AMHRA
(ANALYSE ET MODÉLISATION EN HRA)
MOIO/JMMC

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(OCA-Lagrange)

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AG du JMMC – 4 décembre 2020

- Présentation de AMHRA
- Nouvelle page web
- Statistiques d’utilisation
- Prospective

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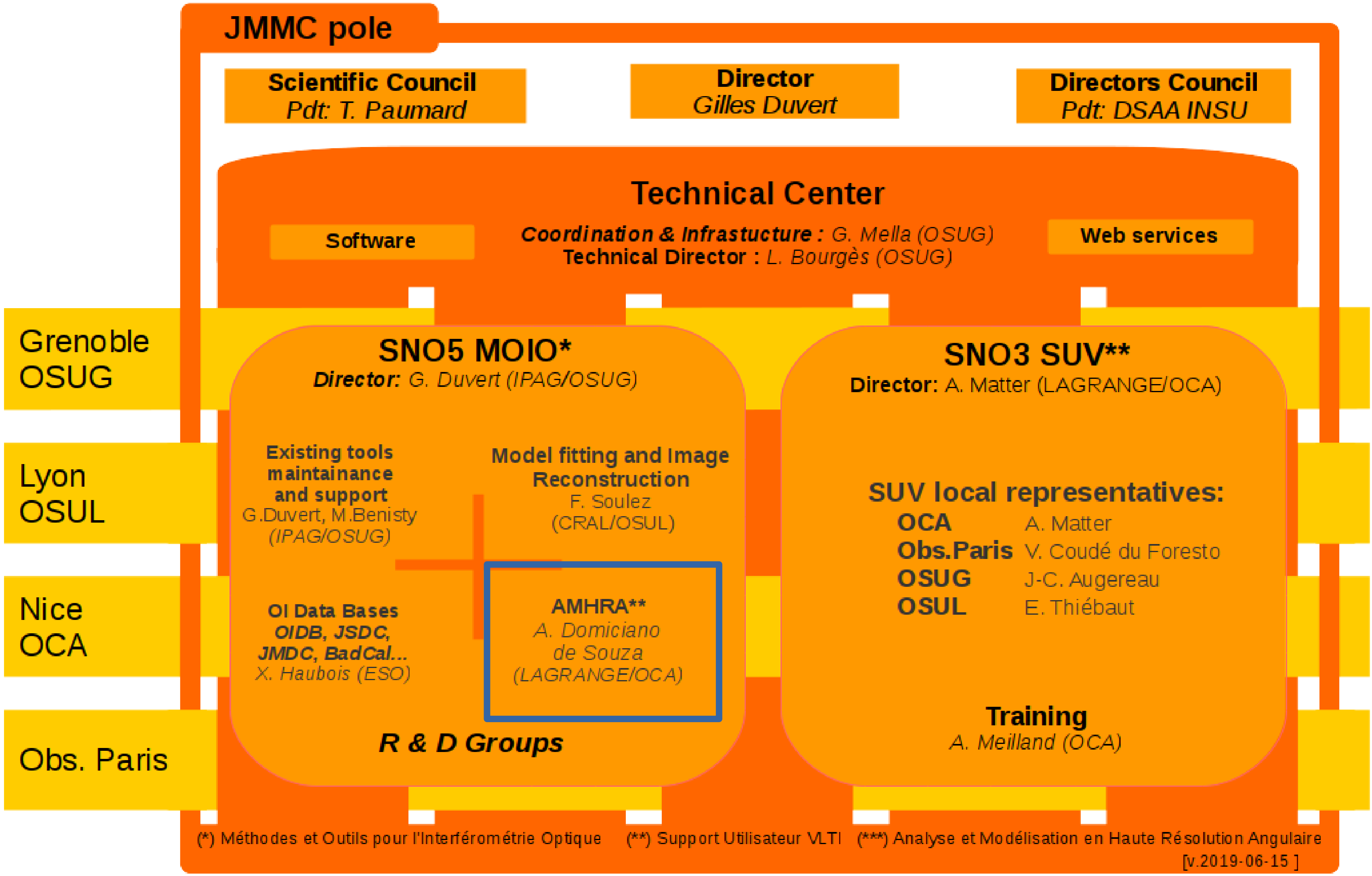
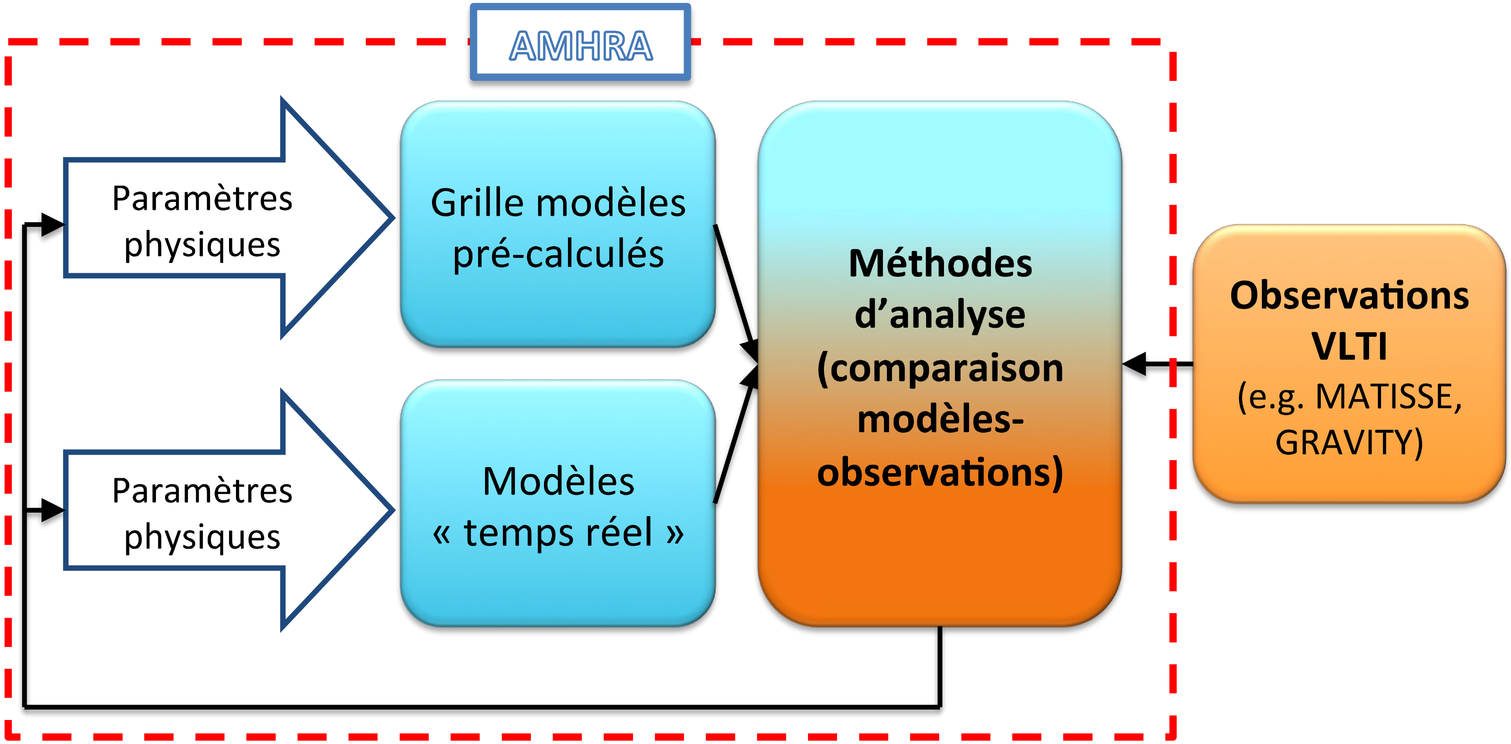
AMHRA dans ANO5 MOIO - PTN JMMC



AMHRA (ANO5 MOIO - PTN JMMC)

AMHRA : Analyse et Modélisation en HRA



Objectif d'AMHRA :

… to develop and/or provide astrophysical models and data analysis tools dedicated to the scientific exploitation of high angular and high spectral facilities (in particular ESO-VLTI instruments) by the astronomical community, including non-specialists in interferometry.

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Nouvelle page web AMHRA (version 1.3.0 ; déc/2020)

<u>Nicolas BRUOT</u>

CDD (depuis le 1er octobre) dans le cadre du CER DOMINO.

1/3 temps sur AMHRA

Amélioration pages AMHRA :

- layout
- aides
- documentation

AMHRA

Analysis and Modeling at High Angular Resolution

Principal investigator: Armando Domiciano

AMHRA develops and provides online astrophysical models and data analysis tools dedicated to the scientific exploitation of high angular and high spectral facilities such as ESO-VLTI. It is aimed at users seeking to prepare, model, and analyze interferometric observations, notably those from the second generation of VLTI instruments, GRAVITY and MATISSE, with unprecedented capabilities on high spectral and spatial resolution.

© ESO

AMHRA provides:

- Polychromatic images from astrophysical models with fast computation time (real time models)
- Polychromatic images from a precalculated grid of astrophysical models
- Spectro-interferometric observables from model images (OIFits modeler)
- Analysis and model-fitting tools for spectro-interferometry

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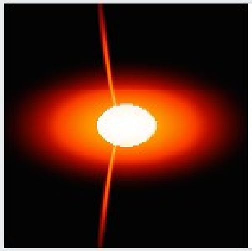
This service was initially published under the name “Analyse et Modélisation en Haute Résolution Angulaire”.

AMHRA is a working group of MOIO/JMMC and is supported by the Observatoire de la Côte d'Azur (OCA) through the DOMINO expertise center.

https://amhra.oca.eu/AMHRA/index.htm

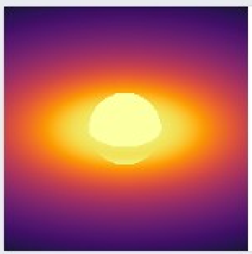
Nouvelle page web AMHRA (version 1.2.0 ; déc/2020)

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 decretion 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.

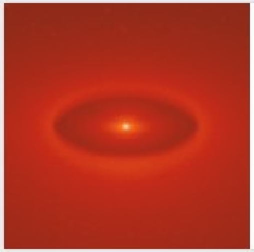
Binary spiral model

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.

https://amhra.oca.eu/AMHRA/index.htm

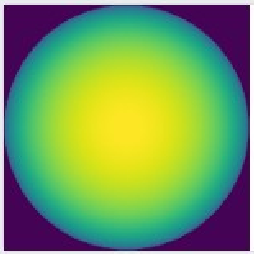
Nouvelle page web AMHRA (version 1.2.0 ; déc/2020)

Precalculated grids of astrophysical models



Supergiant B[e] with HDUST

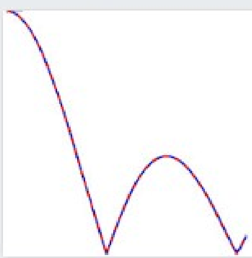
Grid of models for B[e] supergiant stars computed with the 3d Monte Carlo radiative transfer code HDUST. The non-spherical circumstellar envelope (CSE), composed of gas (hydrogen) and dust (silicate), is modelled considering a bimodal outflow description (two-component wind).



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.

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.

https://amhra.oca.eu/AMHRA/index.htm

Nouvelle page web AMHRA: aide et documentation

Description

Model of the continuum emission from a star surrounded by a gaseous circumstellar disk (free-free and bound-free). The disk is assumed to be partially ionized and geometrically thin, with a physical structure given by the viscous Keplerian decretion disk model and depending on physical input parameters (e.g. temperature, density). Images include contributions from the stellar photosphere and from the free-free and bound-free disk emission. DISCO is well suited to model Be stars, but can also be used to model other objects with similar physical components.

Documentation and acknowledgments

The DISCO model was created by A. Domiciano de Souza based on the work of Rodrigo G. Vieira.

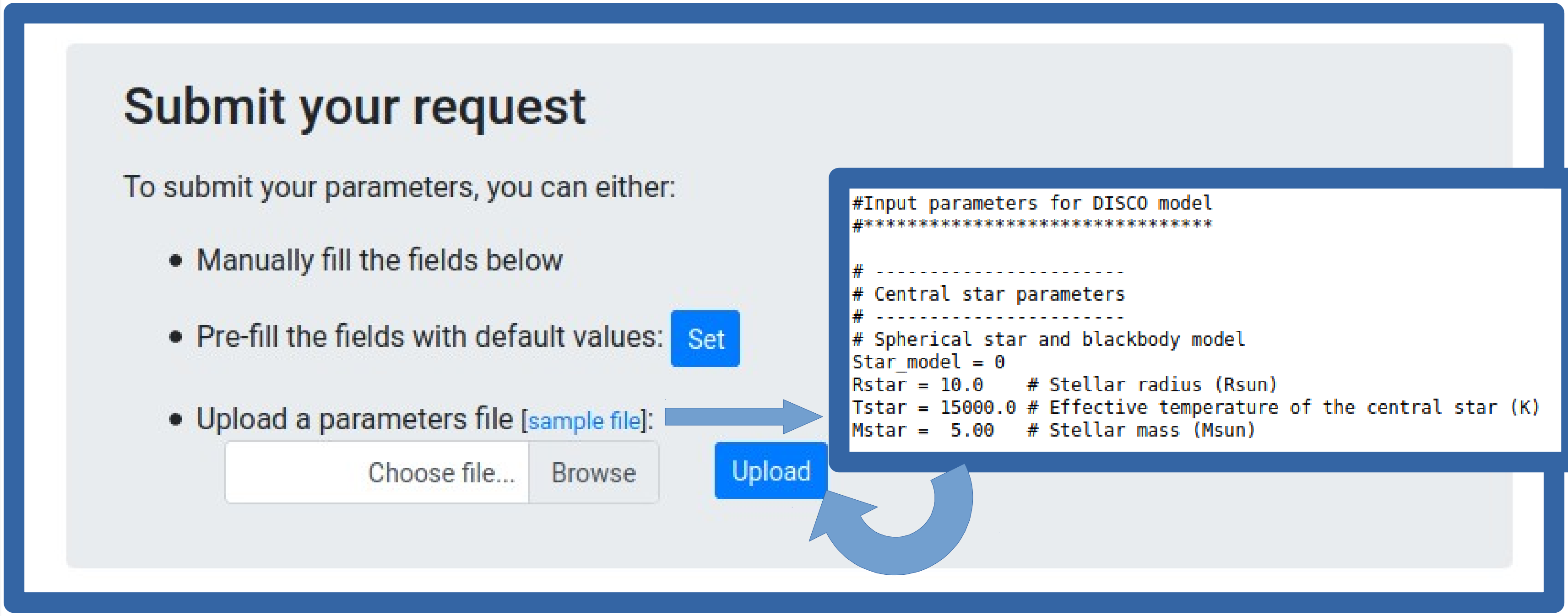
It is described in the following articles:

- **The pseudo-photosphere model for the continuum emission of gaseous disks**
  R. G. Vieira, A. C. Carciofi and J. E. Bjorkman
  MNRAS **454**, 2107-2119 (2015)
  DOI | ads
- **Non-isothermal effects on Be disks**
  R. G. Vieira, A. C. Carciofi and J. E. Bjorkman
  ASPC **506**, 135-142 (2016)
  arXiv | ads

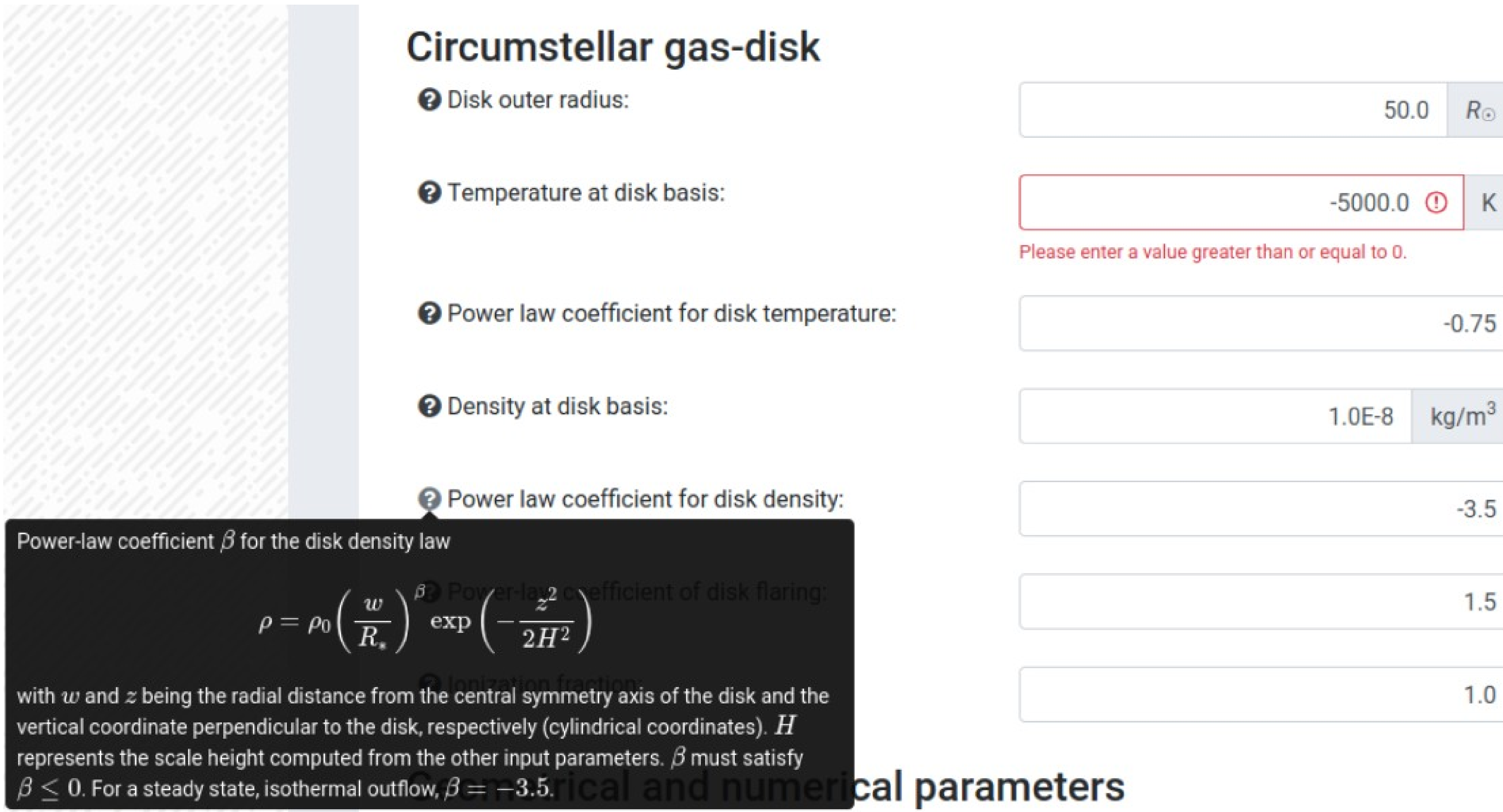
AMHRA's DISCO service can be acknowledged by:

- Mentioning “This research has made use of the Jean-Marie Mariotti Center (JMMC) — MOIO AMHRA service at https://amhra.oca.eu/.”
- And citing the two articles above.

Nouvelle page web AMHRA: fichiers de paramètres



Nouvelle page web AMHRA:
validation à la volée & aide paramètres (avec équations)



Circumstellar gas-disk

Disk outer radius:	50.0	$R_\odot$
Temperature at disk basis:	-5000.0	K
	Please enter a value greater than or equal to 0.	
Power law coefficient for disk temperature:	-0.75	
Density at disk basis:	1.0E-8	kg/m^3
Power law coefficient for disk density:	-3.5	
Power-law coefficient of disk flaring:	1.5	
Ionization fraction:	1.0	

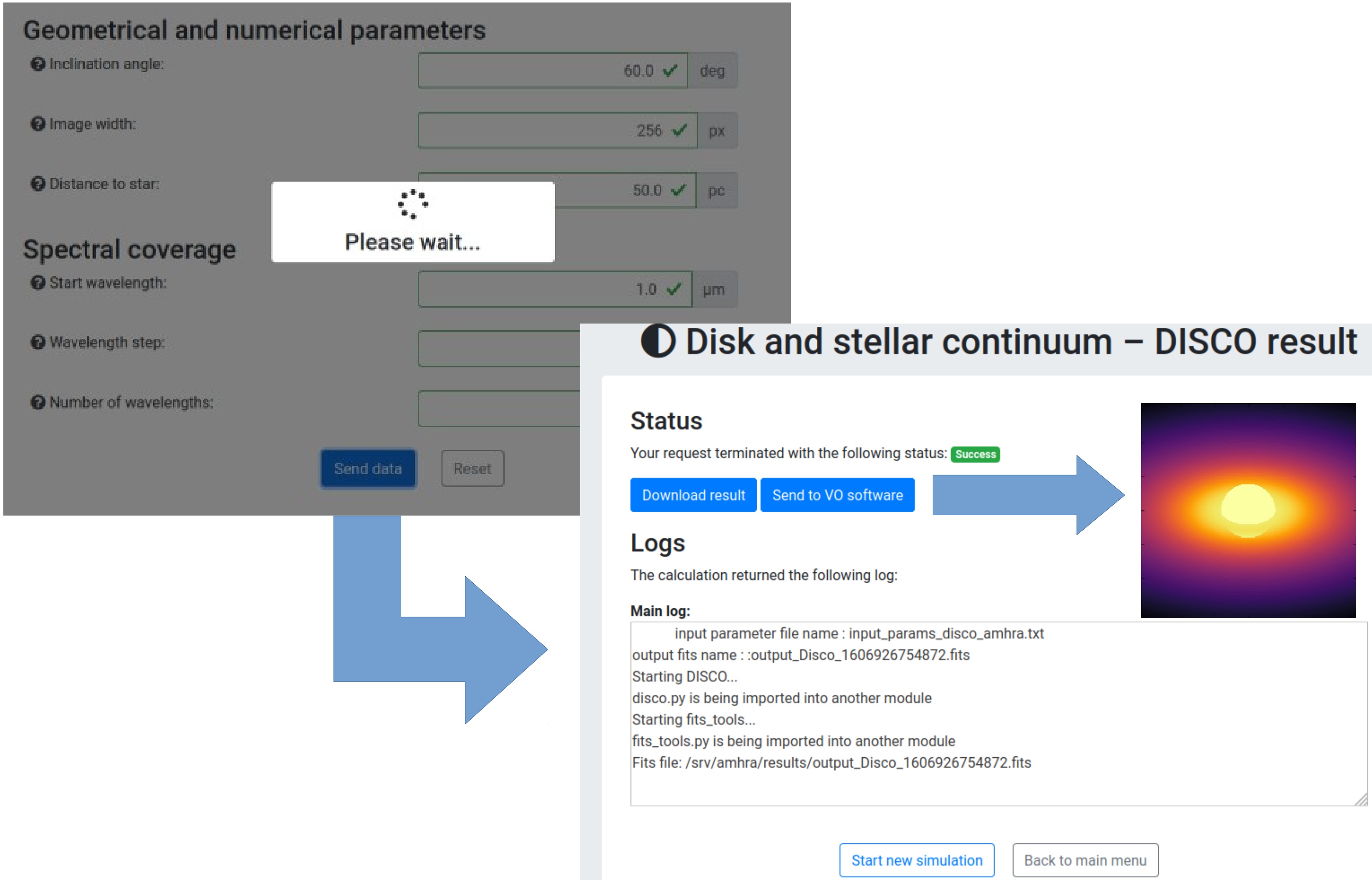
Power-law coefficient β for the disk density law

$$\rho = \rho_0 \left(\frac{w}{R_*}\right)^{\beta} \exp\left(-\frac{z^2}{2H^2}\right)$$

with w and z being the radial distance from the central symmetry axis of the disk and the vertical coordinate perpendicular to the disk, respectively (cylindrical coordinates). H represents the scale height computed from the other input parameters. β must satisfy $\beta \leq 0$. For a steady state, isothermal outflow, $\beta = -3.5$.

Geometrical and numerical parameters

Nouvelle page web AMHRA:
Calcul modèle et output (téléchargement résultats)



Nouvelle page web AMHRA:
Meilleure organisation des modèles en interne

- Homogénéisation entre modèles

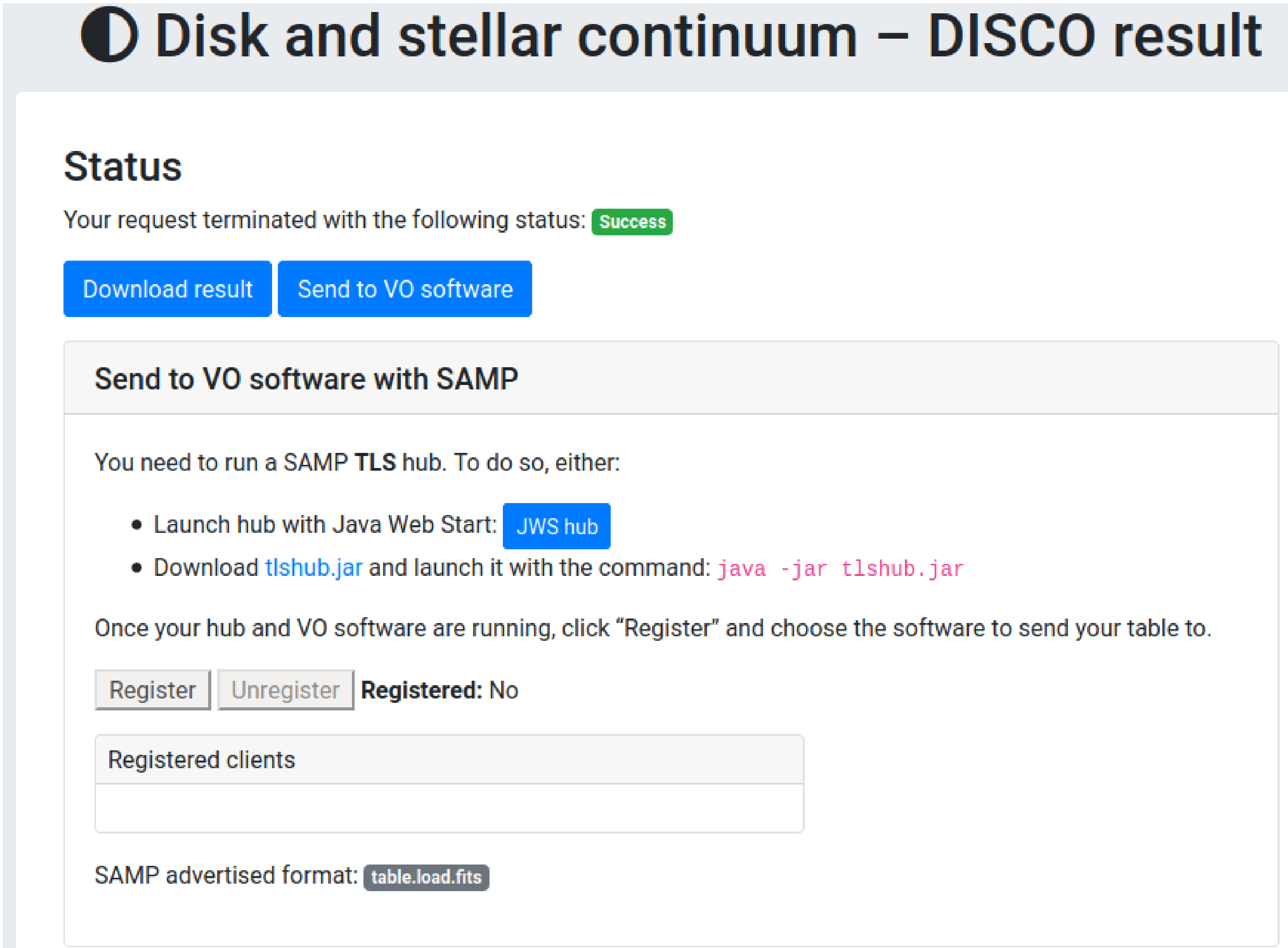
Interface réutilisable
pour de
nouveaux modèles

  - Templates HTML
  - Plus tard :
    - Classes Java servlets et modèles héritées ?
    - Uniformiser les entrées-sorties ?

- Nouvelles librairies:
  - MathJax et jQuery Validation (patchée pour support notation scientifique)

- SVN OCA Gitlab OCA, *Issues* pour communication interne
  - Trac JMMC toujours utilisé pour les retours d’utilisateurs.

Connection aux services OV par SAMP



Demo par Nicolas Bruot…
Possibilité d’envoyer images sur ASPRO ?

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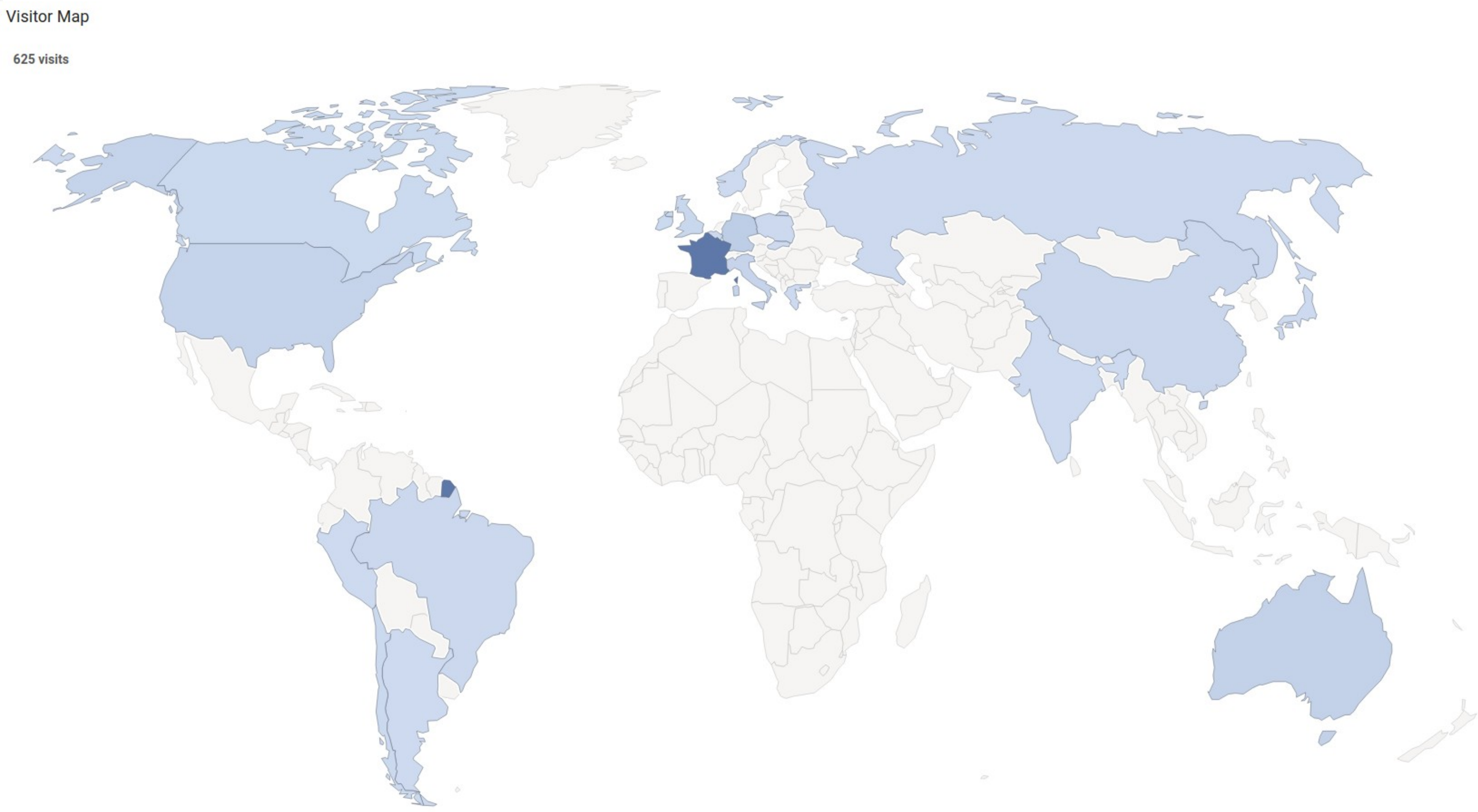
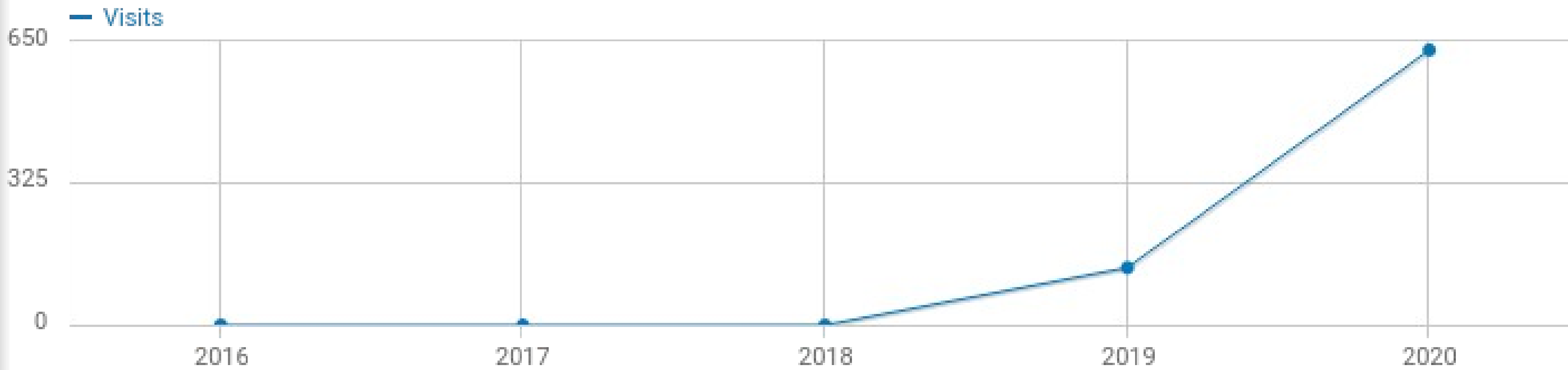
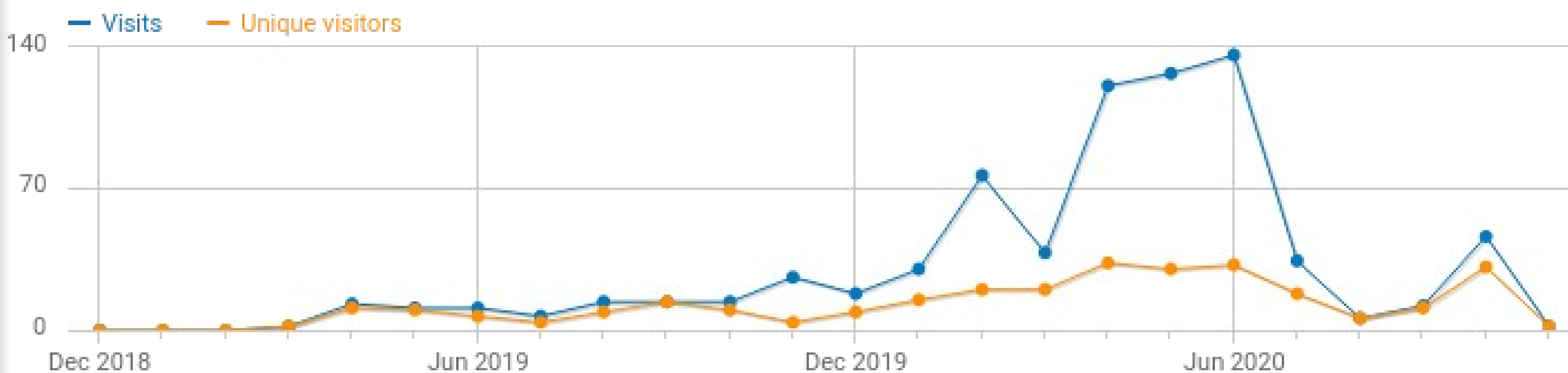
Statistiques d’utilisation



Statistiques d’utilisation





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Prospective

- **Page web :**
  - gestion de multi-utilisateurs (nommage des outputs, gestion des fichiers)
  - tutoriaux sur l’utililisation des modèles et outils
- **Nouveaux modèles astrophysiques :**
  - DISCO: étoile elliptique et gravity darkening, combiner gaz et poussière
  - grilles de modèles BeAtlas HDUST (étoiles massives avec disque), RADMC3D (étoiles jeunes avec disque), CMFGEN (étoiles massives avec vent)
  - DUSTY: étoile avec envelope sphérique de poussière
  - images et profils 1D pour différentes lois de LD (UD, linear, power, etc)
- **Outils d’analyse :**
  - création automatique de grilles de modèles à partir de modèles AMHRA avec calcul de cartes de chi2
- **Lien avec ASPRO :**
  - renvoi automatique des images par SAMP
  - utilisation de profils 1D (limb darkening, CMFGEN, DUSTY) avec calcul d’observables interférométriques par transformée de Hankel

D’autres idées ?