# Exercise 7
# Fluid Dynamics II SS 2022

6.7.2022

## 1 Exercise: Wind tunnel measurement

Continue to analyze the datasets in the folder wind_data/LCA, which were measured at 20kHz and in m/s.

- Calculate the flatness $S_4(r)/3S_2(r)^3$. What would you expect for Gaussian-distributed velocity increments?
- What is the predicted flatness for the K62 model? Try to fit the flatness according to the prediction of the K62 model (this is a bit tricky; choose a fitting range around the Taylor length). Determine the intermittency coefficient $\mu$.

## 2 Exercise: Lundgren hierarchy

Derive a temporal evolution equation for the PDF of a passive scalar $f_1(\theta_1, \mathbf{x}_1, t) = \langle \delta(\theta_1 - \theta(\mathbf{x}_1, t)) \rangle$, which is advected by the velocity field

$$\frac{\partial}{\partial t}\theta(\mathbf{x}, t) + \mathbf{u}(\mathbf{x}, t) \cdot \nabla_{\mathbf{x}}\theta(\mathbf{x}, t) = \lambda \Delta_{\mathbf{x}}\theta(\mathbf{x}, t) \tag{1}$$

*Hint:* Introduce a joint PDF $p(\theta_1, \mathbf{u}_1, \mathbf{x_1}, t)$.
What happens in the case that scalar and velocity field are statistically independent *and* the diffusivity $\lambda$ vanishes?