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*Local Laws and Fluctuations for Log Gases*

We study the statistical mechanics of the log-gas, or  $\beta$ -ensemble, for general potential and inverse temperature. By means of a bootstrap procedure, we prove local laws on a next order energy that are valid down to microscopic length scales. To our knowledge, this is the first time that this kind of a local quantity has been controlled for the log-gas. Simultaneously, we exhibit a control on fluctuations of linear statistics that is valid at all mesoscales. Using these local laws, we are able to exhibit for the first time a CLT at arbitrary mesoscales, improving upon a previous result of Bekerman-Lodhia that was true only for power mesoscales.

The approach that we use generalizes well to the study of Riesz gases in higher dimensions. Time permitting we will discuss some partial extensions of the above work to Riesz gases.