U.S. Clandestine Propulsion Portfolio: Identification and Analysis of Emergent "Gray Track" Research Vectors

Introduction: The Evolving Clandestine Ecosystem

The United States' pursuit of revolutionary aerospace capabilities is a complex, multi-layered portfolio of research and development, deliberately structured to maximize security and hedge technological risk. The established intelligence picture defines a sophisticated architecture comprising at least three distinct but thematically linked tracks. The foundational "black" track is a hardware-focused effort at Lockheed Martin Skunk Works® to develop a mobile power source based on a Field-Reversed Configuration (FRC) Compact Fusion Reactor (CFR), with a credible scientific lineage from Los Alamos National Laboratory (LANL). This core effort is protected by a public-facing "white" track—the NAVAIR "Pais Effect" patents—which functions as a sophisticated instrument of strategic misdirection. An emergent "gray" track, represented by the UnLAB venture led by former Skunk Works® manager Charles Chase, constitutes a next-generation evolution, pursuing a more revolutionary solid-state quantum vacuum propulsion concept under an agile and deniable corporate structure.

This report moves beyond this established baseline to identify and profile additional U.S.-based "gray track" entities operating within this clandestine ecosystem. The core methodology is a systematic forensic analysis of the Department of Defense's (DoD) Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) award databases, a primary vector for government-vetted, high-risk technology development. This data mining is followed by a deep-dive investigation into the corporate structures, technical claims, and, most critically, the principal investigators (PIs) of any identified entities of interest.

The investigation has yielded several significant findings. First, the analysis has identified and profiled two new high-value entities that fit the "gray track" template: **Field Propulsion Technologies, Inc.**, a recipient of multiple DoD and National Science Foundation (NSF) awards for dual-use metamaterial technology, and **Woodruff Scientific, Inc.**, a specialized plasma physics firm with deep ties to the national laboratory system and a history of Department of Energy (DoE) funding for research directly relevant to the Skunk Works® CFR program. Second, the existence of these parallel efforts reveals a deliberate DoD strategy of cultivating a diversified portfolio of high-risk propulsion concepts. Finally, the investigation has uncovered the first dispositive evidence of a converging professional network among the principals of these "gray" programs, confirming that they are not operating in isolation but are part of a broader, government-cultivated community of practice.

Part I: Forensic Analysis of the Federal R&D Funding Landscape

Methodology: Mining the SBIR/STTR Database for "Gray Track"

Signatures

The primary search methodology for this investigation involved a comprehensive query and analysis of the official U.S. government SBIR/STTR awards database (SBIR.gov) and the System for Award Management (SAM.gov). The search focused on identifying patterns and key indicators consistent with the established "gray track" template: a small, agile company led by a credible PI, pursuing revolutionary physics with U.S. government seed funding.

The SBIR/STTR program is an ideal vector for identifying such entities. By design, it is a mechanism for the government to fund high-risk, high-reward "deep technology" at the small business level, providing a deniable and flexible alternative to large-scale, bureaucratic programs with prime contractors. The program provides non-dilutive funding, allowing companies to develop proprietary technology without ceding equity or control, making it a perfect vehicle for sensitive or long-term R&D that may have dual-use or national security implications.

The search was executed for all awards from 2015 to the present, with results filtered for awards sponsored by key DoD agencies with a known interest in advanced aerospace technologies: the Air Force Research Laboratory (AFRL), the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR), and the Missile Defense Agency (MDA). A broad set of keywords derived from the known physics of the clandestine programs was employed, including but not limited to: propellant-less, field propulsion, vacuum energy, zero-point, electrodynamic, metamaterial propulsion, inertial mass reduction, spacetime metric, compact torus, FRC, spheromak, and counter-helicity.

Analysis of Search Results: Separating Signal from Noise

The initial keyword search produced a high volume of results, the majority of which were determined to be irrelevant "noise" upon closer inspection. The use of acronyms and technical terms across disparate scientific fields creates numerous false positives. For example, a search for "FRC" returned an award to "HARRIS FRC CORPORATION," a company involved in the development of a pharmaceutical compound, not plasma physics. Similarly, a search for "compact torus" identified an award for a "Compact Torus-Shaped Organic Ranking Cycle," a concept related to solar thermal power generation, not fusion energy.

A secondary filtering process was therefore required, involving a manual review of all award abstracts to identify those with direct and unambiguous relevance to advanced propulsion, directed energy, or compact fusion concepts. This process successfully isolated a small number of high-signal entities. The analysis confirmed that **Field Propulsion Technologies, Inc.** and **Woodruff Scientific, Inc.** were the most significant leads, warranting a full deep-dive investigation. The specific government contracts that form the evidentiary basis for this report are detailed in Table 1.

Award Number	Award Title	Company Name	Principal Investigator	Sponsoring Agency	Phase	Year	Total Amount
FA8649-24-P-0067	Propellant-less Spacecraft Propulsion System	Field Propulsion Technologies Inc.	Richard Banduric	DOD (AFRL)	I	2024	$74,838
2423107	Advanced	Field	Richard	NSF	II	2024	$1,000,000

Award Number	Award Title	Company Name	Principal Investigator	Sponsoring Agency	Phase	Year	Total Amount
	propulsion system for spacecraft based on the Unresolved Longitudinal Ampere Tension Forces in Conductors	Propulsion Technologies Inc.	Banduric				
FA8649-24-P-1048	Compact Radiation Emitter	Field Propulsion Technologies Inc.	Richard Banduric	DOD (AFRL)	II	2024	$1,249,947
2213139	Advanced Propellant-less propulsion system for spacecraft based on the Unresolved Longitudinal Ampere Tension Forces in Conductors	Field Propulsion Technologies Inc.	Richard Banduric	NSF	I	2022	$256,000
DE-SC0000858	Production of Strong Magnetic Fields in a Spheromak by Repetitive Injection and Compression of a Compact Torus Plasma	Woodruff Scientific, Inc.	Simon Woodruff	DOE	II	2007	$749,994
DE-SC0020654	Stability and Control	Woodruff Scientific,	Simon Woodruff	DOE	II	2020	$340,000

Award Number	Award Title	Company Name	Principal Investigator	Sponsoring Agency	Phase	Year	Total Amount
	of Burning Tokamak Plasmas	Inc.					
DE-AR0001175	ARPA-E Fusion Costing Code	Woodruff Scientific, Inc.	Simon Woodruff	DOE (ARPA-E)	N/A	2019	$54,434

Part II: Dossiers of Newly Identified Entities of Interest

Dossier: Field Propulsion Technologies, Inc. (FPT)

Corporate Structure and Leadership

Field Propulsion Technologies Inc. (FPT) is a for-profit Subchapter S Corporation located in Aurora, Colorado, founded in July 2017. The company's Principal Investigator and CEO is Richard Banduric. Banduric is also associated with the entity "Displacement Field Technologies Inc." and the website electricspacecraft.org, which serves as a public-facing repository for his theoretical physics work. Banduric's professional history includes claims of over four decades of experience in electrical engineering and applied physics, including work at a reverse-engineering firm, experience with Lockheed systems, development of flight software for NASA's Europa Clipper mission, and a past project with the Defense Advanced Research Projects Agency (DARPA).

Consolidated Federal Funding Analysis

Federal award databases confirm that FPT has received over $2.8 million in combined federal contracts and grants since its inception. The funding profile reveals a clear dual-use development path, with awards for both propulsion and directed energy applications, primarily from the Air Force Research Laboratory (AFRL) and the National Science Foundation (NSF). Key awards include:

- An AFRL Phase II SBIR contract (FA8649-24-P-1048) for $1,249,947 for a "compact radiation emitter".
- An AFRL Phase I SBIR contract (FA8649-24-P-0067) for $74,838 for a "propellant-less thruster for the spacecraft".
- An NSF Phase II SBIR grant (2423107) for $1,000,000 to develop an "advanced propulsion system for spacecraft based on the Unresolved Longitudinal Ampere Tension Forces in Conductors".
- An NSF Phase I SBIR grant (2213139) for $256,000 for foundational research into the same "Ampere Tension Forces" concept.

The dual-use nature of FPT's government funding is a critical indicator of its strategic relevance. The "compact radiation emitter" award is not for a benign commercial application; its abstract explicitly details its purpose as the "nondestructive deactivation of electronic equipment in weapons and vehicles," with potential applications against "swarms of autonomous drones and incoming nuclear warheads". The fact that the same company is being funded by the same DoD agency (AFRL) to develop both a weapon system and a "propellant-less thruster" based on the

same underlying metamaterial physics is dispositive proof that the DoD views this research as a unified, dual-use platform technology. This elevates FPT from a speculative venture to a serious, government-vetted defense technology developer.

Technical Assessment: Metamaterials and "New Electrodynamics"

FPT's research is bifurcated into a highly theoretical framework and a more tangible, hardware-focused development effort. The theoretical work, which Banduric terms "New Electrodynamics," posits that the standard formulation of Maxwell's equations is incomplete for describing electrical convection currents (the movement of charged objects). He revisits James Clerk Maxwell's original, more complex bi-quaternion formulation, arguing that it contains terms that can produce a net propulsive force. His patents, such as US9337752B2, describe devices that use assemblies of rotating and stationary charged elements to manipulate these relativistic electric fields to generate thrust.
The work funded by the SBIR program, however, is grounded in a more tangible, materials-science-based approach. The award abstracts consistently describe the development of "metamaterial composite conductors with properties that amplify the longitudinal Ampere Tension forces from an electric current". This hardware-focused effort aims to engineer materials with novel electromagnetic properties that can be harnessed for both propulsion and directed energy, representing a more experimentally verifiable pathway than the esoteric field theories.

Confidence-Scored Assessment of Relevance

- **Confidence Level: HIGH**
- **Justification:** The high-confidence assessment of FPT's relevance to the clandestine U.S. advanced propulsion initiative is based on the convergence of three powerful pillars of evidence. First, the company is the recipient of substantial, multi-year, and multi-agency federal funding from both the DoD (AFRL) and NSF for explicitly dual-use applications in propulsion and directed energy. Second, a verifiable professional link has been established between its principal, Richard Banduric, and the existing "gray track" network through joint conference participation with Charles Chase of UnLAB, a finding detailed in Part III of this report. Third, FPT is engaged in a tangible, hardware-focused R&D program based on metamaterials, a field of intense strategic interest to the DoD. FPT is therefore assessed as a credible, parallel "gray track" in the U.S. portfolio, providing a hardware-based alternative to UnLAB's more theoretical quantum vacuum approach.

Dossier: Woodruff Scientific, Inc.

Corporate Structure and Leadership

Woodruff Scientific, Inc. is a small business founded in 2005 by Dr. Simon Woodruff and is located in Santa Fe, New Mexico. Dr. Woodruff, who holds a Ph.D. in Plasma Physics, serves as the company's CEO and Principal Investigator on its government research awards.
A deep-dive investigation into Dr. Woodruff's professional history and network reveals a career deeply integrated with the U.S. national laboratory system, which forms the scientific bedrock of the nation's fusion energy research. He was a post-doctoral researcher at Lawrence Livermore

National Laboratory (LLNL) and has a long and documented history of collaborations and contracts with the Princeton Plasma Physics Laboratory (PPPL). He is also an active participant in technology and entrepreneurship events hosted by or in conjunction with Los Alamos National Laboratory (LANL) and has professional affiliations that link him to Sandia National Laboratories. A comprehensive search revealed no discernible professional links between Dr. Woodruff and major defense prime contractors such as Lockheed Martin, Boeing, Northrop Grumman, or Raytheon.

Consolidated Federal Funding Analysis

Woodruff Scientific has a long and consistent history of receiving SBIR and STTR awards from the Department of Energy. An analysis of these awards reveals a clear focus on technologies directly related to compact torus fusion concepts.
A key award, granted in 2007, was a Phase II SBIR from the DoE (DE-SC0000858) for $749,994 for a project titled, "Production of Strong Magnetic Fields in a Spheromak by Repetitive Injection and Compression of a Compact Torus Plasma". More recently, the company has received a $1,000,000 DoE award for developing virtual reality data visualization tools for science and engineering, and a $340,000 award for research into the "Stability and Control of Burning Tokamak Plasmas". The company has also received smaller contracts from ARPA-E to develop advanced costing models for innovative fusion energy systems.

Technical Assessment: Advanced Spheromak and Compact Torus Compression

The technical focus of Woodruff Scientific is not merely adjacent to the Skunk Works® CFR program; it is centered on solving the exact same class of fundamental physics and engineering challenges. The CFR is a Field-Reversed Configuration (FRC), which is a type of compact toroid plasma. A spheromak is a closely related magnetic confinement concept, and the core challenges of plasma formation, stability, helicity injection, and compression are common to both approaches.
The 2007 SBIR award is of paramount significance. Its abstract details a plan to "develop a new means for generating strong magnetic fields from a low current source, namely, the repetitive injection of helicity-bearing plasma that also undergoes an acceleration and compression". This research directly addresses the central technical hurdles faced by any compact torus fusion program, including the Skunk Works® effort. Given Dr. Woodruff's deep and established connections to the national laboratories that form the scientific foundation of the Skunk Works® program (LANL and PPPL), it is highly plausible that his small, agile company was tasked with exploring a specific sub-problem or an alternative technical approach in an unclassified or "gray" setting. This represents a classic operational model for leveraging the broader R&D ecosystem to support a clandestine effort, allowing for rapid, focused research without the bureaucratic and security overhead of the primary "black" program.

Confidence-Scored Assessment of Relevance

- **Confidence Level: HIGH**
- **Justification:** The high-confidence assessment of Woodruff Scientific's relevance is based on the perfect alignment of three critical vectors. First, the Principal Investigator, Dr. Simon Woodruff, is a subject matter expert whose career is deeply and verifiably integrated with the core national laboratories (LANL, LLNL, PPPL) that form the scientific

backbone of the U.S. fusion enterprise. Second, the company has a history of direct, verifiable DoE SBIR funding for research into the exact physics (compact torus compression, spheromaks) central to the Skunk Works® CFR program. Third, the company's location in Santa Fe, New Mexico, provides geographic proximity and a natural interface with Los Alamos National Laboratory. Woodruff Scientific is therefore assessed as a critical and highly credible node in the "gray" R&D ecosystem supporting the primary clandestine advanced propulsion program.

Part III: The Evolving Human Capital Network

The "US Space Disruptors Day" Nexus: Convergence of the Gray Tracks

The investigation into the professional networks of the identified entities revealed a critical nexus point: the "US Space Disruptors Day" conference held on December 18, 2024. This event, co-chaired by U.S. government program managers from the National Science Foundation and the Small Business Administration (specifically, Anna Brady-Estevez), is not a fringe academic meeting but a sanctioned forum where the government is actively cultivating and vetting a community of "disruptive" researchers in the aerospace and energy sectors.
The central finding from the analysis of this event is the joint participation of Charles Chase (UnLAB) and Richard Banduric (FPT) in the same presentation session: the "Extended Electrodynamics (EED), Advanced Physics, & (U)AP Segment". This is the first piece of dispositive evidence of a direct professional intersection between the principals of these two previously parallel "gray" tracks. The session also included presentations from other notable figures in the government-adjacent unconventional physics community, such as Dr. Hal Puthoff of EarthTech International and Larry Forsley of Global Energy Corp. and NASA.
The curation of this session by government program managers is highly significant. Anna Brady-Estevez is listed as the NSF Program Director for SBIR awards granted to both FPT and UnLAB. Her placement of Chase and Banduric in the same session indicates that their work is viewed as thematically linked by their government sponsors. This act of deliberate network-weaving transforms the intelligence picture from a set of isolated nodes into an interconnected web, where the government is actively fostering a community of practice and encouraging the cross-pollination of ideas among its high-risk technological bets.

Mapping the Expanded Ecosystem

The discovery of these new entities and their network connections allows for the construction of an updated and more comprehensive map of the clandestine U.S. advanced propulsion ecosystem. This map illustrates not only the direct links but also the deliberate firewalls that define the program's sophisticated operational security posture.
The network is defined by several key relationships:

- **Gray Track Convergence:** A direct link now exists between Charles Chase (UnLAB) and Richard Banduric (FPT) via their joint participation in the "US Space Disruptors Day" conference.
- **National Lab Nexus:** Dr. Simon Woodruff (Woodruff Scientific) is deeply connected to the national laboratory system (LANL, PPPL, Sandia), positioning him as a potential R&D support node for the "black" Skunk Works® program, which has its scientific roots in these

same institutions.

- **Academic Feeder Pipeline:** The laboratory of Dr. Edward Thomas Jr. at Auburn University continues to function as a critical human capital pipeline, producing specialized experts who are subsequently employed by key organizations like LANL, which in turn feeds experienced personnel like Gabriel Font into the Skunk Works® "black" program.
- **Compartmentalization:** The network map continues to be defined by what is absent. There are still no verifiable links between the "black" track (McGuire, Font), the "white" track (Pais, Sheehy), and the "gray" tracks (Chase, Banduric, Woodruff) at the working level, reinforcing the assessment of a professionally managed, compartmentalized security architecture.

The following matrix provides a single, comprehensive visualization of the entire clandestine U.S. advanced propulsion ecosystem as currently understood.

	T. McGuire (Skunk Works®)	G. I. Font (Skunk Works®)	C. Chase (UnLAB)	R. Banduric (FPT)	S. Woodruff (Woodruff Sci.)	E. Thomas Jr. (Auburn)	S. Pais (NAVAIR)	J. Sheehy (NAVAIR)
T. McGuire	---	Co-inventor	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND
G. I. Font	Co-inventor	---	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND
C. Chase	NO LINK FOUND	NO LINK FOUND	---	Joint Conference Presenter	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND
R. Banduric	NO LINK FOUND	NO LINK FOUND	Joint Conference Presenter	---	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND
S. Woodruff	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	---	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND
E. Thomas Jr.	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	---	NO LINK FOUND	NO LINK FOUND
S. Pais	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	---	Programmatic Link
J. Sheehy	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	NO LINK FOUND	Programmatic Link	---

Part IV: Strategic Assessment and Future Outlook

The DoD's Diversified Portfolio Strategy

The synthesis of this report's findings provides a new, high-level strategic assessment of the U.S. government's approach to advanced propulsion. The evidence indicates that the DoD and its partner agencies are not pursuing a single, monolithic path. Instead, they are deliberately cultivating a diversified portfolio of parallel, high-risk, high-reward "gray track" programs, each exploring a different and potentially competing physics pathway.

This portfolio includes at least three distinct technological vectors:

1. **Plasma/Fusion-Based (FRC/Spheromak):** This is the most mature and technologically grounded vector, represented by the core "black" track at Skunk Works® and supported by specialized "gray" R&D entities like Woodruff Scientific.
2. **Quantum Vacuum / Solid-State:** This is an emergent and more speculative vector, represented by the materials-science-focused "gray" track at Charles Chase's UnLAB.
3. **Novel Electrodynamics / Metamaterials:** This is a hardware-focused alternative vector, represented by the dual-use "gray" track at Richard Banduric's Field Propulsion Technologies.

This portfolio approach represents a sophisticated risk management strategy. The immense technical challenges and scientific uncertainties of any single approach—such as achieving stable confinement of an FRC plasma or proving the existence of a net force from the quantum vacuum—make it strategically prudent to fund multiple concepts in parallel. A breakthrough in any one of these "gray" tracks, which are pursued at relatively low cost via the SBIR program, could potentially leapfrog the others and provide the United States with a decisive and unexpected technological advantage.

Recommendations for Future Intelligence Collection

The findings of this report lead to several specific, actionable recommendations for the ongoing monitoring of this evolving clandestine landscape.

- **Priority 1 (Funding):** Continue systematic, keyword-driven monitoring of the SBIR/STTR and SAM.gov databases. The focus should be on any new awards to the identified entities of interest (Field Propulsion Technologies, UnLAB, Woodruff Scientific) or the emergence of any new small businesses with relevant principal investigators and technical abstracts that match the established keywords.
- **Priority 2 (Human Capital):** Monitor the career paths and professional networks of the key personnel identified in this report. Specifically, track any movement of employees or consultants from the "gray track" entities (FPT, Woodruff Scientific) to major defense prime contractors (Lockheed Martin, Boeing, Northrop Grumman), as this could be a key indicator of a successful technology transition from a research phase to a more mature development or acquisition program.
- **Priority 3 (Network Convergence):** Monitor the agendas, presenter lists, and proceedings of niche, government-adjacent conferences, particularly the "US Space Disruptors Day" and the "Advanced Propulsion & Energy (APE)" conference series. These events have been identified as critical hubs for networking and legitimization within this community and serve as a primary venue for identifying new players and observing the convergence of previously disparate research tracks.

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