# Michal Jex
**Czech Technical University in Prague**


## Classical Density Functional Theory: Representability, Universal Bounds and Local Density Approximation

*Joint with Mathieu Lewin, Peter Madsen*


We provide upper and lower bounds on the lowest free energy of a classical system with short range interactions at given one-particle density $\rho(x)$ and prove that the lowest free energy at temperature $T$ with a prescribed density profile $\rho(x)$ can be approximated by the local free energy $\int f_T(\rho(x))\,\mathrm{d}x$, provided that $\rho$ varies slowly over sufficiently large length scales. A quantitative error on the difference is provided in terms of the gradient of the density. Here $f_T$ is the free energy per unit volume of an infinite homogeneous gas of the corresponding uniform density. The proof uses quantitative Ruelle bounds (estimates on the local number of particles in a large system). The talk is based on two recent papers [1, 2].


# References


[1] M. Jex, M. Lewin, P. Madsen: *Classical Density Functional Theory: Representability and Universal Bounds*, Journal of Statistical Physics, vol. 190, no. 4, pp. 73, 2023.

[2] M. Jex, M. Lewin, P. Madsen: *Classical density functional theory: the local density approximation*, accepted to Reviews in Mathematical Physics, preprint arXiv:2310.18028, 2024.