1023-81-1132 **Markus Müller*** (mueller@math.tu-berlin.de), Technische Universität Berlin, Institut für Mathematik MA 7-2, Straße des 17. Juni 136, 10623 Berlin, Germany. *Strongly Universal Quantum Turing Machines and Invariance of Kolmogorov Complexity.*

We show that there exists a universal quantum Turing machine (UQTM) that can simulate every other QTM *until the other QTM has halted* and then halt itself with probability one. This extends work by Bernstein and Vazirani who have shown that there is a UQTM that can simulate every other QTM for an arbitrary, but preassigned number of time steps. Our construction is not limited to QTMs, but can in principle be applied to other quantum computational models (e.g. quantum cellular automata), too.

As a corollary to this result, we give a rigorous proof that quantum Kolmogorov (description-length) complexity as defined by Berthiaume et. al. is invariant, i.e. depends on the choice of the UQTM only up to an additive constant.

Our proof is based on a new mathematical framework for QTMs, including a thorough analysis of their halting behaviour. We introduce the notion of mutually orthogonal halting spaces and show that the information encoded in an input qubit string can always be effectively decomposed into a classical and a quantum part. (Received September 25, 2006)