

Evolution of matter from the interstellar medium to exoplanets with the JWST

Work packages : First Progress report (November 15, 2016)

WP 2 - Preparation of JWST observations

	WP2 : Preparation of JWST observations	Date	People in charge	Deliveries	Progress since mid-2016
1	Improvement of the MIRI observation simulator: - add simulated disk observations with the coronagraph - other improvements necessary for our programs	2016	<u>R. Gastaud</u> , P. Bouchet, A. Coulais, C. Cossou P.-O. Lagage, E. Pantin	Software + upgrade of the user manual	- In progress - Improvement coronagraphy simulator (implementation of various OPD René)
2	Data reduction pipeline (imager): - Providing data reduction algorithms to the STScI - Implement/test the STScI standard pipeline at Paris-Saclay - High level pipelines not implemented by STScI	2016 2017-2019 2016-2017	<u>P. Bouchet</u> , <u>K. Dassis</u> A. Abergel, A. Coulais, D. Dicken, R. Gastaud, P.-O. Lagage, E. Pantin, PhD	Software, Documentation, Test reports Software & documentation	- Done for 2016 (Patrice) - Done for the 2016 version (Alain - Christophe)
3	Exoplanet specifics: 1) MIRI Detector test campaigns at JPL (one per year); Definition, participation, data reduction and interpretation. 2) Specific data pipeline • Member of the STScI WG to specify data pipeline for long observations (mainly exoplanet transit observations) 3) Data challenges: • data reduction, retrieval techniques benchmarking • pipeline Improvement following the data challenge results	2016-2018 2016-2017 2017-2018	<u>D. Dicken</u> , P. Bouchet, A. Coulais, R. Gastaud, P.-O. Lagage +collaboration with JPL and MPIA <u>D. Dicken</u> , P. Bouchet, A. Coulais, R. Gastaud, P.-O. Lagage, M. Ollivier +collab. (STScI and MPIA, SRON...) <u>P.-O. Lagage</u> P. Bouchet, A. Coulais, R. Gastaud, P. Tremblin, E. Pantin, PhD + STScI, MPIA, SRON, ...	Test report Technical note Document with results 1 paper probably in PASP Software and associated documentation	La campagne de tests de 2016 a eu lieu. Réunion à Tucson (du 14 au 18 novembre) pour discuter des résultats et de la suite (Dan, Patrice) Participation in the teleconf of the WG

En plus : organisation de journées JWST à l'IAP (8-10 novembre 2016) pour la préparation de la communauté française à l'exploitation scientifique du JWST (voir le site <https://jwst-2016-2.sciencesconf.org/>)

Implication des les réunions consortium MIRI

Coordination avec la communauté (participation à divers ateliers nationaux et internationaux) pour la préparation de programmes d'observations JWST

WP3 - Modeling & simulations : ISM, PDRs & disks

	WP3 / ISM, PDRs & Disks	Date	People in charge	Deliveries	Progress since mid-2016
1	Dust properties modeling				
	a) Charge distribution	2016-2017	Verstraete, Bocchio, Jones, Ysard	1 paper for a) & b)	Bocchio, Verstraete, Jones, Ysard, submitted to A&A
	b) Size distribution	2016			
	c) aC(:H) equilibrium composition	2017-2019	Dartois, Godard, Jones, Ysard	1 paper (A&A)	Current analysis on the release of photo-produced H ₂ from hydrogenated amorphous carbon (a-C:H) grains and modelled the corresponding diffusion coefficient from temperature-dependent measurements. Martin-Domenech, Dartois, Muñoz-Caro, 2016,
	d) Grain optical properties	2016-2019	Jones, Ysard + collab (Köhler, UK)	2 papers (A&A)	Optical properties computed and incorporated into the THEMIS framework (Jones et al., submitted to A&A). THEMIS web site
	e) DustEM service	2016-2019	Verstraete, Ysard	Updated DustEM tool for the community	Updated data incorporated into DustEM
2	Analysing/ training with pre-JWST data - PDRs - Disks	2016-2019	PDRs PhD, Abergel Disk PhD : Boutercaon, Pantin, Habart, Ysard, Miville-Deschênes Collab. with the lab. experiment team (WP4)	1 paper (A&A) 2 papers (A&A) + Models to be used for task 4	- PDRs : In progress : Modelling of Spitzer + Herschel data using updated dust models (see WP 3.1) - Disks : Analysis of optic adaptative spectroscopics data (VLT/NAOS-CONICA, L band, angular resolution 0.1'') around (pre-)transitional disks. Detection of various carbonaceous dust features (aromatic/aliphatic/diamonds) varying spatially and from source to sources. Modelisation currently in progress.
3	Simulation of JWST observations - PDRs - Disks	2017-2019 2017-2019	ISM PhD, Abergel Disk PhD, Disk postdoc, Habart, Ysard, Pantin	Simulated JWST data	
4	Analysis of JWST observations - PDRs - Disks	2019-2020	ISM PhD, student Abergel Disk postdoc, Pantin, Habart, Ysard Collab. with the lab. experiment team (WP4)	2 papers (A&A) 2 papers (A&A)	

WP3-1 : The optical properties of evolving dust grains (of amorphous carbon and silicate, point b) have been computed and incorporated into the THEMIS framework (Jones et al. 2016). A THEMIS website has also been prepared and is now ready for distribution of the THEMIS grain optical properties (point d) in conjunction with DustEM. At the same time the THEMIS data has been incorporated into the DustEM service and made accessible at <http://www.ias.u-psud.fr/DUSTEM/> (point e).

The charge distribution of THEMIS grains has been studied as well as the associated gas photoelectric heating rate (Bocchio et al 2016). The impact of the size distribution for the charge has also been studied (points a and b).

We studied the release of photo-produced H₂ from hydrogenated amorphous carbon (a-C:H) grains and modelled the corresponding diffusion coefficient from temperature-dependent measurements (point c, Martin-Domenech et al 2016).

- Bocchio, Verstraete, Jones, Ysard, submitted to A&A, *Grain charging and gas heating withi the THEMIS framework*
- Jones, Köhler, Ysard, Bocchio, Verstraete, 2016, submitted to A&A, *The global dust modelling framework THEMIS*
- Martin-Domenech, Dartois, Muñoz-Caro, 2016, *Diffusion of photo-produced H₂ as a function of temperature*

Début de la thèse de T. Bouteron sur les disques (profil nanomatériaux)

Demande de thèse sur les PDRs faite au CNES

WP3 - Modelling & simulations : Exoplanets

	Description	Date	People in charge	Deliveries	Progress since mid-2016
1	Benchmarking of atmospheric exoplanet models	2016	P. Tremblin, P.-O. Lagage + MIRI consortium exoplanet modeling group	1 paper (ApJ)	Draft paper available
2	Simulate the expected effects of composition variations (e.g., C/O ratio) for different scenarii of planet formation in disks, for direct imaging and for the exoplanets transiting	2016-2017	P. Tremblin, P.-O. Lagage + student at UCL	At least 2 papers (ApJ or A&A)	1 paper accepted in ApJ (Marco Rocchetto et al. sur archive)
3	Implement of clouds in the ATMO model	2017-2018	P. Tremblin, postdoc	1 paper (ApJ or A&A)	
4	Development of 3 D models from the dynamico code: Post-processing of 3D models with ATMO to produce 2D maps of the atmosphere transmission spectra, study of simple clouds prescriptions.	2016-2018	S. Fromang, P. Tremblin + postdoc	1 paper (ApJ or A&A)	Familiarization with the code; proposal to GENSI to get computer time.
5	Analysis of the first JWST exoplanet observations in ERS and in GTO	2019	P.O. Lagage, PhD (of WP2), S. Fromang, M. Ollivier, P. Tremblin and international collaborators	At least 1 paper (Nature or Science)	

Texte : demande de thèse faite au CNES

WP4 - Laboratory experiments : Organic Matter

	Description	Date	People in charge	Deliveries	Progress since mid-2016
1	Production of doped analogues - N then O-doped a-C:H by plasma (IAS) - N, then O, S-doped by ion implantation (SIDONIE, CSNSM)	2016-2017	Dartois, Godard, Duprat, Charon (PostDoc)	3 papers (A&A, Icarus or ApJ)	- production of CNO standard for NanoSIMS analyses
2	Analysis of cometary organic matter from the CONCORDIA micrometeorite collection (Raman, EDX, SIMS, etc), Comparison with Rosetta/COSIMA data	2016-2018	Engrand, Duprat, Godard, Dartois, Charon (PostDoc)	2 papers (A&A, Icarus or ApJ)	- STXM-XANES analysis of 2 UCAMMs at the SOLEIL-HERMES beam line - TEM analysis of these 2 UCAMMs at UMET in collaboration with H. Leroux - Search for UCAMMs : identification of 1 new candidate
3	Evolution of physico-chemistry in the ISM - Branching ratios & reaction rates (CnNyHz) with AGAT (ALTO/IPNO). - High- (GANIL, GSI, ...) and low- (SIDONIE, ARAMIS) energy ion irradiation	2016-2018 2016-2017	Chabot, Charon (PostDoc) Dartois, Godard, Duprat, Engrand	4 papers (A&A, Icarus or ApJ) Delivery to the KIDA database	- AGAT Experiment on CnN (Nov. 2016) -
4	Synthesis and preparation of the interpretation of JWST data	2018-2019	Engrand, Dartois, Duprat, Godard, Chabot, Charon (PostDoc) Collab. with the modeling team (WP3)	3 papers (A&A, Icarus or ApJ)	- 1 article accepted by MNRAS as a review article about cometary matter (Engrand et al. 2016)

Texte :

Item1. Production of CNO analogues by plasma for NanoSIMS analyses (isotopic standard)

Item2. The budget will be used from 2017 on. No funding has been required for 2016. Analyses of 2 UCAMM thin sections by STXM-XANES (SOLEIL synchrotron) and transmission electron microscopy (TEM) at UMET Lille. Extraction of micrometeorites from the 2016 filters brought from Antarctica. 1 UCAMM candidate is identified.

Item 3. The experiment on CnN was successfully performed in November 2016. Data reduction is undergoing in the frame of the PhD thesis, under the direction of K.Béroff (ISMO). First BRs would be published in 2017.

The P2IO credits only became available in October 2016. The relocation project of AGAT near Andromede and the associated experimental developments, have been delayed by three months for this "administrative" reason.

Budget execution (45 k€équipement + 5 k€ fct):

10 k€ have been used to construct 2 vacuum chambers with optics systems. 7 k€ euros have been used to improve the process of fabrication of the home made silicon detectors (surface barrier on high resistivity epitaxial silicon layers). 5 k€ have been used for the infrastructure (electrical distribution on the experimental area).

WP4 - Laboratory experiments : Mineral Matter

	Description	Date	People in charge	Deliveries	Progress since mid-2016
1	Sample preparation	Sep 2016-mid 2017	Aléon-Toppani, Djouadi, PhD	Samples ready for analyses	Test (using the FIB) to split a 30 microns grain in 3 slices of different thickness
2	IR spectroscopy - bulk IDPs, meteorite matrix, CAIs - extraterrestrial objects at micron scales	Jan 2017-mid 2018	Aléon-Toppani, PhD, Brunetto, Djouadi	Database of IR signatures (0.4-60 μm) of extraterrestrial materials 2 papers (A&A, GCA or Icarus)	Installation of our new microscope equipped with a FPA detector. First tests on crushed meteorite sample and on CAI FIB slice.
3	Measurements of the porosity of IDPs, and meteorite matrix	June-Dec 2018	Brunetto, Aléon-Toppani	Database of dust porosity 1 Paper (A&A, GCA or Icarus)	
4	Evolution of the primitive extraterrestrial dust under irradiation	mid 2018-mid 2019	Djouadi, Brunetto	1 paper (A&A, GCA or Icarus)	
5	Comparison between laboratory and Spitzer/JWST data	mid 2017- 2020	PhD, Aléon-Toppani, Djouadi, Brunetto Collab. with the WP3 team	4 papers (A&A or Icarus) : GEMS, Olivine/Pyroxene, Irradiation/Evolution, CAIs	

Texte :

Sample preparation:

Different tests have been performed in order to improve the sample preparation of micron grains both for classic IR spectroscopy and for IR tomography.

To be able to perform IR tomography on 30-microns grains, the grains need to be welded on the tip of a very thin needle. Since mid-2016, we have finished to develop the method to weld 30-microns grains to a tungsten needle. In addition, using the FIB, we were able to recover the grain after IR analysis and to slice it in three different slices.

Developpement in IR spectroscopy :

Recently, in collaboration with SMIS-SOLEIL, we have acquired a new FTIR imaging microscope equipped with a 128x128 pixels matrix detector (FPA, Focal Plane Array), which provides simultaneously a large number of spectra on surfaces ranging several centimeters to a few microns. The system also allows to conduct analyzes in 3D. The microscope has been installed during summer 2016. A Ph.D. thesis is in progress on the implementation of this FTIR micro-tomography technique on extraterrestrial materials.