TÉCNICO LISBOA

ipfn INSTITUTO DE PLASMAS E FUSÃO NUCLEAR

MEFT Boosting the Future

Modelling of Corona Discharges in Humid Air

Instituto de Plasmas e Fusão Nuclear

Supervisors:
Dr. Pedro Almeida
Dr. Vasco Guerra

Paula Fernandes, 100358

Motivation

Usual models

Dry air assumptions
Simplified geometries
Neglecting factors
Empirical correction factors

Humidity

Transport properties
Onset conditions
Rate coefficients
EEDF

Space charge accumulation
Photoionization
Non-linear processes
Streamers

Objectives

01 **Identify key parameters affecting corona formation**
02 **Derive and formulate the governing equations**
03 **Conclude and validate the numerical study**
04 **Discuss engineering implications**

Methodology

LisbOn KInetics

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N-Plasmas Reactive: Modelling and Engineering, N-PRiME
High-Pressure Plasmas Group

01 **Initial plasma chemistry analysis, 0D model**
Investigation of corona kinetics: numerical simulation on LoKI
Addition of water vapor into the mixture

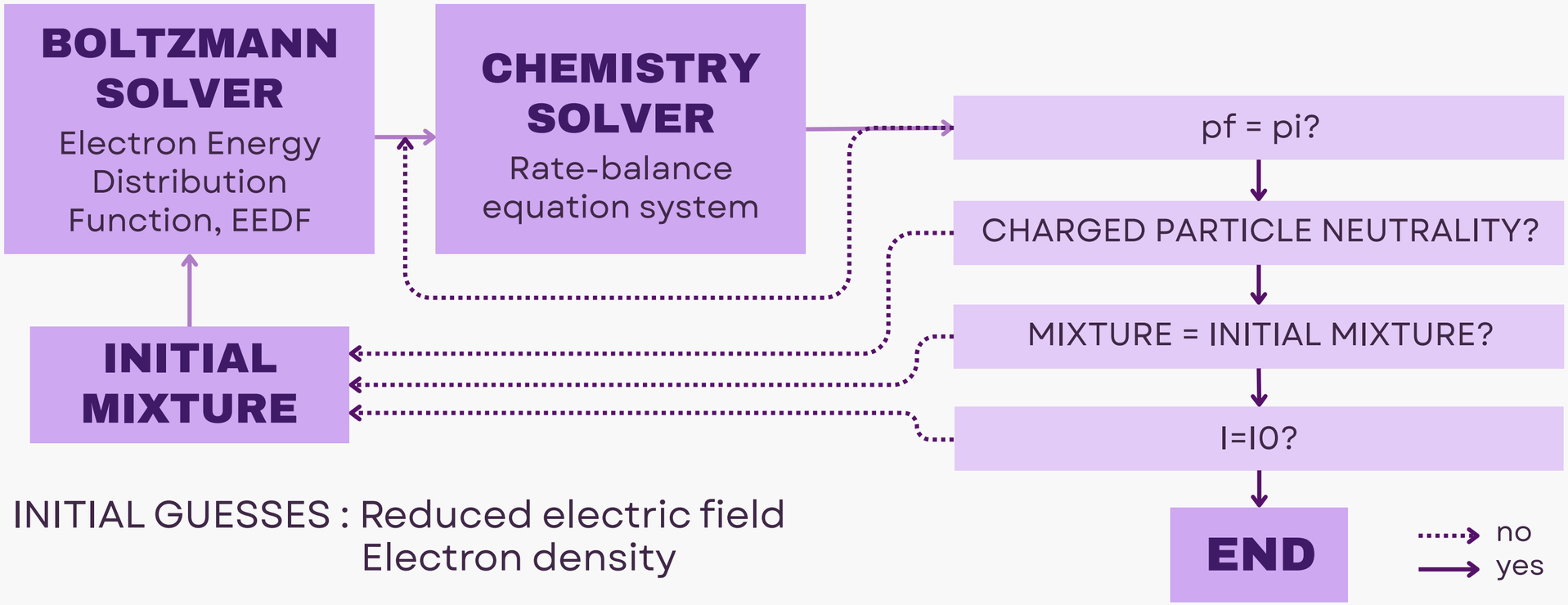
02 **Creation of a kinetic scheme suitable for 1D models**

03 **Final 1D model creation for corona discharges in humid air**
Initial approach based on a dry air kinetic scheme
Continuity equations for ions and electrons + Poisson's equation
Varying humidity values

Methodology

LisbOn KInetics, LoKI

Boltzmann + Chemical blocks
Procedure based on iteractions and cycles



INITIAL GUESSES : Reduced electric field
Electron density

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Thank you!

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Kinetic scheme

Number	Reaction	Process
1	$e + M \rightarrow 2e + M^+$	Electron Impact Ionization
2	$e + O_2 \rightarrow O^- + O$	Two-body (Dissociative) Attachment
3	$e + O_2 + M \rightarrow O_2^- + M$	Three-body Attachment
4	$M + h\nu \rightarrow e + M^+$	Photoionization
5	$O_2^- + M \rightarrow e + O_2 + M$	Collisional Detachment from O_2
6	$O^- + N_2 \rightarrow e + N_2O$	Associative Detachment from O^-
7	$O^- + O_2 \rightarrow O + O_2^-$	Charge Transfer from O^- to O_2
8	$O^- + O_2 + M \rightarrow O_3^- + M$	Conversion of O^- to O_3^-

$M = O_2, N_2$