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Random maps and their cores

Let Q be a large random quadrangulation let R be its largest simple subgraph and P be its second-largest simple subgraph. Then $|R|/|Q|$ is concentrated near a fixed integer $\alpha \in (0,1)$, and $|P|/|Q|$ is very likely close to zero; in other words, large quadrangulations with high probability have a unique simple "core" of linear size, decorated with small (sub-linear size) attachments. We use this picture to show that the pair (Q,R), after suitable rescaling, converges in the Gromov-Hausdorff-Prokhorov sense to a limit (M,M), where M is a random variable with the law of the Brownian map. This requires showing that the distribution of mass in Q and R is asymptotically equal, which we establish through an "invariance principle for exchangeable, asymptotically negligible attachments" for measured metric spaces.