Eukaryotic cells must complete DNA replication before chromosome segregation in order to maintain genomic stability. Complete replication is thought to be ensured by the temporal separation of DNA synthesis (S-phase) from mitosis (M-phase). The ordering of S and M phases is established by increasing levels of cyclin-dependent kinase (Cdk) activity during the cell cycle and is enforced by checkpoints that inhibit chromosome segregation when cells are exposed to severe replication stress or when bulk DNA replication is delayed. However, it is unclear how cells could detect unreplicated DNA during unperturbed conditions, and what the detection thresholds of such mechanism may be. Interestingly, cancer cells exposed to mild DNA replication stress perform DNA synthesis in early mitosis and possibly even in the subsequent G1, raising the possibility that DNA synthesis and mitosis may overlap during normal cell cycles. Supporting this view, certain budding yeast mutants can enter mitosis in the presence of unreplicated DNA.Thus, to what extent eukaryotic cells temporally separate DNA synthesis and segregation under physiological conditions remains an open question.

Here is presented an evidence that 20-40% of normally dividing yeast cells **enter mitosis before the completion of DNA replication**. **DNA synthesis** is inhibited in early mitosis and **resumes in anaphase**, when **Cdk activity drops**. In addition, our data suggest that **anaphase DNA synthesis of chromosome end** regions may contribute to their high **mutation rates** and rapid **evolutionary diversity**.