

# AMHRA and MP3C VO services at OCA

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# AMHRA

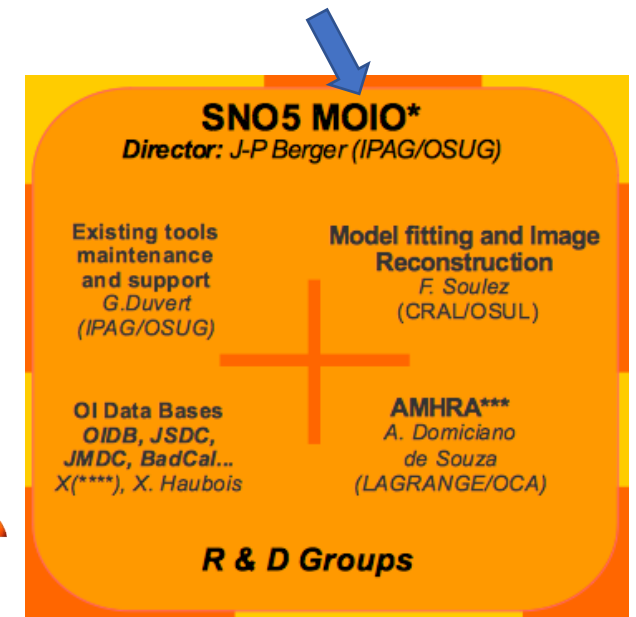
Analysis and Modeling at High Angular Resolution

<https://amhra.oca.eu/>

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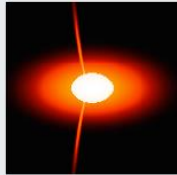
Methods and Tools for Optical Interferometry



**JMMC**

# 1. "Library" of star models

## Real time astrophysical models



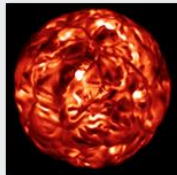
### Kinematic Be disk

Model of the geometry (size and shape) and kinematics (rotation and expansion) of circumstellar, flat, rotating disks, relevant to Be stars. It is suited to interpret spectro-interferometric data obtained on emission lines formed in the disk.



### Disk and stellar continuum – DISCO

Model of the continuum emission from a star surrounded by a gaseous circumstellar disk (free-free and bound-free), with partially ionized and geometrically thin disk with a physical structure given by the viscous Keplerian accretion disk model. DISCO is well suited to model Be stars.



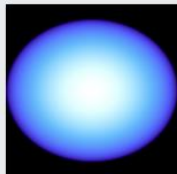
### Evolved stars (RSG, AGB)

Stellar surface maps of evolved stars (RSG and AGB) computed from a 3d hydrodynamical simulation with CO5BOLD-OPTIM3D. The available model corresponds to a star similar to the famous RSG Betelgeuse.



### Binary spiral model

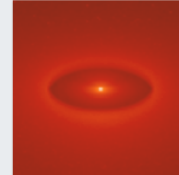
Phenomenological model mimicking the shock caused by the collision between the winds from massive stars (e.g. WR and OB stars) and that results in dusty spirals.



### Analytical Limb-darkening Elliptical or Spherical – ALDES

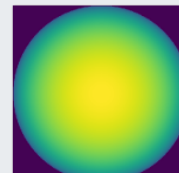
ALDES provides intensity maps (images) or 1d intensity profiles for spherical or elliptical stars showing the limb darkening (LD) effect. Different LD laws are offered: uniform disk, linear, power law, quadratic, square root, logarithmic and four-parameter.

## Precalculated grids of astrophysical models



### Supergiant B[e] with HDUST

Grid of models for B[e] supergiant stars computed with the 3d Monte Carlo radiative transfer code HDUST. The non-spherical circumstellar envelope (CSE), composed of gas (hydrogen) and dust (silicate), is modelled considering a bimodal outflow description (two-component wind).



### Limb-darkening with SATLAS

Grid of models providing intensity maps for spherically symmetric stars, showing the limb darkening effect. The models were computed with the SATLAS model stellar atmospheres for several spectral bands. Data is provided for FGK dwarfs and red giants.

- Fast models: on-the-fly calculation of .fits images and associated data
- Slower models: images retrieved from a precalculated grid

# Example: Analytical Limb-darkening Elliptical or Spherical (ALDES)

## 🕒 Analytical Limb-darkening Elliptical or Spherical – ALDES

### Description

ALDES provides intensity maps (images) or 1d intensity profiles for spherical or elliptical stars showing the limb darkening (LD) effect. Different LD laws are offered: uniform disk, linear, power law, quadratic, square root, logarithmic and four-parameter. The coefficients for each LD law should be provided by the user. If necessary, in the "Documentation and acknowledgments" there are some useful references providing several values of LD coefficients for different LD laws, stellar types, and spectral domains. The analytical forms of the LD laws are also given.

### Stellar apparent shape and size

Model type: Spherical

Angular diameter: 0.0 mas

### Limb-darkening law

Limb-darkening law: Four-parameter

$$\frac{I(\mu)}{I(\mu=1)} = 1 - a(1 - \mu) - b(1 - \sqrt{\mu}) - c(1 - \mu^{1.5}) - d(1 - \mu^2)$$

a: 0.0

b: 0.0

c: 0.0

d: 0.0

### Output options

Compute 1d profile: ☐

Compute 2d profile: ☐

Create PDF: ☐

Send data

Reset

## Status

Your request terminated with the following status: Success

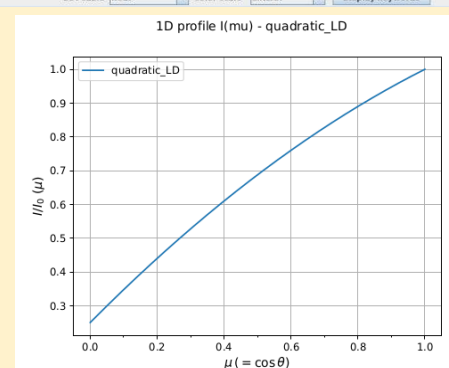
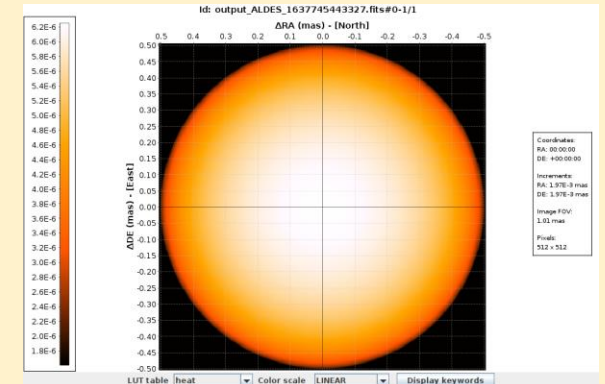
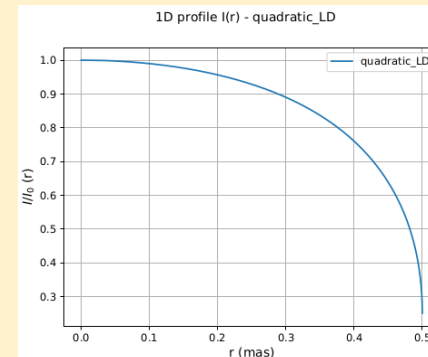
Download result

VO tools

Download corresponding input file



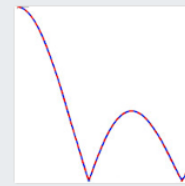
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output\_ALDES\_1637745443327\_r.pdf  
output\_ALDES\_1637745443327\_mu.txt  
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output\_ALDES\_1637745443327.pdf  
output\_ALDES\_1637745443327.fits



## 2. Analysis tools: Comparing models and observations

- Model comparison with observations by comparing with measured observables.
  - Interface to another software from JMMC: ASPRO2
- To come: Model fitting

### Analysis and model fitting tools



#### OIFits modeler

This tool compares real interferometric observations to observables (squared visibilities, closure phases...) calculated by ASPRO routines from a user-provided image (intensity map). Images from AMHRA models or other user-provided images can be used.

# Data origin and delivery

- Calculated on-the-fly or precalculated at OCA
  - Single parent source: the research by the authors' model
- Uses source codes coming from published research by various authors
  - Sometimes with minor adjustments done by us
- Users keep the files corresponding to their requests
  - .fits, .txt, PDF, all can be delivered as a zip
  - Obtained by direct download or sent with SAMP to other VO tools
  - Should contain references to original research and AMHRA
- Possible future: API to launch models

# MP3C: Minor Planet Physical Property Catalogue

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## Motivation

- Increasing numbers of known asteroids and of their physical properties measurements
  - Sizes, masses, albedos...
  - Several big surveys: WISE (NASA), Gaia...
- No service collected, analysed and synthesized the physical properties

MPC, JPL, Ast/Neo-Dys: dynamical properties

# Data science goals

- Aggregates and minimal processing of known data for asteroids. For each asteroid:
  - Names, orbital parameters, physical properties** (masses, diameters, albedos, etc.; multiple measurements for each body), family, spectral classes, and estimated best values for these parameters (weighted averages).
- Uses (via classical html/web portal):
  - Search all known data** for a body and find associated bibliography.
  - Find bodies satisfying criteria** on their best values (e.g. *"search all bodies with best mass > X and best albedo > 0.5"*)
  - Make **statistical analyses and plots** using filters on best values (e.g. *"plot best diameter vs semi-major axis for all bodies with best mass > X"*)
  - Make statistical analyses on specific properties tables (e.g. *"search all known mass measurements (may return multiple measurements for a same body)"*)

## Ceres

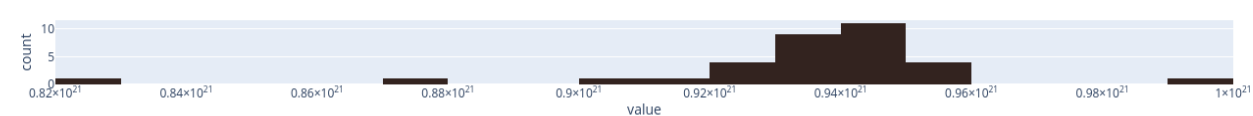
00001, 1801AA, 1899OF, 1943XB, I01A00A, I99O00F, J43X00B

All data for this body: [\[vot\]](#)

### MPC data

Name (number)	Ceres (1)	Number of observations	7283
Packed designation	00001	Number of oppositions	120
a	2.76609	Years observed	1801-2021
e	0.07817	rms	0.51

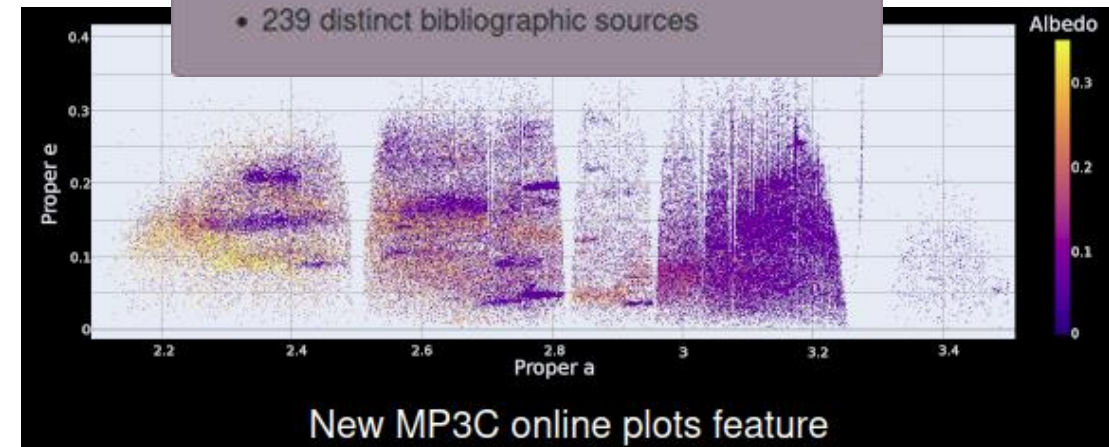
### Mass data



Value	↑↓	Uncertainty up	↑↓	Uncertainty down	↑↓	Author	↑↓	Reference	↑↓	Method	↑↓
8.2700e+20		3.7800e+19		3.7800e+19		Kuzmanoski		1996IAUS...172..207K		Deflec	
8.7300e+20		7.9600e+18		7.9600e+18		Hilton		1999DDA....30..1102H		Deflec	
9.0900e+20		1.4000e+19		1.4000e+19		Kovacevic		2012MNRAS.419.2725K		Deflec	

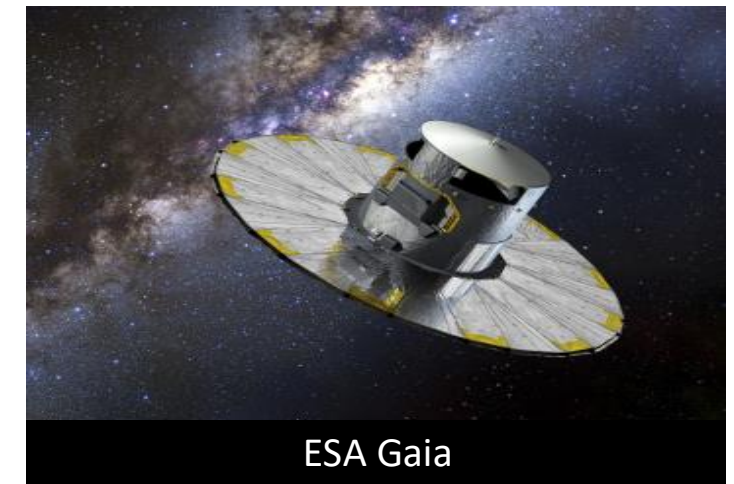
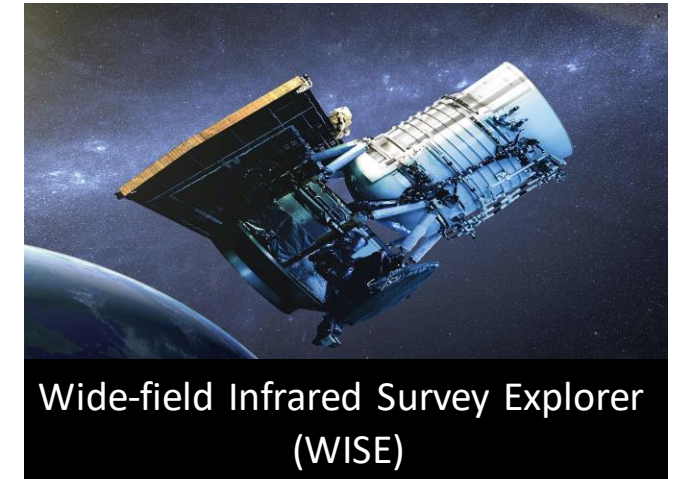
## The MP3C catalogue

- Version: [3.0.0-beta.10 \(2021-11-16\)](#)
- 1,079,231 minor bodies
- 3,363,964 measured properties
- 239 distinct bibliographic sources

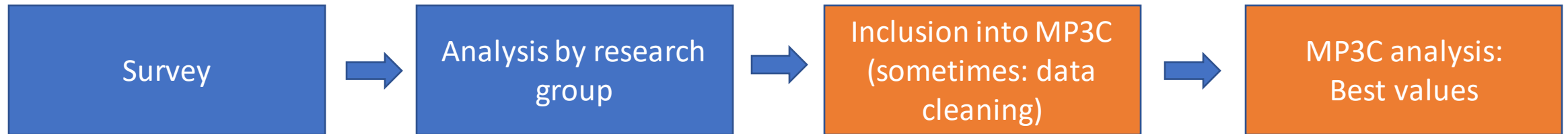




# Data origin



# Common data processing



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## MAIN BELT ASTEROIDS WITH WISE/NEOWISE. I. PRELIMINARY ALBEDOS AND DIAMETERS

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## ABSTRACT

We present initial results from the *Wide-field Infrared Survey Explorer* (WISE), a four-band all-sky thermal infrared survey that produces data well suited for measuring the physical properties of asteroids, and the NEOWISE enhancement to the WISE mission allowing for detailed study of solar system objects. Using a NEATM thermal model fitting routine, we compute diameters for over 100,000 Main Belt asteroids from their IR thermal flux, with errors better than 10%. [...]



In this case, article data products are on VizieR:

<https://cdsarc.cds.unistra.fr/viz-bin/cat/J/ApJ/741/68>

But sources can be very different!