# Foreword

Scientific awareness of the galactic magnetic field arose in the late 40's with Fermi's work on cosmic rays, the discovery of the polarization of dust reddened starlight by Hiltner and Hall, and its interpretation in terms of magnetically aligned dust grains by Spitzer and Tukey and Davis and Greenstein. It was soon clear that the magnetic field and the cosmic ray are tied to the interstellar gas and form together an active dynamical system. Its importance for star formation and interstellar matter energetics was also quickly recognized but more than 50 years after most questions remain quantitatively open due to the paucity of data on the small scale structure of the field.

In the last decade, interferometric surveys have revealed striking patterns in the diffuse polarized emission, imposed by Faraday rotation, that give a way to study the field structure in the intervening ionized medium. The advent of high sensitivity measurements of polarized emission at sub-millimeter wavelengths promise to further open our perspective on the Galactic field. The dust observations will soon extend from high resolution observations from star forming regions with ground based telescopes and the ALMA interferometer to the continuous mapping of the diffuse interstellar medium with Planck.

A few months after the discovery of optical interstellar polarization, the Galactic magnetic field was an unexpected highlight of the first symposium on Cosmical Gas Dynamics held in Paris in august 1949. The Polarization 2005 meeting held at the University of Orsay was also a premiere. For the first time, two communities with disconnected backgrounds but common interests in polarization observations were given the opportunity to meet and learn from each other's research. The measurement of the polarization of the Cosmic Microwave Background has become a major Physics challenge of the decade(s) to come. The numerous experiments designed to achieve this goal have started providing data with unprecedented sensitivity on the Galactic polarization from sub-millimeter to centimetric wavelengths. Detailed modeling of the Galactic contribution to the observed polarization is a required key to the success of their endeavor.

This book gathers invited lectures presented at the meeting. It gives an in depth account of our present knowledge of the Galactic magnetic field from measurements of its structure and intensity to its role in the physics of interstellar matter and star formation. The Galactic part of the book is complemented by three papers that introduce the Cosmic Microwave Background polarization and describe the experiments being built to observe it, with special attention to the Planck ESA mission.

Few years after the Paris Cosmical Gas Dynamics symposium, the discovery of polarized synchrotron emission in the Crab was a new highlight in magnetic field research. Quoting a review by van de Hulst: "From that time on, measuring the polarization and thus mapping the magnetic field became a prime desideratum in galactic radio astronomy". We hope that observations to come will stimulate similar enthusiasm and bring more and more scientists to the field for whom this book will be a useful and lasting reference.

**François Boulanger and Marc-Antoine Miville-Deschênes**

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