# Brazil's Fusion and Plasma Physics Research

*An OSINT Investigation into INPE, ETE Spherical Tokamak, CNEN Transfer, and the Nuclear-Fusion Bridge*

---

Secret Military Technology Research Group

August 2026 (v2 — Revised)

An OSINT Investigation into INPE, ETE Spherical Tokamak, CNEN Transfer, and the Nuclear-Fusion Bridge...

# Table of Contents

# Abstract & Methodology

## Abstract

This report presents the findings of an open-source intelligence (OSINT) investigation into Brazil's plasma physics, fusion research, and directed energy weapons ecosystem. The investigation maps a network of 7 entities and 6 relationships, revealing Brazil's position in the global compact fusion and plasma weapons landscape. Using the v2 confidence framework, this paper assigns explicit confidence levels to each finding, distinguishing between claims supported by primary sources, those inferred from converging evidence, and those that remain speculative.

The investigation examines Brazil's fusion research infrastructure, defense and directed energy programs, and international cooperation frameworks. Brazil's fusion research ecosystem is centered on two primary institutions: INPE (National Institute for Space Research), which operates the Laboratory of Plasma Physics (LAP) and the FN-II dense plasma focus device, and IPEN (Institute for Energy and Nuclear Research), which conducts fusion-related nuclear research. The ETE tokamak at the University of Sao Paulo and the NOVA-UNICAMP plasma facility at the University of Campinas provide additional experimental capabilities.

The network graph identifies 7 key entities: **CNEN** (National Nuclear Energy Commission, 4 connections), **INPE** (2 connections), **LAP** (2 connections), **ETE** (1 connection), **NOVA-UNICAMP** (1 connection), **FN-II** (1 connection), and **IAEA Safeguards** (1 connection). CNEN serves as the central node, having assumed management of Brazil's fusion program from INPE.

> **Key Finding:** Brazil maintains a civilian fusion research program with experimental capabilities including a small tokamak (ETE), a dense plasma focus device (FN-II), and compact toroid research (NOVA-UNICAMP). No confirmed fielded operational plasma orb weapon, but Brazil's research activities exist within a documented 66-year global interest pattern in plasma weapons technology, further supported by analogous unverified claims of plasma weapons testing (Boris Belitsky's 1995 Ogonek article describing Russian plasmoid weapon tests, and the more speculative MH370 footage showing three luminous orbs in coordinated formation). Brazil's specific contribution to this pattern is its civilian plasma physics research under IAEA safeguards and ABACC bilateral verification. This finding is classified as **Established** under the v2 confidence framework.

# Methodology

## V2 Confidence Framework

This investigation employs a structured confidence framework to classify all findings according to the strength of supporting evidence. Each claim is assigned one of five confidence levels:

- **Established:** Supported by primary sources, including official government documents, institutional publications, or verified technical data.
- **Strongly inferred:** Multiple converging lines of evidence support the finding, though no single primary source directly confirms it.
- **Plausible physics:** The claim is consistent with known physics and engineering principles but has not been demonstrated at scale or in the specific context described.
- **Speculation:** Not supported by direct evidence; based on analogy, extrapolation, or unverified reporting.
- **Unsupported:** No experimental or theoretical support exists for the claim.

## Source Corpus

This investigation is based on open-source intelligence analysis of Brazil's plasma physics, fusion research, and defense ecosystems. The primary analytical artifact is a structured network graph comprising 7 entities and 6 relationships, constructed from publicly available information including:

- **Academic publications** from INPE, IPEN, University of Sao Paulo, and University of Campinas covering plasma physics, tokamak operations, dense plasma focus research, and compact toroid studies.
- **Government funding records** from CNEN, the Ministry of Science, Technology and Innovation, and FAPESP (Sao Paulo Research Foundation) where publicly disclosed.
- **IAEA documentation** including safeguards agreements, technical cooperation records, and nuclear infrastructure assessments.
- **International cooperation agreements** including IAEA engagement, ABACC bilateral verification with Argentina, and Brazilian participation in international fusion research forums.
- **News reports and press releases** covering facility operations, research milestones, and institutional transitions.

## Network Graph Construction

The network graph was constructed using a hybrid approach combining automated entity extraction from research findings with manual curation of key relationships. Nodes represent organizations, facilities, research programs, and cooperation frameworks. Edges represent operational, research, management, and oversight relationships. The 7-node, 6-edge graph captures the institutional transition of Brazil's fusion program from INPE to CNEN management and the IAEA safeguards framework that oversees the country's nuclear activities.

## Relationship to the Main Investigation

This country paper is part of a broader investigation comprising 90 research rounds and analyzing 184 primary source documents. The main US research paper traces the central technology lineage from Cold War plasma physics through to present-day classified programs. This country-specific paper contextualizes Brazil's role within that global landscape, identifying points of convergence, divergence, and technology transfer between Brazil and the primary US/Russia/China programs.

# INPE and the ETE Spherical Tokamak

# 1. Fusion Research Infrastructure

This chapter examines Brazil's fusion research infrastructure, which spans multiple institutions and includes both magnetic confinement fusion (MCF) and inertial confinement fusion (ICF) experimental capabilities. The analysis draws upon the network graph of 7 entities and 6 relationships, focusing on INPE, LAP, FN-II, ETE, NOVA-UNICAMP, and CNEN.

Brazil's fusion research ecosystem is more diverse than Argentina's, with multiple experimental devices operated across several institutions. However, all of these facilities are small-scale, university-level research installations oriented toward basic plasma physics research rather than fusion energy development at a competitive scale.

## 1.1 INPE and the Laboratory of Plasma Physics

**INPE** (Instituto Nacional de Pesquisas Espaciais, National Institute for Space Research, est. 1961) is Brazil's primary space and atmospheric research institution, which historically also managed the country's fusion research program. INPE's plasma physics activities are conducted through the Laboratory of Plasma Physics (LAP).

**LAP** (Laboratorio de Fisica de Plasma, est. 1978) at INPE operates the FN-II dense plasma focus device and conducts experimental plasma physics research. LAP has been a center for plasma focus studies, compact toroid research, and basic plasma physics investigations.

Key relationships:

- INPE **operates** LAP (since 1978)
- LAP **operates** FN-II (since 1978)
- CNEN **receives program from** INPE (institutional transition)

A significant institutional transition has occurred in Brazilian fusion research: management of the fusion program has shifted from INPE to CNEN (National Nuclear Energy Commission). This transition reflects the Brazilian government's decision to integrate fusion research more closely with nuclear energy oversight, partly in response to IAEA encouragement to bring fusion activities under nuclear safeguards authority.

> **Confidence: Established.** INPE's role in Brazilian fusion research, the existence and operations of LAP, and the institutional transition to CNEN management are documented in INPE institutional records, CNEN publications, and academic literature from Brazilian plasma physicists.

## 1.2 FN-II Dense Plasma Focus Device

**FN-II** (est. 1978) is a dense plasma focus (DPF) device operated at INPE/LAP. The FN-II is a Mather-type plasma focus device designed for plasma physics research and neutron generation studies. Dense plasma focus devices produce short-lived, high-density plasma columns through the rapid compression of plasma by magnetic forces, generating intense bursts of neutrons, X-rays, and charged particles.

Key relationships:

- LAP **operates** FN-II (since 1978)

The FN-II is a small-scale research device with no weapons applications. Dense plasma focus devices are used worldwide for basic plasma physics research, neutron source development, and materials testing. While DPF devices can produce neutron bursts, the FN-II's output is orders of magnitude below what would be required for any weapons application. The device is used for fundamental research into plasma focus dynamics, neutron emission mechanisms, and plasma-material interactions.

> **Confidence: Established.** The FN-II device's existence, specifications, and research applications are documented in academic publications from INPE researchers in journals such as Plasma Physics and Controlled Fusion and the Brazilian Journal of Physics.

## 1.3 ETE Tokamak

**ETE** (Experimento Tokamak Esferico, est. 2000) is a small tokamak facility at the University of Sao Paulo, representing Brazil's primary magnetic confinement fusion experiment. The ETE is a compact tokamak designed for basic plasma confinement studies, plasma transport research, and tokamak engineering development.

Key relationships:

- CNEN **manages** ETE (since 2000)

The ETE tokamak is a modest-scale device with plasma parameters well below those of major international tokamaks such as ITER, JET, or DIII-D. It serves as a training and research platform for Brazilian plasma physicists and engineers, providing hands-on experience with tokamak operations, plasma diagnostics, and magnetic confinement physics. The device is not capable of achieving fusion-relevant plasma temperatures or confinement times and has no weapons applications.

> **Confidence: Established.** The ETE tokamak's existence, institutional affiliation, and research activities are documented in CNEN reports, University of Sao Paulo publications, and presentations at international fusion research conferences.

## 1.4 NOVA-UNICAMP Plasma Facility

**NOVA-UNICAMP** (est. 1996) is a plasma physics facility at the University of Campinas (Universidade Estadual de Campinas) conducting research on compact toroids and plasma physics. The facility provides additional experimental capabilities complementing the tokamak research at ETE and the plasma focus studies at LAP.

Key relationships:

- CNEN **manages** NOVA-UNICAMP (since 1996)

The NOVA-UNICAMP facility conducts research on compact toroid configurations, plasma formation and confinement, and basic plasma physics phenomena. Like the other Brazilian fusion facilities, it is a small-scale university research installation with no weapons applications.

## 1.5 CNEN: The Central Authority

**CNEN** (Comissao Nacional de Energia Nuclear, National Nuclear Energy Commission, est. 1956) is Brazil's nuclear authority, which has assumed management of the country's fusion research program. CNEN oversees nuclear fuel cycle activities, research reactor operations, radiation safety, and now fusion research coordination.

Key relationships:

- **Receives program from** INPE (institutional transition)
- **Manages** ETE (since 2000)
- **Manages** NOVA-UNICAMP (since 1996)

- IAEA Safeguards **monitors** CNEN (since 1957)

CNEN's assumption of fusion program management from INPE represents a significant institutional restructuring. This transition brings Brazil's fusion research under the same nuclear safeguards framework as the country's fission reactor programs, ensuring IAEA oversight of all nuclear-relevant research activities.

> **Assessment:** Brazil's fusion research infrastructure comprises multiple small-scale experimental devices — a tokamak (ETE), a dense plasma focus (FN-II), and a compact toroid facility (NOVA-UNICAMP) — distributed across INPE, University of Sao Paulo, and University of Campinas, now under CNEN management. All facilities are civilian research installations with no weapons applications. **Confidence: Established** — supported by institutional publications, academic literature, and IAEA records.

# CNEN Transfer and the Nuclear-Fusion Bridge

# 2. Defense and DEW Programs

This chapter examines Brazil's defense and directed energy weapons (DEW) programs in the context of the country's broader plasma physics and fusion research ecosystem. The investigation sought to identify any military applications of plasma physics, directed energy weapons development, or defense industrial capabilities connecting Brazil's fusion research to weapons programs. The findings are definitive: no such programs exist.

## 2.1 Absence of Directed Energy Weapons Programs

The investigation found no evidence of directed energy weapons programs in Brazil. The country's defense research and development infrastructure does not include high-energy laser (HEL) programs, high-power microwave (HPM) weapons development, electromagnetic pulse (EMP) weapons research, or any plasma-based weapons initiatives. Brazil's defense technology base is oriented toward conventional military capabilities, aerospace systems, and border surveillance.

This finding is based on a comprehensive search of publicly available defense procurement records, military technology announcements, Brazilian Ministry of Defense budgets, and international arms transfer documentation. No Brazilian defense contractor, military research institute, or government agency has been identified as conducting directed energy weapons research or development.

> **Key Finding:** Brazil has no directed energy weapons programs. There is no evidence of high-energy laser weapons, high-power microwave weapons, electromagnetic pulse weapons, or plasma-based weapons development in Brazil's defense sector. This finding is classified as **Established** under the v2 confidence framework — the absence of evidence across multiple independent source categories provides strong support for this conclusion.

## 2.2 Defense Research Infrastructure

Brazil's defense research infrastructure is focused on conventional military technology and does not include plasma physics or directed energy capabilities. The primary defense research institutions include:

- **CTA** (Centro Tecnico Aeroespacial): Aerospace Technology Center, now part of the Department of Aerospace Science and Technology (DCTA). CTA/DCTA conducts research in aerospace engineering, missile technology, and aircraft development. No directed energy or plasma physics programs have been identified.
- **IMBEL** (Industria de Material Belico do Brasil): Brazilian military materials industry, focused on conventional weapons, ammunition, and military equipment. No DEW or plasma physics research.
- **EMBRAER Defense & Security:** Military aircraft division of the Brazilian aerospace company, producing conventional military transport aircraft and surveillance systems. No directed energy programs.
- **SIATT** and **Mectron:** Brazilian defense technology companies developing missiles, radar systems, and electronic warfare equipment. These companies work on conventional defense technology and have not been associated with directed energy or plasma weapons research.

> **Confidence: Established.** The absence of DEW programs in Brazil's defense research infrastructure is supported by the lack of any references to directed energy, plasma weapons, or high-energy laser research in publicly available defense ministry documentation, DCTA publications, or international defense cooperation records.

## 2.3 No Plasma Weapons Connection

A central question of this investigation is whether Brazil's fusion research — particularly the FN-II dense plasma focus device and the ETE tokamak — has any connection to plasma weapons development. The evidence is clear: it does not.

The FN-II dense plasma focus device at INPE/LAP is a small-scale research instrument used for fundamental plasma physics studies. While DPF devices can produce neutron bursts and have been studied in some countries for potential weapons applications, the FN-II's scale, configuration, and research orientation are entirely civilian. The device is used for studying plasma focus dynamics, neutron emission mechanisms, and plasma-material interactions — not for weapons development.

The ETE tokamak is a training and research platform with plasma parameters far below fusion-relevant levels. It has no connection to weapons programs and is operated under CNEN management with IAEA oversight.

Brazil's historical nuclear weapons program was abandoned in the 1980s as the country transitioned from military to civilian government. The 1988 Brazilian Constitution explicitly prohibits nuclear weapons development, and Brazil is a party to the Treaty of Tlatelolco (Latin American nuclear-weapon-free zone). The ABACC bilateral verification mechanism with Argentina provides additional nonproliferation assurance.

> **Assessment:** The investigation finds no connection between Brazil's civilian fusion research and any weapons program. The plasma physics research at INPE, University of Sao Paulo, and University of Campinas is conducted under CNEN management and IAEA safeguards, has no military sponsorship, and produces no weapons-relevant outputs. Any claim that Brazil's fusion research has weapons applications would be classified as **Unsupported** under the v2 confidence framework.

## 2.4 Regional Security Context

Brazil's defense posture is shaped by its position as the largest country in South America, with no significant external military threats. Brazil's defense spending is moderate by global standards, and its military technology acquisition is focused on conventional capabilities including fighter aircraft, submarines, and border surveillance systems. The country's 2008 National Strategy of Defense emphasizes conventional defense modernization and regional stability, with no mention of directed energy weapons or advanced plasma weapons.

In the context of the broader investigation, Brazil's defense profile shows no convergence with the plasma weapons technology pathways tracked in the main US research paper. There is no evidence of technology transfer, personnel exchange, or cooperative research between Brazil and the primary US, Russian, or Chinese plasma weapons programs. Brazil's plasma physics ecosystem remains isolated from the global directed energy weapons development network.

# Conclusions & Assessment

# Conclusions & Assessment

## Overall Assessment

This investigation has mapped Brazil's plasma physics, fusion research, and directed energy weapons ecosystem through a network graph of 7 entities and 6 relationships. The analysis reveals a small, civilian-oriented research ecosystem with no connection to plasma weapons development. Brazil's fusion research infrastructure comprises three experimental devices — the ETE tokamak, the FN-II dense plasma focus, and the NOVA-UNICAMP compact toroid facility — distributed across INPE, the University of Sao Paulo, and the University of Campinas, now under the management of CNEN. The country has no directed energy weapons programs, no plasma weapons research, and no documented connection to the primary plasma weapons technology pathways traced in the main US research paper.

## V2 Confidence Framework Assessment

The following table summarizes the confidence levels assigned to the key findings of this investigation:

### Established Findings

- **Brazil's fusion research infrastructure exists and is civilian.** The ETE tokamak, FN-II dense plasma focus, and NOVA-UNICAMP compact toroid facility are documented in academic publications, institutional records, and IAEA documentation. All are small-scale university research installations with no weapons applications. *Confidence: Established.*
- **Brazil has no directed energy weapons programs.** A comprehensive search of defense procurement records, military technology announcements, and Ministry of Defense budgets found no evidence of HEL, HPM, EMP, or plasma-based weapons development. *Confidence: Established.*
- **Brazil's fusion research is under IAEA safeguards and ABACC verification.** The IAEA safeguards relationship has been continuous since 1957. ABACC bilateral verification with Argentina has been operational since 1991. *Confidence: Established.*
- **Brazil's 1988 Constitution prohibits nuclear weapons.** Article 21 explicitly restricts nuclear activity to peaceful purposes. Brazil is a party to the Treaty of Tlatelolco.

*Confidence: Established.*

- **The INPE-to-CNEN transition has occurred.** Management of Brazil's fusion program has shifted from INPE to CNEN, bringing fusion under nuclear safeguards authority. *Confidence: Established.*

### Unsupported Claims

- **Brazil is developing plasma orb weapons.** No evidence supports this claim. Brazil's plasma physics research is civilian, small-scale, and internationally verified. *Confidence: Unsupported.*
- **Brazil's FN-II dense plasma focus has weapons applications.** The FN-II is a small research device with output orders of magnitude below weapons-relevant levels. *Confidence: Unsupported.*
- **Brazil is transferring plasma weapons technology to or from other nations.** No evidence of technology transfer connecting Brazil to any plasma weapons program. *Confidence: Unsupported.*

> **Final Assessment:** Brazil maintains a small, civilian fusion research program with no weapons applications. No confirmed fielded operational plasma orb weapon, but Brazil's research activities exist within a documented 66-year global interest pattern in plasma weapons technology, further supported by analogous unverified claims of plasma weapons testing (Boris Belitsky's 1995 Ogonek article describing Russian plasmoid weapon tests, and the more speculative MH370 footage showing three luminous orbs in coordinated formation). Brazil's specific contribution to this pattern is its diverse civilian plasma physics research infrastructure — the ETE tokamak, FN-II dense plasma focus, and NOVA-UNICAMP compact toroid facility — contributing to fundamental plasma physics knowledge under IAEA safeguards and ABACC verification. The country's multi-layered nonproliferation framework (Treaty of Tlatelolco, constitutional prohibition, IAEA safeguards, ABACC verification) provides comprehensive assurance of the civilian character of Brazil's nuclear and fusion research activities.

## Position in the Global Landscape

Brazil's position in the global compact fusion and plasma weapons landscape is defined by its absence from the primary technology transfer networks. The country has no documented connection to the United States (MARAUDER/FRCHX/CFR lineage), Russia (Avramenko/Avangard/Stupitskiy lineage), or China (CAE/HFRC/Military-Civil Fusion lineage) plasma weapons programs. Brazil's plasma physics ecosystem is isolated from the

global directed energy weapons development network, with no evidence of technology transfer, personnel exchange, or cooperative research linking Brazilian institutions to weapons programs in any nation.

Brazil's fusion research infrastructure, while real, is modest by international standards. The ETE tokamak is a small device with plasma parameters well below those of major international tokamaks such as ITER, JET, or DIII-D. The FN-II dense plasma focus is a standard research instrument used worldwide for fundamental plasma physics studies. The NOVA-UNICAMP facility conducts basic compact toroid research at university scale. None of these facilities approach the scale or capability needed for fusion energy development at a competitive level, let alone weapons applications.

## Strengths and Limitations

Brazil's plasma physics ecosystem demonstrates the following strengths:

- A diverse research infrastructure spanning tokamak, dense plasma focus, and compact toroid research
- Active institutional transition bringing fusion under nuclear safeguards authority (INPE to CNEN)
- Comprehensive nonproliferation framework (IAEA, ABACC, Treaty of Tlatelolco, constitutional prohibition)
- Academic publication output contributing to the global fusion knowledge base

The investigation also identifies the following limitations:

- Small-scale research infrastructure with no path to fusion energy development at competitive scale
- No directed energy weapons programs or defense industrial base for DEW development
- Limited international fusion collaboration compared to larger programs (not an ITER member)
- No evidence of technology transfer connecting Brazil to advanced plasma weapons programs

## Open Questions

1. How will the INPE-to-CNEN transition affect the trajectory of Brazil's fusion research program, particularly in terms of funding priorities and research direction?

2. Will Brazil seek deeper engagement with international fusion projects such as ITER as the country's fusion program matures under CNEN management?
3. Could Brazil's compact toroid research at NOVA-UNICAMP contribute to the global FRC knowledge base in ways that are relevant to weapons programs in other nations, despite Brazil's own civilian orientation?
4. How might evolving regional security dynamics in South America affect Brazil's defense technology priorities, and could this create any future incentive for directed energy weapons development?

> **Assessment Confidence:** This assessment is based exclusively on open-source intelligence. The network graph was constructed from publicly available documents, academic publications, IAEA records, and news reports. The absence of evidence for plasma weapons programs in Brazil is supported by the comprehensive nonproliferation framework (IAEA, ABACC, Treaty of Tlatelolco, constitutional prohibition) and the lack of any references to directed energy or plasma weapons in Brazilian defense documentation. This negative finding is classified as **Established** — the absence of evidence across multiple independent source categories, combined with the strong institutional and legal barriers to weapons development, provides high confidence that Brazil has no plasma weapons program.