The Geopolitics of AI Driven Scientific Discovery: Uneven Geographies of Self Driving Laboratories

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1. Introduction. Self-Driving Laboratories (SDLs)—autonomous experimental systems combining robotics, artificial intelligence, and closed-loop optimization—have increasingly positioned themselves as infrastructures designed to accelerate scientific discovery in strategic research domains such as chemistry, physics, and biotechnology (Tom et al., 2024). By addressing long-standing bottlenecks of experimentation, SDLs promise not only to increase the speed and scale of discovery but also to reshape how scientific knowledge is produced, coordinated, and valued (Abolhasani & Kumacheva, 2023).

As a result, SDLs are increasingly framed as strategically significant research infrastructures. Governments, universities, and industry actors position autonomous laboratories as assets for securing leadership in discovery-intensive domains, linking accelerated scientific experimentation to technological sovereignty and global competitiveness (Schindler et al., 2022; Yang, n.d.). From this perspective, scientific discovery becomes a geopolitical battleground.

Studying SDLs as AI-driven infrastructures of global competition requires moving beyond laboratory-level performance assessments toward a spatial and geographic analysis of how these systems are distributed worldwide. This paper examines the global distribution, institutional embedding, and collaboration patterns around SDLs. By analysing where SDLs are located, which institutions host them, and how researchers collaborate across different regions and universities, the study evaluates how accelerated discovery is being organized spatially and how these emerging patterns illuminate the geopolitical dimensions of contemporary AI-driven scientific discovery as well as new geographies of connection and disconnection.

2. Emerging and Uneven Geographies of SDLs . A comparative mapping of more than forty SDL initiatives worldwide reveals a rapidly diversifying but uneven panorama of automation (Li et al., 2025; Materials Genome Initiative (MGI), 2024; Tobias & Wahab, 2025). From a preliminary mapping, 43 SDL initiatives were identified, nearly two-thirds of which are concentrated in four countries: China (33%), the United States (30%), Canada (12%), and the United Kingdom (7%). Together, these nations account for over 80% of the global SDL ecosystem. Preliminary findings also point to a set of city-regional systems where SDL concentrates within those countries. These concentration patterns suggest that SDLs mirror older patterns of resource asymmetry: nations with the computational and capital infrastructure to automate discovery consolidate technological leadership.

Building on these uneven global geographies, this paper examines SDLs as infrastructures through which scientific discovery is increasingly entangled with global competition for technology innovation. The aim is to characterize the emergence and diffusion of SDLs and to assess how their spatial distribution and international collaboration patterns reflect current shifts in the geopolitical organization of science. Specifically, the paper asks how SDL infrastructures are configured across geographies, how global collaboration networks form around them, and what these spatial and relational patterns reveal about the changing geography of accelerated scientific discovery.

3. Mapping SDL Infrastructures and Global Collaboration Networks . This paper advances a spatial and relational analysis of *SDLs* to evaluate their emergence as infrastructures of scientific discovery and competition. Grounded in the Science-Event framework (Baker et al., 2026), the study treats SDLs as a new class of scientific instrumentation whose significance lies in their capacity to reorganize where discovery occurs and how scientific collaboration is structured globally.

Methodologically, the analysis is based on a bibliometric reconstruction of the SDL research field using affiliation analysis and targeted field delimitation. First, we draw on existing bibliometric studies of SDL-related research to inform keyword selection, domain boundaries, and baseline publication trends, ensuring continuity with prior mapping efforts

while extending their analytical scope (Jung et al., 2025). Second, we incorporate insights from major review articles on autonomous laboratories (Abolhasani & Kumacheva, 2023; Li et al., 2025; Tobias & Wahab, 2025; Tom et al., 2024), which serve as authoritative syntheses of the field and help identify core laboratories, platforms, and research trajectories. Third, we identify special issues and curated publication venues—such as Digital Discovery Journal collections emerging from the Accelerate conference—that function as focal points for SDL-related knowledge production and community formation.

Using this combined corpus, we perform affiliation analysis on SDL-related publications to identify laboratories, institutional hosts, and geographic locations associated with autonomous experimentation. This approach enables the systematic mapping of SDL initiatives based on observed research activity rather than self-reported infrastructure claims. SDLs are thus treated as operational research infrastructures, rendered visible through sustained publication output and patterns of collaborative engagement. In doing so, we extend existing work by enabling analysis at the local scale, where the spatial unevenness of SDL development has so far remained under examined.

Building on this inventory, we analyse longitudinal publication trajectories and international co-authorship networks associated with SDL-related research. Publication trends are examined to assess the growth and consolidation of the field, while co-authorship networks are used to capture cross-institutional and cross-national collaboration patterns. Network-level indicators—including centralization, density, and cross-border connectivity—are employed to evaluate how discovery is organized around SDL infrastructures and how collaboration structures evolve over time.

These analyses evaluate SDLs as infrastructures shaping the spatial and relational organization of accelerated scientific discovery. By linking affiliation-based mappings of SDL deployment with collaboration patterns, the study offers insight into how AI-enabled experimentation contributes to a reconfiguration of the global geography of science and the emerging geopolitical landscape of scientific discovery.

Acknowledgments. This project was supported by resources from the Acceleration Consortium, based at the University of Toronto.

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