

A COLLABORATIVE AI PROJECT FROM THE ASTRO IMAGES PROCESSING (AIP) ASSOCIATION

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Abstract. The AIP-NP project brings together members of the AIP association and professional astronomers to mine astrophysical image surveys for the detection of planetary nebulae (PN), using the concepts of the Artificial Intelligence (AI) modeling. A general presentation of the project is given here.

Keywords: Pro-Am collaboration, Artificial Intelligence, planetary nebulae, image survey mining

1 The Astro Images Processing (AIP) association

Created in 2008, AIP* is a French-speaking association with nearly 500 members. These are pure amateurs, or passionate professionals, aiming for excellence in astrophotography. They often have fixed setups, local or remote (France, Southern Europe, Chile, USA, etc.). They are most often involved in other local associations and clubs. A significant proportion of them participate in Pro-Am projects (exoplanet transits, occultations and detections of asteroids, variable stars, etc.) AIP is very oriented towards the development of skills on all subjects related to astrophotography such as Image Processing and Setup Control and Optimization. Its activity is reflected in frequent videoconference sessions ("e-learning"), and some practical courses, always very "training"-oriented.

2 The interest of a collaborative project

Such a project gives a new dimension to the association by creating a common internal challenge capitalizing on the strengths of its members (know-how, equipment, technical and scientific knowledge). The development of its members' knowledge no longer comes "from above" but is built through internal synergies. For this association that operates mainly as a network, such a project is also a new way of strengthening knowledge, exchanges and sharing the common passion for the deep sky and its mysteries. Finally, by getting closer to the professional community, AIP gives even more meaning to its primary mission, by contributing to the quest for celestial data and their usefulness.

3 Why AI?

AI today brings a power of data analysis that was previously inaccessible. It is becoming essential in our modern world, and in particular in everything related to technology. It is now widely present, if not trivialized, in a whole series of image processing software. The idea behind this project is to use its shape recognition capabilities to identify new celestial "objects", and confirm them using AIP's imaging resources, including its network of observatories abroad.

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*<https://www.astro-images-processing.fr/page/580494-accueil>

4 The AIP-NP project

4.1 The context

The discovery of Planetary Nebulae is a "trendy" topic on which several groups are working around the world. To our knowledge, they are all professionals or academics. This is a field known to several AIP members, who have already discovered such objects (Le Dû et al. 2022a). Their approach has so far been "opportunistic" by detecting certain clues present in their images, and by deepening their nature. This is about moving to another scale. AIP has therefore set up a project group, with its own animation and leaders by field, coordinated in the common objective. They are helped by expert advice both inside and outside the association:

- Pascal Le Dû, 2021 SAF/SF2A Gemini Prize winner
- Jean-Baptiste Marquette, retired CNRS astrophysicist
- Nicolas Outters, co-founder of AIP and discoverer of the OU list of NP which is part of the catalogue published by Le Dû et al. (2022b)
- Yann Sainty, co-discoverer of the Strottner-Drechsler-Sainty Object 1 (Drechsler et al. 2023)

4.2 The sub-projects

The project is based on 3 sub-projects:

1. the AI part for the detection of "suspect" targets
2. the imaging part (acquisition, fusion of images from several setups, final processing) to assess actual detections
3. the management of the flow of targets and their images, throughout the discovery life cycle. It is used to manage images and their analyses. It was created from scratch by a team member, Cédric Champeau

The following two figures illustrate the method of operation, involving various analysts and strategies to apply according to these sub-projects : Fig. 1 shows the main management window, and Fig. 2 gives details of a PN candidate.

5 Conclusions

The search for the completeness of the Galactic planetary nebula census has been recognised for long as a key parameter to derive an accurate estimate of the chemical enrichment rates of nitrogen, carbon, and helium (Jacoby et al. 2007). This is a typical kind of collaborative project between pro and amateurs astronomers, for which important results has been obtained already (Jacoby et al. 2010, & references therein). The Astro Images Processing association has summarising here the contents of its new project AIP-NP to contribute to these efforts using both the power of the AI tools and its extended network of observers. Concerning the AI part, the project presently enters a new phase with a two-months internship of a group of students from CentraleDigitalLab, école Centrale Méditerranée[†] under the supervision of A.L. Méalier, AI engineer who previously worked in the field of astronomy (LeLeu et al. 2012). The project members will likely present their results in forthcoming SF2A/SAF Pro-Am workshops.

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[†]<https://www.groupe-centrale.com/digital-lab/>

Nom	Création	Analystes	Imageurs	Etat	
AIP_60	2024-05-20	Jean-Baptiste Marquette Cédric Champeau - Yann Sainy philippe gilberton Analyses : 1/2	philippe gilberton - TS80-gilbertonp (N, 123 x 93, 1.598"/px) Yann Sainy - HA05 (N, 233 x 155, 1.461"/px) Dominique DANIEL - LMJ-DOM (N, 62 x 47, 0.806"/px) philippe gilberton - C8edge-gilbertonp (N, 42 x 32, 0.551"/px)	NP Suspectée	Editer
AIP_25	2024-05-20	Analyste Champeau - Cédric Champeau Analyses : 1/2	Imageur Champeau - Mon super setup (N, 50 x 38, 0.652"/px) Cédric Champeau - Askar 151PHQ (N, 116 x 78, 0.733"/px) nicolas outters - Itic-Outters-sirene300 (N, 103 x 68, 0.645"/px) Yann Sainy - HA05 (N, 233 x 155, 1.461"/px)	NP Probable à imager	Editer
AIP_87	2024-05-20	Yann Sainy - philippe gilberton Analyses : 0/3	philippe gilberton - TS80-gilbertonp (N, 123 x 93, 1.598"/px) Yann Sainy - HA05 (N, 233 x 155, 1.461"/px)	NP Suspectée	Editer
AIP_27	2024-05-20	Cédric Champeau Analyses : 0/1		NP Potentielle	Editer
AIP_68	2024-05-20	Dominique DANIEL - Cédric Champeau Analyses : 1/2	Dominique DANIEL - LMJ-DOM (N, 62 x 47, 0.806"/px) Dominique DANIEL - LMJ-DOM (N, 62 x 47, 0.806"/px)	NP Soumise	Editer
AIP_104	2024-05-20	philippe gilberton Analyses : 0/2		NP Potentielle	Editer
AIP_88	2024-05-20	Dominique DANIEL - Cédric Champeau Analyses : 1/2	Dominique DANIEL - LMJ-DOM (N, 62 x 47, 0.806"/px) Yann Sainy - HA05 (N, 233 x 155, 1.461"/px) Dominique DANIEL - LMJ-DOM (N, 62 x 47, 0.806"/px)	NP Probable à imager	Editer

Fig. 1. List of PN candidates.

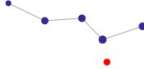
NP Probable à imager AIP_38	
<p>Coordonnées 00h37m7.15s 52°08'34.30"</p> <p>Constellation Cassiopee</p> 	
<p>Etat de la candidate : NP Probable à imager</p> <p>Analyse visuelle Nombre d'analyseurs affectés : 5</p> <ul style="list-style-type: none"> Jean-Baptiste Marquette : En cours Cédric Champeau : En cours Yann Sainy : Terminé Dominique DANIEL : Terminé philippe gilberton : En cours <p>Etat de l'analyse 40% complète</p> <p>Confirmé 0%</p> <p>Incertain 20%</p> <p>Rejeté 20%</p> <p>Images Nombre d'imageurs : 1</p>	<p>Rejeter cette candidate</p> <p>En cliquant sur le bouton ci-dessous, vous rejetez cette candidate :</p> <ul style="list-style-type: none"> les analystes ne pourront plus l'évaluer les imageurs ne la verront plus dans leur liste de travaux <p>Cette opération est réversible.</p> <p>Rejeter</p>
	<p>Changer d'état</p> <p>Cliquez sur un des boutons ci-dessous pour basculer la candidate vers un nouvel état :</p> <p>Retour en arrière</p> <p>← NP Potentielle</p> <p>← NP Suspectée</p> <p>Avancer vers</p> <p>→ NP Soumise</p> <p>→ NP Confirmée</p>

Fig. 2. Detailed parameters of a given PN candidate.

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