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Magnetic Fields throughout Stellar Evolution

Edited by

Pascal Petit

Moira Jardine

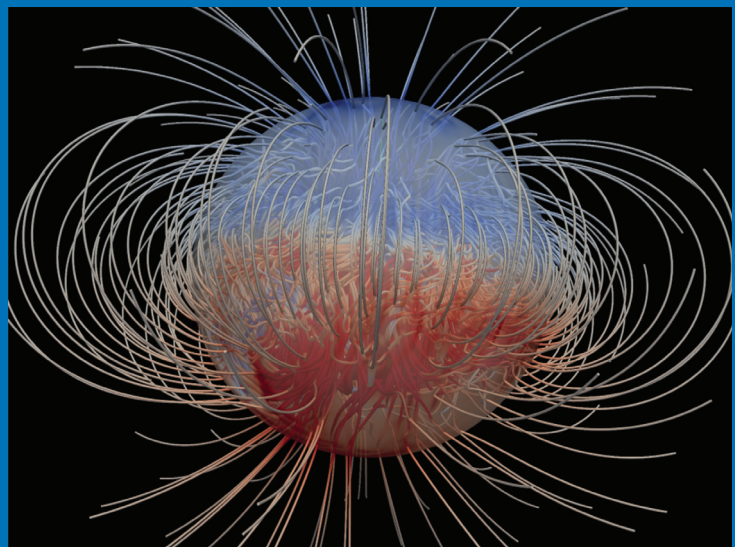
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MAGNETIC FIELDS THROUGHOUT STELLAR EVOLUTION

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COVER ILLUSTRATION:

Numerical dynamo in a rapidly-rotating spherical shell that models the magnetism of an active fully convective M dwarf. Due to the ordering influence of the dominating Coriolis force, convection develops as large scale convective columns that maintain the dynamo action. The surface topology of the magnetic field is dominated by its dipolar component. At depth, the magnetic field lines show a more intricate structure. The color of the field lines scale with the amplitude of the radial component of the magnetic field (red outward, blue inward) and the surface is made transparent to highlight the magnetic field structure at depth. Credits: Thomas Gastine

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**MAGNETIC FIELDS
THROUGHOUT STELLAR
EVOLUTION**

**PROCEEDINGS OF THE 302nd SYMPOSIUM OF
THE INTERNATIONAL ASTRONOMICAL UNION
HELD IN BIARRITZ, FRANCE
AUGUST 25–30, 2013**

Edited by

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Foreword

All phases of stellar evolution are influenced by the presence of magnetic fields in the interior and close environment of stars. Magnetic fields play a central role in the spindown of young stars, through magnetized outflows, star-disc interaction or magnetically-driven winds. They also impact the vertical settling of chemical species, leading to abnormal surface abundances observed in stars more massive than the Sun. In the advanced phases of stellar evolution, magnetic fields influence stellar evolution through their contribution to the mass-loss of cool giants and supergiants. Finally, extreme magnetic fields are observed in a small fraction of compact stellar remnants, powering X-ray and gamma ray emission.

Although most of these points have been identified decades ago, the ability to measure stellar magnetic fields and incorporate them in stellar models is relatively new. In this young and still growing research domain, the last few years have seen the dawn of a new era, with the advent of powerful tools strengthening both observational and modelling approaches to this field, rapidly changing our view of stellar magnetism throughout stellar evolution. The aim of this symposium was to bring together colleagues from all of these research areas. The topics covered spanned all phases of evolution, from the formation of stars and their early accreting years, through main sequence evolution for both low and high mass stars, and also the final stages of stellar evolution. Much of stellar astronomy now has relevance for the new field of exoplanets, and this brought another community to the symposium.

In addition to synthesizing the expertise of many research areas, the symposium also provided a forward look to the challenges and opportunities of the forthcoming decade. With an increasing number of present or future ground-based instruments in the visible and near infrared domains, stellar spectropolarimetry is now delivering direct magnetic field measurements throughout most of the Hertzsprung-Russell diagram. Combined with tomographic modelling, spectropolarimetric data sets provide the surface distribution of the magnetic vector with increasing spatial and temporal resolution. Many indirect tracers of magnetic activity are also available from X-rays to sub-millimetric and radio wavelengths, providing us with observational clues on the effect of magnetic fields at various distances from the stellar surface (chromosphere, corona, accretion flows, winds, jets). Statistical studies based on huge samples are also obtained from space-borne observatories like KEPLER, offering a completely new view of stellar activity. They will soon be complemented by systematic activity measurements provided by the GAIA spacecraft. This wealth of observational material is progressively getting closer to the richness of solar observations, for which continuous monitoring is now available at extremely high spatial resolution and throughout most of the electromagnetic spectrum (e.g. HINODE, SDO). This symposium showed clearly that these tight observational constraints constitute a necessary guidance to numerical simulations of stellar magnetism, which now use the power of massively parallel supercomputers, enabling the investigation of stellar dynamos through global 3-D simulations of convective layers, as well as the evolution of magnetic fields in radiative zones. The future indeed promises to be a rich one for studies of stellar magnetism throughout stellar evolution.

Pascal Petit, Moira Jardine & Hendrik Spruit

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 Jérôme Ballot
 Fabienne Bastien
 Olga Bayandina
 Lionel Bigot
 David Bohlender
 Ana Borisova
 Sudeshna Boro Saikia
 Jonathan Braithwaite
 Allan Sacha Brun
 Varvara Butkovskaya

c

Matthieu Castro
 Corinne Charbonnel
 Patrick Crozet

d

Khalil Daiffallah
 Alexandre David-Uraz
 José Dias do Nascimento
 Stephanie Douglas
 Natalia Drake

f

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 marianne faurobert
 Gregory Feiden
 Colin Folsom
 Nathalia Fonseca
 Yori Fournier
 Kotaro Fujisawa

g

Rafael Garcia
 Thomas Gastine
 Philippe Gondoin
 Konstantinos Gourgouliatos

Scott Gregory
 Jose Groh
 Jason Grunhut

h

Elodie Hébrard
 Huib Henrichs
 Fabrice Herpin
 Masaya Higa
 Wynn Ho
 Gaïtee Hussain

i

Elisa Iñiguez Garin

j

Moira Jardine
 Sandra Jeffers
 Colin Johnstone
 Laurène Jouve
 Aaron Juarez

k

Viktor Khalack
 Oleg Kochukhov
 Renada Konstantinova-Antova
 Heidi Korhonen
 Zsolt Kovari
 Levente Kriskovics
 Dmitry Kudryavtsev
 Manfred Küker
 Andreas Künstler
 Ryuichi Kurosawa

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Norbert Langer
 Andrea Lavagno
 Agnès Lèbre
 Jyri Lehtinen
 Roxanne Ligi
 François Lignières
 Stuart Littlefair
 Edward Liverts
 Joe Llama
 Arturo Lopez Ariste

m

Stephen Marsden
Alexander Martin
Stéphane Mathis
Titos Matsakos
Luiz Mendes
Sergio Miranda Aranguren
Joe Mitchell
David Montes

n

Silvana Navarro
Coralie Neiner

o

Stanley Owocki

p

Ana Palacios
Pascal Petit
Véronique Petit
Nikolai Piskunov
Mikhail Pogodin
Katja Poppenhaeger
Ralph Pudritz

r

Julio Ramirez
Denis Rastegaev
Nanda Rea
Ansgar Reiners
Timo Reinhold
Andreas Reisenegger
Claudia Rodrigues
Rachael Roettenbacher

Iosif Romanyuk
Lisa Rosén
thierry Roudier
Naum Rusomarov

s

Laurence Sabin
Victor See
Evgeny Semenko
Denis Shulyak
Aditi Sood
Hendrik Spruit
Deniss Stepanovs

t

Svetla Tsvetkova

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Adriana Valio
Krisztián Vida
Aline Vidotto
Conrad Vilela-Lewandowski
Wouter Vlemmings

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Gregg Wade
Lucianne Walkowicz
Joern Warnecke
Andrew West
Nicholas Wright

y

Rakesh Yadav
Ilya Yakunin