

# Juan Pablo Solís Ruiz

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## PROFILE

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Engineering Physics graduate with a strong focus on fusion and plasma physics, numerical modelling and scientific computing. Experienced in developing original physics simulation codes (PIC, MHD, two-fluid, Grad-Shafranov) and custom Geant4 frameworks. Highly motivated to pursue graduate studies in fusion science, combining solid theoretical training with hands-on computational and engineering skills.

## EDUCATION

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**Tecnológico de Monterrey**, Monterrey, Mexico Jun 2025  
B.S. in Engineering Physics (Ingeniería Física Industrial)  
GPA: 92.29 / 100 Academic Talent Scholarship (2021–2025)

## ONLINE COURSES & CERTIFICATIONS

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**PlasmaApplicationX: Plasma Physics – Applications**, EPFLx / edX 2025  
Ecole Polytechnique Fédérale de Lausanne – Verified Certificate.  
Topics: space and astrophysical plasmas; industrial and medical plasma applications; thermonuclear fusion physics including power balance and magnetic confinement devices (tokamaks and stellarators).

**PlasmaIntroductionX: Plasma Physics – Introduction**, EPFLx / edX 2025  
Ecole Polytechnique Fédérale de Lausanne – Verified Certificate.  
Topics: Debye shielding and plasma parameters; single-particle motion in electromagnetic fields; kinetic and fluid descriptions (Vlasov, two-fluid, MHD); equilibrium and stability; MHD waves and basic numerical modelling exercises.

**Complete Guide to C++ Programming Foundations**, LinkedIn Learning 2025  
Certificate of completion. Topics: C++ fundamentals for scientific and engineering applications (types, pointers, references, control flow, functions, classes and introductory use of the STL).

Lean Six Sigma White Belt – Certification 2023

## RESEARCH & PROJECTS IN FUSION AND PLASMA PHYSICS

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### STAR-like Spherical Tokamak Equilibrium (FreeGSNKE)

- Built a STAR-like spherical tokamak model in FreeGSNKE, including vessel geometry and PF/CS coil set.
- Ran PF/CS current scans with a misfit-based optimisation to obtain a low-aspect-ratio, highly elongated bean-shaped equilibrium with positive triangularity.
- Computed MHD diagnostics (separatrix geometry,  $q(\psi)$ , pressure,  $\beta_p$ , toroidal current density, magnetic shear) and generated a quasi-static ramp-up animation.
- *Tools*: Python, NumPy, Matplotlib, FreeGSNKE.

### PIC Simulation of Two-Stream Instability

- Implemented a 1D electrostatic Particle-In-Cell (PIC) code including charge deposition, field solver and particle pusher for periodic plasmas.
- Reproduced the exponential growth phase of the two-stream instability and compared numerical growth rates with analytical theory.
- Produced phase-space plots and field evolution diagnostics to study nonlinear saturation.
- *Tools*: Python, NumPy, SciPy, Matplotlib.

### Two-Fluid Plasma Wave Simulation (1D/2D)

- Developed a two-fluid plasma framework with separate ion and electron dynamics coupled to Maxwell-type field equations.
- Validated dispersion relations for several plasma wave branches (R/L, O/X, electrostatic modes) against theoretical predictions.
- Designed a modular structure allowing 1D/2D setups, boundary conditions and parameter scans.
- *Tools*: Python, NumPy, SciPy, Matplotlib.

## Z-Pinch MHD Stability Simulation

- Implemented a resistive-MHD solver to model the time evolution of an axial Z-pinch.
- Reproduced characteristic sausage and kink instabilities under different current and pressure profiles.
- Built a modular codebase prepared for future extensions (additional physics, higher-dimensional geometries).
- *Tools*: Python, NumPy, SciPy, Matplotlib.

## OTHER SCIENTIFIC & ENGINEERING PROJECTS

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### Geant4 Simulation Framework for Customizable Radiography Imaging

- Constructed a reusable Geant4 framework for X-ray radiography and tomography of arbitrary samples.
- Implemented flexible geometry, source and detector configurations to support different experimental scenarios.

### ComSatsP4 – Bidirectional S-Band Communications System for a CubeSat

- Co-designed a bidirectional communication system between a climate observation CubeSat and a ground station, integrating a fractal patch antenna for the satellite, a directional ground antenna and an S-band link prototype.
- Implemented a communications stack inspired by the CCSDS space packet protocol, including packetisation, sequence control and basic error detection for image and diagnostic data.
- Prototyped and validated the link using commercial hardware (Raspberry Pi, nRF24L01-based transceivers and custom PCB antennas), debugging packet fragmentation issues and demonstrating reliable image transmission in realistic lab conditions.

## EXPERIENCE

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**Volunteer – GeoStats**, Monterrey, Mexico

Aug 2023 – Aug 2024

- Mapped femicides in Nuevo León using GIS tools and contributed to a predictive model for the metropolitan area of Monterrey.
- Helped identify support networks and areas of social backwardness to assist social organizations.

**Peer Tutor – Calentando Ideas**, Monterrey, Mexico

Feb 2023 – Jun 2023

- Provided physics tutoring and mentoring for high-school students facing academic difficulties.
- Helped students prepare for quizzes and exams, improving their performance and confidence.

## AWARDS & HONOURS

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Academic Talent Scholarship, Tecnológico de Monterrey

2021–2025

First Place – Quantum Hackathon 2023, Tecnológico de Monterrey

## TECHNICAL SKILLS

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*Programming & Scientific Computing:*

Python, MATLAB, Julia, C++; data science libraries (NumPy, SciPy, Pandas, Matplotlib); optimisation and scientific simulation workflows.

*Simulation & Modelling:*

Geant4; custom PIC/MHD/two-fluid plasma codes; numerical methods for ODEs and PDEs; Fourier and spectral techniques.

*RF, Antennas & Experimental Skills:*

Basic RF link design; patch/fractal antenna design on FR4 (KiCad); S-band CubeSat communications prototype; optical laboratory techniques (interferometry, diffraction, spectroscopy); basic electronics and instrumentation.

*Data Science & Analysis:*

Statistical modelling, basic machine learning (regression, classification), data visualisation and exploratory data analysis.

## LANGUAGES

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Spanish – Native (C2)

English – Advanced (C1, TOEFL iBT 98)

German – Elementary (A2)