

*Ecole doctorale Astronomie & Astrophysique d'Ile-de-France*  
(ED127)

OBSERVATOIRE DE PARIS (SIEGE DE L'ECOLE DOCTORALE)  
UNIVERSITES PIERRE-ET-MARIE-CURIE (PARIS VI),  
DENIS-DIDEROT (PARIS VII), PARIS SUD XI (ORSAY),  
VERSAILLES-ST QUENTIN

&

PARTENARIATS: ECOLE NORMALE SUPÉRIEURE (ULM)  
ECOLE NATIONALE DES SCIENCES GÉOGRAPHIQUES

DIRECTION DES SCIENCES DE LA MATIERE (CEA)

***Doctoral lectures- Cours Doctoral- 2021***

***for PhD students, post-docs, and all interested***

***Registration required to <<ed127.formations@ias.u-psud.fr>>***

***Distant Galaxies : Observations and models from  $z>7$  up to dark ages***

***Les Galaxies Lointaines : Observations et Modèles de  $z>7$  aux âges sombres***

**Site : Institut d'Astrophysique de Paris (IAP)**

**Dates: May 10-14, 2021**

**Coordinated by \*Observations : Dr François Hammer (Obs.Paris) francois.hammer@obspm.fr**

**\*Modèles : Pr Brigitte Rocca-Volmerange (IAP,Paris) brigitte.rocca@iap.fr**

**Abstract :**

Distant Galaxies at  $z>7$  will be keys to discover the galaxy formation physics, redshifts of formation in relation with cosmology, the reionization of the universe and the environment (DM haloes, clusters,..) to primeval fluctuations, but also clarifying their links with AGN and quasars or starbursts. Already discovered up to  $z>7$ , individual as deep large galaxy surveys will reveal their formation with the perspectives of future telescopes on the far-UV to farIR/submm domains, extended to X-gamma rays as the synchrotron emission. Presently models are limited at  $z=6$  by spectroscopic measurements requiring predictions for  $z>7$ . Numerical simulations, still incompatible and requiring a specific expertise are not presented here.

The present lectures propose clarifying talks, exercises and discussions to help PhD students, postdocs or young researchers for their orientations as to complete their general galaxy backgrounds.

1. General principles on stellar mass growth, evolution of metals and dust, distance effects with basic kinematics.
2. Future observations with the perspectives of JWST, Euclid and e-ELT (sensitivity, spectral and angular resolutions).
3. Models of spectro-photometrical evolution (SED, magnitudes, colors, mass, distance, redshifts, environments).

\*) "*Studying Distant Galaxies: Methods and Analyses*" Hammer et al., <https://arxiv.org/abs/1701.03794> ou <http://www.worldscientific.com/worldscibooks/10.1142/q0016>

\*\*\*) *Code Pégase.3 (Fioc & Rocca-Volmerange 2019, A&A.)* <http://www2.iap.fr/users/fioc/Pegase/Pegase.3/>

**Lundi/Monday, IAP, salle séminaires May 10, 2021**

**9h30-12h30 Morphological classification and basic kinematics for galaxies: the case of distant galaxies.** Morphology and Spatially resolved kinematics: mergers versus rotating disks & Tully-Fisher relation

**Francois Hammer**, Astronome, Observatoire de Paris

Lunch, déjeuner

**14h00-15h15, salle TP 35-37 Presentation and news on PEGASE.3** (Fioc & Rocca-Volmerange, 2019ab) – A spectrochemical model of galaxy evolution with dust. Metal effects on stellar continua, nebular lines. (Python and Fortran95) **Michel Fioc**, IAP, Assistant Prof. , SU.

**15h30 -17h30 TP1: Initiation to the code Pégase.3** Evolution of components santes (gas, stars, metals and grains) with star formation. **Membres group Pégase, IAP**

**Mardi/Tuesday, IAP, salle séminaires May 11, 2021**

**9h30-11h Spectrochemical evolution distributions (SED) and distance effects**

**11h15-12h45 The most distant galaxies at  $z > 7$**

**Brigitte Rocca-Volmerange**, IAP, Pr U. Paris-Saclay émerite,

Lunch, déjeuner

**14h00 -17h30 salle TP 35-37 TP 2 : Building of synthetic SEDs, high-z colors.**

Access to stellar mass **Members group Pegase, IAP**

**Mercredi/Wednesday, IAP salle séminaires May 12, 2021**

**9h15-10h45 DustPedia: galaxies and others codes, A.Jones, IAS, Astronome**

**11h -12h45 Polarized dust foregrounds from Planck2018 (IAP, K. Benabed)**

lunch, déjeuner , free afternoon après-midi libre

**Jeudi/Thursday, IAP, salle séminaires May 13, 2021**

**9h30-12h30 : Large SURVEYS and luminosity/mass functions** (examples : CANDELS, VUDS, 3D-HST) . **F. Hammer, GEPI, Observatoire de Paris**  
déjeuner

**14h00-15h30 ALMA\_MUSE\_HUFD. H2 and molecular bands, P. Oesch, U.Genève:**

**15h45-16h45 ALMA- [CII] & warm dust continuum in a  $z=8.31$ LBG, T. Bakx**

**16h45-17h45 Reionization of the Universe from MUSE, R. Bacon, Obs. Lyon**

**Vendredi/Friday, IAP, May 14, 2021**

**9h30- 11h salle TP 35-37 TP3 Star mass and CII,OIII lines EW from Pegase.3 at all z:**

**11h15-12h45: Finalisation of TPs, Member Group Pegase**

déjeuner

**Salle séminaires,**

**14h00-15h00, Turbulence-regulated star formation, Pierre Guillard, IAP, Assit.Pr.SU**

**15h00 -16h00 The role of strong DLA, Pasquier Noterdaeme, IAP, astronome**

**16h15-17h15 Gamma-ray-Bursts at high  $z$  , Frédéric Daigne, IAP, Professor SU**

**17h15-17h45 Discussion and conclusion**