

*Ain Shams University
Faculty of Girls for Art,
Science and Education*

THESIS FOR M. SC. IN PHYSICS
SUBMITTED BY

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*Demonstrator in Plasma and Nuclear Fusion Dept. Nuclear Research
Centre- Atomic Energy Authority Cairo - Egypt*



TITLE OF THESIS

**PLASMA - WALL INTERACTION IN
TOKAMAK**

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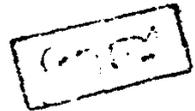
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1997



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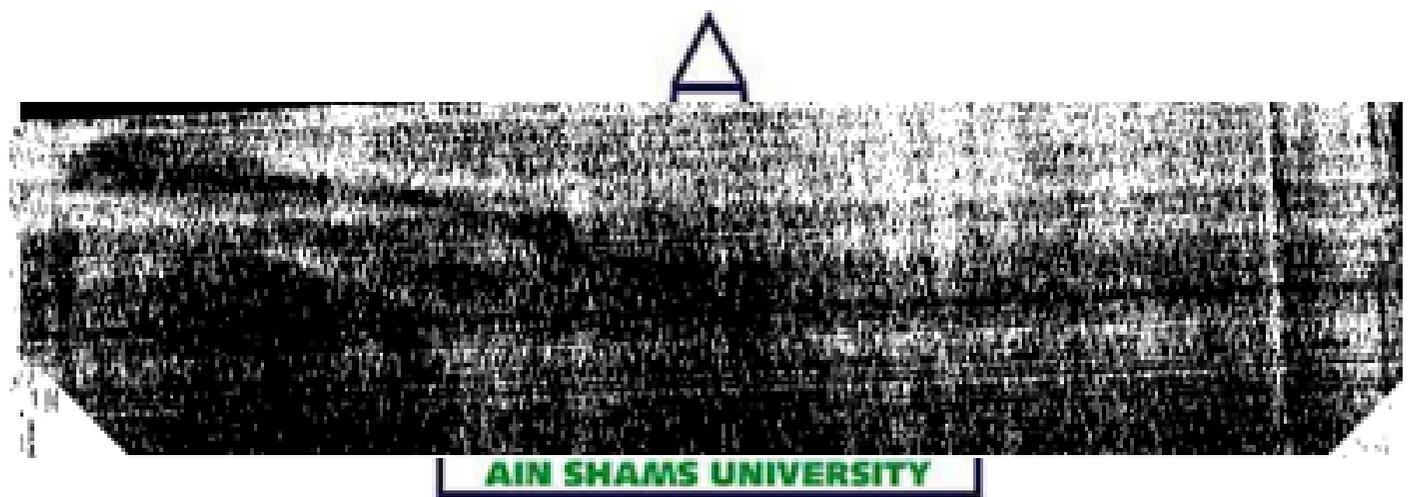
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REFERENCES

ARABIC SUMMARRY



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SUMMARY

The present work gives a detailed analysis of studying the transport coefficients for a plasma in small size tokamak (EGYPTOR), and studying also one of the transport coefficients for some impurity elements in plasma

In chapter I, some light on magnetic confinement, closed toroidal confinement systems, and tokamak magnetic system, plasma impurities, effect of impurities in plasma, mechanism of impurities' production, and impurities control is given. In addition a review of the previous work is presented

Chapter II gives an investigation the calculations of transport coefficients of plasma in straight homogenous and stationary magnetic and electric fields, starting from Expanding the correction function $\chi_u(X, \xi, t)$ which measure the deviation of the local distribution function f'' from the local plasma equilibrium will be called a reference stat in terms of "Irreducible Tensorial Hermite Polynomials". The expansion coefficient is called "Irreducible Hermitian Moments" and qualified the scalar, vector, and tensor part of correction function then by forming the moments equations and solving it, we get the transport coefficients by using two approximation. 13 and 21 Grad moment approximation

In chapter III: The same problem in as chapter 2 is considered but for light impurity element such as Oxygen and then the viscosity coefficient only of this element is calculated only in different charge states. The viscosity coefficient of one of the heavy impurity elements in plasma as Chromium ion is also calculated.

In chapter IV: A separate consideration of the values of transport coefficient in presence of a very strong magnetic field, i.e. in the limit .

$$|\kappa_{\alpha}| = |\omega_{\alpha} \tau| = \left| \frac{e_{\alpha} B}{m_{\alpha} c} \tau \right| \gg 1$$

m_{α} mass of species α , e_{α} charge of species α , B magnetic induction
 τ is collision time .

In addition a comparison with other treatments were studied .Finally the results, discussions and conclusions of chapters II and III are given in chapter four .

The major parts of this thesis has been published in the following :

1. BEHAVIOUR OF OXYGEN IMPURITIES IN TOKAMAK

R. N. EL - SHARIF , A.H. BEKHIT

6th Conference of Nuclear Sciences and Applications, 15 - 20 March (1996), Cairo ,
Egypt.

2. COEFFICIENTS OF VISCOSITY FOR HEAVY IMPURITY ELEMENT IN TOKAMAK

R. N. EL - SHARIF , A. H. BEKHIT

3rd Conference on Radiation Physics, 13- 17 Nov., (1996) Al-Minia , Egypt .

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