**Department of Electrical and Computer Engineering**

TEXAS TECH UNIVERSITY
Edward E. Whitacre Jr.
College *of* Engineering

## Spring 2024 Seminar Series

**Seminar Title**: *Hydrodynamic models of electric charge transport: structure-preserving numerical methods*

**Time**: 2:00-2:50 PM, Friday, Apr 5, 2024
**Location:** Holden Hall 150

**Speaker**:
**Ignacio Tomas**
Department of Mathematics, TTU

**Abstract:**
The electric charge transport model hierarchy is roughly divided into particle models, kinetic models, hydrodynamic models, and diffusive models (e.g. drift-diffusion models). This talk focuses on hydrodynamic models. The first model to be discussed is the one-species Euler-Poisson model. This model describes the conservation of mass momentum and energy of an electron-fluid in the electrostatic regime. The second model to be discussed is the standard ideal MHD model. The ideal MHD model describes a quasi-neutral fluid in the low-frequency regime: the model is derived by neglecting displacement currents and electron inertia effects, therefore it cannot meaningfully be used to describe electrostatic regimes. Even though these two models represent quite different physical regimes, the numerical methods that preserve essential structural stability properties of the systems are strikingly similar. In this talk, we describe the essential ingredients required to preserve the positivity of density, the positivity of internal energy, and the energy stability of the numerical schemes.

**Speaker Bio:**
Dr. Ignacio Tomas obtained his PhD in Applied Mathematics from the University of Maryland (College Park) in 2015. He was a Visiting Assistant professor in the Department of Mathematics at Texas A&M from Aug-2015 to Dec-2019, where he worked in the development of numerical methods for hyperbolic systems of conservation laws. From Jan-2019 to July-2022 he worked at Sandia National Laboratories (SNL). During his time at SNL he worked in algorithm and code development to solve multi-fluid models of electric charge as well as code verification/validation efforts. Since August 2022 he has been an Assistant Professor in the Department of Mathematics at TTU. Most of his current efforts target the development of numerical methods for models of electric charge transport.