

CU 8: ASTROPHYSICAL PARAMETERS

**Work Breakdown Structure
for GWP-S-811-10000
'Provide synthetic stellar spectra'**

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Revision history

rev. no.	date	author	comments on changes
2	2006.06.16	AJK	Major revision incorporating input from object-WP managers collected during April and May 2006
1	2006.04.05	AJK	Initial version

1 Introduction

GWP-S-811-10000 computes synthetic stellar spectra of single stars for Gaia-wide use. This is a formidable task requiring expertise of various stellar communities around Europe. The deliverables (grids of spectra at various levels of sophistication) are used directly by many WPs of CU8 and made available as Gaia-simulated data by CU2.

In an first step (to be completed in 2006) a first major grid is to be constructed based on the (heterogeneous) data already available in the various communities. Subsequently, this grid will be updated to reflect the scientific progress in modelling stellar structure, stellar atmospheres and spectra. The computation of spectra (and related issues like man power and computing resources) is within the responsibility of the respective object-WP coordinator.

The approach is essentially theoretical, but the nature of the Gaia data necessitates calibration procedures based on observed spectra. This will be done in collaboration with GWP-S-811-20000 ('Provide calibrations of training data', led by Caroline Soubiran). A serious problem in this context is the fact that the photometers have saturation limits around 10^m , such that classical (bright) fundamental and standard stars cannot be used for a direct calibration.

There is an online version of this WP with related information and discussions on the Gaia-Wiki at

http://www.rssd.esa.int/SA-general/Projects/GAIA/wiki/index.php?title=CU8:_GWP-S-811-10000

A related document (the Wiki page of the Extended Stellar Parametrizer) can be found at

http://www.rssd.esa.int/SA-general/Projects/GAIA/wiki/index.php?title=CU8:_GWP-S-835-00000

2 Data formats and naming convention

For the cycle 2 simulations data release (early 2007), data-format standardization is unlikely to be enforced in all aspects (grid spacing, sampling etc.). This is to acknowledge that a majority of the data is already available as grids computed for purposes other than Gaia. However, some standardization will be required to facilitate the data handling. The same applies to a naming scheme for the data files. Details will be communicated in July. Antonella Vallenari will execute subsequent steps (convolution to simulate rotation, simulation of reddening and binarity etc.; see the latest version of GAIA-C8-SP-OAPD-AV-003 on Livelink) with the actual instrument simulation being handled by CU2.

3 Important deadline(s)

Please supply the data you have available/computed for the cycle 2 data release by October 31th at the latest. Details of the submission procedure will be communicated in early October.

4 Work packages within GWP-S-811-10000

The following pages present a standardized account of the work that is foreseen to be done in GWP-S-811-10000. There are three WPs common to all ten (currently identified) object WPs: specifications, stellar physics and grid boundaries. All coordinators are invited to contribute to these common WPs.

5 Notes on individual WPs

GWP-S-811-10010 (see 'Data formats and naming convention' section above)

GWP-S-811-10400 This WP is slightly special in the sense that the main emphasis does not lie on the actual computation of spectra. Rather, efforts are made here to identify the parameter ranges of abundance-anomalous stars. Model atmospheres and spectra will subsequently be computed by the GHOST team.

Gaia DPAC WP:		GWP-S-811-10010
Title: Specifications		
Provider: OP Centre code	Manager: Andreas Korn & Frédéric Thévenin	
Start: 01/01/2006	End: 31/12/2006	Effort: 0.1 MY/year
Objective: Specify data requirements (grid spacing, wavelength coverage, physical units, sampling, BC_G etc.), file format and naming scheme.		
Tasks: <ul style="list-style-type: none"> • set content-related specification • set format-related specifications • decide on a naming scheme 		
Input:		
Output: A list of specifications		
Deliverables: A list of specification all object WPs adhere to.		
Dependencies:		
Interfaces: GWP-S-811-20000 ('Provide calibrations of training data', led by Caroline Soubiran), GWP-S-811-30000 ('Assemble training data grids', led by Antonella Valenari) and CU2 ('Data Simulations').		
Remarks: For DR2 (Nov. 2006), no file format is enforced, as this release mainly collects existing data grids. Fluxes and spectra must, however, be on a (specified) physical flux scale.		

Gaia DPAC WP:		GWP-S-811-10020
Title: Expert Panel on Stellar Physics		
Provider: OP Centre code	Manager: Andreas Korn & Frédéric Thévenin	
Start: 01/01/2006	End: 31/12/2018	Effort: 0.2 MY/year
Objective: Decide whether physics beyond standard models shall be implemented for Gaia's Astrophysical Parametrization.		
Tasks:		
Input: Sophisticated stellar-atmosphere and stellar-structure theory. Examples for possibly relevant effects are diffusion of elements in A-type stars, rotation in B-type stars and the existence of chromospheres among late-type stars.		
Output: Quantitative tests documenting the impact of a given effect on Gaia AP.		
Deliverables: Recommendations as to what physics is to be used in certain parts of the HRD.		
Dependencies: This WP relies heavily on groups or individuals willing to investigate such effects and finding ways of implementing them.		
Interfaces:		
Remarks: All coordinators are invited to take part in this WP.		

Gaia DPAC WP:		GWP-S-811-10030
Title: Expert Panel on Sub-Grid Boundaries		
Provider: OP Centre code	Manager: Andreas Korn & Frédéric Thévenin	
Start: 01/01/2006	End: 31/12/2018	Effort: 0.2 MY/year
Objective: In regions of overlap between grids, assign a certain grid to a certain part of the HRD. Secure continuity between different subgrids.		
Tasks:		
Input: Grids of stellar spectra, observations of fundamental and standard stars.		
Output: Quantitative tests documenting the performance of a grid of spectra.		
Deliverables: Recommendations as to which grid is to be used in a certain part of the HRD.		
Dependencies: Only applicable to regions of the HRD covered by more than one grid.		
Interfaces: Relies on the object WPs supplying overlapping grids, GWP-S-811-20000 ('Provide calibrations of training data', led by Caroline Soubiran) for testing.		
Remarks: All coordinators are invited to take part in this WP.		

Gaia DPAC WP:		GWP-S-811-10100
Title: White Dwarfs		
Provider: OP Centre code	Manager: Uli Heber	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute comprehensive grids of spectra (mostly $T_{\text{eff}} \geq 10\,000\text{ K}$) for Gaia AP via GSP-phot and GSP-spec.		
Tasks:		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, atomic and molecular data.		
Output: model atmospheres, synthetic stellar spectra		
Deliverables: Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010 and GWP-S-811-10020		
Interfaces: This WP is closely related to an SSU in GWP-S-835-00000 ('Extended Stellar Parametrizer').		
Remarks: LTE, NLTE and hybrid LTE/NLTE models of the following people will be used : Dreizler, Heber, Homeier, Jeffery, Koester, Napiwotzki, Przybilla, Rauch, Werner. Contact heber@sternwarte.uni-erlangen.de for further details.		

Gaia DPAC WP:		GWP-S-811-10200
Title: Hot Stars		
Provider: OP Centre code	Manager: J.-C. Bouret (GHOST team)	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
<p>Objective:</p> <p>For stars with effective temperatures greater than 10000 K and which are not white dwarfs, compute a comprehensive grid of spectra for the determination of astrophysical parameters via GSP-phot, GSP-spec or the ESP.</p>		
<p>Tasks:</p> <ol style="list-style-type: none"> 1. Build a grid of spectra for different opacity regimes and for effective temperatures greater than 10000 K and which are not white dwarfs. 2. Define and compute the missing atomic data by comparison of synthetic spectra with observations. 		
<p>Input:</p> <p>Stellar atmosphere theory, observations of standard stars or prototype peculiar stars, atomic data, opacities.</p>		
<p>Output:</p> <p>model atmospheres, synthetic stellar spectra</p>		
<p>Deliverables:</p> <p>Grids of synthetic stellar spectra showing variance in T_{eff}, $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).</p>		
<p>Dependencies:</p> <p>GWP-S-811-10010 and GWP-S-811-10020 and GWP-S-835-10000</p>		
<p>Interfaces:</p> <p>This WP is directly related to ESP Hot Stars GWP-S-835-10000 and GWP-S-811-10400.</p>		

Remarks:

Softwares we are using and that we are presently planning to use are: TLUSTY, CMFGEN, FASTWIND, FASTROT. A first version of the grid will be available for the end of 2006. Computations will be performed in the framework of the GHOST (Gaia HOt Stars Team). A belgian national PRODEX proposal will be introduced to get funding for a PhD in Astrophysics that should put about 0.8 MY/yr on the modeling of hot and emission line stars. Contact jean-claude.bouret@oamp.fr for further details.

Gaia DPAC WP:		GWP-S-811-10300
Title: Emission-Line Stars		
Provider: OP Centre code	Manager: Christophe Martayan (GHOST team)	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute comprehensive grids of spectra for Gaia AP via GSP-phot and GSP-spec.		
Tasks:		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, atomic and molecular data.		
Output: model atmospheres, synthetic stellar spectra		
Deliverables: Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010 and GWP-S-811-10020		
Interfaces: This WP is closely related to ESP Emission-line stars GWP-S-835-50000.		
Remarks: Contact christophe.martayan@obspm.fr for further details.		

Gaia DPAC WP:		GWP-S-811-10400
Title: Abundance-Anomalous Stars		
Provider: OP Centre code	Manager: Vytas Straizys	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
<p>Objective:</p> <p>Provide the ranges of astrophysical parameters for computing model atmospheres and synthetic spectra for abundance-anomalous stars.</p>		
<p>Tasks:</p> <ol style="list-style-type: none"> 1. Compile catalogs of the abundance anomalous stars in the high temperature range (Ap/Bp, Am/Fm, He-strong, He-weak, blue horizontal branch stars) and the cool range (R, N, S, CH and barium stars). 2. Provide the ranges of T_{eff}, $\log g$ and abundances of different elements for each stellar type. 3. Compare synthetic theoretical spectra with spectral energy distributions of real stars. 4. Calculate synthetic color indices and other photometric parameters which are needed for identification and parametrizing of stars with anomalous abundances. 5. Develop classification algorithms for stars with anomalous abundances. 		
<p>Input:</p> <p>Synthetic spectra of model atmospheres and the observed spectral energy distributions of real stars (from the literature and from special observations when the literature data are missing).</p>		
<p>Output:</p> <p>Algorithms for identification and parametrizing of various abundance anomalous stars. Estimation of degeneracies, model atmospheres, synthetic stellar spectra.</p>		

Deliverables:

Reports on the work progress and the final report by the end of 2008 (description of the classification methods and algorithms and recommendations for other WPs).

Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).

Dependencies:

GWP-S-811-10010 and GWP-S-811-10020, catalogues and spectra of such anomalous stars (partially via GWP-S-811-20000).

Interfaces:

This WP is closely related to an SSU in GWP-S-835-00000 ('Extended Stellar Parametrizer').

Remarks:

Contact strazys@itpa.lt for further details.

Gaia DPAC WP:		GWP-S-811-10500
Title: Cool Stars		
Provider: OP Centre code	Manager: Bengt Gustafsson (MARCS team)	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute comprehensive grids of spectra ($T_{\text{eff}} \leq 8000$ K, all gravities, all metallicities) for Gaia AP via GSP-phot and GSP-spec.		
Tasks:		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, atomic and molecular data.		
Output: model atmospheres, synthetic stellar spectra		
Deliverables: Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010 and GWP-S-811-10020. Coordination with GWP-S-811-10800.		
Interfaces: This WP is closely related to ESP Cool Stars GWP-S-835-20000.		
Remarks: Contact bengt.gustafsson@astro.uu.se for further details.		

Gaia DPAC WP:		GWP-S-811-10600
Title: Cool (Chromospherically-Active) Stars		
Provider: OP Centre code	Manager: Alessandro Lanzafame	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute grids of spectra for chromospherically active stars (with effective temperature in the range 2500 – 7500 K) for Gaia AP via GSP-phot and GSP-spec and ESP-Cool Stars.		
Tasks: Generate NLTE synthetic profiles for activity sensitive lines for a grid of activity level and integrate them in the general synthetic spectral library. Explore advanced methods for including chromospheric activity.		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, observations of chromospherically active stars, atomic and molecular data, cool star synthetic spectra		
Output: model atmospheres including chromosphere, cool-star chromospherically active synthetic spectra.		
Deliverables: Grids of NLTE synthetic spectra for chromospherically active stars as a function of T_{eff} , $\log g$, $[M/H]$, and activity level. Subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010, GWP-S-811-10020, GWP-811-10500		
Interfaces: This WP is closely related to ESP Cool Stars GWP-835-20000		
Remarks: Contact alanzafame@oact.inaf.it for further details.		

Gaia DPAC WP:		GWP-S-811-10700
Title: Metal-Poor Cool Stars		
Provider: OP Centre code	Manager: Andreas Korn & Frédéric Thévenin	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute comprehensive grids of spectra for Gaia AP via GSP-phot and GSP-spec.		
Tasks: <ul style="list-style-type: none"> • Develop and implement hydrodynamic model atmospheres with efficient statistical-equilibrium line formation (ALI, Gauss-Seidel) • Test such models using standard and reference stars • construct (small) grids of spectra (initially) covering particularly interesting regions of the HRD, e.g. the metal-poor main-sequence turnoff for age determinations (concerns mainly RVS spectra) 		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, atomic and molecular data.		
Output: model atmospheres, synthetic stellar spectra		
Deliverables: Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, $[M/H]$ (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010 and GWP-S-811-10020		
Interfaces: This WP is closely related to ESP Cool Stars GWP-S-835-20000.		
Remarks: Contact akorn@astro.uu.se or frederic.thevenin@obs-nice.fr for further details.		

Gaia DPAC WP:		GWP-S-811-10800
Title: Carbon Stars and Supergiants		
Provider: OP Centre code	Manager: Bertrand Plez	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute comprehensive grids of spectra ($T_{\text{eff}} \geq 2500$ K, all gravities, all metallicities) for Gaia AP via GSP-phot and GSP-spec.		
Tasks:		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, atomic and molecular data.		
Output: model atmospheres, synthetic stellar spectra		
Deliverables: Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010 and GWP-S-811-10020. Coordination with GWP-S-811-10500.		
Interfaces:		
Remarks: Contact bertrand.plez@graaal.univ-montp2.fr for further details.		

Gaia DPAC WP:		GWP-S-811-10900
Title: Cool and Ultra-Cool Stars		
Provider: OP Centre code	Manager: Peter Hauschildt (PHOENIX team)	
Start: 01/01/2006	End: 31/12/2018	Effort: 1.0 MY/year
Objective: Compute comprehensive grids of spectra ($T_{\text{eff}} \geq 100$ K, all gravities, all metallicities) for Gaia AP via GSP-phot and GSP-spec.		
Tasks:		
Input: Stellar atmosphere theory, observations of fundamental and standard stars, atomic and molecular data.		
Output: model atmospheres, synthetic stellar spectra		
Deliverables: Grids of synthetic stellar spectra showing variance in T_{eff} , $\log g$, [M/H] (and other parameters, if applicable), subsequent updates with a higher level of modelling realism. Bolometric corrections to the G magnitude (BC_G).		
Dependencies: GWP-S-811-10010 and GWP-S-811-10020		
Interfaces: This WP is closely related to ESP Ultra-cool Stars GWP-S-835-30000.		
Remarks: Contact yeti@hs.uni-hamburg.de for further details.		