Project acronym:	ACCELERATES
Project:	Acceleration in Extreme Shocks: from the microphysics to laboratory and astrophysics scenarios
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Host Institution (HI):	INSTITUTO SUPERIOR TECNICO
Call Details:	Advanced Grant (AdG), PE2, ERC-2010-AdG_20100224

Summary

What is the origin of cosmic rays, what are the dominant acceleration mechanisms in relativistic shocks, how do cosmic rays self-consistently influence the shock dynamics, how are relativistic collisionless shocks formed are longstanding scientific questions, closely tied to extreme plasma physics processes, and where a close interplay between the micro-instabilities and the global dynamics is critical. Relativistic shocks are closely connected with the propagation of intense streams of particles pervasive in many astrophysical scenarios. The possibility of exciting shocks in the laboratory will also be available very soon with multi-PW lasers or intense relativistic particle beams. Computational modeling is now established as a prominent research tool, by enabling the fully kinetic modeling of these systems for the first time. With the fast paced developments in high performance computing, the time is ripe for a focused research programme on simulation-based studies of relativistic shocks. This proposal therefore focuses on using self-consistent ab initio massively parallel simulations to study the physics of relativistic shocks, bridging the gap between the multidimensional microphysics of shock onset, formation, and propagation and the global system dynamics. Particular focus will be given to the shock acceleration mechanisms and the radiation signatures of the various physical processes, with the goal of solving some of the central questions in plasma/relativistic phenomena in astrophysics and in the laboratory, and opening new avenues between theoretical/massive computational studies, laboratory experiments and astrophysical observations.

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