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Energy-Modulated Computing:

First Samples of Self-Powered Life on a Die

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Web resources:

<http://async.org.uk>

<https://blogs.ncl.ac.uk/alexjakovlev/category/energetic-computing/>

<http://www.workcraft.org>

This demo will illustrate the principle of **energy-modulated computing** according to which the flow of energy entering a computing system determines its computational flow. This principle will be fundamental for building future autonomous systems, such as those powered by energy harvesting sources and aimed for survival in power-deficient conditions. The demo includes a set of experimental circuits (with three VLSI chips and PCBs) to work in variable power supply conditions and software tools for digital and analogue co-design, including:

- (i) a reference-free voltage sensor based on self-timed charge-to-digital converter (180nm chip),
- (ii) a fully speed-independent SRAM providing data retention down to very low V_{dd} level, and operating in run-time varying V_{dd} (90nm chip);
- (iii) a self-timed 8051 microcontroller that dynamically adjusts its operation to power levels; it was semi-automatically synthesized using our own model "Conditional Partial Order Graphs" (130nm chip)
- (iv) a switched-capacitor power converter for asynchronous loads (PCB version).
- (v) EDA software tool Workcraft.