Symposium Identifying Optimal Physical Implementations for beyond von Neumann Computing Concepts (SYCC)

jointly organized by
the Magnetism Division (MA),
the Low Temperature Physics Division (TT),
the Thin Films Division (DS), and
the Semiconductor Physics Division (HL)

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Emerging ambitious cognitive tasks have triggered the development of new powerful computer architectures that are disruptively different to the traditional von-Neumann computer architecture. Fields of applications include smart manufacturing, autonomous driving, machine learning for robotics, data analytics, diagnostics, efficient sensing or the creation of predictive material property models, the understanding of important brain functionalities, enabling the study of long-term processes such as learning, development, and neuro-degenerative diseases. With Moore's law coming to an end, the speed and energy efficiency of incumbent computing devices is inadequate to cope with the in-time demands for processing big data efficiently. A range of fundamentally different new computing concepts have been devised such as neuromorphic computing, reservoir computing, probabilistic or stochastic computing. To implement this, circuits that achieve reconfigurable three-dimensional connectivity, and the exploitation of new devices that incorporate synaptic or neural functions, or strong nonlinear responses are considered. A key question is the physical realization by different concepts and materials platforms (resistively switching oxides, hybrid organic-inorganic nanoparticle, spintronics) that are currently being explored. It is obvious that different physical realizations optimize the implementation and performance of different computing concepts. This symposium reviews recent progress in physical implementations of complementary computational paradigms with a focus of highlighting the advantages, disadvantages and limitations of the different physical systems.

Overview of Invited Talks and Sessions

(Lecture hall H1)

Invited Talks

SYCC 1.1	Fri	9:30–10:00	H1	**On the Link Between Energy and Information for the Design of Neuromorphic Systems** — •Narayan Srinivasa
SYCC 1.2	Fri	10:00–10:30	H1	**Encoding neural and synaptic functionalities in electron spin: A pathway to efficient neuromorphic computing** — •Kaushik Roy
SYCC 1.3	Fri	10:30–11:00	H1	**Neuromorphic computing with spintronic nano-oscillators** — •Philippe Talatchian, Miguel Romera, Sumito Tsunegi, Flavio Abreu Araujo, Vincent Cros, Paolo Bortolotti, Juan Trastoy, Kay Yakushiji, Akio Fukushima, Hitoshi Kubota, Shinji Yuasa, Maxence Ernoult, Damir Vodenicarevic, Tifenn Hirtzlin, Nicolas Locatelli, Damien Querlioz, Julie Grollier
SYCC 1.4	Fri	11:15–11:45	H1	**Artifcial Intelligence and beyond von Neumann architectures, a mutual opportunity** — •Mirko Prezioso, Farnood Merrikh Bayat, Dmitri Strukov
SYCC 1.5	Fri	11:45–12:15	H1	**Brain-inspired approaches in ultrafast magnetism** — •Johan H. Mentink

Sessions

SYCC 1.1–1.5	Fri	9:30–12:15	H1	**Identifying optimal physical implementations of non-conventional computing**