EXOZODI Project
ANR Programme Blanc 2010

Project coordinator : J.-C. Augereau (IPAG)

Overview

- **Two partners:**
  - IPAG, scientific coordinator: J.-C. Augereau
  - LESIA, scientific coordinator: P. Thébault
- **Duration: 4 years :** Dec. 20, 2010 – Dec. 19, 2014
- **Budget: 430 kEuros**
  - 3 two-year post-doc positions + 6 month short term contract. About ~ 3/4 of the overall project budget
  - Modest contribution to near-IR interferometric instruments
  - Missions
- Web page:
  http://www-laog.obs.ujf-grenoble.fr/~augereau/Site/ANR_EXOZODI.html

Overview

	Budget	Permanent staff (persons.months)	Non-permanent staff (persons.months)	Overall Cost of the Project
IPAG	~ 257 kEuros	74.5	60	~1.2 Meuros
LESIA	~ 173 kEuros	72.8	56.5	~1.1 Meuros

IPAG

J.-C. Augereau
H. Beust
J.-B. Lebouqin
J. Lebreton
B. Lazareff
G. Zins
2 Post-Docs

LESIA

P. Thébaut
V. Coudé du Foresto
B. Mollier
3 IRs
2 IEs
1 Post-Doc
1 CCD

External Collaborators

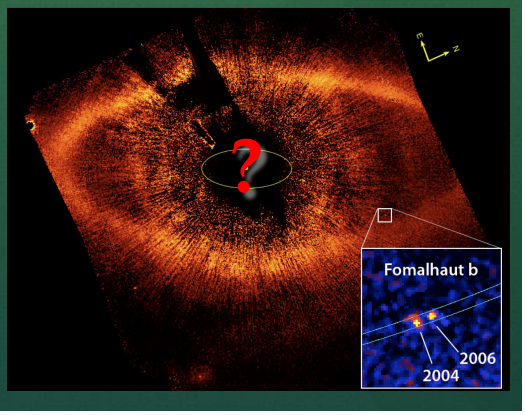
O. Absil (Liège)
D. Defrère (Bonn)
A. Brandeker (Stockholm)
S. Charnoz (CEA/Saclay)
M. Kama (Amsterdam)
R. Reche (Probayes)
E. DiFolco (CEA/Saclay)
J. Olofsson (Heidelberg)
J.-P. Berger (ESO)

Zodiacal dust in the Solar System

- Within ~2 AU, the **inner solar system is filled with dust** near the ecliptic plane
- Origin: **tails of comets** or when **asteroids collide**.
- It's **not a smooth cloud**:
  - Dust bands: asteroids families?
  - Dust trails: short period comets?
  - Resonant ring caused by the Earth

Zodiacal dust in the Solar System

- **Tiny total mass** :
  equivalent to a medium-sized asteroid (~ 10^{-8} M_{Earth})
- But in the form of small grains,
  it is the **most luminous circumsolar component**,
  although it has a low vertical
  optical thickness (~ 10^{-7} @ 1AU)
- Potential noise source for future
  Earth-like finding missions
- Motivated several studies
  to search for exozodiacal,
  debris disks around nearby stars



Scientific objectives

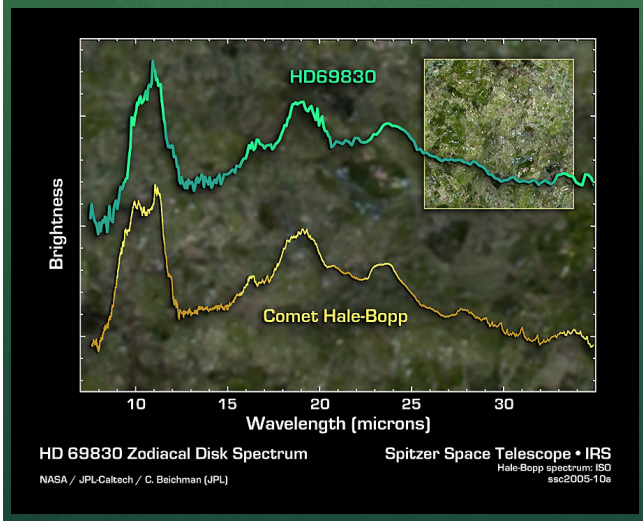
- **Exo-zodiacal dust disks:**
  Dust clouds in and around the
  habitable zone of stars
  = warm/hot debris disks

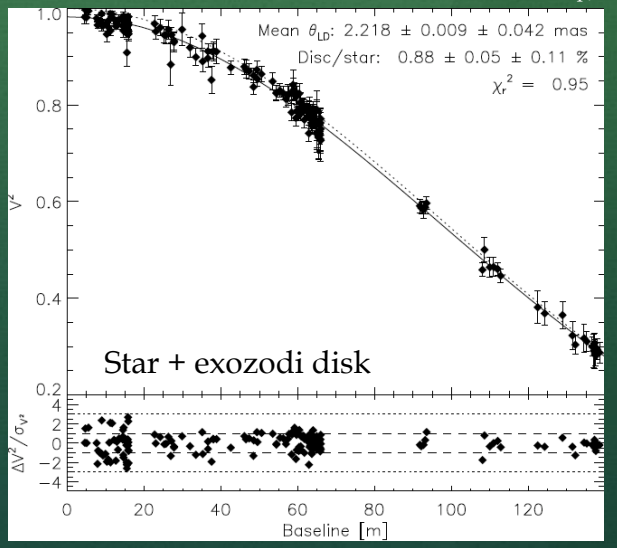
- **Goal of the EXOZODI project:**
  detecting and understanding the
  origin of
  exozodiacal dust

Scientific objectives

- Two detection techniques

Fomalhaut, Absil et al. 2009, ApJ





Scientific objectives

- Near-IR Interferometric Observations:
  - survey of ~100 stars, the first of that size
  - Northern hemisphere: FLUOR/CHARA
  - Southern hemisphere: PIONIER/VLTI

- Modeling:
  - radiative transfer,
  - collisions,
  - classical N-body simulations,
  - cometary evaporation

- New numerical codes:
  - development of the next generation of model able to handle both the collisions and the dynamics
  - gas generation due to high-velocity collisions

5 Tasks

COORDINATORS
- V. Coudé du Foresto [LESIA]
- J.-B. Lebouquin [LAOG]

PARTNERS
- LAOG : PIONIER instrument team
- LESIA: FLUOR instrument team+ RI#1

EXTERNAL COLLABORATORS
- J.-P. Berger [ESO/ LAOG]

- Task 1: Instrumentation
  - Implementation of a new camera on FLUOR at the CHARA array
    - Better sensitivity and gain in statistical precision
    - 6 month short-term contract for on-site integration, testing and commissioning of the camera (at Mt Wilson)
  - Extension of the PIONIER capability to the K-band
    - Get the H-K color of exozodis, and validate some of the CHARA detections with an different instrument

5 Tasks

COORDINATORS
- V. Coudé du Foresto [LESIA]
- O. Absil [Liège]

PARTNERS
- LAOG: J.-B. Lebouquin and POST-DOC #1
- LESIA: B. Mollier

EXTERNAL COLLABORATORS
- J.-P. Berger [ESO/ LAOG]

- Task 2: observing program
  - Magnitude-limited sample:

	# MS (K < 4)	# MS w. debris (K < 4)	# MS (K < 5)	# MS w. debris (K < 5)
All	303	45	1158	103
North	156	16	536	42
South	147	29	622	61
-10° < dec < +20°	73	8	256	21

  - Goal: 100 stars observed.
    ~ 40 nights at FLUOR-CHARA, ~ 20 nights at PIONIER-VLTI
  - Data reduction:
    Post-Doc #1, supervised by JB Lebouquin

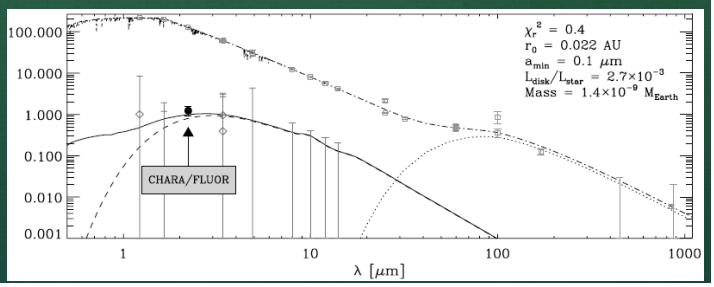
5 Tasks

Coordinators
- J.-C Augereau [LAOG]

Partners
- LAOG: J.-C. Augereau, and J. Lebreton

External Collaborators
- M. Kama [Amsterdam]
- J. Olofsson [MPIA]

- Task 3: SED modeling and synthetic observations
  - Making the connection between observations and dynamical models. GRaTer code
    - Improvement of the grain sublimation prescription
    - Improvement of the collision timescale calculation, and better estimates of dM/dt
    - Making GRaTer compatible with dynamical models
  - Expertise already available



5 Tasks

Coordinators
- P. Thébault [LESIA]
- H. Beust [LAOG]

Partners
- LAOG: J.-C. Augereau, and Post-Doc #2
- LESIA: Post-Doc #3

External Collaborators
- A. Brandeker & R. Nilsson [Stockholm]

- Task 4: numerical simulations
  - Natural collisional evolution of asteroid belts
    - Code by P. Thébault & JC Augereau 2007
    - Update, i.p. to include grain evaporation by collisions
  - Stochastic events, such as the Late Heavy Bombardment (LHB)
    - Planet Migration
    - N-body codes
    - Comet evaporation
  - Post-Doc #2, supervised by JCA + H. Beust

5 Tasks

Coordinator
- P. Thébault [LESIA]

Partners
- LAOG: J.-C. Augereau, H. Beust, Post-Doc #2
- LESIA: Post-Doc #3

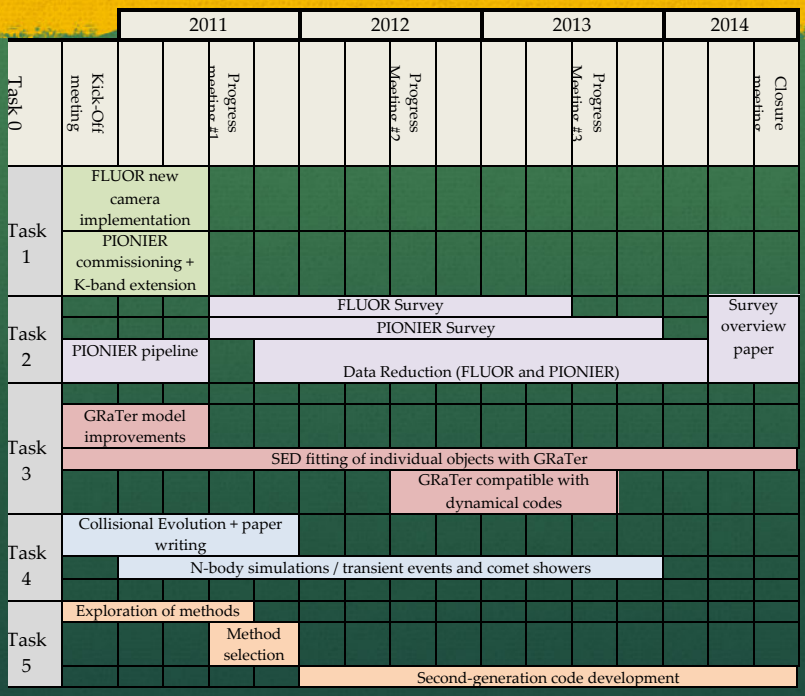
External Collaborators
- R. Reche [Probayes company, Grenoble]

- Task 5: 2nd generation of numerical models
  - Holy Grail
    - Development of a N-body code with collisions
    - Interest goes beyond exozodis: debris disks in general
    - Several options to be explored
  - Post-Doc #3, supervised by P. Thébault

Origin of Exozodis

- Detailed studies of individual systems [Tasks 3, 4 & 5]
  - SED modeling [Task 3]
    - Archival Data [Task 3]
    - Near-IR Inteferometric Survey [Task 2]
      - FLUOR Observations [Task 2]
        - FLUOR: camera implementation [Task 1]
      - PIONIER Observations [Taks 2]
        - PIONIER K-band extension [Task1]
  - Collisional Evolution of Asteroid Belts [Task 4]
    - Update of Thébault & Augereau (2007) code [Task 4]
  - Comet shower [Task 4]
    - Investigation of transient events for individual systems (Nice-like models) [Task 4]
  - Development of 2nd generation models [Task 5]
    - Identification of the best approach [Task 5]
      - Investigation of various options (see text) [Task 5]

Planning ot the tasks



Diner Tonight !

- Bouchon Montagnard,
  3 rue génissieu, Grenoble
  Tél.:04 76 27 53 50
  http://le-bm.fr/
- Who is coming ?