


# Hey GPT, can you help me understand the Universe?

Giacomo Beccari & Henri M. J. Boffin

 Check for updates

Generative AI and large language models like ChatGPT are reshaping how we do science, including astronomy. These tools can play major roles in transforming data processing, research proposal evaluations, and even administrative tasks, potentially reducing the need for human intervention in areas like programming and peer review. This rapid technological evolution shouldn't be accepted blindly, however, but instead calls for a multidisciplinary examination of its scientific, sociological, and cognitive impacts.

On 30 November 2022, OpenAI started a revolution by releasing the first public demo of ChatGPT (ChatGPT-3.5). While the first generative pre-trained transformer (GPT) model from OpenAI was released in 2018<sup>1</sup>, ChatGPT represented the first publicly accessible implementation of the GPT model tailored for interactive, conversational use – a fundamental change for users, who instead of having to learn how to use an application programming interface (API) could now simply 'chat' with a large language model (LLM). No need any more for any specific technical knowledge nor any coding skills. The success of this approach was extraordinary, with more than a million new users in a few weeks after its release. Only two years after the first release of ChatGPT, the number of chatbots and LLM-based applications has flourished, offering a variety of different services, such as data analysis, coding and programming support, software debugging and development, image creation and manipulation, text revision, and creative writing.

Like many fields of research, astronomy relies on the extensive use of data, often requiring advanced analytical skills for statistical analysis and coding development. Moreover, astronomers often face complex software development and overall reserve much mental energy and time to update their knowledge and understanding – mostly by reading peer-reviewed papers that are published in great numbers daily. It is hence not a surprise that ChatGPT-like technologies quickly started to play a significant role in the daily professional life of astronomers<sup>2</sup>, with studies showing that ChatGPT may have been involved in many recent abstracts, while some even dream of making discoveries without humans<sup>3</sup>. This technology potentially offers obvious advantages in terms of efficiency in a scientific context where the demand of intellectual resources, creativity, persistent focus, and dedication are required to maintain the highest standard of quality in research while collaborating (and competing) in a continuously growing community of scientists. However, the use of GPT technologies (as for any new

technology) should also force the community to reflect on possible consequences of their use on the development of science, the growth of knowledge, and in particular, the way scientists process data, write and evaluate applications of all sorts (research grants, observing proposals, job applications). GPT technologies and, more broadly artificial intelligence (AI) might also have a non-negligible sociological impact, overtaking some of the tasks currently requiring human intervention, hence removing, or mitigating the need for a variety of skills (such as programming, peer review and evaluations, administrative tasks).

Driven by these thoughts, the European Southern Observatory (ESO) organized in September 2024 an [online conference](#) "Hey GPT! Can you help me understand the Universe? A synoptic view of the impact of chatGPT-like technologies on the future of astronomy". The conference aimed at offering a platform to experts of different backgrounds to help the astronomical community gather a deeper understanding of what GPT-like language models mean and discuss the impact of their use for astronomers. We hosted talks from software developers with the scope of having an in-depth look into the present and future status of the technology and how they are currently used in astronomy. Cognitive psychologists helped us comprehend the potential impact of the use of AI and GPT language models on the cognitive skills of researchers at any career stage, with a focus on the potential future transformations of the way astronomy and science in general is done. We further discussed the impact of AI and GPT technologies on hiring and evaluation processes while challenges for journal editors and impact on ethics were discussed on the last day of the conference. The talks are all available [online](#).

During the conference, we also conducted a few surveys of the attendants. At the start of the workshop, an overwhelming majority of the 80 respondents (89%) stated that LLMs are useful for astronomy, with a further 9% saying "maybe". Most of them also regularly use these LLMs – 32% daily, 38% weekly, 15% monthly, while only 7% had never used these – with 50% using ChatGPT, then a further 30% almost equally spread among Claude, Gemini, and Copilot. This confirms quite a general use and provides further justification for such a conference, with the caveat that participants in such a conference are likely to have experimented LLM models. Thoughts of the attendees about the advantages and risks of LLMs are summarized in [Fig. 1](#).

In this contribution, we summarize some of the aspects of the discussions that we consider most critical and novel in an interdisciplinary spirit. We won't present the technologies or their applications in astronomy, and we invite readers to watch the corresponding presentations online or refer to, for example, [ref. 2](#).

## Cognitive psychology

Cognitive psychology emphasizes how humans adapt their mental strategies when interacting with external tools, such as computers and AI systems, and highlights the balance required to harness AI's efficiency while safeguarding critical thinking and problem-solving skills.



required for distinguishing high-impact proposals from less significant ones. It further showed weak correlations between AI-generated assessments and human evaluations (see also ref. 10).

Transparency and accountability are paramount in integrating AI into research assessment. National funding organizations, such as the [German Research Foundation](#) and Swiss National Science Foundation, emphasize the need for ethical guidelines and proactive disclosure of AI use. Ensuring compliance with existing standards of research integrity and ethics is crucial for maintaining trust in these processes<sup>11</sup>.

## Discussion

It is clear that ChatGPT-like technologies, which are becoming more and more powerful at a frantic pace, are and will continue to be used (see, among others, refs. 12–14.), given their potential large number of applications. However, despite all the inherent issues related to them and which form part of an ethical study of AI – apart from those discussed above, we should also mention those related to sustainability, their black-box nature that is so incompatible with scientific research, privacy concerns, the culture and dominance of big actors, the numerous biases, but also plagiarism. Among the respondents to our conference survey, more than half agreed that using LLMs for writing proposals and papers raises issues of plagiarism – as also stated by some publishers and funders. In the future, if watermarks for AI-generated text may exist<sup>15</sup>, this can only be a stop-gap solution. Most respondents indeed agreed that the use of AI in general and LLMs in particular should be proactively disclosed, to ensure that trust is still present among the scientific community. In this respect, it is also noteworthy that about two thirds of the respondents felt that the use of LLMs should be regulated. There is clearly work to be done here by our community, and given the widespread nature of these technologies and the fact that they will quickly evolve from just chatting to agentic AIs, the sooner such regulations are put in place, the better. Several publishers have already put in place some guidelines on how to use AI to write or referee papers. More general regulations should be considered. Such

regulations should be global, however, as reproducing the regulatory gap that now exists between Europe and the rest of the world with the EU AI Act will likely be detrimental.

**Giacomo Beccari** <sup>1,2</sup>  & **Henri M. J. Boffin** <sup>1,2</sup>

<sup>1</sup>European Southern Observatory, Garching bei München, Germany.

<sup>2</sup>These authors contributed equally: Giacomo Beccari, Henri M. J. Boffin.

 e-mail: [gbeccari@eso.org](mailto:gbeccari@eso.org)

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## Competing interests

The authors declare no competing interests.