On the chemical and spectro-photometric evolution of nearby galaxies
van den Hoek, L.B.

Citation for published version (APA):
van den Hoek, L. B. (1997). On the chemical and spectro-photometric evolution of nearby galaxies

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
Contents

1 General introduction and thesis outline

2 Star formation in galaxies: local and global processes in the ISM 5
   2.1 Introduction ............................................................................................................. 5
   2.2 Star formation in the local disk ISM ................................................................. 5
   2.3 Global star formation in galaxies ....................................................................... 7
   2.4 The stellar mass function at birth ..................................................................... 9

3 Modelling the chemical evolution of the Galactic disk: basic equations, assumptions, and stellar input data 13
   3.1 Basic equations and model assumptions .............................................................. 14
      3.1.1 Star formation and Initial Mass Function ....................................................... 14
      3.1.2 Newly synthesized and unprocessed metals .................................................. 15
      3.1.3 Initial conditions, model parameters, and solution method ....................... 16
   3.2 Stellar lifetimes and remnant masses ............................................................... 20
      3.2.1 Stellar lifetimes ............................................................................................ 20
      3.2.2 Remnant masses ......................................................................................... 21
   3.3 Stellar nucleosynthesis prescriptions ................................................................ 23
      3.3.1 Definition of stellar yields ........................................................................... 24
      3.3.2 Asymptotic Giant Branch stars ................................................................... 25
      3.3.3 Supernova Type II ....................................................................................... 33
      3.3.4 Supernova Type Ia ...................................................................................... 40
      3.3.5 Supernova Type Ib/c ................................................................................... 42
      3.3.6 Close binary stars ....................................................................................... 44
   3.4 Overall comparison of the yields of intermediate and massive stars ............... 45
      3.4.1 Overview of the stellar yields adopted ......................................................... 45
      3.4.2 Cumulative IMF weighted yields ................................................................. 45
      3.4.3 Net yield function ....................................................................................... 51
      3.4.4 Comparison of net yields ........................................................................... 51
      3.4.5 Concluding remarks ................................................................................... 55

A Appendix A: Approximate and exact solutions of the galactic chemical evolution equations ................................................. 57

B Appendix B: Normalization of the SFR ................................................................... 58
4 Modelling the chemical evolution of the Galactic disk: basic considerations, selected models, and results

4.1 Basic considerations
  4.1.1 Notation and calibration of abundances
  4.1.2 Sample selection criteria
  4.1.3 Inhomogeneous chemical evolution of the Galactic disk
  4.1.4 Stellar orbital diffusion
  4.1.5 Evolution of the vertical structure of the Galactic stellar disk
  4.1.6 Distinction between halo, thick and thin disk stars
  4.1.7 Radial abundance gradients
  4.1.8 Concluding remarks

4.2 Modelling the Age-Metallicity Relation
  4.2.1 Model assumptions
  4.2.2 Basic set of models
  4.2.3 Resulting AMRs
  4.2.4 Selected models for the Galactic disk

4.3 Results
  4.3.1 The Present-day and Initial Mass Function
  4.3.2 Post main-sequence stars: total number and formation rates
  4.3.3 Star formation, gas depletion, and infall rates
  4.3.4 Element abundances in the Galactic disk and halo
  4.3.5 Planetary nebulae abundances
  4.3.6 The white dwarf luminosity function
  4.3.7 Remnant mass distribution of low and intermediate mass stars
  4.3.8 Metallicity and age distributions of long-living stars

4.4 Discussion and conclusion

5 Inhomogeneous chemical evolution of the Galactic disk: evidence for sequential stellar enrichment?

5.1 Introduction
5.2 Observations
  5.2.1 Main-sequence F and G dwarfs
  5.2.2 Chemical evolution of the solar neighborhood
  5.2.3 Open clusters

5.3 Model characteristics and assumptions
  5.3.1 Model description
  5.3.2 Outline of model computations
  5.3.3 Model input parameters
  5.3.4 Stellar evolution data

5.4 Results
  5.4.1 Reference model
  5.4.2 Sequential stellar enrichment
  5.4.3 Episodic infall of metal-deficient matter
  5.4.4 Metal-poor gas infall combined with sequential enrichment
  5.4.5 Additional abundance constraints
6.8 Discussion .................................................................................. 264
  6.8.1 Star formation history ............................................................ 264
  6.8.2 Present-day star formation ....................................................... 265
  6.8.3 On the formation of LSB galaxies .......................................... 267
6.9 Concluding remarks ..................................................................... 267

References ....................................................................................... 269
Publications ....................................................................................... 281
Dankwoord (Acknowledgements) ....................................................... 283
Summary .......................................................................................... 285