

# The ESO Cosmic Duologues

Giacomo Beccari<sup>1</sup>  
Henri M. J. Boffin<sup>1</sup>

<sup>1</sup> ESO

On 26 April 1920, Harlow Shapley and Heber Curtis engaged in a debate on the scale of the Universe which became known as the Great Debate. That event continues to be seen as an exemplary way of addressing controversies, particularly in astronomy. While, after 100 years, many (if not all) of the scientific questions raised during the Great Debate have been answered, it is a common feature of research that as one question is answered new and often unexpected questions show up. Inspired by these considerations, ESO decided to commemorate the Great Debate with a series of events called the ESO Cosmic Duologues.

Since early this year, the world has had to face extreme challenges caused by the COVID-19 pandemic. These circumstances have had drastic and often tragic consequences for many people around the world. Cities have experienced varying degrees of closure of commercial and social activities, while for long periods of time, citizens have been asked to maintain social distancing measures and to essentially live in confinement in their own homes. Academia and research have of course also been affected, with scientists forced to continue their work through teleworking or remote working arrangements, including quickly having to arrange online lectures and courses in many educational institutions. Most of the planned international conferences, science events, seminars and collaborative meetings have been postponed, if not cancelled, except in the few cases where arrangements could be made to move them online.

At ESO we felt a responsibility to find creative outlets at this time to help maintain and further develop scientific interactions, and to ignite curiosity around some of the biggest questions in astronomy today — attempting to address humanity’s need to understand its surroundings.

We feel it is important from time to time for scientists to leave their, often narrow, field(s) of specialisation to revisit some of the main hypotheses or assumptions that underpin today’s astronomical research: for example, is MOND a viable alternative to the standard Lambda-Cold-Dark-Matter model ( $\Lambda$ CDM)? Do intermediate-mass black holes exist and is the question even relevant? What is really meant by the stellar initial mass function? Are rings in discs around young stars really signposts of planets?

## A series of live web events

The Great Debate of Shapley and Curtis (Curtis, 1921 and Shapley, 1921) itself follows a model set much earlier by Galileo Galilei in his book *Dialogo* — or in English, *Dialogue Concerning the Two Chief World Systems* (Galilei, 1632) — which presented arguments as a dialogue between two philosophers and an intelligent layperson. In ESO’s Cosmic Duologues this discussion is between two scientists, with a third scientist acting as moderator.

**Table 1.** The agenda of the events. All the PDF files of the presentations, the recordings of the live events, and a brochure summarising the answers from the speakers to questions posted by attendees on YouTube’s Live Chat are linked from the duologue webpages<sup>1</sup>.

Date	Topic	Speakers	ESO Moderator
27 April 2020	Dark Matter and MOND	Azadeh Fattahi (Durham, UK), Federico Lelli (Cardiff, UK)	Steffen Mieske
11 May 2020	Intermediate Mass Black Holes: To be or Not to be?	Marta Volonteri (IAP, France), Tom Maccarone (Texas Tech University, USA)	María Díaz Trigo
25 May 2020	Initial Mass Function: Universal... or Not?	Tereza Jerabkova (IAC/GTC, La Palma, Spain; Bonn University, Germany), Andrew Hopkins (AAO Macquarie – Macquarie University, Australia)	Giacomo Beccari
8 June 2020	The formation and evolution of the Solar System	Megan Schwamb (Queen’s University Belfast, UK), Sean Raymond (Université de Bordeaux, France)	Cyrielle Opitom
29 June 2020	Substructure in protoplanetary discs: a signpost of planet formation?	Edwin (Ted) Bergin (University of Michigan, USA), Alessandro Morbidelli (OCA, Nice, France)	Stefano Facchini
6 July 2020	Dust at high $z$	Marusa Bradac (UC Davis, USA), Andrea Ferrara (Scuola Normale Superiore, Pisa, Italy)	Paola Andreani
20 July 2020	The atmospheres of Exoplanets	Neale Gibson (School of Physics, Trinity College Dublin, Ireland), Jonathan Fortney (University of California Santa Cruz, USA)	Valentin Ivanov

The Cosmic Duologue series started on 27 April 2020 and was held roughly every second week. The goal was to ensure a dialogue between two (hence “duologue”) professional astronomers, each an internationally recognised expert in their field, moderated by an ESO astronomer (staff or Fellow), with the aim of shedding light on the current state of some of the major questions in astronomy. While the Shapley–Curtis debate was held at the Smithsonian Museum of Natural History in Washington, DC, the confinement measures forced us to organise the ESO Cosmic Duologues as a series of live web-based events.

Table 1 shows the agenda of the events, including the list of topics, the speakers and the moderators. We strove to involve young researchers and to ensure a good gender balance. These efforts were fairly successful, with a female representation among the speakers of 35% (5/14), and a corresponding 43% (3/7) fraction among the moderators.

## Technical aspects

The duologues were hosted using the web-based video conferencing tool Zoom and live streamed on a dedicated YouTube channel<sup>2</sup>. The attendees at the live event were encouraged to ask questions and participate in the duologue

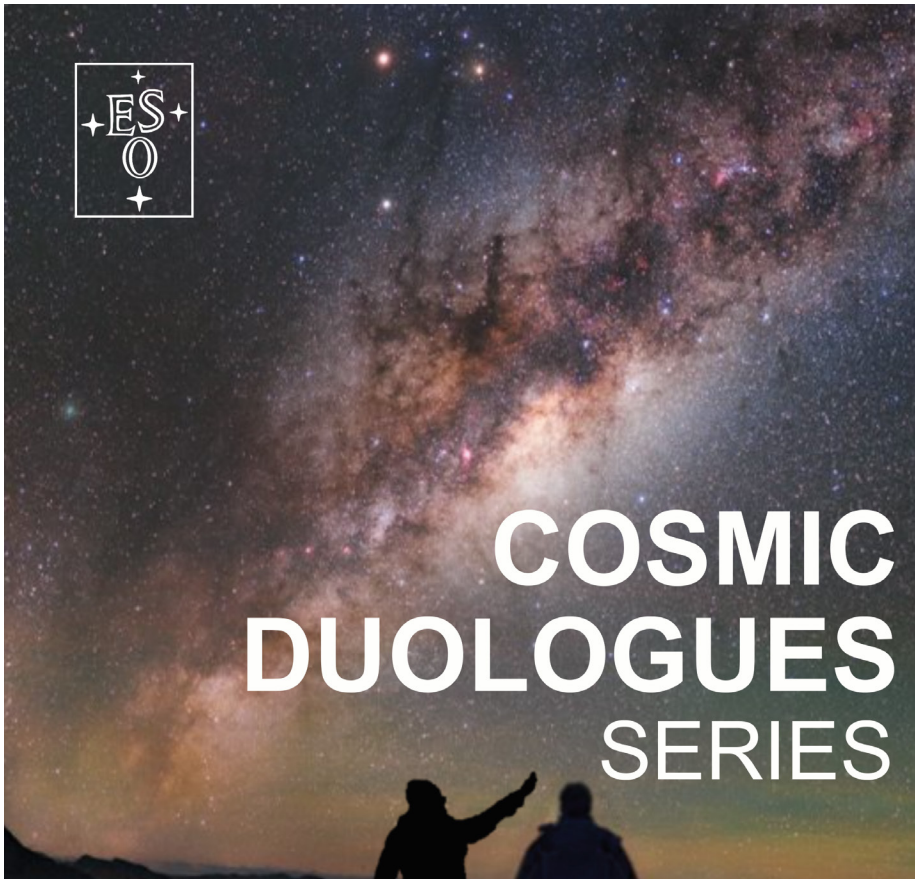


Figure 1. ESO Cosmic Duologues poster.

by posting their questions on the Live Chat on YouTube (or using a web form or by email if they preferred). All of the video recordings of the live events, including the content of the live chat, are available on YouTube. Links to the videos and the PDFs of the presentations are available on the duologue webpages<sup>1</sup>.

Each event started with an introduction to the topic by the moderator, who sometimes also presented a few slides. The two speakers were then asked to each give a 20-minute talk on the topic, highlighting their perspective and vision on the current state of research in the area. In particular, the speakers were asked to place the focus on open issues in order to later engage in a dialogue aimed at emphasising the critical areas and open questions. After the two talks, the stage was opened for dialogue. The moderator was asked to keep an eye on the Live Chat in order to catch the questions coming from the attendees and pass

them on to the speakers. At the same time, we monitored the dedicated email accounts and forwarded these questions via the Zoom platform to the moderator, together with any other input.

As shown in Table 1, the first duologue was about Modified Newtonian Dynamics (MOND) versus dark matter. The discussion was between Azadeh Fattahi

(Durham, UK) who spoke about dark matter and Federico Lelli (Cardiff, UK) speaking about MOND; it was chaired by Steffen Mieske (ESO). This topic is of the highest astrophysical interest, as the existence of dark matter has profound implications for the formation and evolution of galaxies at all redshifts, as well as for our understanding of galaxy dynamics. The atmosphere of the duologue was extremely pleasant, and the overall tone was professional and engaging.

This first event was streamed live on the YouTube channel<sup>3</sup> with almost 350 participants at its peak. In Figure 2 we show a snapshot of the event on YouTube. The attendees gave life to an animated discussion on the Live Chat, highlighting pros and cons of both theories. We were very pleased to witness the active participation of astronomers of all ages, career stages and genders. This event was proof that a virtual platform has the unexpected effect of breaking down physical barriers and can trigger a truly wide participation in the scientific discussion. It was particularly gratifying to note that the younger astronomers appeared less intimidated to engage with the speakers than they might have been in an auditorium setting. At the time of writing, this event has accumulated almost 2500 views on YouTube — quite a spectacular achievement for a professional event.

### Ensuring a legacy

The positive, professional and cordial spirit in which all of the duologues were conducted was greatly appreciated by all

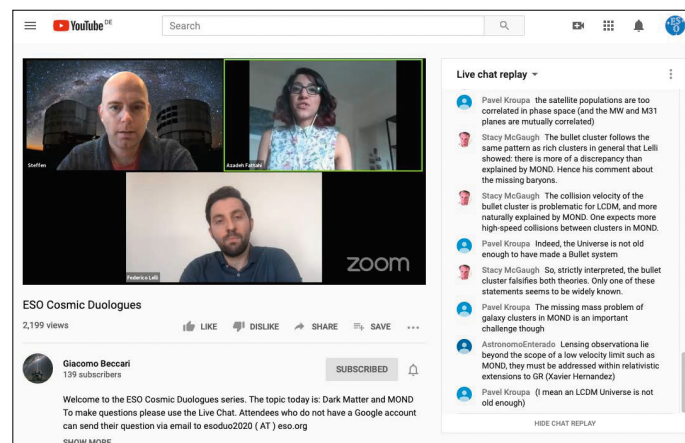


Figure 2. A snapshot from the live stream on YouTube of the first Cosmic Duologue entitled “Dark Matter vs MOND”.

participants and attendees. The YouTube videos have already collected more than 6400 views in total and represent an invaluable resource to astronomers at all stages of their careers.

In order to provide the community with a summary of the most relevant and still open scientific questions raised during the duologues, we have collected some of them in a booklet. Each chapter is presented in the form of an interview with the speakers, who answer questions raised during the live events. While the entire booklet, which will include an introduction to each topic written by the moderator of the corresponding duologue, will be electronically published later in 2020, a draft of each chapter can be already downloaded from the dedicated page for the corresponding duologue.

In conclusion, the ESO Cosmic Duologues allowed us to engage with and reach the astronomical community under challenging circumstances with an original and lively series of scientific discussions centred around some of the most topical areas in astrophysics. We note that, as the rate of science productivity continues to escalate (as can be traced for example by the ever-increasing amount of data and numbers of papers and conferences), it is imperative to take a step back and reflect on some of the scientific assumptions that constitute the pillars of astronomical knowledge today.

#### Acknowledgements

We would like to thank all the speakers who accepted our invitation to participate in the ESO Cosmic Duologues. We are also extremely thankful

to those who acted as moderators and invested their energy and creativity to make this series possible. We also acknowledge the support of the ESO Directorate for Science and the ESO Office for Science.

#### References

- Curtis, H. 1921, *Bull. Nat. Res. Coun.*, 2, 194  
 Galilei, G. 1632, *Dialogue Concerning the Two Chief World Systems*, (Firenze: Per Gio: Batista Landini)  
 Shapley, H. 1921, *Bull. Nat. Res. Coun.*, 2, 171

#### Links

- <sup>1</sup> Cosmic Duologue webpages: [duo.eso.org](http://duo.eso.org)  
<sup>2</sup> Cosmic Duologue YouTube channel: [youtube.com/channel/UC70TAbRgtfFobkWcmYFVS7w](https://youtube.com/channel/UC70TAbRgtfFobkWcmYFVS7w)  
<sup>3</sup> Dark Matter and MOND Cosmic Duologue: [youtu.be/cuY-dgkenn4](https://youtu.be/cuY-dgkenn4)

A. Tyndal/ESO



People are enjoying the sunset on top of Cerro Paranal in Chile.