding then allows informed diagnostics (and perhaps therapeutic) approaches to a variety of diseases where mucociliary clearance in the airways is compromised. We have started exploring particularly cystic fibrosis, where the rheological properties of the mucus are affected and prevent efficient cilia synchronization.

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