Time-dependent density functional theory: the Runge-Gross mapping,

initial state dependence and memory

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In this presentation we will give an overview of the basic uniqueness and existence theorems

underlying time-dependent density functional theory, the conditions under which they are valid

and their implications. We further give some numerical examples that illustrate the complicated

initial state and memory dependence of the exchange-correlation potential. Finally we will show

how initial state dependence and memory arises in many-body perturbation theory and how this

can be used to get further insights for designing approximate density functionals.