Fusion Frontiers: FRC, CFR, and Covert Programs Timeline

Timeline of Key Events

This timeline synthesizes information from the provided sources, focusing on the development of Field-Reversed Configuration (FRC) and Compact Fusion Reactor (CFR) technologies, related propulsion concepts, and clandestine programs.

Pre-1946:

• **Nicholas Christofilos's early interests:** Nicholas Christofilos, a Greek engineer, pursues interests in nuclear physics, studying German textbooks and applying for a patent on an accelerator.

1946:

• **Astron Project inception:** Nicholas Christofilos applies for a patent on an accelerator and the Astron project begins at Livermore National Laboratory, focusing on the E-layer (a ring of relativistic electrons) within a magnetic mirror device.

1949:

• **James Tuck joins Los Alamos:** James Tuck emigrates to Los Alamos at the invitation of E. Teller to work on the hydrogen bomb project. He first spends a year at the University of Chicago with Fermi, Anderson, and Marshall.

1950s:

• **CIA's "Human Ecology Fund":** The CIA historically uses front organizations like the "Human Ecology Fund" to covertly fund universities and researchers for sensitive projects.

• **Project MKUltra:** The CIA's Directorate of Science & Technology (DS&T) conducts coercive and unethical experiments in human behavior.

1956:

• **Astron Project continues:** The Astron project, under Nicholas Christofilos, continues at Livermore National Laboratory.

1962:

• **NRL Aerobee-Hi rocket launch:** The U.S. Naval Research Laboratory (NRL) launches an Aerobee-Hi rocket with multiple spectrographs from the White Sands Missile Range.

• **Blevin & Thonemann's RMF research:** The technique of generating azimuthal electron currents in plasma using rotating magnetic fields is first investigated by Blevin & Thonemann.

• **NRL Reactor Development:** NRL develops an instrument for detecting fuel-element rupture in water-cooled reactors.

1967:

• **High Beta Plasma Conference:** Proc. Topical Conf. High Beta Plasma, 1967, featuring Green and Newton, and Kaleck, Kever, Könen, Noll, Sugita, Waelbroeck, and Witulski, discussing trapped reverse field configurations.

1970:

• **LDRD funding at LANL:** Laboratory-Directed Research and Development (LDRD) program established at LANL to fund forefront science and technology relevant to NNSA and DOE missions.

1971:

• **Yoshikawa & Christofilos plasma physics paper:** S. Yoshikawa and H. Christofilos publish in the Proceedings of the Fourth International Conference on Plasma Physics and Controlled Nuclear Fusion Research.

1973:

• **Astron Project conclusion:** The Astron project at Livermore National Laboratory concludes.

Mid-1970s - Early 1990s:

• **Foundational FRC research at LANL:** Los Alamos National Laboratory conducts foundational research into Field-Reversed Configurations (FRCs), discovering anomalous stability, identifying and suppressing rotational instability (n=2), establishing confinement scaling, and demonstrating FRC translation.

1975:

• **LANL FRC research begins:** LANL initiates its Magnetized Target Fusion (MTF) program, with early FRC research starting around this time, predating the later FRX-L.

1976:

• **IEEE Trans. Plasma Sci. publication:** G. X. Kambic and W. M. Krawczonek publish "A Heavy Ion Beam Probe System for Investigation of a Modified Penning Discharge" in IEEE Trans. Plasma Sci., PS-4, 1.

1977:

• **Parks, Turnbull, Foster on Nucl. Fusion:** P. B. Parks, R. J. Turnbull, C. A. Foster publish in Nucl. Fusion 7_ (1977) 539.

• **NASA TM X-3485:** G. X. Kambic and W. M. Krawczonek publish NASA TM X-3485, National Aeronautics and Space Administration (1977).

1978:

• **Parks, Turnbull on Phys. Fluids:** P. B. Parks, R. J. Turnbull publish in Phys. Fluids 21_ (1978) 1735.

• **Eskov et al. on Compact Toroidal Configuration:** A.G. Es'kov et al. publish "Features of Plasma Heating and Confinement in a Compact Toroidal Configuration" in the Proceedings of the Seventh International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Innsbruck, Austria.

• **Milora, Foster on IEEE Trans. Plasma Sci.:** S. L. Milora, C. A. Foster publish in IEEE Trans. Plasma Sci. PS-6 (1978) 578.

• **Freidberg, Faarlstein on Phys. Fluids:** J. P. Freidberg, L. D. Faarlstein publish in Phys. Fluids 1_1_, 1207 (1978).

1979:

• **Sherwood Meeting paper:** H. H. Chen, Y. C. Lee, C. S. Liu, and D. Montgomery present "An Equilibrium of a Tokamak Center Plasma With Gravity" at the Sherwood Meeting on Theoretical Aspects of Controlled Thermonuclear Research.

• **Milora, Foster on Rev. Sci. Instrum.:** S. L. Milora, C. A. Foster publish in Rev. Sci. Instrum. _50 (1979) 482.

• **Linford et al. on FRC:** R. K. Linford, W. T. Armstrong, D. A. Platts, and E. G. Sherwood publish "Field-Reversed Theta Pinch" in Plasma Physics and Controlled Nuclear Fusion Research 1978, Vol. II, IAEA-CN-37/S-1-1.

1980:

• **Milora et al. on Nucl. Fusion:** S. L. Milora, G. L. Schmidt, R. Fonck, C. A. Foster et al. publish in Nucl. Fusion 20 (1980) 1491.

• **Quimby and Steinhauer on Phys. Fluids:** O.C. Quimby and L.C. Steinhauer publish in Phys. Fluids 23, 1426 (1980).

1981:

• **Armstrong et al. on FRX experiments:** W. T. Armstrong et al. publish "Field-reversed experiments (FRX) on compact toroids" in Physics of Fluids 24, no. 11 (1981): 2068-2089, which includes the FRX-A and FRX-B data.

• **Kutuzov et al. on flux loss:** M. I. Kutuzov, V. P. Semenov, and E. P. Strizhov publish on flux loss during FRC formation.
• **Tuszewski on FRC:** M. Tuszewski publishes "Excluded flux analysis of a field-reversed plasma," Phys. Fluids, vol. 24, no. 2126, pp. 2126–2127, 1981.

1982:

• **Milroy and Brackbill on numerical studies:** R. D. Milroy and J. U. Brackbill publish "Numerical studies of a field-reversed theta-pinch plasma," Phys. Fluids, vol. 25, pp. 775–783, 1982.
• **Armstrong et al. on flux trapping:** W. T. Armstrong, D. G. Harding, E. A. Crawford, and A. L. Hoffman publish "Flux-trapping during the formation fo field-reversed configurations," Phys. Fluids, vol. 25, pp. 2121–2127, 1982.
• **W. Willenberg's report for MSNW:** H.J. Willenberg, Project Leader, publishes "Definition and Conceptual Design of a Small Fusion Reactor," Mathematical Sciences Northwest, Inc. Report MSNW 1159.

1983:

• **Spencer Scaling Law paper:** A seminal paper on adiabatic compression of FRCs is published by Spencer, Tuszewski, and Linford from Los Alamos National Laboratory, establishing fundamental scaling laws.

1986:

• **Hoffman et al. on FRC formation:** A. L. Hoffman, R. D. Milroy, J. T. Slough, and L. C. Steinhauer publish "Formation of field-reversed configurations using scalable, low-voltage technology," Fusion Technol., vol. 9, pp. 48–57, 1986.

1988:

• **Tuszewski's FRC review article:** M. Tuszewski publishes his canonical review article on FRC equilibrium, stability, formation, and transport in Nuclear Fusion, codifying LANL's expertise.

1991:

• **FWM in plasmas studied:** Foundational theoretical and experimental work exploring Four-Wave Mixing (FWM) in plasmas for generating phase conjugation begins.

1997:

• **Yakov Krasik joins Technion:** Professor Yakov Krasik joins the Technion – Israel Institute of Technology to establish the Plasma and Pulsed Power (P4) Laboratory.

1999:

• **MTF Program at LANL faces termination:** Richard E. Siemon presents to the Fusion Energy Sciences Advisory Committee, describing MTF as a "low cost path to fusion" but noting its imminent funding termination.
• **Lazarian & Vishniac (LV99) model:** Lazarian & Vishniac propose their theoretical framework for magnetic reconnection.

2000:

• **Shouyin Y. Zhang receives Ph.D.:** Shouyin Y. Zhang receives his Ph.D. in plasma physics from the Institute of Plasma Physics (ASIPP), Chinese Academy of Sciences.

c. 2001-2003:

• **FRX-L active at LANL:** The Field Reversed Experiment-Liner (FRX-L) project at LANL is active, producing experimental results and serving as a plasma injector for the MTF program.

2001:

• **Shouyin Y. Zhang joins LANL:** Shouyin Y. Zhang joins the P-24 Plasma Physics Group at Los Alamos National Laboratory (LANL) as a Postdoctoral Research Associate.

c. 2002-2005:

• **NASA FRC Acceleration Space Thruster (FAST) Experiment:** The FAST experiment is active at NASA's Marshall Space Flight Center (MSFC), investigating a repetitive FRC source for propulsion.

2003:

• **PTX program evolves from FAST:** The FAST experiment evolves into the Plasmoid Thruster Experiment (PTX), continuing work on accelerating compact toroids for propulsion.

2004:

• **Intrator et al. IEEE paper:** Dr. Intrator is lead author on a 2004/2006 IEEE paper, "A High-Density Field Reversed Configuration Plasma for Magnetized Target Fusion," detailing foundational contributions to MTF target plasma.

• **Steve Danziger joins BAE:** Steve Danziger joins BAE Systems.

2006:

• **Epstein's "Confronting Gravity" workshop:** Jeffrey Epstein hosts the "Confronting Gravity" workshop on St. Thomas, USVI, attended by prominent theoretical physicists and experimental plasma physicist Dr. Edward Thomas Jr.

c. 2007-2013:

• **FRCHX at AFRL Shiva Star:** The Field-Reversed Configuration Heating Experiment (FRCHX) is active at AFRL's Shiva Star facility, an integrated system demonstration for MTF, forming and compressing FRCs with imploding metal liners.

November 2007 - February 2011:

• **Anthony Pancotti at AFRL:** Anthony Pancotti serves as a Senior Scientist at the Air Force Research Laboratory (AFRL) at Edwards Air Force Base.

2009:

• **IEPC-2009-265 publication:** John Slough (MSNW), David Kirtley (MSNW), and Thomas Weber (University of Washington) publish "Pulsed Plasmoid Propulsion: The ELF Thruster" at the 31st International Electric Propulsion Conference.

March 2011:

• **Anthony Pancotti joins MSNW:** Anthony Pancotti transitions to MSNW LLC as Propulsion Lead.

2012:

• **Boeing/AFRL CHAMP test:** AFRL and Boeing conduct the first test mission of the CHAMP HPM weapon system at the Utah test range.

• **NASA Phase I Final Report for Fusion Driven Rocket:** Anthony Pancotti is listed as "Mission Analysis and Spacecraft Design Lead" on the 2012 NASA Phase I Final Report for the "Fusion Driven Rocket" at MSNW.

2013:

• **Charles Chase public presentation:** Charles Chase delivers a public presentation outlining "disruptive" technologies at Lockheed Martin Skunk Works®, including a concept directly correlated to the CFR program.

• **Dr. Nakhleh returns to LANL:** Dr. Nakhleh returns to Los Alamos National Laboratory as Division Leader for the X-Theoretical Design (XTD) Division.

• **July 2013 Wurden et al. abstract:** G.A. Wurden et al. publish an abstract detailing an increase in FRC trapped flux lifetime to 14-16 μs at FRCHX by lengthening the magnetic trap.

• **APS DPP Session NO5:** A session on "Magnetic Reconnection and Related Topics" is held at APS-DPP, with presentations by LANL T-2 theorist Dr. Hui Li and LANL P-24 experimentalists Dr. T.P. Intrator and Dr. T.E. Weber.

c. 2013-2015:

• **Magnetized Shock Experiment (MSX) active:** MSX is established at LANL, functioning as a testbed for developing technologies critical for FRCHX, including plasma gun-assisted formation.

December 2013:

• **Ami DuBois departs Auburn for TAE:** Ami DuBois, having completed her PhD at Auburn University, moves to TAE Technologies as a Postdoc.

January 9, 2014:

• **Lockheed Martin patents filed:** Lockheed Martin files foundational patents for the Compact Fusion Reactor (CFR) program.

Early 2014:

• **ER=EPR conjecture operationalized:** The theoretical framework for the Trivergence Protocol, engineering a traversable wormhole, is established in the U.S. by synthesizing the ER=EPR conjecture with vacuum engineering and spacetime metric manipulation.

March 8, 2014:

• **Malaysia Airlines Flight 370 disappears:** MH370 disappears, leading to a catastrophic loss of the 20-person Freescale Semiconductor team, a critical single-point-of-failure for the clandestine CFR program. This is assessed as a deliberate U.S. asset denial operation (Project Quiet Exodus).

June 3, 2014:

• **Dr. Thomas P. Intrator dies:** Dr. Thomas P. Intrator, a pivotal figure in high-density FRC plasma research at LANL, passes away.

2015:

• **Plasma-gun-assisted FRC formation paper:** A paper is published detailing the significant improvement in FRC formation in a conical θ-pinch using plasma gun assistance, achieving a ~350% increase in trapped flux.

• **BAE Manassas QML Level V certification:** BAE's Manassas facility achieves the military's QML Level V certification for its 45-nanometer ASICs, demonstrating readiness for the CFR control system program.

• **Post-2014 Wurden research shift:** Dr. Glen Wurden's publication record shows a shift away from direct FRC compression experiments to broader academic and conceptual roles within LANL's unclassified fusion program.

• **Knapp et al. publish on MagLIF:** P.F. Knapp et al. publish "Effects of Magnetization on Fusion Product Trapping and Secondary Neutron Spectra" in Physics of Plasmas.

2015-2018:

• **Hui Li, Xiaocan Li, et al. theoretical papers:** A cluster of theoretical and computational papers on particle acceleration in reconnection are published by Hui Li, Xiaocan Li, and collaborators, assessed as unclassified outputs from the 2014 LDRD work.

2016:

• **Anthony Pancotti's dual roles:** Anthony Pancotti's career begins to overlap, taking on roles at both MSNW LLC and Helion Energy.

• **Xiaocan Li at UAH:** Dr. Xiaocan Li is a Postdoctoral Research Assistant at the University of Alabama in Huntsville (UAH).

2017:

• **Anthony Pancotti's testimony:** Anthony Pancotti is identified as "Director of Propulsion Research, MSNW LLC" in congressional subcommittee testimony.

• **Pre-existing BAE-Freescale IP integration:** BAE Systems has already integrated Freescale's foundational IP into its radiation-hardened design libraries.

• **No public footprint for MSNW:** No publicly documented press releases, partnership announcements, marketing materials, or media mentions related to MSNW LLC's research activities since 2017.
• **Xiaocan Li returns to LANL:** Dr. Xiaocan Li returns to Los Alamos National Laboratory as a Postdoctoral Research Associate in the T-2 Theoretical Division.

2017-2020:

• **Lockheed Martin "Advanced Materials" effort:** Lockheed Martin conducts a dedicated "Advanced Materials" effort focused on materials for a mobile, aerospace-ready FRC plasma device (Tungsten, Lithium-6, FLiBe).

2018:

• **TAE leadership change:** TAE Technologies rearranges its leadership, preparing for the next chapter in fusion.
• **Sam Altman's Bilderberg attendance:** Sam Altman attends the annual Bilderberg Meetings, demonstrating integration into high-level Western national security establishment.
• **John Slough returns to MSNW:** Dr. John Slough departs Helion Energy to return to his role as President of MSNW LLC.
• **DARPA SoC design project:** DARPA initiates a project on "Posh Open Source Hardware" to lower barriers to SoC design.

2019:

• **Yakov Krasik's student at MIT PSFC:** An electrical engineering student from the Technion, supervised by Professor Krasik, is a Visiting Fellow at the MIT Plasma Science and Fusion Center (PSFC).
• **AMSC and Brookhaven National Laboratory collaboration:** AMSC collaborates with Brookhaven National Laboratory on ion irradiation for HTS wire, enhancing in-field performance, with applications for military (30-50K) and fusion (20K) specifically mentioned.

December 2019:

• **Spencer LeBlanc departs Auburn for Boeing:** Spencer LeBlanc, having completed his PhD at Auburn University, moves to Boeing Prime Defense/Aerospace Contractor.

2020:

• **PRC's "crash program" post-MH370:** The PRC launches a coordinated, multi-institutional "crash program" in strategic microelectronics, leveraging intelligence from the MH370 incident to functionally replicate Freescale's core capabilities.
• **Xiaocan Li at Dartmouth College:** Dr. Xiaocan Li becomes a Research Associate B at Dartmouth College Physics and Astronomy.

October 2020:

• **Anthony Pancotti leaves MSNW Propulsion Lead role:** Anthony Pancotti concludes his role as Propulsion Lead at MSNW LLC.

2021:

• **HelicitySpace collaboration with LANL:** HelicitySpace collaborates with LANL on "Simulation of the Helicity Drive Magneto-Inertial Fusion Concept."

March 2022:

• **GA-EMS railgun projectile test series:** GA-EMS announces a major test series for guided, hypersonic projectiles originally designed for the railgun, fired from conventional powder guns.
• **Xiaocan Li at Dartmouth College as Research Scientist:** Dr. Xiaocan Li becomes a Research Scientist at Dartmouth College Physics and Astronomy.

Mid-2022:

• **GA-EMS HPM patent filed:** A patent for "Synchronization of high power radiofrequency sources" is filed by GA-EMS technical leads Staines and Cluggish, describing coherent phasing of multiple, distributed HPM emitters.

2023:

• **Helion 'Trenta' decommissioning:** Helion Energy's sixth-generation prototype, 'Trenta', is decommissioned after achieving 9 keV total bulk plasma temperatures, executing over 10,000 high-power fusion pulses, and validating FRC scaling laws with D-D and D-^{3}He fusion rates.

• **NT-Tao joins Princeton E-ffiliates Partnership:** nT-Tao joins the Princeton E-ffiliates Partnership, establishing formal collaboration with Princeton University and Princeton Plasma Physics Laboratory (PPPL).

May 2023:

• **Dylan Funk departs Auburn for LANL:** Dylan Funk, having completed his PhD at Auburn University, moves to Los Alamos National Laboratory (LANL) for FRC Research.

June 2024:

• **BAA FA8651-22-S-0001 published:** The Air Force Research Laboratory (AFRL) Munitions Directorate publishes Broad Agency Announcement (BAA) FA8651-22-S-0001, providing a framework for funding revolutionary propulsion concepts.

Mid-2024:

• **CFR Orb flight testing begins:** The Lockheed Martin Skunk Works® CFR Orb platform begins flight testing. This is attributed to $1.5 billion in "reach-forward losses" by Lockheed Martin Aeronautics in the subsequent two financial quarters due to "design, integration, and test challenges."

August 2024:

• **AFRL BAA amendment:** Amendment 5 to BAA FA8651-22-S-0001 is updated as of July 18, 2024.

September 2024:

• **Xiaocan Li returns to LANL as Staff Scientist:** Dr. Xiaocan Li returns to Los Alamos National Laboratory as a Staff Scientist in the T-2 Theoretical Division.

November 2024:

• **NSF-hosted interagency meeting:** An NSF-hosted interagency meeting on "disruptive technology" brings together Larry Forsley (LCF), Charles Chase (UnLAB, ZPE), and Richard Banduric (Field Propulsion Technologies, Novel Electrodynamics).

December 2024:

• **Qu and Fisch publication:** Kenan Qu and Nathaniel J. Fisch publish on relativistic four-wave mixing in plasmas to produce quantum entangled photon pairs and squeezed states in Physical Review E 110, 065211 (2024).

March 2025:

• **AFRL BAA amendment:** Amendment 6 to BAA FA8651-22-S-0001 is updated as of March 2025.

August 20, 2025:

• **MSNW website accessed:** MSNW Group website accessed.

• **John Slough ResearchGate profile accessed:** John Slough's ResearchGate profile accessed.

• **Msnw (ZUJKEA8YLMC6) - HigherGov accessed:** HigherGov profile for MSNW accessed.

• **House Report 115-1080 - GovInfo accessed:** House Report 115-1080 on activities of the Committee on Science, Space, and Technology accessed.

• **Northwest Security Services Jobs in Seattle, WA - ZipRecruiter accessed:** ZipRecruiter for Northwest Security Services accessed.

• **Security Clearance Jobs in Washington - ClearanceJobs accessed:** ClearanceJobs for Washington accessed.
• **FAQs Supplier Information - Lockheed Martin accessed:** Lockheed Martin supplier FAQs accessed.
• **Resources | Lockheed Martin accessed:** Lockheed Martin supplier resources accessed.
• **Department Publications - BYU Physics and Astronomy accessed:** BYU Physics and Astronomy publications accessed.
• **Helion Trenta poster APS DPP 2024 accessed:** Helion Trenta poster from APS DPP 2024 accessed.
• **Helion Energy - Wikipedia accessed:** Helion Energy Wikipedia page accessed.
• **Technology - Helion accessed:** Helion Technology page accessed.
• **The problems with Helion Energy - Reddit accessed:** Reddit discussion on Helion Energy accessed.
• **Helion- Direct Energy Recovery : r/fusion - Reddit accessed:** Reddit discussion on Helion Direct Energy Recovery accessed.
• **David Kirtley - Founder & CEO at Helion Energy | The Org accessed:** David Kirtley's profile on The Org accessed.
• **Magnetized Target Fusion - Los Alamos Fusion Energy Sciences accessed:** LANL's MTF page accessed.
• **Magnetized Target Fusion. A Proof-of-Principle Research Proposal - ResearchGate accessed:** ResearchGate for MTF proposal accessed.
• **Progress on the FRX-L FRC plasma injector at LANL for magnetized ... accessed:** UNT Digital Library for FRX-L accessed.
• **(PDF) Overview of high density FRC research on FRX-L at Los ... accessed:** ResearchGate for FRX-L overview accessed.
• **USA - LANL-FE accessed:** IAEA for LANL-FE accessed.
• **Coil system for plasmoid thruster - NASA Technical Reports Server (NTRS) accessed:** NTRS for plasmoid thruster coil system accessed.
• **US7808353B1 - Coil system for plasmoid thruster - Google Patents accessed:** Google Patents for plasmoid thruster coil system accessed.
• **Mike HOUTS | National Aeronautics and Space Administration ... accessed:** ResearchGate for Mike Houts accessed.
August 31, 2025:
• **Measurements of magneto-Rayleigh–Taylor instability growth ... | Physics of Plasmas | AIP Publishing accessed:** AIP Publishing for MRT instability measurements accessed.
• **Measurements of Magneto-Rayleigh-Taylor instability growth ... - OSTI.GOV accessed:** OSTI.GOV for MRT instability measurements accessed.
• **Experimental Demonstration of Fusion-Relevant ... - OSTI.GOV accessed:** OSTI.GOV for fusion demonstration accessed.
September 8, 2025:
• **Thomas Weber - Google Scholar accessed:** Thomas Weber's Google Scholar profile accessed.
• **The electrodeless Lorentz force thruster experiment - ResearchGate accessed:** ResearchGate for ELF thruster accessed.
• 场反构型无电极洛伦兹力推力器研究进展 **accessed:** Chinese Journal reference for ELF thruster accessed.

• **Electrodeless Lorentz Force Thruster (ELF) - UW Aeronautics and Astronautics Department accessed:** UW Aeronautics and Astronautics Department for ELF Thruster accessed.
• **Eberhard Weber - Wikipedia accessed:** Eberhard Weber Wikipedia page accessed.
• **Toru WEBER | Maastricht University ... - ResearchGate accessed:** ResearchGate for Toru Weber accessed.
• **Plasma-gun-assisted field-reversed configuration ... - AIP Publishing accessed:** AIP Publishing for plasma-gun-assisted FRC formation accessed.
• **Review of the Los Alamos FRX-C experiment - UNT Digital Library accessed:** UNT Digital Library for FRX-C review accessed.
• **Electron energy confinement in field reversed configuration plasmas - ResearchGate accessed:** ResearchGate for electron energy confinement accessed.
• **Fusion, accessed September 8, 2025, http://fusionenergy.lanl.gov/Documents/FRX-L-MachinePaper-RSI-July2003.pdf accessed:** LANL's FRX-L Machine Paper accessed.
• **PLASMA JWSICS LABORATORY - INIS-IAEA accessed:** INIS-IAEA for Plasma JWSICS Laboratory accessed.
• **Observations of tilt instabilities in field-reversed configurations of a confined plasma | Phys. Rev. Lett. - Physical Review Link Manager accessed:** Physical Review Link Manager for tilt instabilities accessed.
• **Field reversed configurations - SciSpace accessed:** SciSpace for field reversed configurations accessed.
September 2025:
• **Physics of Plasmas 31, 032118 (2024) accessed:** Physics of Plasmas article 31, 032118 (2024) accessed, dated 11 Septem ber 2025 15:23:46.
• **Phys. Plasmas 22, 032706 (2015) accessed:** Physics of Plasmas article 22, 032706 (2015) accessed, dated 01 Septem ber 2025 20:25:40.
Future:
• **FRC Propulsion System Fully Operational:** Anticipated to fundamentally reshape strategic deterrence.
• **"Project Exodus" goals:** Engineering of a traversable wormhole using three entangled, rotating plasma orbs.
• **Russian "magnetic plasma accelerator" testing:** Testing of a prototype is slated to occur in a large-scale experimental stand at TRINITI.

Cast of Characters

Individuals:
• **Nicholas Christofilos:** Greek engineer with no formal physics credentials; brain-child of the Astron project at Livermore National Laboratory (1956-1973), focusing on the E-layer. Pioneered crucial ideas like the induction linac and the field-reversed configuration.
• **E. Teller:** Assembled a team in 1949 to work on the hydrogen bomb project at Los Alamos, inviting James Tuck to join.
• **Fermi, Anderson, Marshall:** Collaborated with James Tuck at the University of Chicago on the large cyclotron in 1949.
• **James Tuck:** Physicist who worked on weapon research. In 1949, accepted E. Teller's invitation to Los Alamos, after spending a year at the University of Chicago with Fermi, Anderson, and Marshall. Developed a theory for extracting electron beams by parametric excitation of the radial orbit.

• **H. H. Chen, Y. C. Lee, C. S. Liu:** Co-authors with D. Montgomery on a 1979 paper about tokamak center plasma and gravity, affiliated with the University of Maryland.
• **D. Montgomery (Dr. David Montgomery):** Foundational theorist in plasma self-organization, providing essential physics for stable Field-Reversed Configurations (FRCs). Co-authored a 1979 paper on tokamak center plasma and gravity. His work on plasma vortices (FRCs) is linked to the study of rotating gravitational objects and the Kerr metric.
• **R. Siemon (Richard E. Siemon):** From Los Alamos National Laboratory. Described Magnetized Target Fusion (MTF) as a "low cost path to fusion" in a May 1999 presentation, despite the program facing imminent funding termination. Also a co-author on FRC-related papers.
• **M. Tuszewski (Dr. M. Tuszewski):** Key experimentalist and theorist on LANL's FRX-C and FRX-C/T programs, co-authoring critical papers on stability and axial dynamics. Synthesized a decade of experimental and theoretical progress into a canonical 1988 review article on FRCs in Nuclear Fusion. Key member of the foundational FRX-L experimental team. Later transitioned to Tri Alpha Energy (now TAE Technologies).
• **R. K. Linford:** From Los Alamos National Laboratory. Foundational theorist, establishing institutional knowledge base for FRC compression and working on FRX experiments.
• **John Slough (Dr. John Slough):** World-renowned expert in FRC physics and primary inventor on many of Helion Energy's foundational patents. Key academic partner from the University of Washington for the NASA FRC Acceleration Space Thruster (FAST) Experiment (c. 2002-2005). Founded MSNW LLC and secured follow-on funding for the "Fusion Driven Rocket" program. Departed Helion Energy in May 2018 to return as President of MSNW LLC. Co-founder of Helion Energy.
• **David Kirtley (Dr. David Kirtley):** CEO and co-founder of Helion Energy. Previously worked at MSNW LLC and has deep ties to the University of Washington's plasma physics community.
• **Thomas Weber (Dr. Thomas Weber):** Affiliated with the University of Washington in 2009. Co-author with John Slough and David Kirtley on the IEPC-2009-265 paper "Pulsed Plasmoid Propulsion: The ELF Thruster." His 2010 dissertation was also on the ELF thruster experiment. Served as a mentee to Dr. Thomas P. Intrator on MSX.
• **Glen A. Wurden (Dr. Glen A. Wurden):** Senior Member, IEEE, and Team Leader for the Magnetized Plasma Team in P-24 Plasma Physics at Los Alamos National Laboratory. Lead author of a 2016 Journal of Fusion Energy "community white paper" on Magneto-Inertial Fusion. His post-2014 research shifted from FRC compression to broader academic and conceptual roles. Key personnel on FRX-L, MSX, and FRCHX.
• **Shouyin Y. Zhang:** Received his Ph.D. in plasma physics in 2000 from the Chinese Academy of Sciences. Joined LANL's P-24 Plasma Physics Group as a Postdoctoral Research Associate in 2001.
• **Thomas P. Intrator (Dr. Thomas P. Intrator):** Deceased June 3, 2014. A pivotal figure in the U.S. national laboratory ecosystem's pursuit of high-density FRC plasmas for MTF. Senior scientist, program leader, experimentalist, and critical mentor within LANL's P-24 Thermonuclear Plasma Physics group. Key contributions to FRX-L, MSX, and FRCHX. His work is assessed to have de-risked core plasma physics for transition to clandestine programs like the Skunk Works® CFR.
• **John H. Degnan (Dr. John H. Degnan):** From Air Force Research Laboratory (AFRL). Collaborated with Dr. Glen Wurden on a 2016 Magneto-Inertial Fusion white paper. AFRL counterpart to Dr. Intrator on FRX-L and FRCHX.
• **Charles Chase:** Former public messenger for the CFR program. His career at Lockheed Martin included roles as a low-observable engineer on the F-117A Nighthawk and managing the

Revolutionary Technology Programs organization at Skunk Works®. Co-founded UnLAB, a "gray track" entity pursuing quantum vacuum force extraction. Confirmed professional interactions with Dr. Harold Puthoff and Richard Banduric.

• **Harold E. Puthoff (Dr. Harold E. Puthoff):** Leads EarthTech International and Quantcomm LLC. Architect of synthesis for the Trivergence Protocol, leading the clandestine vacuum engineering track. Key theoretical work on vacuum engineering and spacetime metric manipulation. Has recent patents for "Communications system" granted to Quantcomm LLC. Direct, repeated professional interactions confirmed with Chase and Banduric.

• **Salvatore Pais (Dr. Salvatore Pais):** Key inventor on U.S. Government-owned patents for generating "exotic matter" conditions. His patents are part of the "white" program for strategic obfuscation and budgetary justification.

• **Thomas McGuire:** Program lead and co-inventor on core patents for the Compact Fusion Reactor (CFR) program at Lockheed Martin Skunk Works®. Patents focus on solving material science challenges for a mobile, aerospace-applicable FRC plasma device.

• **Gabriel Ivan Font:** Co-inventor on core patents for the Compact Fusion Reactor (CFR) program at Lockheed Martin Skunk Works®. His career is verifiably tracked from plasma research at Los Alamos National Laboratory (LANL) to the clandestine program, facilitating the transfer of critical "tribal knowledge."

• **Anthony Pancotti (Dr. Anthony Pancotti):** Critical human capital vector in the FRC ecosystem. Holds a Ph.D. in Aerospace Engineering. Served as a Senior Scientist at AFRL (2007-2011), Propulsion Lead at MSNW LLC (2011-2020), and held increasingly senior roles at Helion Energy (2016-Present), including Chief of Staff and Head of R&D. His work at MSNW was explicitly propulsion-focused, including the "Fusion Driven Rocket" and "Electrodeless Lorentz Force (ELF) Thruster."

• **Edward Thomas Jr. (Dr. Edward Thomas Jr.):** Associate Professor in the Physics Department at Auburn University and Coordinator of the Plasma Sciences Laboratory in 2006. Specializes in experimental plasma physics, dusty plasmas, space plasmas, plasma instabilities, and fusion energy. Speaker at Epstein's "Confronting Gravity" workshop. His laboratory at Auburn serves as a human capital pipeline to entities like LANL, TAE, and Boeing.

• **Matthew P. Giese (Colonel Matthew P. Giese):** Senior USAF test pilot. Individual Mobilization Augmentee (IMA) to the 412th Test Wing Commander at Edwards AFB. In his civilian capacity, he is the Chief Pilot for a major defense contractor (identified as Boeing for F-15EX programs, but previously Lockheed Martin Aeronautics for F-16 and F-22). Serves as a seamless interface between prime contractor development efforts and USAF test and evaluation.

• **Terry Crimmins:** President of the Electronic Systems (ES) sector at BAE Systems (2015-2020), responsible for top-level strategic and financial oversight, including work at Manassas.

• **Steve Danziger:** Site executive for BAE Systems Manassas facility (2015-2020) and Director of Quality for Space Systems. Central to the CFR SoC program's success.

• **Yakov Krasik (Professor Yakov Krasik):** Central node of the Israeli human capital network for advanced aerospace propulsion. Director of the Plasma and Pulsed Power (P4) Laboratory at the Technion – Israel Institute of Technology. Background in Soviet pulsed power and plasma physics. His research interests include high-energy-density physics, warm dense matter, pulsed power systems, and high-power microwave generation. Prolific in patents (26) and student supervision (23 PhD, 26 MSc). Long-standing relationship with Rafael Advanced Defense Systems.

• **Oded Gour-Lavie:** CEO and Co-founder of nT-Tao. Holds an electrical engineering degree from the Technion. Former Commander of the Israeli Submarine Force and Head of Legal & Strategic

Policy in the IDF Planning Directorate. Visiting Fellow at the MIT Plasma Science and Fusion Center (PSFC) in 2019.

• **David Yanuka (Dr. David Yanuka):** PhD student in Professor Krasik's P4 Lab, focused on high-energy-density matter. Transitioned to the Faculty of Aerospace Engineering at Technion, researching hypersonic flow using advanced plasma diagnostics.

• **Alexey Voronov:** Publicly champions Russia's "magnetic plasma accelerator" program at TRINITI.

• **Anatoly Zhitlukhin:** From TRINITI. Critical enabling technology for Russia's program, specializing in pulsed power systems for compact torus formation. Has cultivated a core team of researchers at TRINITI.

• **S.V. Ryzhkov:** Central academic figure at the Lebedev Physical Institute (LPI) and Bauman Moscow State Technical University (BMSTU). Led research (2010-2015) explicitly identifying a "thermonuclear motor" as a key FRC application.

• **Ivan Romadanov:** Student of S.V. Ryzhkov. Took a position at the Princeton Plasma Physics Laboratory (PPPL), a U.S. FRC research center.

• **Hui Li (Dr. Hui Li):** LANL T-2 theorist. Involved in presentations on "Magnetic Reconnection and Related Topics" at APS-DPP in 2013. Co-authored theoretical and computational papers on particle acceleration in reconnection (2015-2018).

• **Xiaocan Li (Dr. Xiaocan Li):** Collaborated with Hui Li on theoretical and computational papers on particle acceleration in reconnection (2015-2018). Postdoctoral Research Assistant at UAH (2016-2017). Returned to LANL's T-2 Theoretical Division as a Postdoctoral Research Associate (2017-2020) and later as a Staff Scientist (Sep 2024-Present). His research focuses on theoretical and computational modeling of magnetic reconnection.

• **Richard Banduric:** Principal of Field Propulsion Technologies, Inc. (FPT). Researches "New Electrodynamics" and "metamaterial composite conductors" for propulsion. Confirmed professional interactions with Charles Chase and Dr. Harold Puthoff.

• **Scott C. Hsu (Dr. Scott C. Hsu):** Leads LANL's Plasma Liner Experiment (PLX), a successor concept to the MTF program, leveraging innovations from MSX.

• **Deepak K. Gupta:** Key personnel at TAE Technologies, whose publications confirm extensive research on FRC merging and stability.

• **Michl Binderbauer:** Key personnel at TAE Technologies, whose publications confirm extensive research on FRC merging and stability.

• **Hiroshi Gota:** Key personnel at TAE Technologies, whose publications confirm extensive research on FRC merging and stability.

• **Thomas Roche:** Key personnel at TAE Technologies, whose publications confirm extensive research on FRC merging and stability.

• **E.B. Hooper:** Key figure on the Sustained Spheromak Physics Experiment (SSPX).

• **B.I. Cohen:** Key figure on the Sustained Spheromak Physics Experiment (SSPX).

• **Masaaki Yamada:** Expert at the Princeton Plasma Physics Laboratory (PPPL) in FRC research, specifically on the Princeton Field-Reversed Configuration (PFRC) experiment.

• **Elena V. Belova:** Expert at the Princeton Plasma Physics Laboratory (PPPL).

• **Adam Martin:** Key personnel at NASA MSFC for the FAST/PTX program. Continued to publish on plasma propulsion concepts.

• **Richard Eskridge:** Key personnel at NASA MSFC for the FAST/PTX program. Continued to publish on plasma propulsion concepts.

• **Mike Houts:** Key personnel at NASA MSFC for the FAST/PTX program. Had a prior history at LANL and continued work at MSFC focusing on nuclear systems.

• **Stephen L. Rodgers:** Key personnel at NASA MSFC for the FAST/PTX program.
• **W. D. Getty:** From Electron Physics Laboratory, Department of Electrical and Computer Engineering, University of Michigan. Author of "FIELD-REVERSED PLASMA G^H BASED ON THE ISVEP.SE-PINCH DISCHARGE".
• **Peter Thiel:** Co-founded Mithril Capital (investor in Helion, Palantir, BlackSky) and Palantir Technologies (data analytics contractor for U.S. intelligence community and DoD).
• **Sam Altman:** Investor in Helion Energy. Known for investments in AI, fusion, advanced fission, and high-speed aerospace. Repeated attendance at Bilderberg Meetings.
• **R. Scott Forney III:** President of General Atomics Electromagnetic Systems (GA-EMS). Overseen advancements in high energy density pulsed power systems and electromagnetic railguns.
• **Nick Bucci:** Vice President of Program Management and later VP of Defense Systems & Technologies at GA-EMS. Had a significant tenure at Lockheed Martin before joining General Atomics, representing a "Customer-to-Supplier" move.
• **Hugh Menown:** Appointed MBE for his work at Teledyne e2v in developing double-cathode and hollow anode thyratrons.
• **Gabriella Druitt:** Current Director of Engineering at Teledyne e2v; focus appears to be on space imaging.
• **Alexander Otto (Dr. Alexander Otto):** 19-year veteran of AMSC and globally recognized leader in HTS wire development with dozens of patents and publications. Founded Solid Material Solutions, LLC.
• **John M. Ulliman:** Former VP from Northrop Grumman; key engineer/scientist at AMSC, associated with patents for integrating HTS components into naval power and propulsion architectures.
• **Timothy MacDonald:** Rotating Machines Engineer at AMSC with expertise in HTS propulsion motors for the U.S. Navy.
• **Srivatsan Sathyamurthy:** Senior Research Scientist at AMSC with a background at Oak Ridge National Laboratory and expertise in pulsed laser deposition for HTS materials. Listed as inventor on critical joint patent with Brookhaven National Laboratory.
• **Stephen Minter:** Principal Investigator at Cryomagnetics, Inc. for a DOE STTR award for a high-field magnet project.
• **Michael Coffey:** Business Official at Cryomagnetics, Inc. for a DOE STTR award for a high-field magnet project.
• **Charles K. Crawford (Dr. Charles K. Crawford):** MIT physicist and founder of Kimball Physics, inventor on many of its key patents.
• **Abigail LePage:** President and CEO of Kimball Physics.
• **Jim Tallarico:** Chief Operations Officer of Kimball Physics.
• **Chanpreet Singh:** Lead inventor on U.S. Patent 10,999,497 for an SoC architecture with parallel processing circuits and a dedicated data exchange circuit for multi-orb synchronization.
• **Hua Guan:** Lead inventor on U.S. Patent 12,166,417 for advanced Power Management Integrated Circuits (PMICs) with ultra-fast transient response.
• **Chen Yunji:** Key leader in China's post-MH370 strategic microelectronics "crash program," associated with the Chinese Academy of Sciences Institute of Computing Technology (CAS ICT).
• **Robert Gore:** Project lead for two campaigns at LANL (XTD-IDA) where developed equations will be implemented into LANL's RAGE production code for programmatic engineering efforts.
• **Nikolai Yampolsky:** Author of "Optimization of Compton Source Performance through Electron Beam Shaping" in the 2015 LANL Annual Report.

• **D. P. Kouri:** Principal Investigator at Sandia National Laboratories for a project on fusing data, uncertainty, and simulation in novel algorithms.
• **M. W. Heinstein:** Principal Investigator at Sandia National Laboratories for a project on modeling blast loading on thin shell structures.
• **E. M. Redline:** Principal Investigator at Sandia National Laboratories for research on improving mechanical and fracture properties of chain-polymerized thermosets.
• **A. A. Talin:** Principal Investigator at Sandia National Laboratories for research on charge and energy transport in metal-organic frameworks (MOFs).
• **D. A. Black:** Principal Investigator at Sandia National Laboratories for work exploring capabilities and limitations of analytic photocurrent models.
• **P.F. Knapp, P.F. Schmit, S.B. Hansen, M.R. Gomez, K.D. Hahn, D.B. Sinars, K.J. Peterson, S.A. Slutz, A.B. Sefkow, T.J. Awe, E. Harding, C.A. Jennings, M.P. Desjarlais et al.:** Co-authors with P.F. Knapp on the 2015 Physics of Plasmas paper "Effects of Magnetization on Fusion Product Trapping and Secondary Neutron Spectra."
• **J.F. Ihlefeld, M. Brumbach, A.A. Allerman, D.R. Wheeler, and S. Atcitty:** Authors of "AlGaN Composition Dependence of the Band Offsets for Epitaxial Gd_2O_3/AlxGa1-xN ($0 \leq x \leq 0.67$) Heterostructures" (2014).
• **C. Nakhleh (Dr. C. Nakhleh):** Division Leader for the X-Theoretical Design (XTD) Division at Los Alamos National Laboratory (2013-2018). His career is linked to the "weaponization" of plasma physics for the U.S. Stockpile Stewardship Program. Frequent collaborator with key figures in pulsed-power and Z-pinch physics. Co-authored papers on Magneto-Rayleigh-Taylor (MRT) instability measurements.
• **M. C. Herrmann (Dr. Michael C. Herrmann):** Key co-author with Dr. Nakhleh on MagLIF papers, often in a leadership role.
• **K. J. Peterson (Dr. Kyle J. Peterson):** Manager/Staff Scientist for ICF Target Design at Sandia National Laboratories. Key experimentalist and frequent lead author on MagLIF papers, working alongside Nakhleh.
• **Kenan Qu:** Co-author with Nathaniel J. Fisch on a 2024 paper on relativistic four-wave mixing in plasmas.
• **Nathaniel J. Fisch (Dr. Nathaniel J. Fisch):** Co-author with Kenan Qu on a 2024 paper on relativistic four-wave mixing in plasmas.
• **Christopher A. Eusebi:** Collaborator with Dr. Harold Puthoff on patents for a "Communications system" granted to Quantcomm LLC.
Institutions/Organizations:
• **MSNW LLC:** Redmond-based company known for advanced technology like the "Fusion Driven Rocket." Experienced a clandestine funding transition post-2017, suggesting operation as a classified subcontractor or entity operating under security protocols. John Slough is President. Received NASA and DoD funding for FRC propulsion concepts. Functions as a "gray track" propulsion program.
• **Lockheed Martin Skunk Works®:** Elite division of Lockheed Martin, primary institution for the "black" track development of the Compact Fusion Reactor (CFR) program. Filed foundational patents for the CFR in January 2014.
• **Boeing Phantom Works / The Boeing Company:** Lead for flight operations and testing of the FRC/CFR platform, leveraging Boeing's vast infrastructure and experience. Col. Matthew P. Giese was identified as Boeing's F-15 Chief Test Pilot.

• **BAE Systems (Manassas facility):** Logical successor to Freescale Semiconductor for developing the custom, radiation-hardened System-on-Chip (SoC) for the CFR control system after the MH370 incident. Possessed pre-existing technological lineage to Freescale's intellectual property. Achieved QML Level V certification for 45-nanometer ASICs in August 2015.
• **Freescale Semiconductor:** Team aboard MH370 (March 2014) possessed irreplaceable expertise for developing the bespoke control system ("Trivergence Protocol") for the CFR platform. Their loss created a critical vulnerability.
• **Los Alamos National Laboratory (LANL):** Undisputed epicenter of foundational FRC and Magnetized Target Fusion (MTF) research from the 1970s-1990s. Hosted FRX-A, FRX-B, FRX-C, FRX-C/T, FRX-L, and MSX experiments. P-24 Thermonuclear Plasma Physics group. T-2 Theoretical Division (Dr. Hui Li, Dr. Xiaocan Li).
• **Air Force Research Laboratory (AFRL):** Collaborated with LANL on Magnetized Target Fusion, hosting the FRCHX experiment at the Shiva Star facility (c. 2007-2013). Munitions Directorate (FA8651-22-S-0001 BAA).
• **Helion Energy:** Commercial fusion company pursuing a pulsed magneto-inertial fusion (MIF) concept, aiming for net electricity from D-^{3}He fuel. Developed the 'Trenta' prototype (decommissioned 2023). Co-founded by John Slough, David Kirtley, Chris Pihl, and Anthony Pancotti. Functions as a strategic parallel asset and incubator for specialized human capital.
• **UnLAB LLC / Unlab Inc.:** New "gray track" entity founded by Charles Chase, pursuing "Fluctuation Flow Propulsion" and quantum vacuum force extraction. Operates with a public-facing 501(c)(3) non-profit and a for-profit R&D entity.
• **Field Propulsion Technologies, Inc. (FPT):** "Gray track" entity focusing on "metamaterial composite conductors" engineered to amplify longitudinal Ampere Tension forces. Received substantial dual-use funding from AFRL. Richard Banduric is a principal.
• **Woodruff Scientific, Inc.:** Specialized plasma physics firm with deep, long-standing ties to the national laboratory system, forming part of the "gray track."
• **EarthTech International:** Research entity led by Dr. Harold Puthoff, focusing on "vacuum engineering."
• **Quantcomm LLC:** New entity for Dr. Harold Puthoff and Christopher A. Eusebi, holding patents for a "Communications system" using field-free potentials.
• **Princeton Plasma Physics Laboratory (PPPL):** Key TAE collaborator, with experts like Masaaki Yamada and Elena V. Belova in FRC research (e.g., Princeton Field-Reversed Configuration (PFRC) experiment). Ivan Romadanov joined after studying with S.V. Ryzhkov in Russia.
• **TAE Technologies (formerly Tri Alpha Energy):** Leading U.S. private company developing FRC fusion technology. Collaborated with Russia's Budker Institute of Nuclear Physics (BINP) for Neutral Beam Injectors (NBIs).
• **Auburn University (Physics Department, Plasma Sciences Laboratory):** Dr. Edward Thomas Jr.'s affiliation, serving as a pipeline for specialized talent in experimental plasma physics to national laboratories and defense contractors.
• **Technion – Israel Institute of Technology (Plasma and Pulsed Power (P4) Laboratory, Faculty of Aerospace Engineering):** Central hub for cultivating high-energy-density physics expertise in Israel. Led by Professor Yakov Krasik. Hosts the Aerospace Plasma Laboratory (APL).
• **nT-Tao:** Israeli company developing a compact fusion reactor based on a stellarator design. Joined the Princeton E-ffiliates Partnership in 2023. Oded Gour-Lavie is CEO.
• **Rafael Advanced Defense Systems:** Israeli state-owned defense prime; has long-standing and trusted relationship with Professor Krasik's laboratory.

• **Israel Aerospace Industries (IAI):** Israeli state-owned defense prime; maintains formal collaborations with the Technion.
• **State Nuclear Corporation "Rosatom" (Russia):** Applied development track for Russia's advanced aerospace propulsion, centered at TRINITI.
• **Troitsk Institute of Innovative & Thermonuclear Research (TRINITI) (Russia):** Institution within Rosatom, focuses on the development of a "magnetic plasma accelerator" and pulsed power systems.
• **Lebedev Physical Institute (LPI) (Russia):** Foundational academic track for Russia's FRC research.
• **Bauman Moscow State Technical University (BMSTU) (Russia):** Foundational academic track for Russia's FRC research.
• **Kurchatov Institute (Russia):** Provides high-level strategic and scientific oversight for Russian nuclear and fusion research.
• **Budker Institute of Nuclear Physics (BINP) (Russia):** World-leading center for specialized sub-systems like neutral beam injectors, collaborating with TAE Technologies.
• **General Atomics Electromagnetic Systems (GA-EMS):** Key U.S. developer of high energy density pulsed power systems and high-power capacitors, including for electromagnetic railguns. R. Scott Forney III is President. Nick Bucci is VP of Defense Systems & Technologies.
• **Teledyne e2v (UK):** Dominant global manufacturer of high-power pulsed thyratrons, critical switching technology for FRC formation. Hugh Menown was a key historical figure.
• **AMSC (American Superconductor):** Prominent U.S. manufacturer of second-generation (2G) Amperium® HTS wire. Licensed foundational patents from Oak Ridge National Laboratory (ORNL). Dr. Alexander Otto is a key technical personnel. Researching advanced flux pinning and irradiation techniques for HTS wire, with applications for fusion mentioned.
• **Cryomagnetics, Inc.:** Specializes in custom superconducting magnet systems, located near Oak Ridge, Tennessee. Stephen Minter and Michael Coffey are key personnel.
• **Kimball Physics:** U.S. manufacturer of precise, modular UHV chambers. Founded by Dr. Charles K. Crawford. Abigail LePage is President and CEO.
• **ELVA-1:** Manufactures millimeter-wave interferometers and reflectometers for plasma diagnostics; supplied a 300 GHz interferometer to TAE Technologies.
• **Chinese Academy of Sciences (CAS) (Institute of Computing Technology (ICT), Institute of Microelectronics (IME)):** Primary R&D engine for China's post-MH370 "crash program" in strategic microelectronics. The ICT was tasked with novel SoC architectures.
• **China Academy of Engineering Physics (CAEP):** Involved in China's post-MH370 "crash program" in strategic microelectronics, with rad-hard laboratories.
• **Sandia National Laboratories:** Involved in Magnetized Liner Inertial Fusion (MagLIF) and High-Energy-Density Physics (HEDP) experiments, including MRT instability measurements on the Z-Machine.