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# Barcelona Computational Foundation: From first principles to clinical and societal translation

Francesca Castaldo – Co-founder & Executive Director

Barcelona Computational Foundation (BCOM), Barcelona, Spain · [www.bcom.one](http://www.bcom.one)

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## ABSTRACT

Brains, minds, and societies are fundamentally computational phenomena. The **Barcelona Computational Foundation (BCOM)** is a new, non-profit research institute – inspired by the Santa Fe model and rooted in Barcelona's thriving computational-neuroscience ecosystem – that takes this premise seriously. I would like to introduce BCOM to the BARCCSYN community: *what we are, why now, and how we propose to move the computational study of the brain from isolated models toward a coherent programme spanning first principles to clinical and societal translation.*

BCOM's scientific model is a pyramid: **philosophy** at the base, rising through **algorithms** (digital physics, algorithmic information theory), **life, brains, interacting agents**, and **ecosystems**. Each layer is a research pillar with its own outputs and methods, held together by one commitment – that mechanistic, generative, interventional models must be comparable across scales. Interdisciplinarity here is not rhetorical: philosophy forges the conceptual spine (concepts, ontologies, ethics); mathematics and physics supply the formal language; biology and neuroscience ground it in wetware; and an **Art & Science Studio** treats art as a *research instrument*, working alongside labs to probe and communicate the objective–subjective bridge.

As flagship, I will present our **computational neuropsychiatry** programme, with **Major Depressive Disorder** as case study. Patients are formalized as *algorithmic agents* – a modeling engine, an objective function, a planning engine – yielding mechanism-based *algorithmic biotypes* rather than DSM clusters. Neuroimaging, behavioral, and AI-augmented first-person reports are assimilated into personalized whole-brain models on the connectome, enabling *in silico* testing of tES, pharmacological, and psychotherapeutic interventions before clinical application. Sibling programmes extend the same algorithmic-agent framework to a theory of agency across cells, brains, and hybrid human–AI collectives (*Liquid Intelligence*) and to open-ended cultural evolution in synthetic societies (*Cognitive Cultural Evolution*).

BCOM is open-science, community-first, and Barcelona-based. I will close with an **invitation to the BARCCSYN community**: collaborations, visiting fellowships, shared computational infrastructure, and a home for the interdisciplinary questions that neuroscience cannot answer alone.

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**Keywords** whole-brain models · algorithmic information theory · computational psychiatry · digital twins · neurophenomenology · agency · cultural evolution · art & science · philosophy of mind