	EUROPEAN COMMISSION RESEARCH DG HUMAN RESOURCES AND MOBILITY	EXT Periodic Activity Report

Project No.: 14265

Project Acronym: CIFIST

Project Full Name: Cosmological Impact of the First Stars

Marie Curie Actions

EXT Periodic Activity Report

Period covered: from 01/09/2006 **to** 31/08/2007

Period number: 2nd

Start date of project: 01/09/2005

Project coordinator name:
Dr. PIERCARLO BONIFACIO

Project coordinator organisation name:
Observatoire de Paris

Date of preparation: 12/10/2007

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Marie Curie Actions

EXT Periodic Activity Report

GENERAL INFORMATION

Project No.:	14265
Project acronym:	CIFIST
Project full name:	Cosmological Impact of the First Stars
Period number:	2nd
Period covered - start date:	01/09/2006
Period covered - end date:	31/08/2007
Project start date:	01/09/2005
Project duration [months]:	48
Project coordinator name:	Dr. PIERCARLO BONIFACIO
Project coordinator organisation name:	Observatoire de Paris
Date of submission:	18/09/2007

SUMMARY OF THE RECRUITMENT DURING THE REPORTING PERIOD

Contractor: Observatoire de Paris

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	Working time commitment	No. of full-time equivalent months covered by this recruitment during the reporting period
		Country	LFR					
Hans-G. Ludwig	MER (> 10 years)	DE-Germany	No	Male	01/09/2005	31/08/2009	Full Time	48.0
Jonay Gonzalez Hernandez	ESR (<4 years)	ES-Spain	Yes	Male	01/09/2005	31/08/2009	48.0	Full Time
Luca Sbordone	ER (4-10 years)	IT-Italy	No	Male	01/09/2006	31/08/2009	36.0	Full Time
Natalie Behara	ESR (<4 years)	CA-Canada	No	Female	01/09/2006	31/08/2009	36.0	Full Time

GENERAL PROGRESS OF THE PROJECT

Please indicate if the project	a) is, at this stage, being implemented as originally planned

If you answered b) or c) please include a detailed description of the modifications in the report (one page)

Qualitative indicators of progress and success

The milestones for this reporting period are: the mid-term report, the mid-term review and the creation of a web site to host the reports and the publications of the Team. The mid-term report (and associated questionnaires) were delivered on Auguts 28th 2007. The mid-term review took place on October 10th 2007 at Observatoire de Paris, Meudon site, with the presence of the Project Officer Dr. E. Vandeweert. The mid-term review procedure was successfully completed. The Team's web site is operative (http://www.galax.obspm.fr/CIFIST/), it hosts the approved reports, a list of the Team's publications and home pages for all the Team members. In addition the site hosts password restricted pages which have information useful internally, like a calendar with all relevant events and missions/vacations of Team members. Password restricted pages are used also to exchange observational and theoretical data with collaborating scientists. As a service to the community CIFIST is hosting the web pages of the workshop on "NLTE line formation for trace elements", held in Nice in July-August 2007.
The main qualitative indicator of progress and success of the Team is the number of scientific publications produced. In the reporting period 19 papers have been published on refereed papers, 1 more is accepted and in press on Astronomy and Astrophysics. Nine more papers (of which 2 invited talks) have been published in conference proceedings and non-refereed journals. Taking into account also the contribution of the PhD candidate this implies an average production of 3.3 refereed papers/year/person, this is well above typical publication rates in succesful astronomical institutes. As a comparison one can take the Italian Istituto Nazionale di Astrofisica, of which the two most productive observatories (Trieste and Milan) produce 2.5 refereed papers/year/person.

PROJECT ACHIEVEMENTS

Scientific highlights

The Team continued its activities normally, the addition of the two new members was very swift and successful. The two new members were able to contribute positively to the Team's activities right from the beginning. We may distingush four main lines along which the Team achieved concrete results:

1) Observing proposals to secure data to be exploited in the course of the project: we submitted proposals to the European Southern Observatory, the Telescopio Nazionale Galileo, the REM robotic telescope, the Canada France Hawaii Telescope, the Keck telescope, the Subaru telescope and Observatoire de Haute Provence. We were quite succesful , in spite of the high pressure on these facilities, only on CFHT, Keck and Subaru we did not obtain any time.

Approved observing proposals which include CIFIST members as PIs or Co-Is

A) ESO period 79
1. 079.D-0434 Caffau/ Ludwig/ Sbordone/ Spite
   Sulphur abundance in Galactic stars measured by the 1045,nm IR lines
   UT1 8.2m+CRIRES 19h
2. 079.D-0734 Sbordone/ Hill/ Chieffi/ Limongi/ Ludwig/ Spite/ Spite/ Bonifacio
   Magnesium isotopic ratios in low metallicity stars: a probe of the early enrichment scenarios
   UT2 8.2m+UVES 19h
3. 079.B-0837 Marconi/ Bonifacio/ Szeifert/ Sbordone/ Monaco/ Zaggia/ Venn/ Giuffrida
   Mapping the metallicity of stars in the Sgr Dwarf Spheroidal Galaxy: a constraint on the Early Star Formation
   UT2 8.2m + FLAMES 28h
4. 079.D-0021 Monaco/ Bonifacio/ Pancino/ Sbordone
   The lithium content in Omega Centauri
   UT2 8.2m + FLAMES 3nights
5. 079.D-0399 Gonzalez Hernandez/ Bonifacio/ Zaggia
   Probing the diffusion-turbulence theory for lithium in NGC 6397
   UT2 8.2m + FLAMES 15h
6. 079.D-0782 Zaggia/ Bonifacio/ Ludwig/ Cayrel/ Beers
   Searching for Metal Poor Stars in Sloan Fields 2.2m+WFI 2nights

B) TNG AO 15
1. 37. Bonifacio et al. Radial velocity monitoring of r-process-enhanced metal-poor stars
   TNG + SARG 11h
2. 10. Sbordone et al.
   Magnesium isotopic ratios in low metallicity stars: a probe of the early enrichment scenarios
   TNG + SARG 27h

C) REM AO 15
1. Bonifacio et al. Photometric survey of metal-poor stars
   220h REM

D) ESO period 80

1. 080.B-0858 Zaggia/ Caffau/ Bonifacio/ Girardi
   A stellar Halo pencil beam deep spectroscopic survey: probing the nature of true Halo stars
   UT2 8.2m+FLAMES 20h
2. 080.D-0333 Gonzalez Hernandez/ Bonifacio/ Ludwig/ Cayrel/ Behara/ Molaro
   Searching for 6Li in the most metal-poor dwarf of the binary CS 22876--032
   UT2 8.2m+UVES 4n

3. 080.D-0194 Hill/ Beers/ Behara/ Bonifacio/ Cayrel/ Francois/ James/ Spite/ Spite/ Schatz/ Wanajo
Tracking the r-process: a study of metal-poor r-enhanced stars
UT2 8.2m+UVES 4n

D) OHP 2007B

1. Planets around solar twins Bonifacio, Pasquini, Biazzo, Melo, Bedin, Randich,Ludwig
1.93m+SOPHIE 6n
2. Binarity among r-enhanced stars Sbordone, Monaco, Beers, Gomzalez-Hernandez, Bonifacio, Frebel, Carollo
1.93m+SOPHIE 4n

E) TNG AOT 16
1. The chemical composition of the Sagittarius Northern Stream
Monaco, Bonifacio, Bellazzini, Ferraro, Buzzoni, Marconi, Zaggia, Sbordone
TNG+SARG 29h

For a Total of 15 approved proposals,.Even considering only the time obtained at VLT, the amount is impressive: over 21 nights which are worth over 1 million euros. This testifies the hard work and the winning innovative ideas which have been produced by the Team.

2) Search of metal-poor stars. Extremely metal-poor stars, the study of which constitutes the core science of the Team, are very rare and their identification requires dedicated surveys and sophisticated analysis strategies. Our approach of using the Sloan Digital Sky Survey (http://www.sdss.org/) to select candidate metal-poor stars proved to be very successful. In the course of an approved proposal in period 78 at ESO-VLT we obtained high resolution spectra for a sample of 15 stars. Preliminary analysis of the spectra demonstrates that the metalllicity estimates obtained from the SDSS spectra (R~2000) are indeed reliable and all the candidates are indeed of extremely low metallicity. We are currently proposing for ESO period 81 follow-up observations for 4 of these stars which are of particular interest. One carbon star ([Fe/H]=-3.2, [C/Fe]=+2.0, which should be the result of binary mass transfer from a former AGB companion and will allow us to study in detail the nucleosynthesis of the s-process at these extremely low metallicities. The three most metal -poor stars observed in period 78 ([Fe/H]~-3) need further observations to measure their Li abundance. For two of them we already have an upper limit on the Li abundance which is significative and we could be in fact beginning to see the dispersion in Li abundances at very low metallicities which is predicted by some models.

The other project we are pursuing is to select metal-poor candidates photometrically, by supplementing the SDSS broad band photometry with photometry in a narrow band filter centered on the CaII K line. From our theoretical predictions such a technique should allow us to select stars with [Fe/H]< -3.5. Time has been allocated for a pilot project on the ESO/MPI 2.2m telescope and data with the narrow band filter ESO#865 on the Wide Field Imager has been acquired for approximately ten square degrees. The data is in the course of analysis and we shall see if it is possible to calibrate this narrow band photometry with the desired accuracy.

3) Analysis of high resolution spectra. Using spectra available as part of the "First Stars" project legacy, metallicities and Li abundances for a sample of 18 extremely metal poor stars have been published (Bonifacio et al. 2007), another paper on the abundances of other elements is in preparation and will be shortly submitted to A&A. The binary system CS 22876-32, which hosts the two most metal-poor known dwarfs has been analyzed using 1D and 3D model atmospheres, a paper on this will be submitted shortly, the main results have been presented at two international conferences. In collaboration with S. Andriewsky (Odessa Observatory) the NLTE abundances of Na and Al for the whole sample of stars (dwarfs and giants) observed in the "First Stars" programme. The paper on Na is already published (Andriewsky et al. 2007),
while the paper on Al has just been submitted. The spectra of the extremely metal-poor stars extracted from the HK and Hamburg-ESO surveys, observed with UVES at VLT in period 77 and with SARG at TNG in AO13, have been reduced. Stellar parameters, metallcities and Li abundances have been determined and a paper is in preparation, the main results have been presented at an international conference.

4) 3D model atmospheres and synthetic spectra. Thanks to computer cluster acquired by CIFIST and to the computing time granted by the super computing centre CINECA (Italy) 28 new 3D model atmospheres have been computed. More models are being computed, the goal is that by the end of the project a small grid of models, and tools for their exploitation will be made available to the community. These models are now being actively exploited, like in the case of CS 22876-32 or in the systematic study of 3D effects in the Sun and other stars. The elements for which results have already been published are sulphur (Caffau & Ludwig 2007, Caffau et al. 2007) and phosphorous (Caffau et al. 2007). Papers are in preparation on oxygen (two papers, of which one on the centre-to-limb variation in the [OI] lines), Hf, Eu and Th.

The use of 3D models has given a significative contribution to establishing the role of convective line asymmetries in the determination of Li isotopic ratios (Cayrel et al. 2007 A&A in press), a result which is likely to have far-reaching results both on cosmology and on stellar structure and evolution.

Finally there is an on-going work, in collaboration with M. Steffen (Potsdam) and B. Freytag (Lyon) to improve and develop both the model atmosphere code and the line formation code. Ludwig (2007) has developed a novel and innovative mathematical technique for the computation of accurate rotational profiles, using very few angles, as is necessary to do in 3D modelling, to keep low the computational burden.

Teaching and training activities

One of the team members (H.-G Ludwig) is supervising the PhD thesis of a candidate of the Observatoire de Paris (E. Caffau). Four papers on refereed journals, which will constitute part of the thesis have already been published, four more are in advanced stage of preparation and should be submitted before the end of the year.
From October 2005 to December 2005 a student of the Copenhagen University, Niels Bohr Institute (Camilla Juul Hansen) has been hosted by the CIFIST Team, working towards her master thesis under the supervision of P. Bonifacio. The thesis was successfully defended in August 2007 and C.J. Hansen has begun a PhD at the European Southern Observatory. A paper on the work carried out in Paris is in preparation.
From January 2007 to April 2007 a PhD candidate of the Bologna University (Alessio Mucciarelli) was hosted by the CIFIST team, working towards his PhD thesis under the supervision of P. Bonifacio. Several papers based on the work done in Paris are in preparation.

Dissemination of results

All members of the Team have been very active in participating conferences during which they delivered 6 talks, of which 3 invited and 4 posters.
Attended conferences
1. Towards the European ELT, Marseille, 27th Nov 06 - 1st Dec, 2006 (P. Bonifacio, invited talk)
2. The 2007 ESO Instrument Calibration Workshop, Garching, January 23-26, 2007 (P. Bonifacio, invited talk)
3. New Trends in Radiation Hydrodynamics, 9-11 May 2007, Stockholm, Sweden (H.-G. Ludwig, invited talk)
4.Structure formation in the Universe", 27 May - 1 June 2007, Chamonix, France (H.-G. Ludwig, poster)
5. Milky Way Halo - Bonn, 29th May - 2nd June 2007 (J. Gonzalez Hernandez, contributed talk, N. Behara, poster)
6. First Stars III, 16-20 July 2007, Santa Fe, USA (H.-G Ludwig, contributed talk, L. Sbordone, poster, J.Gonzalez Hernandez, poster)
7. 3rd Meeting on Hot Subdwarfs and Related Objects - Bamberg, 23 - 27 July, 2007 (N. Behara, contributed talk)
8. Non LTE line formation for trace elements in stellar atmospheres, 30th Julyt- 4th August, Nice, France(Behara, Bonifacio, Caffau, Gonzalez Hernandez, Ludwig, Sbordone)

ADDITIONAL INFORMATION

Please indicate any additional information, which may be considered useful to assess the work done during the reporting period. The socio-economic aspect of the project may be addressed in this section.

Attachments	
Name	
Date	
Signature	