Annual Report 2022

KØBENHAVNS UNIVERSITET

Danmarks Grundforskningsfond
Danish National Research Foundation

Danmarks Tekniske Universitet
DTU

Contact: Guarn Elizabeth Nissen,

Website: cosmicdawn.dk

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Editor: Guarn Elizabeth Nissen

Layout: Peter Daniel Johannsen

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The Cosmic Dawn Center

Directors' Statement

July 11, 2022 was a historic day for astronomy. It was then, at 11:30 pm Central European Time, that the first images from the James Webb Space Telescope (JWST) were unveiled to the world. The unveiling was transmitted live from the White House, where the president of the United States unveiled the first image from what he called a "miraculous" space telescope. In the subsequent months, JWST produced a flurry of spectacular data at a breathtaking pace. In the short period since its first image was released, i.e. not even a full year by the time of writing this, the JWST has broken the record for the most distant galaxy observed several times.

Sune Toft, Center Director

Perhaps the biggest surprise coming from JWST so far, is its discovery of galaxies so early and so massive that they are in tension with our understanding of cosmic structure formation in the early Universe. Another explanation is that astronomers have systematically overestimated the masses of distant galaxies. In fact, a group of DAWN scientists has pioneered a new, and more realistic, way of weighing distant galaxies, which suggests the first galaxies were up to 10 times less massive than previously thought, which would bring them into accordance with our models of structure in the universe. Which of these two scenarios is the correct one is currently a matter of intense debate. It is clear that regardless of the answer, it will fundamentally change our view of how and when the first galaxies formed.

These findings, along with a flurry of breakthroughs across astronomy that was only made possible with JWST, led the prestigious journal *Science*, to award the JWST with the 2022 *Breakthrough of the Year Award*.

Thomas Greve, *Center Co-Director*

A major highlight of the past year was the Copenhagen DAWN Conference, which took place from June 22-24, 2022, at the Royal Danish Academy of Science and Letters. The conference was attended by approximately 120 researchers, including nine world-leading international experts, who were invited to give keynote talks on the DAWN research themes: "First Galaxies", "First Metals", "First Black Holes", and "Galaxy Evolution". Overall, the Copenhagen DAWN Conference 2022 was a resounding success. Included in this report is a special feature article entitled "Copenhagen DAWN Conference 2022" providing a detailed summary of the event.

There is no doubt that the invasion of Ukraine in February 2022 had a negative impact on the astronomy community. ESA's EUCLID mission, which DAWN is heavily involved in, was on track for a mid-2022 launch on a Russian Soyuz rocket from Europe's spaceport in French Guiana. However, because of the war, Russian ground support left French Guiana, leaving Euclid without a launch vehicle. The Ariane 6 rocket, the only European alternative to Soyuz, was only scheduled to have its first test flight in late 2023. Luckily, a solution was found in which SpaceX will launch Euclid on one of its Falcon 9 rockets from Cape Canaveral, Florida. Euclid was shipped from its testing site in Cannes to Florida in February 2023 and is set to launch in mid-July.

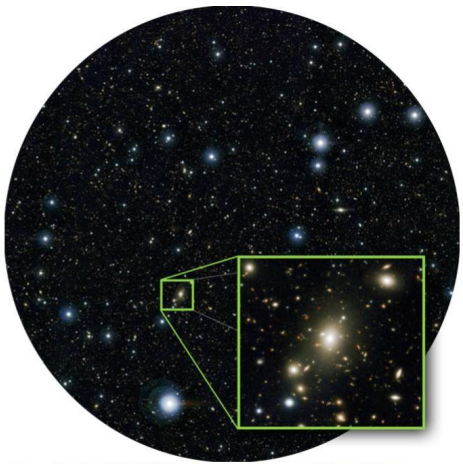
Copenhagen was the site for the first EUCLID consortium meeting in 2012, a year after the mission was selected by ESA for implementation. It is, therefore, appropriate that the last EUCLID consortium meeting before the launch of the mission will also take place in Copenhagen. DAWN is organizing the meeting, which will take place in June 2023, and will welcome over 350 astronomers from around the world in Copenhagen to discuss and coordinate the science that will be made possible by EUCLID. DAWN scientists are heavily involved in the EUCLID mission with the Cosmic Dawn Survey adopted as a Key Science project for EUCLID. The unique survey data that the EUCLID telescope will provide, within a year from now, will thus be extremely important to DAWN's scientific mission.

The lifeblood of DAWN is our talented and enthusiastic young scientists. Again this year, we are extremely happy to have welcomed several new postdocs and students to DAWN. As in previous years, many of our young and early career scientists at DAWN won accolades and prestigious grants in 2022. Bitten Gullberg, for example, won a Villum Young Investigator grant, which will allow her to build a group at DAWN that will focus on understanding what drives the extreme star formation in starburst galaxies in the young Universe. Kasper Heintz won a Villum Experiment grant to install powerful cameras on two existing telescopes located at observatories on La Palma and Tenerife, respectively. This will make it possible to discover and monitor the bright, early phases of stellar explosions such as kilonovae, fast radio bursts and gamma-ray bursts. Last but not least, Charlotte Mason, DAWN's most recent faculty hire, won a Carlsberg Semper Ardens Accelerate grant to study how the first stars in the Universe formed. We are extremely proud of these, as well as many other, achievements made by our early career scientists at DAWN.

Annual Highlights 2022

COSMOS2020: A Panchromatic View of the Universe through Cosmic Time

Covering a full two square degree area on the sky — nine times as large as the disk of the full Moon — the Cosmic Evolution Survey (COSMOS) has become a cornerstone of extragalactic astronomy. Starting as a Hubble Space Telescope Treasury project and later followed up with observations from telescopes around the world and across the entire electromagnetic spectrum, COSMOS is designed to probe the formation and evolution of galaxies through cosmic time.



A Section of the COSMOS Field, *cropped to a field of view equal to the size of the full Moon. The zoom-in contains around 1,000 galaxies. Credit: ESO, UltraVISTA team, TERAPIX, CNRS, INSU, & CASU.*

A major milestone was reached last year with the "COSMOS2020" catalog (Weaver et al. 2022a). With the data gathered throughout the seven years since the preceding data release, the catalog contains galaxies more than twice as faint as previously. Thus, COSMOS2020 presented the detection of more than one million galaxies.

The power of COSMOS2020 lies in its use of bleeding-edge galaxy model-fitting techniques. With accurate measurements of the light emitted from radio waves, to infrared, and all the way to X-rays, the catalog not only shows a coherent history of the evolution of galaxies through 97% of cosmic time; it also provides a firm basis for follow-up observations with the James Webb Space Telescope, in particular spectroscopy.

The Ancestor of a Supermassive Black Hole

Arguably, the most enigmatic entity in astrophysics is a black hole; a clot of gravity so immense that nothing may escape. How the most massive of these behemoths can build up billions of Solar masses already in the early Universe is a bit of a mystery. Theories predict that supermassive black holes undergo an early phase of rapid growth, with a highly star-forming galaxy evolving first to a dust-obscured, compact object and then transitioning to an unobscured luminous quasar.

Both dusty starbursts and luminous quasars are extremely rare in this epoch. It was therefore a breakthrough when Fujimoto et al. (2022) discovered a galaxy with physical properties lying in-between these rare objects, thereby providing an important avenue toward understanding the birth of supermassive black holes.

Interestingly, the galaxy was found in archival observations from the Hubble Space Telescope. Other authors had noticed the source but thought it was a dwarf star in our own galaxy. This shows how big discoveries may sometimes be hidden just in front of us.

Organization

Recruitment and Gender Strategy

DAWN's recruitment strategy continues to uphold simplicity while focusing on attracting and recruiting the top candidates from around the globe regardless of gender, ethnicity or cultural background. Postdoc and PhD positions are offered yearly through wide, open international calls. All deadlines are individual for applications, rounds of interviews, offers and acceptances, while following the international academic hiring cycle. We continue to organize a summer research program which attracts some of the most talented undergraduate researchers from the United States and Denmark. This year nine males and five females participated in the program.

In 2022 we recruited five new postdoctoral fellows, two females and three males, who are nationals of Germany, India, North Macedonia, United States and Denmark, and arrived from institutes in the Netherlands, the United States, France and Iceland.

Four postdocs concluded their DAWN fellowships in 2022. Three continued as postdocs abroad (two of them in prestigious NASA Hubble and ESO fellowships), and one transitioned to industry to work for a robotics company in Italy.

Through our PhD fellowship program we hired two PhD students, a female and a male, who are nationals of Switzerland and China. Two PhD students graduated and continued on to postdoctoral fellowships in the Netherlands and the United States.

The Cosmic Dawn Center shares its location at DTU Space and the Niels Bohr Institute.

Scientific Progress and Research Updates in 2022

Research Integrity and Data Management

In astrophysics we are adhering fully to the guiding principles of FAIR concerning the management of scientific data. FAIR is an acronym for Findability, Accessibility, Interoperability, and Reuse of digital assets. In all of these four categories we have practices in astronomy tuned to meet these principles. All data are automatically stored in searchable archives. The data format is FITS (Flexible Image Transport System). Fits-files have two components: *1.)* a binary data file and *2.)* a so-called header, which contains all the meta-data required for understanding the data. Typically, principal investigators have one year of proprietary access to data resulting from their accepted observing proposal. After this proprietary period, everybody can access the data both in its raw form or as calibrated and reduced data.

Concerning the wider context of research integrity, we also do what we can to follow guidelines and regulations. All scientists, including PhD students, are receiving training in the rules and principles behind the proper conduct of research.

Research Plan and Themes

The Cosmic Dawn Center published 172 articles in peer-reviewed journals during 2022. This section describes, for a selected subset, how they fit into our main research topics. A few particularly relevant preprints currently undergoing peer-review are also included, indicated by their arXiv ID.

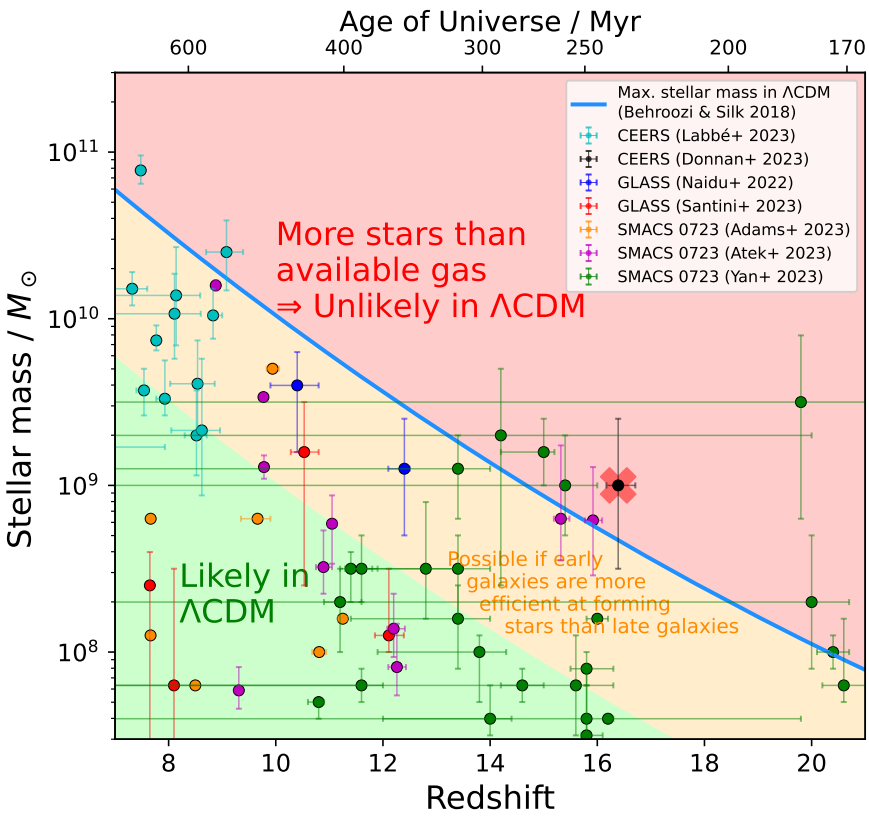
An Update on James Webb

One year ago, we were holding our breaths while the James Webb Space Telescope was slowly getting itself ready for science, and in July we finally saw the first scientific data. Only a few days after the first data release in July, the first reports of galaxies seen farther back in time than ever before appeared on the arXiv preprint server. Although we did expect Webb to "break the redshift record", the speed at which the record was broken again and again was astounding.

What was even more remarkable was that, for many of these galaxies, their measured stellar masses were much higher than expected to be physically possible. At least according to our understanding of hierarchical clustering and galaxy assembly under the currently accepted concordance model, the "ΛCDM model".

Cosmological Redshift

Arguably, the most essential concept in astronomy is the redshift of light, denoted by the letter z. The farther light travels in the Universe, the more it is redshifted. The factor z therefore is a measure of how far back in time we peer.
Before Webb, the record redshift of a galaxy was $z \approx 11$, corresponding to 400 million years (Myr) after the Big Bang. At the time of writing, the most robust candidates for the most distant galaxies are at redshifts $z \approx 12-13$, when the Universe was around 350 Myr old.



Stellar mass vs. redshift *of galaxies recently observed with JWST*[1]*. The secondary x axis shows the corresponding age of the Universe at the time we see them. The solid blue line*[2] *shows the threshold stellar masses for a cumulative number density of 1 object in a volume of* 10^5 Mpc^3*, roughly equal to the volumes in which the data were obtained. If a survey finds with significant confidence that galaxies with stellar masses larger than this had a cumulative number density higher than* 10^{-5} Mpc^{-3}*, it would rule out ΛCDM. The line assumes a 100% star formation efficiency, i.e. with stellar mass-tohalo mass equal to the average cosmic baryon fraction. Assuming a more modest star formation efficiency of 10% — which is still high compared to most lower-redshift models — shifts down the line, leaving even more galaxies in tension with ΛCDM. The red cross marks the galaxy CEERS-93316 which was first announced as a $z \sim 17$ galaxy*[3] *but recently confirmed to be a member of a $z = 4.9$ cluster*[4]*.*

The figure above shows many of the newly discovered sources for which redshift and stellar masses have been determined. The galaxies were found in three different fields of comparable survey volumes, $\sim 10^5$ Mpc^3. One is the very first image released to the public, the galaxy cluster SMACS 0723, and the two others are the Early Release Science program GLASS (Treu et al. 2022) and CEERS[5]. The blue line[6] shows the maximum stellar mass of a galaxy expected to be found in such a volume if we assume that 1) the concordance model of the structure and evolution of the Universe, the so-called ΛCDM model, is correct, and 2) galaxies at that time were somehow able to convert 100% of their gas

[1] The data are taken from Labbé et al. (2023), Donnan et al. (2023), Naidu et al. (2022b), Santini et al. (2023), Adams et al. (2023), Atek et al. (2023), and Yan et al. (2023).

[2] Obtained from Behroozi & Silk (2018).

[3] Donnan et al. (2023), Harikane et al. (2023).

[4] Haro et al. (arXiv:2303.15431).

[5] Finkelstein et al. (2023).

[6] Adopted from Behroozi & Silk (2018).

to stars. Because of the time needed to build up stellar mass, galaxies with masses above this line, in the red domain, are so rare that they are highly unlikely to be found in the surveyed volume.

Disturbingly, a few of the galaxies seemingly defy the timescales of ΛCDM. The star formation efficiency is defined as the fraction of available gas that a galaxy is able to convert to stars on a dynamical timescale. Most models require a very low efficiency to match observations, and a 100% star formation efficiency is a factor of at least 10 more efficient than in the more nearby Universe. If instead we assumed 10%, the division between the two domains would move down, indicated by the intermediate, yellow region. This would mean that even more galaxies would seem to be in tension with the timescales of structure formation.

Nevertheless, there are numerous alternative explanations that must be explored before claiming the downfall of ΛCDM: By far, most of the redshifts are "photometric", meaning that they are based on the galaxies' colors. At the time of writing, only a few have been followed up to obtain the much more accurate, but also time-consuming, spectra. Moreover, the models used to estimate redshifts from colors are based on physics from the more local Universe. As demonstrated by Sneppen et al. (2022), accounting for the different gas temperature in the early Universe, the calculated masses of the galaxies may be significantly smaller, shifting the galaxies down in the plot above by a factor of at least ten (i.e. toward the green, "likely" domain). On the other hand, Giménez-Arteaga et al. (2022) show that stellar masses of poorly resolved galaxies could in fact by under-estimated by a similar amount, moving them up again, because an older, unresolved stellar population may be outshone by young stars and hence be undetected.

A popular science article on our website cosmicdawn.dk, "Galaxies at Cosmic Dawn", describes several other conceivable explanations. Additionally, recent studies[7] hint at yet another possible alternative: Stellar masses are estimated from the amount of light, but now more and more high-redshift galaxies turn out to contain "active galactic nuclei" – the energetic feedback of gas plunging into supermassive black holes —- the bright light of which may dominate over starlight. However, this is no less interesting; although the timescales of galaxy formation may be "saved", it raises the question of how supermassive black holes may form on such short timescales.

All these results are just scratching the surface with the first data available. James Webb fully has the capability to answer many or all of these questions, but it will take time with more data and careful analyses. What the last half year has shown us is that Webb is exceeding expectations in all aspects; in particular the spectrograph NIRSpec, documented in Jakobsen et al. (2022, Top 10.III) has turned out to perform outstandingly well.

The First Galaxies

James Webb was designed to teach us about the first galaxies and their early evolution. In addition to the ones mentioned above, amongst the studies that made it through peer-review in 2022 were Finkelstein et al. (2022) who present the discovery of a galaxy at redshift 12, and Castellano et al. (2022) who reported several galaxies with redshifts up to 15.

Again, the majority of all these galaxies is spectroscopically unconfirmed, but the $z \approx 12.4$ galaxy was followed up with deep observations with the Atacama Large Millimeter Array (ALMA) radio telescopes in Chile (Bakx et al. 2022) yielding a redshift of $z = 12.117 \pm 0.001$.

[7] E.g. Larson et al. (2023); Kocevski et al. (2023).

The power of NIRSpec spectroscopy was demonstrated by Schaerer et al. (2022), who presented accurate measurements of the amount of oxygen and nitrogen in two galaxies at redshifts ~ 8, something which would have been impossible without James Webb.

Galaxy Evolution

A paramount issue with the lack of spectroscopic confirmation mentioned above is that the templates used to interpret the photometrical data are based on physics known from the more local Universe. It is well known, but in several ways largely ignored, that physical conditions in the early Universe were quite different from today. One of these conditions is the temperature of the star-forming gas which, as we go farther back in time, was hotter. This was investigated in a series of papers by Sneppen et al. (2022), Steinhardt et al. (2022b, Top 10. VII), and Steinhardt et al. (2022a) who found that models work better if we assume that there are fewer small stars (in astronomers' terms, they need a "less bottom-light initial mass function").

At slightly later epochs in the history of the Universe, the evolution of galaxies was explored by Matharu et al. (2022) who confirmed the emerging picture that galaxies both form their stars, and stop forming their stars, in an "inside-out" manner 5–10 billion years ago, and Rizzo et al. (2022) who characterized the dynamical state of galaxies up to 13 billion years ago. This was also the epoch of the remarkable discovery of a compact object that turned out to be the theorized bridge between dusty, starbursting galaxies and bright quasars (Fujimoto et al. 2022, Top 10.I)[8].

A major breakthrough in the field of galaxy evolution came in the beginning of the year, with the publication of the COSMOS2020 catalog, containing images across the full electromagnetic spectrum of more than one million galaxies (Weaver et al. 2022a, Top 10.X). Numerous studies have already been based on this catalog, e.g. Shuntov et al. (2022) who studied the relation between stars and the dark matter that a galaxy contains. Another remarkable study was presented by MSc student (Sillassen et al. 2022, Top 10.VI)[9] who, while developing new software for automatic detection of galaxy clusters, serendipitously discovered a galaxy group at $z = 3.7$ in the COSMOS2020 catalog, the earliest structure seen to date in this "maturing phase".

Quenching – Galaxies Die

Promoting student work is one of DAWN's core values, and has often resulted in student-led publications. With over 50,000 galaxies from the COSMOS field, DAWN-IRES summer student Sam Cutler found that internal processes, not the environment, likely is the main reason that, below a certain threshold, galaxies that have stopped forming stars are not smaller in size, even if they are smaller in mass (Cutler et al. 2022). In a numerical study, summer student Hollis Akins explored different pathways to this so-called quenching (Akins et al. 2022b).

Investigating the reasons and mechanisms by which galaxies stop forming stars is essential to characterize the life of galaxies. Using COSMOS2020 galaxies, Ito et al. (2022) found that active galactic nuclei played an important role in quenching galaxies in the early Universe[10].

Active galactic nuclei are not the only means to shut down star formation; at intermediate and low redshifts different mechanisms were explored in the SQuIGL$\vec{L}$E and MaNGA surveys by Suess et al.

[8] See Breaking news from the dawn of the Universe.
[9] See Master student discovers a group of galaxies clustered together in the early Universe.
[10] See Black holes helped quenching star formation in the early Universe.

(2022b) and Otter et al. (2022), respectively. Although a deficiency of cold gas -— the fuel needed for stars – is often involved, the latter study found that some galaxies may have plenty of cold gas, but that this gas may be "disturbed" by nearby galaxies and become too turbulent to be able to form stars efficiently.

Reionization – Opaque to Transparent

While galaxy evolution depends on processes in the interstellar medium, galaxies themselves had a profound impact on the intergalactic medium in the period known as the Epoch of Reionization. To prepare observations of galaxies in this epoch with both ALMA and the Hubble and James Webb telescopes, Kokorev et al. (2022, Top 10.IV) compiled a catalog of more than 200,000 galaxies observed with ALMA and Hubble.

The Epoch of Reionization
When the first luminous sources appeared a few 100 Myr after the Big Bang, their energetic radiation ionized the gas between galaxies, i.e. split the atoms into protons and electrons.
This process took around half a billion years, and by its completion the Universe has transitioned from being opaque to transparent to ultraviolet light, which is the wavelength region in which these early galaxies emit most light.

On the theoretical side, much insight into the progression of reionization has been gained from the "First Light And Reionisation Epoch Simulations" (FLARES)[11], a suite of simulations that combines the large-scale statistics of a cosmological, hydrodynamical simulation with the high resolution of zoomed-in regions. With these simulations, Vijayan et al. (2022, Top 10.IX) investigated the properties of massive, dusty galaxies during reionization. They find a good match between numerous physical properties of the simulated galaxies and the observations we have at hand so far during this yet relatively unexplored period. The simulations were further explored in Wilkins et al. (2022a,b), proving FLARES to be an excellent testbed for interpreting soon-to-come observations from the James Webb Space Telescope.

The Interstellar Medium

The evolution of galaxies is inherently linked to physical processes in the space between the stars; the mixture of atoms, molecules, and dust grains known as the interstellar medium. Molecules tend to emit light in the radio wave regime, and are therefore best studied using radio telescopes such as ALMA. In this way, Valentino et al. (2022, Top 10.VIII) found that the light emitted from carbon and hydrogen, respectively, in a galaxy 700 Myr after the Big Bang was offset from each other by more than 10,000 lightyears, leading to clues on the galaxy's structure and how the light escapes. Similarly, Liu et al. (2022), exploiting the high resolution of ALMA to observe a nearby galaxy down to almost lightyear-scale, studied how individual gas clumps collide and how this leads to turbulence in the gas.

In another ALMA study, Heintz et al. (2022) was able to quantify how fast galaxies in the early Universe accrete gas from the intergalactic medium. Dust similarly emits light at long wavelengths; with ALMA and other radio telescopes, Jin, Shuowen et al. (2022) found galaxies in the early Universe that, due to massive amounts of dust, were hidden from our sight, demonstrating that this type of galaxies contributed significantly to the total star formation at that time[12].

[11] Described in Lovell et al. (2021).
[12] See Radio- and microwaves reveal the true nature of dark galaxies in the early Universe.

Feature Articles

A Doctorate at DAWN

John Weaver, PhD

I joined DAWN at the very beginning as the first PhD Fellow to be hired. It was a time of excitement and promise. We were all preparing to move from the ageing Rockerfeller building down the road to the modern *Vibenshus*. Despite their duties helping orchestrate the move, the senior staff continued to carve out time to facilitate scientific discussions and progress. I was deeply impressed. Their infectious enthusiasm, in addition to the sheer energy of starting a new center, kept all the new PhD hires — Vasily Kokorev, Meghana Killi, and myself — above the anxiety surrounding the move, and so we could dive into our research.

After the move, the work of building up the center continued in earnest. I am grateful that the leaders of DAWN afforded everyone, even junior PhD students like me, the opportunity to contribute ideas to shape the work culture and social activities. The horizontal, community-driven ethos has been enormously successful in connecting members of the center and driving the research forward. I was treated as a colleague by all levels of the center, including my own advisor, and afforded the independence and respect to speak my mind and be listened to. I felt that I could meaningfully contribute to conversations about research as well as the future direction of the center.

Throughout my time at DAWN, I felt a strong sense of belonging — partly from the leadership roles given to the students (e.g. Julefrokost planning) — and also a wide support network from the entire center, including our admin staff and many international associates (one whom I now work for). These two key ingredients allowed me to focus on my work and keep the all-too-common anxieties of PhD students to a minimum. I have found that this unique and highly successful work ethos, especially how PhD students are respected, is rarely followed by other institutions, to their detriment. In my opinion, the combination of respect and support are two key strengths of DAWN that have enabled its PhD students to lead breakthrough scientific discoveries of international significance.

Going forward now as a postdoctoral researcher, I realize that it is now my responsibility to continue practising the same respect and support that I had received at DAWN so that the next generation — such as my own PhD advisees — can succeed. I am forever grateful for the independence, support, and respect given to me at DAWN which has provided a foundation for a successful scientific career.

John Weaver, *A DAWN PhD graduate, currently working at the UMass as a postdoc.. (Image Credit: Helena Baungaard-Sørensen)*

Copenhagen DAWN Conference 2022

Guarn Nissen, Center Coordinator

After 3 years of postponement, the DAWN Conference Copenhagen 2022 finally took place 22-24 June 2022 at The Royal Danish Academy of Science and Letters (*Videnskabernes Selskab*) in downtown Copenhagen. This neo-renaissance building filled with historical paintings and antique furnishings was an excellent venue for hosting our conference, giving our guests a firsthand account of the richness of Danish scientific history reflected through art.

The aim of the conference was to gather leading experts in the field of galaxy formation and evolution to give talks, share ideas and participate in vivid and engaging panel discussions, both in person and online. The following international experts attended and gave keynote talks on the DAWN research themes: "First Galaxies", "First Metals", "First Black Holes", and "Galaxy Evolution":

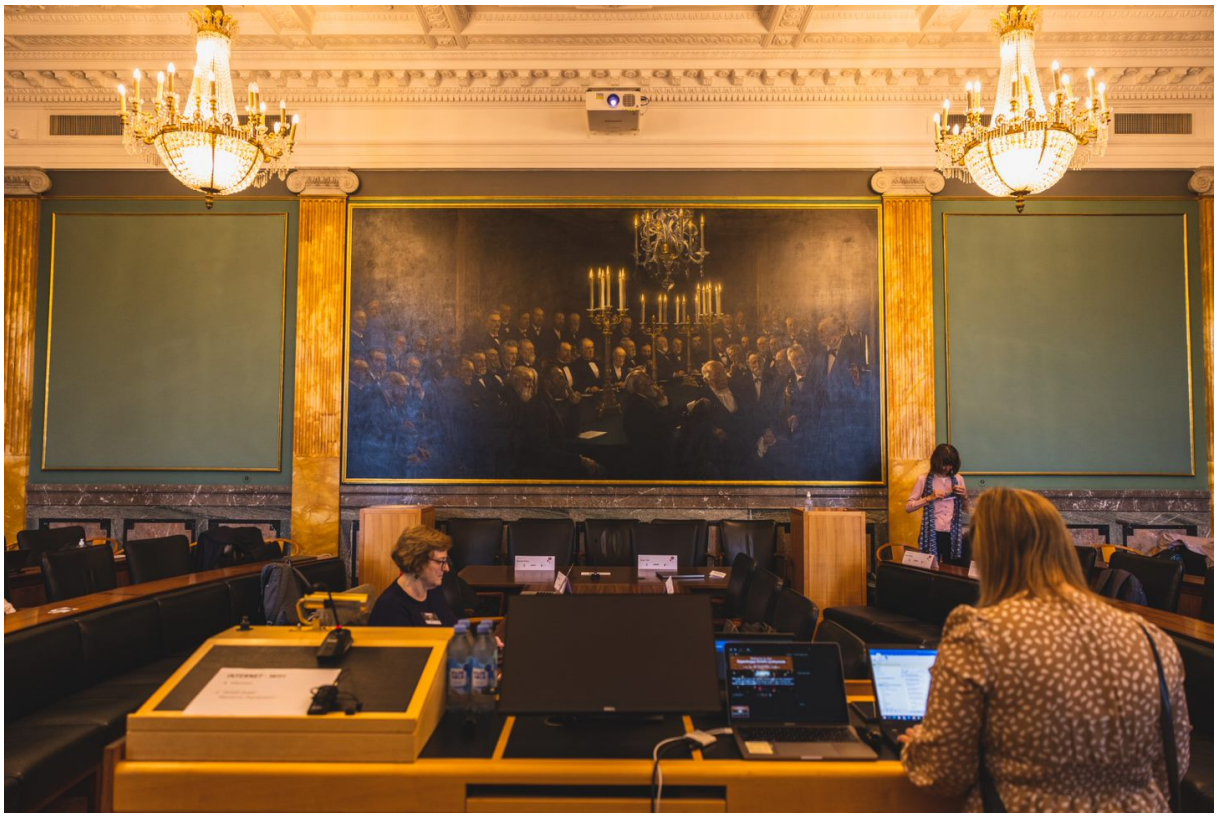
Günther Hassinger	European Space Agency
Kartik Sheth	NASA Headquarters for the JWST
Masami Ouchi	University of Tokyo
Alice Shapley	University of California, Los Angeles
Roberto Maiolino	Kavli Institute for Cosmology, Cambridge
Bahram Mobasher	University of California, Riverside
Lisa Kewley	Australian National University College
Tommaso Treu	University of California, Los Angeles
Meg Urry	Yale Center for Astronomy & Astrophysics
Priya Natarajan	Yale Center for Astronomy & Astrophysics
David Elbaz	CEA Saclay Astrophysics Department
David Sanders	University of Hawaii

Along with the experts, nearly 120 participants attended the event, including DAWN staff members and international associates. Students from our annual summer programs, namely SURF@DAWN and DAWN IRES Scholar's Program also attended. Several DAWN Postdoctoral Fellows and PhD Students submitted posters and gave talks on their research. All talks and presentations were followed by Q&A sessions which ensured vibrant discussions throughout the conference. Additionally, the poster session provided excellent opportunities for the young scientists and students to engage with the experts on a one-on-one basis to receive enlightening input and valuable feedback.

John Weaver, PhD, and Malthe Brinch *at the poster session. (Image Credit: Zarko Ivatec)*

As the conference took place during the midsummer solstice, we took the opportunity to introduce our guests to the bonfire and firework celebrations of Sankt Hans Aften. Transporting the group to Roskilde Harbor, we visited the Viking Museum and sailed Viking Ships in the Roskilde Fjord before arriving at the nearby restaurant and settling down to a delightful conference dinner. We nearly missed the celebrations on the beach and the bus back to Copenhagen as dinner conversations were remarkably interesting and utterly engaging.

Needless to say, the Copenhagen DAWN Conference 2022 was a resounding success and certainly left our guests looking forward to their next visit to Copenhagen and more scientific collaborations.



The Royal Danish Academy of Science and Letters. (Image Credit: Zarko Ivatec)

Awards

NASA Awards Postdoctoral Fellowships for 2022

Seiji Fujimoto, Former DAWN postdoctoral researcher — nasa.gov

NASA has selected 24 new Fellows for its prestigious NASA Hubble Fellowship Program (NHFP). The NHFP is one of the highlights of NASA's pursuit of excellence in astrophysics. The program enables outstanding postdoctoral scientists to pursue independent research in any area of NASA Astrophysics, using theory, observation, experimentation, or instrument development. Nearly 450 applicants vied for the 2022 fellowships. Each fellowship provides the awardee up to three years of support.

DAWN's former postdoctoral Fellow, Seiji Fujimoto, University of Texas Austin, Decoding a Rosetta Stone for Galaxies at the Epoch of Reionization With JWST and ALMA, is a member of the of the Hubble Fellows and is shown in the yellow section of this montage.

Once selected, Fellows are categorized into three broad scientific questions NASA seeks to answer about the universe:

How does the universe work? — Einstein Fellows

How did we get here? — Hubble Fellows

Are we alone? — Sagan Fellows

The newly selected NHFP Fellows began their programs in the fall of 2022 at a university or research center of their choosing in the United States.

Let There Be Light: How Did The Universe's First Stars Form?

Charlotte Mason, DAWN Associate Professor — Carlsbergfondet

What? There is a missing chapter in our Universe's history: we cannot see the first stars and galaxies that lit up the Universe. How and when did galaxies form from the primordial soup of atomic hydrogen and helium to produce the diversity we see today? This is still an open question and a frontier in astrophysics. In the last few months, the James Webb Space Telescope (JWST) has expanded our horizon to this 'Cosmic Dawn', and early results have challenged theoretical models of how stars and galaxies formed. This project aims to constrain how stars formed in the early universe, by measuring the demographics of stars and the efficiency of star formation in early universe galaxies from revolutionary new JWST data.

Why?

How did we get here? Around 100 million years after the Big Bang, theoretical models predict the first stars and galaxies formed in our Universe. As they burned and exploded, the stars created every atom in our world, except hydrogen and helium, and the early galaxies were the building blocks for galaxies like our own home, the Milky Way. But all of this is untested — until now we have not been able to see the earliest galaxies, so we do not have concrete evidence for how these first stars and galaxies formed.

How?

As we look into space we can actually see back in time - as light takes so much time to travel across the universe, when we look at very distant galaxies we are seeing them as they were when the light was emitted from them - billions of years ago, though this requires the most powerful telescopes on Earth and in space. New infra-red technology on the James Webb Space Telescope (JWST) means that we can see further back in time than ever before, to the period when the first galaxies formed. We will analyse the first JWST observations of some of the earliest galaxies forming in the universe. We will measure these galaxies' high energy starlight and its absorption by dust to infer the demographics of their stars and the efficiency with which stars form in early galaxies. By comparison to theoretical models and simulations we will develop a new understanding of how the first stars formed.

Professor Charlotte Mason *speaking at the Copenhagen DAWN Conference 2022 (Image Credit: Zarko Ivatec)*

Otto Hahn Medal

Francesca Rizzo, DAWN postdoctoral researcher — mpa-garching

Congratulations to Francesca Rizzo, who has just been awarded the Max Planck Society's "Otto Hahn Medal" for her original and groundbreaking work into the kinematic and dynamical properties of high-redshift galaxies.

With the aim of motivating the young scientists to pursue a career in research, every year the Max Planck Society awards the Otto Hahn Medal for outstanding scientific achievements to the most talented early career researchers. This year, one of the awardees was Francesca Rizzo, a postdoctoral fellow at the Cosmic Dawn Center.

As with most of these awards, the prize was conferred to Francesca Rizzo for the work she did in connection with her Ph.D. studies, which were carried out at the Max Planck Institute for Astrophysics, supervised by Simona Vegetti and Simon White.

Francesca Rizzo *receiving the Otto Hahn Medal.*

Understanding galaxies

During her Ph.D. studies, Francesca Rizzo investigated the kinematics and dynamics of distant galaxies — that is, the internal motion of gas, one of the main ingredient making up galaxies.

The Otto Hahn Medal

Studying the most distant galaxies is difficult because they are small and faint. Sometimes, however, astronomers are lucky that they line up with a massive foreground galaxy, or even a cluster of galaxies. In this case, the gravity may amplify the light of the background galaxy, making it easier to see, or even split the image up in multiple images on the sky, as well as distort the images.

Because of this distortion, astronomers must be careful when interpreting the observed images. In her thesis, Francesca Rizzo developed a novel technique that is able to reconstruct the structure and kinematics of the background galaxies.

Not only did Rizzo develop this technique; she also applied it to radio observations conducted with the Atacama Large Millimeter Array in Chile. Surprisingly, her analysis showed that galaxies in the early Universe was more ordered and less turbulent than expected from galaxy formation and evolution models.

The Otto Hahn Medal is accompanied by a prize of €7,500.

Best Young Italian Researcher in Denmark

Francesco Valentino, DAWN Assistant Professor — *Instragram Announcement*

Assistant professor Francesco Valentino has been awarded the "B.I.R.D." prize in the class of Physical and Engineering sciences in 2022 for his research on the early formation and evolution of the first quiescent galaxies in the Universe.

During a ceremony held at the Italian Institute of Culture on 2 June, DAWN's Francesco Valentino has been awarded the B.I.R.D. prize 2022 by the Italian Ambassador, Luigi Ferrari.

The prize, sponsored by the Italian Embassy, the Italian Institute of Culture, and the Association of Italian Researchers and Scientists in Denmark (ARSID), is awarded in recognition of innovative research conducted by young Italian scientists in Denmark.

Francesco Valentino *receiving the B.I.R.D award*

Dying galaxies

While some galaxies form stars at a continuous rate throughout most of the history of the Universe, others somehow stop forming stars. Which physical processes "quenched" these galaxies, and what made them stay quiescent, is still not well understood, although we know now that it must have to do with a lack of fuel - that is, cold gas.

In particular in the early Universe, where a relatively steady supply of fresh gas from the intergalactic medium accreted onto the young galaxies, the reason for the quiescence of galaxies is puzzling.

In his research, Francesco Valentino has come closer to some of the answers, especially with his discovery of the most distant, quiescent galaxies. Because of the time it takes light to travel from the distant galaxies to us, these galaxies are seen when the Universe was only 1.5 billion years old, some 10% of its current age.

The analysis that Valentino and his collaborators carried out showed e.g. that these galaxies, in a short time, had gone from forming thousands of stars every year, to virtually forming none.

`SXDS-27434`; the most distant quiescent galaxy ever seen, at a redshift of $z = 4.01$ (from Tanaka, Valentino, et al. 2019).

Valentino's research was conducted in collaboration with members of the Cosmic Dawn Center, the University of Tokyo, and several other institutes all over the world. The research was supported by the Carlsberg and the Danish National Research Foundations

DAWN's science communicator, Peter Laursen *giving a talk about the James Webb Space Telescope at Odense Studenterhus (Image Credit: Helena Baungaard-Sørensen).*

Public Outreach

DAWN Conferences and Events

Speaker	Topic	Link to event
Lise Christensen *Folkeuniversitet i København*	Hvad kvasarene fortæller os om stoffet inde i galakserne	
Lise Christensen *Folkeuniversitet i Aarhus, Emdrup*	Hvad kvasarene fortæller os om stoffet inde i galakserne	
Johan Fynbo *Bestil en forsker*	Black holes	forsk.dk
Johan Fynbo *Program for high schools*	Hvad er meningen	hvadermeningen.nu
Johan Fynbo *Interview/podcast*	Sorte huller	aasr.dk
Johan Fynbo *Folkeuniversitetet*	Flere emner, 20 foredrag	fukbh.dk
Johan Fynbo *Foredrag*	Big Bang	Dagbladet Information
Victoria Strait *Public Talk*	JWST/First galaxies	planetarium.dk
Aswin Vijayan *Astronomy on Tap, Copenhagen*	Astrophysics	astronomyontap.org
Kasper Elm Heintz *Public lecture at the Planetarium*	The first galaxies with JWST	
Kasper Elm Heintz *Astronomy on Tap, Copenhagen*	Fast Radio Bursts	
Kasper Elm Heintz *Podcast "Rumsnak"*	Fast Radio Bursts and gamma-ray bursts	facebook.com

Speaker	Topic	Link to event
Kasper Elm Heintz *Public lecture at Folkeuniversitet*	Fast Radio Bursts	
Kasper Elm Heintz *Feature Article*	Fast Radio Bursts	
Steven Gillman *James Webb Space Telscopen first image recepetion*	Release of the first images from the telescope	space.dtu.dk
Peter Laursen *Press release*	An interview about the distance record-breaking galaxy measurement from the JWST	cosmicdawn.dk
Peter Laursen *Press release*	First images from the JWST press release and event.	cosmicdawn.dk
Peter Laursen *Press release*	Has James Webb observed galaxies so distant and so big that they defy current physics? (full press release)	cosmicdawn.dk
Peter Laursen *Press release*	Has James Webb observed galaxies so distant and so big that they defy current physics? (short press release)	cosmicdawn.dk
Peter Laursen *Press release*	Master's student Nikolaj Sillassen was testing his software and accidentally discovered a galaxy group in the early Universe.	cosmicdawn.dk
Peter Laursen *Press release*	Galaxies may be completely invisible to humans, but reveal themselves in radio and microwave observations. Peter Laursen wrote a press release about the results obtained by Jin, Shuowen et al. (2022).	cosmicdawn.dk
Peter Laursen *Press release*	Finally! We have confirmed the most distant galaxy ever seen.	cosmicdawn.dk
Peter Laursen *Press release*	A news entry about a Nature Communications paper on a galaxy group orbiting a hyper luminous galaxy.	nbi.ku.dk

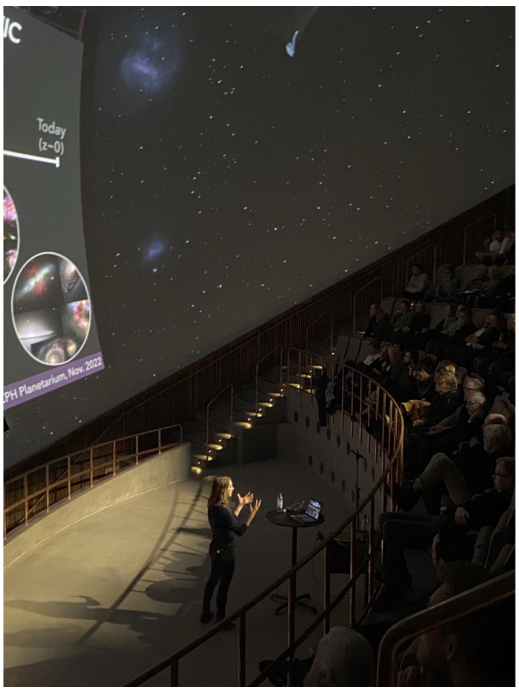
Speaker	Topic	Link to event
Peter Laursen *Press release*	DAWN'ers discover a kilonova associated with a long gamma-ray burst.	nbi.ku.dk
Peter Laursen *Press release*	Our MSc student, Albert Sneppen, applied an astrophysical method on to discover a link between global warming and locally unstable weather.	nbi.ku.dk
Peter Laursen *Press release*	Black holes helped quenching star formation in the early Universe.	science.ku.dk
Peter Laursen *Press release*	DAWN'ers discover a single star, 28 billion lightyears away, and dubbed it "Earendel".	eurekalert.org
Peter Laursen *Newspaper Interview*	James Webb's observation schedule is out now. The first observations will be carried out 27 June.	ing.dk
Peter Laursen *Newspaper Interview*	Interview with a journalist from the Laser Focus World magazine, who wrote a splendid article about Earendel.	laserfocus-world.com
Peter Laursen *Newspaper Interview*	Contributions to a Mette Mølgaard article from videnskab.dk about multiverses	videnskab.dk
Peter Laursen *Newspaper Interview*	Will black holes swallow the whole Universe? Interview with Simon Taarnskov Aabech from videnskab.dk.	videnskab.dk
Peter Laursen *Newspaper Interview*	Astronomers found "rogue" planets, roaming aimlessly around without a star. Journalist Mette Mølgaard interviewed about this.	videnskab.dk
Peter Laursen *Newspaper Interview*	Interview by Frederik Sonne from videnskab.dk about the first James Webb images	videnskab.dk
Peter Laursen *Newspaper Interview*	An interview about the James Webb space telescope and its differences/similarities when compared to the Hubble Space Telescope.	videnskab.dk

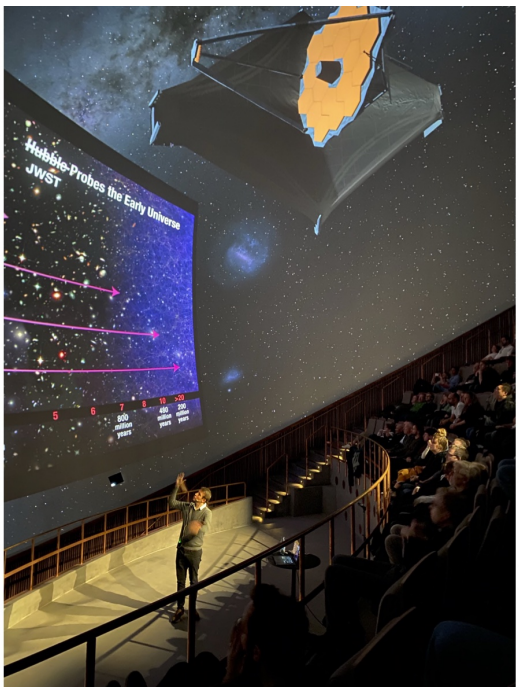
Speaker	Topic	Link to event
Peter Laursen *Newspaper Interview*	Interview with videnskab.dk about Peter Laursen's article on the remarkably big galaxies in the early Universe, discovered by James Webb.	videnskab.dk
Peter Laursen *TV Interview*	TV2/News interview on the James Webb release.	yousee.dk
Peter Laursen *TV Interview*	Interview with Mette Blomsterberg in DR/Aftenshowet about the new James Webb observations.	dr.dk
Peter Laursen *TV Interview*	TV2/Lorry had a feature story on the Niels Bohr Institute Centennial about galaxies and James Webb and similar (featuring Peter Laursen around 12:00).	tv2lorry.dk
Peter Laursen *Radio Interview*	Another interview about rogue planets in the radio station "Den Uafhængige" (begins at 1:01:10).	facebook.com
Peter Laursen *Radio Interview*	At last all James Webb's mirrors are in place, and the telescope is fully cooled to 6K. Interview with Radio4's Aftenradio (at 01:00:30).	radio4.dk
Peter Laursen *Radio Interview*	Finally the James Webb Space Telescope started "real" scientific observations! Interview about the first images in Radio4 (at 01:01:55).	radio4.dk
Peter Laursen *Radio Interview*	More on dusty galaxies in Radio4 (at 00:06:10).	radio4.dk
Peter Laursen *Radio Interview*	A Talk about the James Webb data, which was released that day (at 01:00:53).	radio4.dk
Peter Laursen *Radio Interview*	Radio4 interview about the distance record-breaking galaxy measurement from the JWST (at 01:15:03).	radio4.dk

Speaker	Topic	Link to event
Peter Laursen *Radio Interview*	James Webb's first light is eighteen copies of the star HD 84406, because the mirrors are have not completed their alignment. Interview in Radio4 (at 20:30).	radio4.dk
Peter Laursen *Radio Interview*	Seiji Fujimoto discovered an object which might be the transition from a dusty galaxy to a quasar. Peter Laursen is interviewed about this in Radio4's "Den Nye Rumalder" (at 38:45).	radio4.dk
Peter Laursen *Radio Interview*	On winter solstice, Radio4 released a program called "darkness", where Peter Laursen speaks about Dark Matter (at 01:20:00).	radio4.dk
Peter Laursen *Radio Interview*	An interview about the distance record-breaking galaxy measurement from the JWST (at 19:35).	radio4.dk
Peter Laursen *Radio Interview*	Follow-up interview with Radio4 on James Webb which has now surpassed its most critical points (from 33:10).	radio4.dk
Peter Laursen *Radio Interview*	James Webb is home! With a small boost correcting its speed by a mere 1.6 m/s, Webb now orbits L2. Interview about that on Radio4 (from 29:42).	radio4.dk
Peter Laursen *Podcast*	Podcast on James Webb's first galaxies! Interview with Kaare Svejstrup from Berlingske's "Pilestræde" about the brand new images of galaxies from Webb.	spotify.com
Peter Laursen *Podcast*	Talk about galaxies in Vildt Naturligt ("Wildly Natural") on Danish Radio P1 hosted by Johan Olsen and Vicky Knudsen .	dr.dk
Peter Laursen *Popular Science Article*	My article about spiral galaxies is now available in Danish.	videnskab.dk
Peter Laursen *Book Contribution*	Fact-checking and consulting done by Peter Laursen	strandbergpublishing.dk

Speaker	Topic	Link to event
Peter Laursen *Public Talk*	Week 39 is national "Science Festival". Talks on galaxies, cosmology, and James Webb on various schools and high-schools.	naturvidenskabsfestival.dk
Peter Laursen *Public Talk*	Talk at the Niels Bohr Institute annual theme day with inspiration for secondary and high-school teachers.	nbi.ku.dk
Peter Laursen *Public Talk*	As a part of The Danish Science Festival, Peter Laursen talks about the James Webb Space Telescope in Tårnby Library.	taarnbybib.dk
Peter Laursen *Public Talk*	Participation in "Cosmic Comedy" in the Planetarium.	planetarium.dk
Francesca Rizzo *Interview*	Interview for the European Research Infrastructure for Science, technology and Innovation policy Studies	risis2.eu
Francesca Rizzo *Interview*	Interview for Kvinder i Fysik	kvinderifysik.dk
Gonzalo Prieto Lyon *Astronomy on Tap*	Astronomy talks for the general public at Huset Bar	facebook.com
Francesco Valentino *Public Presentation*	Presentation at the Italian Institute of Culture in combination with B.I.R.D award.	
Peter Jakobsen *Interview with Journalist Gunver Lystbæk Vestergård*	Interview with Weekendavisen about the James Webb Space Telescope	Weekendavisen
Charlotte Mason *Interview for Science*	Early JWST results	science.org
Charlotte Mason *Interview for Scientific American*	Early JWST results	scientificamerican.com

Speaker	Topic	Link to event
Charlotte Mason *Interview for videnskab.dk*	JWST early science plans	videnskab.dk
Charlotte Mason *TV documentary interview*	Early universe galaxy formation	dr.dk
Charles Steinhardt *Folkeuniversitetet course*	Kosmologi	
Katriona Gould *Public Outreach*	Galaxies with JWST	facebook.com





Victoria Strait (left) and Kasper Heintz (right) *presenting at the Planetarium in Copenhagen.*

Conferences, Events & Talks

DAWN Conferences and Events

Title of Event	Date
Copenhagen DAWN Conference 2022	June
DAWN DTU A&A Seminar	14 - 16 December
NOT Workshop - A Telescope for the Future	07-10 June
DAWN Winter School	7-11 February
BUFFALO Workshop, Marseilles	April
EAS 2022 (Session Organizer)	27 June - 01 July
Astronomers for Planet Earth Virtual Symposium 2022	28 November - 02 December

Talks held by Employees at DAWN

Title	Venue	Speaker
ESO 60 Years Celebration	Festsalen at Geocentret	Bitten Gullberg
Oxford Seminar	University of Oxford	Vasily Kokorev
UT Lunch Seminars	University of Texas, Austin	Vasily Kokorev
IPAC Seminar	IPAC/Caltech	Vasily Kokorev
UCLA Seminar	University of California, Los Angeles	Vasily Kokorev
SVOM Burst Advocates Workshop	Les Houches, France	Lise Christensen
NOT - A Telescope for the Future	Santa Cruz de La Palma	Johan Fynbo
VASCO Workshop	Stockholm	Johan Fynbo
Unveiling the Nature of Optically-Dark Galaxies	Yunnan University by Zoom	Yuanpei Yang

Title	Venue	Speaker
Super-Deblended FIR+submm+radio Catalog & the nature of optical-dark galaxies	Institut Astrophysique de Paris	C. Casey, J. Zavala, M. Shuntov, S. Fujimoto
Lunch Talk	Leiden Observatory	Jasleen Matharu
In Situ View of Galaxy Formation 2	Ringberg Castle, Germany	Minju Lee
A half-Century of Millimeter and Submillimeter Astronomy	Miyakojima Mirai Souzou center and City hall of Miyakojima City, Japan	Minju Lee
L-Galaxies Workshop	University of Hertfordshire	Aswin Vijayan
Local Astronomy Colloquium	University of Geneva	Kasper Heintz
ESO-Hypatia Early Career Researcher Symposium	Europena Southern Observatory (ESO)	Kasper Heintz
Local Astronomy Colloquium	Radboud University	Kasper Heintz
Behind the Curtain of Dust IV 2022	Sexten, Italy	Lijie Liu
COSMOS2020: COSMOS Team Meeting Paris 2022	Insitut d'Astrophysique de Paris	S. Toft, M. Brinch, V. Kokrev, J. Weaver and C. McPartland
Colloquium	University of Cambridge	Georgios Magdis
Colloquium	Laboratoire de Marseille	Georgios Magdis
Colloquium	University College London	Georgios Magdis
Colloquium	Imperial College	Georgios Magdis
The Interstellar Medium of Infrared Galaxies from the Present to Cosmic Noon	Valencia, Spain	Francesco Valentino
5th Cosmologicy School	Krakow, Poland	Francesco Valentino

Title	Venue	Speaker
Reionization on a Blackboard Workshop	Center for Computational Astrophysics, New York, USA	Charlotte Mason
The Growth of Galaxies in the Early Universe Conference	Sexten, Italy	Charlotte Mason
Learning the High-Redshift Universe Conference	Online	Charlotte Mason
Königstuhl Colloquium	Max Planck	Charles Steinhardt
Invited Seminar	Harvard	Charles Steinhardt
Invited Seminar	Princeton	Charles Steinhardt
Colloquium	Illinois	Charles Steinhardt
Invited Seminar	Minnesota	Charles Steinhardt

DAWN Cake Talks

DAWN Cake Talk Team

The DAWN "Cake Talks" tradition originally began in 2018 as a chance for visiting researchers (usually early career) to share their research in a 20 minute talk over cake. One advantage of the pandemic is that researchers are able to give talks remotely, and the DAWN Cake Talks are now held weekly, with speakers from all over the world.

In 2022, DAWN held 51 talks, 47 of which were by speakers outside of DAWN. Speakers from 36 institutes, in 14 different countries, on 4 continents, visited DAWN both physically and virtually to present their research. Among these speakers are DAWN-IRES and SURF summer students from the United States.

Guests & Visitors

Guest Speakers

Speaker	Date	Title
Enrico Garaldi *MPIA*	13-01-2022	A Fierce New Challenge: Simultaneously Understanding First Galaxy Formation, Reionization and their Connection
Adélaïde Claeyssens *Stockholm University*	20-01-2022	The Lensed Lyman-α MUSE Arcs Sample (LLAMAS): Morphological Properties of Faint High Redshift Lyman-α Emitters
Leonard Burtscher *Leiden Observatory*	27-01-2022	Astronomy and the Climate Crisis
Rohan Naidu *Harvard University*	03-02-2022	Solving Reionization with Resolved Lyman-α
Chris Harrison *Newcastle University*	16-02-2022	A Multi-Faceted Perspective of How Supermassive Black Holes Influence Galaxy evolution
Anne Hutter *Kapteyn Astronomical Inst.*	17-02-2022	Astraeus: A Framework to Simulate Early Galaxies and Reionization
Manuela Schuetze *Minddistrict GmBH*	24-02-2022	It's OK to not be OK - Confronting the Mental Health Crisis in Academia.
Ben Keller *University of Heidelberg*	10-03-2022	Empirically-Motivated Feedback in Galaxy Evolution
Yuxiang Qin *University of Melbourne*	10-03-2022	Studying high-redshift galaxies and their interaction with the intergalactic medium
Rahul Kannan *Harvard University*	17-03-2022	First results from the THESAN project: Predictions for multi-tracer line intensity mapping in the Epoch of Reionization
Matt Nicholl *Birmingham University*	23-03-2022	Tidal disruptions of stars by supermassive black holes
Taylor Hutchison *Texas A&M University*	24-03-2022	Peering through the Cosmic Fog: What Powers the UV in Galaxies During Reionization?
Frank Baaijens *Eindhoven University*	31-03-2022	Female academics are too scarce. So their applications are going to the top of the pile

Speaker	Date	Title
Joris Witstok *Kavli Institute*	07-04-2022	Uncovering the physics of star formation in the Epoch of Reionization with [CII] 158 μm and [OIII] 88μm
Sara Lucatello *INAF Osservatorio*	28-04-2022	Uncounscious bias in academia (and elsewhere): what it is, what does it do and what can we do about it
Fergus Cullen *University of Edinburgh*	04-05-2022	Iron and Oxygen abundances in star-forming galaxies at $z = 3.5$
Anna-Christina Eilers *MIT*	05-05-2022	The Growth of Supermassive Black Holes
Patricia Bolan *UC Davis*	12-05-2022	The Who, What, and When of Reionization: Constraints on the Timeline and Sources
Natascha Foerster Schreiber *MPE — Garching*	18-05-2022	Star-Forming Galaxies at Cosmic Noon
Unnikrishnan Sureshkumar *The Jagiellonian Uni.*	19-05-2022	Correlations between galaxy properties and environment in the cosmic structure
Daniela Huppenkothen *SRON Institute*	25-05-2022	Rethinking Academic Hiring: Experirences from Three Years of Hiring for a Postdoctoral Fellowship
Lucia Perez *Princeton*	02-06-2022	Constraints on the Epoch of Reionization with the Void Probability Function of Lyman-α Emitters
Siân Phillips *LJMU*	02-06-2022	High-resolution [CII] kinematics in a normal star-forming galaxy from the Epoch of Reionization
Chiara Circosta *UCL*	09-06-2022	Lookering for observational signatures of feedback from active galactic nuclei
Søren Staal *DTU*	09-06-2022	Analyzing the morphology of high-z galaxies with FLARES and JWST
Shude Mao *Tsinghua University*	15-06-2022	Exosolar Planets with Graviational Microlensing
Mahsa Kohandel *Scuola Normale Superiore*	16-06-2022	Dynamically "cold" disks as the Epoch of Reionization
Sarah Bodansky *UMass Amherst*	16-06-2022	Surveying the Dust Masses of Star-Forming Galaxies with the LMT/ToITEC

Speaker	Date	Title
Ezra Huscher *LASP*	30-06-2022	The Case of the Missing Carbon IV
Sam Cutler *UMass Amherst*	30-06-2022	The Resolved Star-Forming Histories of $z \sim 2$ Galaxies
Chandra Sekhar Murmu *Indian Inst. of Tech.*	21-06-2022	Probing the High-Redshift Universe with Galaxy Line-Intensity Mapping
Anshuman Tripathi *Indian Inst. of Tech.*	21-06-2022	Extraction of HI 21cm signal from Low Frequnency Radio Observations using ANN
Laia Barrufet *University of Geneva*	11-08-2022	Unveiling the Nature of Infrared Bright, Optically Dark Galaxies with Early JWST Data
Andrea Weibel *University of Geneva*	11-08-2022	Is there Spectroscopic Evidence for Ongoing Quenching in SDSS Green Valley Galaxies?
Christian K. Jespersen *Princeton*	18-08-2022	Learning Galaxy Properties From Merger Tress with Mangrove
Adele Basturk *CalTech*	24-08-2022	Probing CDM interactions in high-z galaxy clustering with the BUFFALO HST survey
Riley Tam *CalTech*	24-08-2022	Evidence for Inside-Out Growth in Galaxy Simulations
Ethan Garcia *CalTech*	01-09-2022	Unlocking Star Formation in Galactic Photometry
Thomas Cleveland *CalTech*	01-09-2022	Constraints and Predictions on Alternatives to Dark Energy
Key Ito *University of Tokyo*	08-09-2022	AGN Activity and Environment of Massive Quiescent Galaxies at High Redshift
Laura Kreidberg *MPIA*	14-09-2022	Plantes are Places: Exoplanet Atmosphere Characterization in the JWST Era
Antonello Calabrò *INAF*	15-09-2022	ISM kinematics and outflows in star-forming galaxies at $z \sim 3$
Marshall Perrin *STSCI*	22-09-2022	JWST: From First Photons to First Science
Michele Ginolfi *University of Firenze*	22-09-2022	A swarm of galaxies revealed around a hot dust-obscured hyper-luminous galaxy

Speaker	Date	Title
Shenli Tang *Kevli IPMU*	23-09-2022	The Conections between merges and SMBHs: comprehensive understanding from spectroscopy and photometry
Fabian Walter *MPIA (DAWN Associate)*	27-09-2022	On peer-review refereeing
Anita Zanella *INAF Padova*	29-09-2022	Sonification and Sound Design for Astronomy Research, Education and Public Engagement
Lily Whitler *University of Arizona*	06-10-2022	Probing early stellar mass assembly with reionization-era galaxy formation histories
Kartheik Iyer *University of Toronto*	13-10-2022	There and back again: galaxy star formation histories across observations and theory
Adam Muzzin *York University*	14-10-2022	Resolving to Resolve (or Re-solve?) Issues in Galaxy Formation with Resolved Data
Amirnezam Amiri *University of Florence*	20-10-2022	A new, multi-cloud method to model line emission in galaxies
Stephen Wilkins *University of Sussex*	26-10-2022	Exploring the Earliest Phase of Galaxy Evolution
Mitali Damle *University of Potsdam*	03-11-2022	There is always more than meets the eye: The circumgalactic medium
Carlos Gómez Guijarro *CEA/CNRS Paris-Saclay*	10-11-2022	Understanding the role of compact star formation in galaxy evolution
Julie Wardlow *Lancaster University*	16-11-2022	Understanding the environments of extreme dusty star-forming galaxies in the distant Universe
Stephanie Ho *New Mexico State University*	17-11-2022	Understanding the Galaxy Ecosystem: Gas Flow in The Circumgalactic Medium
Kathryn Ross *Curtin University*	24-11-2022	Balancing the Equation: Thriving vs Surviving as a Minority in STEM
Victoria Fawcett *Newcastle University*	01-12-2022	Why is colour special? Fundamental differences between red and blue quasars
Vicente Estrada-Carpenter *Texas A&M University*	08-12-2022	Studying the Spatially Resolved Stellar Populations of High Redshift Galaxies using JWST NIRISSGRIM Data

Speaker	Date	Title
Kate Whitaker *UMass Amherst*	15-12-2022	My personal journey as an academic mama: Lessons in not only surviving, but thriving

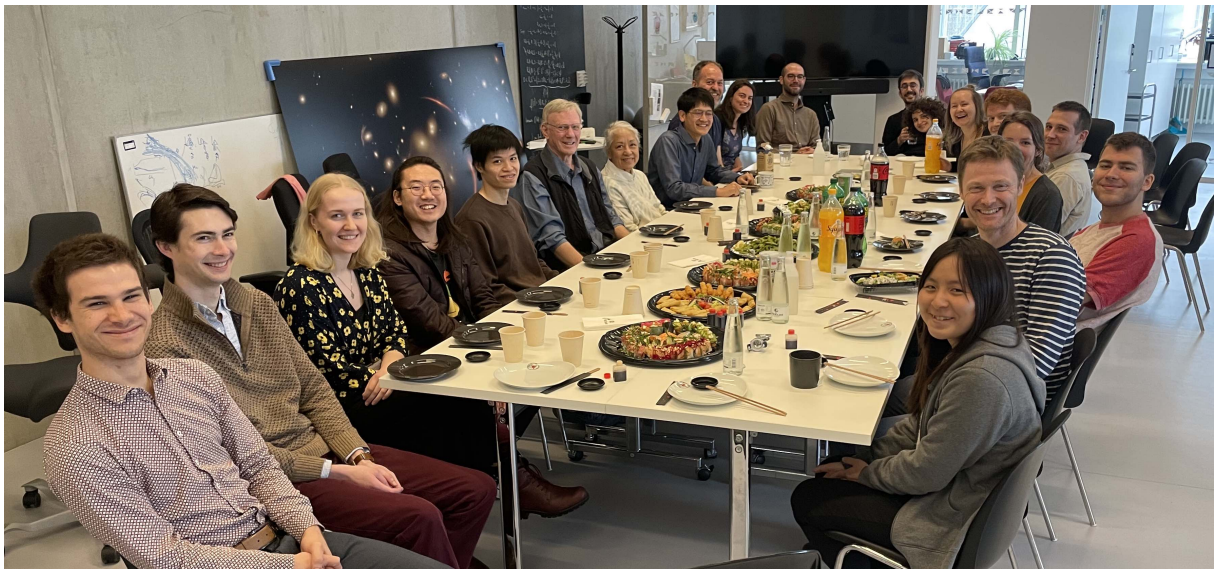
Guest Researchers

Visitor	Arrival	Departure	Affiliation
Thomas Reynolds	01-01-2022	31-12-2022	University of Turku
Alkistis Pourtsidou	07-01-2022	30-01-2022	University of Edinburgh
Anna de Graaff	24-01-2022	26-01-2022	Leiden University
Yuxiang Qin	10-03-2022	12-03-2022	University of Melbourne
Thomas Hérard	14-03-2022	01-07-2022	Sorbonne University
David Sanders	01-04-2022	01-07-2022	University of Hawai'i
Henry McCracken	12-04-2022	24-04-2022	Institut d'Astrophysique de Paris
Bahram Mobasher	12-04-2022	24-04-2022	UC, Riverside
Marko Shuntov	12-04-2022	24-04-2022	Institut d'Astrophysique de Paris
Jackson Mann	17-04-2022	17-08-2022	CalTech
Fernanda de Oliveira	18-04-2022	29-04-2022	University of Kapteyn
Fergus Cullen	02-05-2022	05-05-2022	University of Edinburgh
Xin Lin	09-05-2022	16-05-2022	Université de Versailles
Unnikrishnan Sureshkumar	19-05-2022	21-05-2022	Jagiellonian University
Sam Cutler	05-06-2022	20-08-2022	UMASS
Ezra Huscher	05-06-2022	20-08-2022	NMSU
Eric Rumsfeld	05-06-2022	20-08-2022	WESLEYAN
Sarah Bodansky	05-06-2022	20-08-2022	UMASS

Visitor	Arrival	Departure	Affiliation
Hanga Andras-Letanovszky	05-06-2022	20-08-2022	ARIZONA
Allan VanZandt	05-06-2022	20-08-2022	UMICH
Lauren Elicker	05-06-2022	20-08-2022	UC
Martin Sparre	10-06-2022	11-06-2022	Potsdam University
Rebeca Reyes-Carrion	12-06-2022	20-08-2022	UPR
Adele Basturk	12-06-2022	26-08-2022	CalTech
Andrei Staicu	13-06-2022	26-08-2022	CalTech
Riley Tam	13-06-2022	27-08-2022	CalTech
Ethan Garcia	19-06-2022	02-09-2022	CalTech
Anne Hutter	19-06-2022	22-06-2022	University of Groningen
Kate Whitaker	20-06-2022	25-06-2022	UMass, Amherst
Trity Pourbahrami	20-06-2022	25-06-2022	Gordon & Betty Moore Foundation (DAWN Associate)
Desika Narayanan	20-06-2022	25-06-2022	University of Florida
Kartik Sheth	20-06-2022	25-06-2022	NASA
David Elbaz	22-06-2022	25-06-2022	Université Paris-Saclay
Alice Shapley	22-06-2022	25-06-2022	UCLA
Thomas Cleveland	22-06-2022	02-09-2022	CalTech
Tommaso Treu	22-06-2022	25-06-2022	UCLA
Roberto Maiolino	22-06-2022	25-06-2022	University of Cambridge
Lisa Kewley	22-06-2022	25-06-2022	Harvard & Smithsonian
Masami Ouchi	22-06-2022	25-06-2022	University of Tokyo
Meg Urry	22-06-2022	25-06-2022	Yale University
Bahram Mobasher	22-06-2022	25-06-2022	University of California (Riverside)
Adam Carnell	22-06-2022	25-06-2022	Royal Observatory Edinburgh

Visitor	Arrival	Departure	Affiliation
Maximilian Stritzinger	22-06-2022	25-06-2022	Aarhus University
Håkon Dahle	22-06-2022	25-06-2022	University of Oslo
Garrelt Mellema	22-06-2022	25-06-2022	Stockholm University
Ivelin Georgiev	22-06-2022	25-06-2022	Stockholm University
Luis Colina	22-06-2022	25-06-2022	SNRC (DAWN Associate)
Günther Hasinger	22-06-2022	25-06-2022	European Space Agency
Thøger Emil Rivera-Thorsen	22-06-2022	25-06-2022	Stockholm University
Sidney Lower	27-06-2022	30-06-2022	University of Florida
Hollis Akins	28-06-2022	01-07-2022	University of Texas, Austin
Michał Piotr Lipiec	18-07-2022	05-08-2022	CalTech
Laia Barrufet de Soto	03-08-2022	18-08-2022	Universitè de Genève
Andrea Weibel	03-08-2022	18-08-2022	Universitè de Genève
Kei Ito	15-08-2022	16-09-2022	University of Tokyo
Andrew Bunker	24-08-2022	26-08-2022	University of Oxford
James Dunlop	24-08-2022	26-08-2022	University of Edinburgh
Yuxiang Qin	22-08-2022	14-10-2022	Univerisity of Melbourne
René Rasmussen	30-08-2022	30-11-2022	Aarhus University
Hiroyuki Hirashita	12-09-2022	14-09-2022	ASIAA
Antonello Calabrò	14-09-2022	16-09-2022	INAF - Observatory of Rome
Shenli Tang	20-09-2022	24-09-2022	University of Tokyo
Marshall Perrin	20-09-2022	23-09-2022	Space Telescope Science Institute
Michele Ginolfi	22-09-2022	26-09-2022	European Southern Observatory
Fabian Walter	26-09-2022	29-09-2022	MPIA (DAWN Associate)
Christian Kragh	08-10-2022	17-08-2022	Princeton
Westley Brown	10-10-2022	14-10-2022	York University

Visitor	Arrival	Departure	Affiliation
Danilo Marchesini	10-10-2022	14-10-2022	Tufts University
Adam Muzzin	11-10-2022	14-10-2022	York University
Krishna Naidoo	14-10-2022	12-11-2022	Polish Academy of Sciences
Terese Hansen	18-10-2022	31-12-2022	Stockholm University
Will Roper	19-10-2022	29-10-2022	University of Sussex
Stephen Wilkins	25-10-2022	27-10-2022	University of Sussex
Carlos Gómez Guijarro	09-11-2022	13-11-2022	CEA Paris-Saclay
Julie Wardlow	15-11-2022	19-11-2022	Lancaster University



Welcome Lunch for Dave Sanders.

Work of art by Katriona Gould, *a PhD Student at DAWN*

Meet the Cosmic Dawn Team

Meet the Team

Sune Toft
Center Director

Thomas Greve
Center Co-Director

Guarn Nissen
Center Coordinator

Johan Fynbo
Section Leader

Helena B.-Sørensen
Section Secretary

Allan Hornstrup
Head of Astrophysics

Darach Watson
Associate Professor

Georgios Magdis
Associate Professor

Charles Steinhardt
Associate Professor

Gabriel Brammer
Associate Professor

Pascal Oesch
Associate Professor

Charlotte Mason
Associate Professor

Lise Christensen
Associate Professor

Birgitta Nordström
Professor Emerita

Peter Jakobsen
Affiliate Professor

Kasper Heintz
Assistant Professor

Peter Laursen
Scientific Communicator

Bo Milvang-Jensen
Senior Researcher

Anton Sørensen
Senior Researcher

Michael Andersen
Senior Consultant

Bitten Gullberg
Carlsberg Int. Fellow

Aswin Vijayan
DAWN Fellow

Victoria Strait
DAWN Fellow

Anne Hutter
DAWN Fellow

Jasleen Matharu
DAWN Fellow

Lijie Liu
DAWN Fellow

Francesca Rizzo
DAWN Fellow

Minju Lee
DAWN Fellow

Shuowen Jin
Postdoc

Conor McPartland
Postdoc

Steven Gillman
Postdoc

Marko Shuntov
Postdoc

Meghana Killi
PhD Student

Clara Arteaga
PhD Student

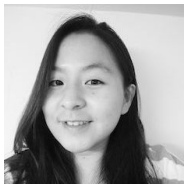
Malte Brinch
PhD Student

Kate Gould
PhD Student

Vadim Rusakov
PhD Student

Gonzalo P. Lyon
PhD Student

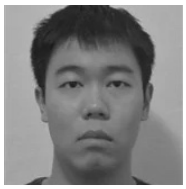
David Blanquez
PhD Student



Ting-Yi Lu
PhD Student

Joonas Viuho
PhD Student

Natalie Allen
PhD Student



Dazhi Zhou
PhD Student

Simone Vejlgaard
PhD Student

Albert Sneppen
PhD Student

Iris Jermann
PhD Student

Guozhen Ma
PhD Student

Flóra A. Zentai
Student Helper

Peter Johannsen
Student Helper

International Associates

Trity Poubahrami
International Associate

Kate Whitaker
International Associate

Karina Caputi
International Associate

Kristian Finlator
International Associate

Peter Capak
International Associate

Desika Narayanan
International Associate

Fabian Walter
International Associate

Luis Colina
International Associate

Claudia Lagos
International Associate

Farewell to

Francesco Valentino
Associate Professor

Seiji Fujimoto
Postdoc

John Weaver
PhD Student

Vasily Kokorev
PhD Student

Nina Bonaventura
Postdoc

Master's Students 2022/2023

Student Name	Supervisor Name
Cecilie Henneberg	Johan Fynbo
Mads N.-Lynggaard	Johan Fynbo
Arthur Kadela	Johan Fynbo
Christopher Andersen	Johan Fynbo
Shu Yan Zheng	Johan Fynbo
Flemming Fischer	Johan Fynbo
Nikolaj Sillassen	G. Magdis & S. Jin

Student Name	Supervisor Name
Jesper Larsen	Lise Christensen
Lise K. Nøland	Kasper Elm Heintz
Luka Vujeva	Charles L. Steinhardt
Hao Zhang	Lise Christensen
Rachel Gledhill	Victoria Strait
Isabella Henum	Victoria Strait

Alumni

Name	Position
Francesco Valentino	Assistant Professor
Daniel Ceverino	Assistant Professor
Kimihiko Nakajima	DAWN Fellow
Seiji Fujimoto	DAWN Fellow
Nina Bonaventura	DAWN Fellow
John Weaver	PhD Student
Vasily Kokorev	PhD Student
Carlos Guijarro	PhD Student
Mikkel Stockmann	PhD Student
Isabella Cortzen	PhD Student

Name	Position
Ditlev Frickmann	MSc Student
Ioannis Mageiras	MSc Student
Marina Koukouvaou	MSc Student
Jiaming Yao	MSc Student
Han Lei	MSc Student
Athanasios Anastasious	MSc Student
Cecilie Nørholm	MSc Student
Christina Konstantopoulou	MSc Student
Simon Pochinda	MSc Student
Christian Kragh Jespersen	MSc Student

DAWN employees and collaborators *at the Copenhagen DAWN Conference 2022 (Image Credit: Zarko Ivetic).*

Publications

Top Ten DAWN Articles 2022

Fujimoto, S., G. B. **Brammer**, D. **Watson**, G. E. **Magdis**, V. **Kokorev**, T. R. **Greve**, S. **Toft**, F. **Walter**, R. Valiante, M. Ginolfi, R. Schneider, F. **Valentino**, L. **Colina**, M. Vestergaard, R. Marques-Chaves, J. P. U. **Fynbo**, M. Krips, C. L. **Steinhardt**, I. **Cortzen**, F. **Rizzo**, and P. A. **Oesch** (Apr. 2022). *A dusty compact object bridging galaxies and quasars at cosmic dawn*. In: Nature 604.7905, pp. 261–265. DOI: 10.1038/s41586-022-04454-1. arXiv: 2204.06393 [astro-ph.GA].

Giménez-Arteaga, C., G. B. **Brammer**, D. Marchesini, L. **Colina**, V. Bajaj, M. **Brinch**, D. Calzetti, D. Lange-Vagle, E. J. Murphy, M. Perna, J. Piqueras-López, and G. F. Snyder (Nov. 2022). *High-resolution Hubble Space Telescope Imaging Survey of Local Star-forming Galaxies. I. Spatially Resolved Obscured Star Formation with Hα and Paschen-β Recombination Lines*. In: The Astrophysical Journal Supplement Series 263.1, p. 17. DOI: 10.3847/1538-4365/ac958c. arXiv: 2210.00028 [astro-ph.GA].

Jakobsen, P., P. Ferruit, C. Alves de Oliveira, S. Arribas, G. Bagnasco, R. Barho, T. L. Beck, S. Birkmann, T. Böker, A. J. Bunker, S. Charlot, P. de Jong, G. de Marchi, R. Ehrenwinkler, M. Falcolini, R. Fels, M. Franx, D. Franz, M. Funke, G. Giardino, X. Gnata, W. Holota, K. Honnen, P. L. Jensen, M. Jentsch, T. Johnson, D. Jollet, H. Karl, G. Kling, J. Köhler, M. .-. Kolm, N. Kumari, M. E. Lander, R. Lemke, M. López-Caniego, N. Lützgendorf, R. Maiolino, E. Manjavacas, A. Marston, M. Maschmann, R. Maurer, B. Messerschmidt, S. H. Moseley, P. Mosner, D. B. Mott, J. Muzerolle, N. Pirzkal, J. .-. Pittet, A. Plitzke, W. Posselt, B. Rapp, B. J. Rauscher, T. Rawle, H. .-. Rix, A. Rödel, P. Rumler, E. Sabbi, J. .-. Salvignol, T. Schmid, M. Sirianni, C. Smith, P. Strada, M. te Plate, J. Valenti, T. Wettemann, T. Wiehe, M. Wiesmayer, C. J. Willott, R. Wright, P. Zeidler, and C. Zincke (May 2022). *The Near-Infrared Spectrograph (NIRSpec) on the James Webb Space Telescope. I. Overview of the instrument and its capabilities*. In: Astronomy and Astrophysics 661, A80. DOI: 10.1051/0004-6361/202142663. arXiv: 2202.03305 [astro-ph.IM].

Kokorev, V., G. **Brammer**, S. **Fujimoto**, K. Kohno, G. E. **Magdis**, F. **Valentino**, S. **Toft**, P. **Oesch**, I. **Davidzon**, F. E. Bauer, D. Coe, E. Egami, M. Oguri, M. Ouchi, M. Postman, J. Richard, J. .-. Jolly, K. K. Knudsen, F. Sun, J. R. **Weaver**, Y. Ao, A. J. Baker, L. Bradley, K. I. **Caputi**, M. Dessauges-Zavadsky, D. Espada, B. Hatsukade, A. M. Koekemoer, A. M. Muñoz Arancibia, K. Shimasaku, H. Umehata, T. Wang, and W. .-. Wang (Dec. 2022). *ALMA Lensing Cluster Survey: Hubble Space Telescope and Spitzer Photometry of 33 Lensed Fields Built with CHArGE*. In: The Astrophysical Journal Supplement Series 263.2, p. 38. DOI: 10.3847/1538-4365/ac9909. arXiv: 2207.07125 [astro-ph.GA].

Naidu, R. P., P. A. **Oesch**, P. van Dokkum, E. J. Nelson, K. A. Suess, G. **Brammer**, K. E. **Whitaker**, G. Illingworth, R. Bouwens, S. Tacchella, J. Matthee, N. **Allen**, R. Bezanson, C. Conroy, I. Labbe, J. Leja, E. Leonova, D. Magee, S. H. Price, D. J. Setton, V. **Strait**, M. Stefanon, S. **Toft**, J. R. **Weaver**, and A. Weibel (Nov. 2022b). *Two Remarkably Luminous Galaxy Candidates at z ≈ 10-12 Revealed by JWST*. In: The Astronomical Journal Letters 940.1, p. L14. DOI: 10.3847/2041-8213/ac9b22. arXiv: 2207.09434 [astro-ph.GA].

Sillassen, N. B., S. **Jin**, G. E. **Magdis**, E. Daddi, J. R. **Weaver**, R. Gobat, V. **Kokorev**, F. **Valentino**, A. Finoguenov, M. Shuntov, C. Gómez-Guijarro, R. Coogan, T. R. **Greve**, S. **Toft**, and D. **Blanquez Sese** (Sept. 2022). *A galaxy group candidate at z ≈ 3.7 in the COSMOS field*. In: Astronomy and Astrophysics 665, p. L7. DOI: 10.1051/0004-6361/202244661. arXiv: 2209.05895 [astro-ph.GA].

Steinhardt, C. L., A. **Sneppen**, H. Hensley, A. S. Jermyn, B. Mostafa, J. R. **Weaver**, G. **Brammer**, T. H. Clark, I. **Davidzon**, A. C. Diaconu, B. Mobasher, V. Rusakov, and S. **Toft** (July 2022a). *Implications of a Temperature-dependent Initial Mass Function. III. Mass Growth and Quiescence*. In: The Astrophysical Journal 934.1, p. 22. DOI: 10.3847/1538-4357/ac7642. arXiv: 2206.01750 [astro-ph.GA].

Valentino, F., G. **Brammer**, S. **Fujimoto**, K. E. **Heintz**, J. R. **Weaver**, V. **Strait**, K. M. L. **Gould**, C. **Mason**, D. **Watson**, P. **Laursen**, and S. **Toft** (Apr. 2022). *The Archival Discovery of a Strong Lyα and [C II] Emitter at $z = 7.677$*. In: The Astronomical Journal Letters 929.1, p. L9. DOI: 10.3847/2041-8213/ac62cc. arXiv: 2203.03657 [astro-ph.GA].

Vijayan, A. P., S. M. Wilkins, C. C. Lovell, P. A. Thomas, P. Camps, M. Baes, J. Trayford, J. Kuusisto, and W. J. Roper (Apr. 2022). *First Light And Reionisation Epoch Simulations (FLARES) - III. The properties of massive dusty galaxies at cosmic dawn*. In: Monthly Notices of the Royal Astronomical Society 511.4, pp. 4999–5017. DOI: 10.1093/mnras/stac338. arXiv: 2108.00830 [astro-ph.GA].

Weaver, J. R., O. B. Kauffmann, O. Ilbert, H. J. McCracken, A. Moneti, S. **Toft**, G. **Brammer**, M. Shuntov, I. **Davidzon**, B. C. Hsieh, C. Laigle, A. Anastasiou, C. K. Jespersen, J. Vinther, P. **Capak**, C. M. Casey, C. J. R. **McPartland**, B. **Milvang-Jensen**, B. Mobasher, D. B. Sanders, L. Zalesky, S. Arnouts, H. Aussel, J. S. Dunlop, A. Faisst, M. Franx, L. J. Furtak, J. P. U. **Fynbo**, K. M. L. **Gould**, T. R. **Greve**, S. Gwyn, J. S. Kartaltepe, D. Kashino, A. M. Koekemoer, V. **Kokorev**, O. Le Fèvre, S. Lilly, D. Masters, G. **Magdis**, V. Mehta, Y. Peng, D. A. Riechers, M. Salvato, M. Sawicki, C. Scarlata, N. Scoville, R. Shirley, J. D. Silverman, A. **Sneppen**, V. Smolčić, C. **Steinhardt**, D. Stern, M. Tanaka, Y. Taniguchi, H. I. Teplitz, M. Vaccari, W. .-. Wang, and G. Zamorani (Jan. 2022a). *COSMOS2020: A Panchromatic View of the Universe to $z \sim 10$ from Two Complementary Catalogs*. In: The Astrophysical Journal Supplement Series 258.1, p. 11. DOI: 10.3847/1538-4365/ac3078. arXiv: 2110.13923 [astro-ph.GA].

DAWN Articles 2022

Acebron, A., C. Grillo, P. Bergamini, G. B. Caminha, P. Tozzi, A. Mercurio, P. Rosati, G. **Brammer**, M. Meneghetti, M. Nonino, and E. Vanzella (Dec. 2022a). *New strong lensing modelling of SDSS J2222+2745 enhanced with VLT/MUSE spectroscopy*. In: Astronomy and Astrophysics 668, A142. DOI: 10.1051/0004-6361/202244836. arXiv: 2208.13788 [astro-ph.GA].

Acebron, A., C. Grillo, P. Bergamini, A. Mercurio, P. Rosati, G. B. Caminha, P. Tozzi, G. B. **Brammer**, M. Meneghetti, A. Morelli, M. Nonino, and E. Vanzella (Feb. 2022b). *VLT/MUSE Observations of SDSS J1029+2623: Toward a High-precision Strong Lensing Model*. In: The Astrophysical Journal 926.1, p. 86. DOI: 10.3847/1538-4357/ac3d35. arXiv: 2111.05871 [astro-ph.GA].

Akins, H. B., S. **Fujimoto**, K. **Finlator**, D. **Watson**, K. K. Knudsen, J. Richard, T. J. L. C. Bakx, T. Hashimoto, A. K. Inoue, H. Matsuo, M. J. Michałowski, and Y. Tamura (July 2022a). *ALMA Reveals Extended Cool Gas and Hot Ionized Outflows in a Typical Star-forming Galaxy at $z = 7.13$*. In: The Astrophysical Journal 934.1, p. 64. DOI: 10.3847/1538-4357/ac795b. arXiv: 2206.06939 [astro-ph.GA].

Akins, H. B., D. **Narayanan**, K. E. **Whitaker**, R. Davé, S. Lower, R. Bezanson, R. Feldmann, and M. Kriek (Apr. 2022b). *Quenching and the UVJ Diagram in the SIMBA Cosmological Simulation*. In: The Astrophysical Journal 929.1, p. 94. DOI: 10.3847/1538-4357/ac5d3a. arXiv: 2105.12748 [astro-ph.GA].

Atek, H., L. J. Furtak, P. **Oesch**, P. van Dokkum, N. Reddy, T. Contini, G. Illingworth, and S. Wilkins (Apr. 2022). *The star formation burstiness and ionizing efficiency of low-mass galaxies*. In: Monthly Notices of the Royal Astronomical Society 511.3, pp. 4464–4479. DOI: 10.1093/mnras/stac360. arXiv: 2202.04081 [astro-ph.GA].

Bakx, T. J. L. C., J. A. Zavala, I. Mitsuhashi, T. Treu, A. Fontana, K.-i. Tadaki, C. M. Casey, M. Castellano, K. Glazebrook, M. Hagimoto, R. Ikeda, T. Jones, N. Leethochawalit, C. **Mason**, T. Morishita, T. Nanayakkara, L. Pentericci, G. Roberts-Borsani, P. Santini, S. Serjeant, Y. Tamura, M. Trenti, and E. Vanzella (Dec. 2022). *Deep ALMA redshift search of a $z \sim 12$ GLASS-JWST galaxy candidate*. In: Monthly Notices of the Royal Astronomical Society. DOI: 10.1093/mnras/stac3723. arXiv: 2208.13642 [astro-ph.GA].

Begley, R., F. Cullen, R. J. McLure, J. S. Dunlop, A. Hall, A. C. Carnall, M. L. Hamadouche, D. J. McLeod, R. Amorín, A. Calabró, A. Fontana, J. P. U. **Fynbo**, L. Guaita, N. P. Hathi, P. Hibon, Z. Ji, M. Llerena, L. Pentericci, A. Saldana-Lopez, D. Schaerer, M. Talia, E. Vanzella, and G. Zamorani (July 2022). *The VANDELS survey: a measurement of the average Lyman-continuum escape fraction of star-forming galaxies at $z = 3.5$*. In: Monthly Notices of the Royal Astronomical Society 513.3, pp. 3510–3525. DOI: 10.1093/mnras/stac1067. arXiv: 2202.04088 [astro-ph.GA].

Bellocchi, E., M. Pereira-Santaella, L. **Colina**, A. Labiano, M. Sánchez-García, A. Alonso-Herrero, S. Arribas, S. García-Burillo, M. Villar-Martín, D. Rigopoulou, F. **Valentino**, A. Puglisi, T. Díaz-Santos, S. Cazzoli, and A. Usero (Aug. 2022). *Compact molecular gas emission in local LIRGs among low- and high-z galaxies*. In: Astronomy and Astrophysics 664, A60. DOI: 10.1051/0004-6361/202142802. arXiv: 2204.02055 [astro-ph.GA].

Bezanson, R., J. S. Spilker, K. A. Suess, D. J. Setton, R. Feldmann, J. E. Greene, M. Kriek, D. **Narayanan**, and M. Verrico (Feb. 2022). *Now You See It, Now You Don't: Star Formation Truncation Precedes the Loss of Molecular Gas by 100 Myr in Massive Poststarburst Galaxies at $z \sim 0.6$*. In: The Astrophysical Journal 925.2, p. 153. DOI: 10.3847/1538-4357/ac3dfa. arXiv: 2111.14877 [astro-ph.GA].

Bhandari, S., K. E. **Heintz**, K. Aggarwal, L. Marnoch, C. K. Day, J. Sydnor, S. Burke-Spolaor, C. J. Law, J. Xavier Prochaska, N. Tejos, K. W. Bannister, B. J. Butler, A. T. Deller, R. D. Ekers, C. Flynn, W.-f. Fong, C. W. James, T. J. W. Lazio, R. Luo, E. K. Mahony, S. D. Ryder, E. M. Sadler, R. M. Shannon, J. Han, K. Lee, and B. Zhang (Feb. 2022). *Characterizing the Fast Radio Burst Host Galaxy Population and its Connection to Transients in the Local and Extragalactic Universe*. In: Astronomical Journal 163.2, p. 69. DOI: 10.3847/1538-3881/ac3aec. arXiv: 2108.01282 [astro-ph.HE].

Birkmann, S. M., P. Ferruit, G. Giardino, L. D. Nielsen, A. García Muñoz, S. Kendrew, B. J. Rauscher, T. L. Beck, C. Keyes, J. A. Valenti, P. **Jakobsen**, B. Dorner, C. Alves de Oliveira, S. Arribas, T. Böker, A. J. Bunker, S. Charlot, G. de Marchi, N. Kumari, M. López-Caniego, N. Lützgendorf, R. Maiolino, E. Manjavacas, A. Marston, S. H. Moseley, N. Prizkal, C. Proffitt, T. Rawle, H. W. Rix, M. te Plate, E. Sabbi, M. Sirianni, C. J. Willott, and P. Zeidler (May 2022). *The Near-Infrared Spectrograph (NIRSpec) on the James Webb Space Telescope. IV. Capabilities and predicted performance*

for exoplanet characterization. In: Astronomy and Astrophysics 661, A83. DOI: 10.1051/0004-6361/202142592. arXiv: 2202.03309 [astro-ph.IM].

Böker, T., S. Arribas, N. Lützgendorf, C. Alves de Oliveira, T. L. Beck, S. Birkmann, A. J. Bunker, S. Charlot, G. de Marchi, P. Ferruit, G. Giardino, P. **Jakobsen**, N. Kumari, M. López-Caniego, R. Maiolino, E. Manjavacas, A. Marston, S. H. Moseley, J. Muzerolle, P. Ogle, N. Pirzkal, B. Rauscher, T. Rawle, H. .-. Rix, E. Sabbi, B. Sargent, M. Sirianni, M. te Plate, J. Valenti, C. J. Willott, and P. Zeidler (May 2022a). *The Near-Infrared Spectrograph (NIRSpec) on the James Webb Space Telescope. III. Integral-field spectroscopy*. In: Astronomy and Astrophysics 661, A82. DOI: 10.1051/0004-6361/202142589. arXiv: 2202.03308 [astro-ph.IM].

Bolan, P., B. C. Lemaux, C. **Mason**, M. Bradač, T. Treu, V. **Strait**, D. Pelliccia, L. Pentericci, and M. Malkan (Dec. 2022). *Inferring the intergalactic medium neutral fraction at $z \sim$ 6-8 with low-luminosity Lyman break galaxies*. In: Monthly Notices of the Royal Astronomical Society 517.3, pp. 3263–3274. DOI: 10.1093/mnras/stac1963. arXiv: 2111.14912 [astro-ph.GA].

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