

Scaling Theory of Gelation

F. Leyvraz¹

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1. Instituto de Ciencias Físicas, Universidad Nacional Autónoma de México,
Av. Universidad s/n, Colonia Chamilpa, 62210 Cuernavaca, Morelos, México

Gelation arises in systems involving irreversible aggregation of clusters when the mass flow to infinity becomes non-zero at a finite time t_g . It is readily seen that after t_g the cluster concentrations $c(m, t)$ of clusters of mass m at time t decay slowly as the mass $m \rightarrow \infty$, namely as $m^{-\tau_0}$, where τ_0 is an exponent which can be calculated explicitly in terms of the aggregation model. On the other hand *at the gel time* t_g things are far more complex. A scaling theory is presented here which allows in principle to determine the behaviour of $c(m, t_g)$ as $m \rightarrow \infty$ as well as the behaviour of $c(m, t)$ as $m \rightarrow \infty$ and simultaneously $t \rightarrow t_g$, when an appropriate combination $x = m/(t_g - t)^{-1/\sigma}$ is kept fixed. In particular, it is shown that, in accordance with numerical work, exponents describing the behaviour of $c(m, t_g)$ bear no necessary relation to τ_0 .