The Mapping and Modelling of Spiral Structure in the Milky Way :

The Potential of the Interstellar Medium

Lee James Summers, BSc(Hons), MSc(R).

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signed: . . . . . .
Lee James Summers

Date: . . . . . .

Abstract

GENTLEMEN, -

It was in 1864 that the first clues as to the nature of the space between stars were first identified in literature. These spaces became known as the interstellar medium. Any study of star formation must include an understanding of this interstellar medium (ISM) and its various component parts. Molecular clouds, dense regions of the ISM, are the sites where all known star formation is thought to occur. Hence, whenever an area containing young stars reside, it is assumed that one will also find a molecular cloud. Knowledge of these stellar birthplaces assist not only in models of stellar evolution, star formation potential, rate and efficiency - but also the ISM gives indications as to Galactic structure and the dynamics therein.

Within this thesis I begin with an introduction and historical background of the field before detailing the research which was conducted. Firstly, I discuss a new model describing the spatial and kinematic structure of the Milky Way's spiral potentials; the Perseus arm, the Outer arm and the outer Scutum-Centaurus arm and also the kinematics of the streaming motions of the gas within them. Material associated with each of these arms is then extracted.

Using the models and spiral arm maps derived, I present spatially convolved maps of each spiral arm region (Perseus, Outer and Scutum-Centaurus) at a constant linear scale. By minimising the biases inherent with angular observations of our Galaxy, this presents the data as an analogue of - and as such directly comparable to - extragalactic observations of spiral structure. Finally I present a series of analyses performed on the data and models; derivation of large-scale properties of the spiral arms (i.e. identification of where the arm is unconfused with fore- and back-ground emission, scale height, velocity dispersions, arm mass); dynamical analyses of the models; molecular cloud decomposition of the constant-linear-scale-maps. The findings are then compared with those in the Galactic and extra-galactic literature.

I am, Gentlemen,
Yours Faithfully,
L. J. Summers

(Abstract in the style of: Christiansen & Hindman (1952), the first detection of Galactic HI)


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