
Dark Cosmology Centre



Danmarks Grundforskningsfonds Center for
Kosmologi ved Københavns Universitet

ANNUAL REPORT 2005 (1 SEP – 31 DEC)

1. Highlights of the Year

The origin of short gamma-ray bursts

Following a long-term effort (launched prior to the establishment of the Centre), aimed at elucidating the nature of gamma-ray bursts and using them as probes of the distant Universe, researchers at the Centre led several observational campaigns on short gamma-ray bursts. These enigmatic cosmic explosions were discovered more than 35 years ago, but since their energetic gamma radiation lasts less than 2 seconds it makes them extremely difficult to catch. Dark Cosmology Centre ('DARK') researchers discovered the first optical afterglow from a short gamma-ray burst, published 6 Oct in the journal *Nature*, and participated in other discoveries on short gamma-ray bursts published in the same issue.

In two short gamma-ray bursts, association with energetic supernovae, as found in most long-duration gamma-ray bursts, was ruled out. Moreover, one burst was found in the immediate vicinity of a luminous, non-starforming elliptical galaxy belonging to a cluster of galaxies. Because of the lack of supernovae and because elliptical galaxies are generally devoid of very massive stars but rich in tight binary systems, the preferred model now is that short gamma-ray bursts are the consequence of the merging of two very compact objects.

This discovery has paved the way for unravelling the secrets of short gamma-ray bursts and was accordingly named by the journal *Science* as its Breakthrough of the Year #4. Danish weekly *Ingeniøren* named it the best Danish scientific achievement of 2005.



Setting up the infrastructure

The opening of the Centre on 1 Sep 2005 was marked by a reception in Santorini in connection with an international meeting on gamma-ray bursts. Meanwhile, in Copenhagen, delays meant that the Centre could not move into its new premises until 1 Dec. Part of the Centre is now established in newly renovated rooms, financed by the host institution and done in collaboration with the Centre. The Centre hosted an opening reception on 29 Nov together with the two other new DNRF centers for Models of Life and Molecular Movies located at the Niels Bohr Institute. Around 150 guests made it a memorable day.



We have installed glass walls between the hallway and the offices and have researchers and students share offices as means to provide an open environment where everybody is easily accessible and the information flow between researchers working on different projects is efficient. The rooms have been furnished with focus on traditional Scandinavian design characteristics—light, functional furniture made of basic materials such as wood, steel, leather and glass. We have also created a 'DARK lounge' as part of the efforts to establish a pleasant and productive environment for all Centre employees.

The Centre has built up a new IT infrastructure around Apple OS X computers. All researchers (including PhD students) have been provided with laptops (PowerBooks/MacBooks) so that they can work efficiently both in the office, at home and while traveling. Students are equipped with desktop computers (iMacs). A computer server (Apple dual G5) has been set up to act as main server (login/mail/web). The server also provides backup system and is used for numerical modeling in a local Xgrid configuration (small-scale distributed computing that use idle resources on local computers). For intense model calculations we use the supercomputing facilities available through the Danish Center for Scientific Computing.

Hiring our staff

Our Centre is our staff. It is therefore a major landmark that the Centre was almost fully staffed before the end of 2005. The secretary, Janaki Lund Jensen, was hired already in the spring of 2005 and the IT manager, Brian Lindgren Jensen was employed as early as June to set up the Centre IT infrastructure.



Researchers committed for the duration of the Centre form the permanent research and administrative core. These are: Prof. Jens Hjorth, Dr. Johan Fynbo, Dr. Anja Andersen, Dr. Kristian Pedersen, Dr. Jesper Sollerman and Dr. Darach Watson. Hjorth, Fynbo and Andersen are permanent staff at the Niels Bohr Institute. Of these, only Andersen and Sollerman were funded by the Centre in 2005.

Short-term temporary positions were awarded to Dr. Jesper Sommer-Larsen and Dr. Troels Haugbølle. This was done specifically to kick-start activities in simulation of galaxy and structure formation at the Centre immediately.

Open advertisements for PhD student (3 year) and postdoctoral researcher (2 year) positions were made on the American Astronomical Society (AAS) Job Register, the principle international resource for job notices in astronomy and astrophysics. In response to this announcement approximately 40 postdoctoral and 30 PhD student applications were received. The best candidates were short-listed by a hiring committee. After discussions with these applicants, positions were offered to the most suitable candidates. Dr. Maximilian Stritzinger and Dr. Marceau Limousin were hired as postdoctoral researchers on 2 year contracts. Dr. Tamara Davis was hired in a similar way following a prior announcement, partly funded by Villum Kann Rasmussen Foundation. Chloé Féron, Christina Thöne and Dong Xu were employed as PhD students.

A permanent lectureship at the Niels Bohr Institute in theoretical cosmology was announced with a closing date of 1 Oct 2005. The position will be funded by the Centre for the first five years.

The aspiration of the Centre towards increasing the representation of women in astronomy in Denmark is being put into practice through a positive awareness of qualified women scientists. Now at the Centre, 30% of the scientists on longer-term contracts above PhD level are women. Including PhD students, this is 44%. In *Nature* (Watson, Andersen & Hjorth, *Nature* **436**, 174, 2005), we published an analysis of the gender distribution in the first European Young Investigator Awards.

Cosmology 2005 – A reality check

The Centre arranged and co-financed—together with Niels Bohr Institute and NORDITA—a major conference in Copenhagen during December 14–17; “Cosmology 2005—A reality check”. The conference attracted about 150 participants, including a very large fraction of all Nordic researchers working within this area. Information about the conference can be obtained from the dedicated conference web pages at the Centre web site (www.dark-cosmology.dk).

Prizes and awards

Anja C. Andersen received the EC Descartes Prize for excellence in science communication.

Jesper Sollerman received the 2005 Anna-Greta and Holger Crafoord fund award for work in the field of cosmology. He was also awarded one of the Danish National Bank apartments in Nyhavn for the year 2005/2006.

A chronological lists of events, including prizes, awards, grants and other recognitions is provided in Appendix 1.

2. Research 2005

As described in the research plan the Centre's projects revolve around using cosmic lighthouses like supernovae and gamma-ray bursts (GRBs) for constraining cosmological parameters and studying distant galaxies. The Centre is operating with four scientific themes (dark energy, dark matter, dark ages, cosmic dust), three key projects and a series of smaller or more risky projects.

Key Project 1: Probing the end of the dark ages

Our study of the dark ages mostly focuses on using GRBs or distant galaxies as probes.

The discovery of GRB 050904 at $z = 6.29$ implies that we now know that GRBs occurred less than a billion years after the Big Bang when the Universe was less than 7% of its present age. Researchers at the Centre (Watson et al.) found that GRB 050904 was the most distant known X-ray source—more than 100000 times brighter than the most luminous quasars at this distance. The brightness of GRB 050904 makes it reasonable to expect that GRBs can be observed at even larger distances, including the end of the dark ages, if GRBs are produced by the very first generation of stars.

Using our target-of-opportunity programme at the Nordic Optical Telescope we detected and studied the second most distant GRB known for which we determined a redshift of $z=5.3$. In fact this event was the most distant known GRB at the time until the new record holder GRB 050904 appeared three weeks later. Our joint analysis of GRB distances showed them to be the most distant class of objects in the Universe with a mean redshift of 2.8 and potentially an excellent tracer of the history of star formation (Jakobsson et al.).

An international project conceived and led by researchers at the Centre (Hjorth et al.) was submitted as a 'Large Programme' in response to ESO's call for proposals in Oct 2005. The project was approved in December and will run for two years at ESO's Very Large Telescope. This is a very large observational effort consisting of about 300 hr of observing time. The goal is to characterize the galaxies hosting GRBs, which are believed to be typical star-forming galaxies, possibly with a bias towards primeval galaxies, i.e. galaxies forming stars out of chemically unevolved gas. Such galaxies most likely have a lot in common with the first galaxies that formed in the Universe, and hence ended the dark ages.

Concerning the use of distant galaxies as a probe, we started to design a large survey (Fynbo et al.) for very distant galaxies using a new ESO telescope—the near-IR survey telescope VISTA. The goal is to detect a few tens of the very first galaxies that formed at redshift of about 9 (about 500 million years after the Big Bang). The survey is expected to start in late 2007 and continue in 2008. The main achievement in 2005 was the ordering of the filters that will be used in the survey.

Key Project 2: Supernova cosmology

Jesper Sollerman arrived from Stockholm in Sep 2005 to initiate the Centre's supernova efforts in collaboration with the ESSENCE team¹. A first report (Sollerman et al.) on the ESSENCE project for

¹ ESSENCE is a ground-based supernova survey designed to constrain the equation of state of the dark energy (w) by measuring luminosity distances for about 200 Type Ia supernovae over a five-year period.

the 13th European Physical Society conference (Beyond Einstein—Physics for the 21st Century) describes the progress of ESSENCE during the initial two years. Jesper Sollerman conducted observations at the VLT for the ESSENCE project on 3 nights in Oct 2005, concluding the third ESSENCE year.

The most important events related to this project were the arrival of two new postdocs: Tamara Davis and Max Stritzinger. Max Stritzinger arrived in November from Germany to work on supernova physics related to the cosmological studies using SNe Ia as probes. Tamara Davis arrived in Copenhagen from Australia in December and presented a talk on ESSENCE at the Cosmology 2005 conference just after her arrival.

As part of the initiative to model dust formation in supernova remnants and cool luminous pulsating stellar atmospheres, the establishment of a mineral database was initiated. For the numerical modeling of cool pulsating stellar atmospheres, Anja C. Andersen has begun rewriting the numerical code together with the Centre's associate scientist Susanne Höfner at Uppsala University. For the modeling of dust production in supernova remnants initial contacts have been established with Cecilia Kozma at Stockholm University. Kozma has a supernova code which will be useful for calculations of dust formation in supernovae at low metallicities.

Key Project 3: The nature of dark matter

An initiative has been launched for understanding the systematics involved in deriving cluster masses from X-ray data. The idea is to take computer simulations of galaxy clusters and produce X-ray “observations” of these by invoking the instrumental responses to the simulated clusters. By analysing these “observations” in the same way as real data, and comparing the derived cluster mass to the true cluster mass known from the simulations, insight is obtained into systematic effects biasing cluster mass estimation from X-ray data. This is crucial in order to establish scaling relations between e.g. cluster mass and intracluster gas temperature. An end-to-end pipe-line has been set up, taking a cluster from a cosmological N-body/hydro simulation, calculating the X-ray emission from each gas particle, ray-tracing the emitted photon through the XMM-Newton telescope+detector system, producing simulated data, and analysing the data in a standard way. First results indicate that X-ray data can be used to derive the cluster mass to about 10% accuracy—provided that great care is taken in the spectral analysis of the X-ray data. This project will be a key contribution to the XMM-Newton Large Programme with the goal of establishing cluster scaling relations from a statistical, representative sample of more than 30 nearby clusters (Pedersen et al.).

A promising dark matter candidate is the sterile neutrino arising from a minimal extension of the “standard model” of particle physics. Sterile neutrinos nicely explain several basic problems in the Universe, e.g. the abundance of dark matter, the rough structure of dark matter halos and the baryon asymmetry in the Universe. Also, it is an appealing feature of sterile neutrinos that their existence likely can be confirmed or rejected from astrophysical observations in the near future. Since sterile neutrinos should decay into a “normal” neutrino and a photon, the abundance of dark matter throughout the Universe, should make the photons from decaying sterile neutrinos detectable with current instruments. The photon energy should be equal to half the rest mass of the sterile neutrino and be very narrow. Using data from the Chandra X-ray Observatory, we (Riemer-Sørensen et al.) have initiated searches for a narrow emission line in the 0.1–10 keV energy band from sterile neutrinos in the Milky Way halo and in nearby galaxies and clusters of galaxies. A more sensitive search for decay

lines was planned on basis of data from the Hard X-ray Detector (HXD) on board the Suzaku (previously Astro-E2) X-ray satellite. Unfortunately, the HXD failed right after launch, but instead a less sensitive search will be carried out based on high resolution data from the Chandra and XMM

The first steps in the Centre's theoretical efforts in the field of dark matter and the link to astroparticle physics were taken through the announcement of a permanent position in theoretical cosmology.

Smaller or more risky projects

Modeling Lyman α emission from early galaxies: We have started modeling the Ly α properties of young galaxies, on the basis of fully cosmological galaxy formation simulations. In particular the emission of Ly α radiation, associated with so-called "cold accretion" of filamentary gas onto proto-galaxies and galaxy groups, has been determined (Sommer-Larsen et al.). The detection of a Lyman α blob with no detectable emission at any other wavelength, allowed us to infer the cold accretion of filamentary gas onto a dark matter halo at $z=3.15$ (Nilsson et al.). Moreover, progress has been made in the modeling of Ly α resonant scattering transfer out of proto-galaxies, and the calculation of the observational consequences of this.

Fossil groups: N-body/hydrodynamical computer simulations have been used to study the formation of the so-called "fossil" groups of galaxies. These are systems dominated by a large elliptical galaxy which is substantially brighter than the second brightest galaxy. So far, it has been a puzzle why about 15% of all galaxy groups are fossil groups. It is found that fossil groups are galaxy groups forming earlier than non-fossil groups, and therefore are more evolved systems at the present day (Sommer-Larsen et al.). Hence fossil groups are expected to be relaxed systems and as such well suited systems for mapping out the distribution of dark matter on galaxy group scales.

Measurement of extinction curve using afterglows of GRBs: The largest known column density damped Lyman α absorber was discovered in a GRB at redshift $z=2.90$ (Watson et al.). A large multiwavelength dataset was acquired and used to determine the spectral energy distribution and evolution of this burst. From these data it was shown that the extinction of the afterglow was well reproduced in the optical/UV with a Small Magellanic Cloud type extinction similar to many afterglows. But at the same time it was proved that the soft X-ray photoelectric absorption overpredicts the afterglow reddening in the optical/UV by more than an order of magnitude. A flat (or grey) extinction curve, which has been the dominant paradigm to explain lack of reddening in GRB afterglows, was excluded as the general explanation of the excess X-ray absorption problem. It was shown for the first time that a metals-to-dust ratio well above the Galactic/LMC/SMC value is also required. A new theory to explain the excess absorption problem was suggested involving the extremely young ages of the star-formation in GRB host galaxies.

Obscured star formation: Analysis of data from the Spitzer Space telescope in combination with UV, optical, near-infrared and sub-mm data as a probe of the obscured star formation in GRB host galaxies was initiated (Castro Cerón et al.).

3. Cooperation and collaboration

Scientific collaboration with research groups in Denmark and abroad

The research conducted at the Centre is highly international, as evidenced by the fact that the 10 papers published in 2005 have authors affiliated to a total of 63 institutions from 13 countries. This comes from established networks and consortia (e.g. FP5 and FP6 RTN networks, see research plan) but is also often formed on a case by case basis, especially in case where observational data from many facilities around the world is put together in collaborative work. There is also collaboration with all Danish astrophysics research institutes (see the research plan).

Exchange of researchers

The Centre has started up its visitor program, including collaboration with its associates (see the research plan). We also used the visitor programme to invite speakers for the Cosmology 2005 conference. During the first months (i.e. Autumn 2005), before moving into the new offices, the visitor programme was starting up at a slow pace, but we still managed to host a dozen guest researchers for shorter periods of time. The 2005 list of visiting scientists is given in Appendix 2. The list of visitors is also maintained at the Centre web site.

A list of research visits and participation in conferences by researchers at the Centre is given in Appendix 3.

Organization of conference

As mentioned in the Highlights section, the Centre co-organized a ‘reality check’ conference in Dec 2005. The aim of the conference was to bring together researchers working both with theory and people working on observational aspects of contemporary cosmology. The Centre took the opportunity of the occasion to invite some of the leading scientists within the research areas most closely related to its research plan. There were also many talks scheduled by young Nordic researchers working within the field of interest of the Centre. The program and list of participants is given in Appendix 4.

Advisory committee

The Centre has had a few informal interactions with its Advisory Committee in 2005. In particular, Prof. Richard Ellis participated in the December conference. The Centre plans to initiate more formal relations in 2006 and a site visit in 2007.

Coordination with the host institution

Interaction and coordination with the host institution, notably through the Niels Bohr Institute, is generally smooth and satisfactory, through the organizational setup described in the contract. It should be noted though that there was a significant delay in preparing the office space. More worryingly there continue to be considerable problems with new accounting systems which also affect the Centre’s overview of its finances and its ability to make financial transactions.

4. Research Training

The Centre started the preparatory work, including securing external funding, for organizing a Nordic Summer School in observational astrophysics to be held at La Palma in June 2006. In the school, PhD students from the Nordic and Baltic countries will learn how to prepare and carry out observations at both the Nordic Optical Telescope and the Swedish solar telescope on the mountain (Roque de los Muchachos, La Palma).

At the Niels Bohr Institute the Centre is offering a number of graduate courses in the fields covered by our research plan (dark matter, dark energy, and to some degree galaxy formation). The Centre is also significantly involved in undergraduate teaching, e.g. in the first astronomy course offered to the physics students, which is a first year introduction to cosmology.

The Centre initiated work on a detailed plan for research training. Key elements are to further the ability to pursue independent, interesting research and to develop administrative skills (supervision, fund raising and project management). For postdocs we also offer the opportunity to be involved in teaching for those who express an interest in this.

5. Economy

External funding (1 Sep – 31 Dec 2005), not including contributions from the host institution, was as foreseen in the contract. The value of the external funding, 1.2 MDKK cf. Appendix 5, is about half that of the funding received from the DNRF.

6. Publications

The main scientific production of the Centre consists of scientific papers published in esteemed, refereed, international journals. All preprints are also posted prior to publication at the arXiv preprint archive. In this report we list only refereed papers published in 2005 and only papers that were written, revised, or edited after the start of the Centre (1 Sep), by people affiliated to the Centre at that time (a total of 10 papers). At the Centre website we maintain a daily updated list of hyperlinked published papers each year as well as a list of all, as yet, unpublished preprints, posted at the arXiv archive (as of 22 March 2006 there are 14 unpublished papers posted in 2005). Though the ADS, CITEBASE or SLAC/SPIRES there is ready access to reads and citation statistics for the Centre publications. As of 22 March 2006 the 10 papers have received a total of 197 citations according to the ADS, more than a factor of 5 above the average citation rate in this period for the relevant journals, and have been read 2281 times through the ADS. Two of these papers are in the ten most cited papers in astronomy journals (including Nature and Science) published during this period.

In the list of publications given in Appendix 6 we also list major publications not directly related to the research plan. These include a Nature correspondence on selection bias and several papers popularizing our research in Danish.

7. Communications

Several of the Centre's employees have over the years established a very high public outreach profile and the Centre's outreach initiatives are naturally building on this. A common, focused public outreach program has been set up, targeting mainly the general public. Also guidelines for internal communication within the Centre, between the Centre and its host institute, and between the Centre and the international scientific community have been set up.

On 2 Dec, Anja C. Andersen was awarded the EU's 2005 Descartes Prize for Research & Science Communication "for her exceptional gift for presenting the complexities of science to a popular audience". This sparked considerable interest by the media, resulting in many interviews and articles.

In relation to the discovery of the first optical afterglow from a short gamma-ray burst, a major campaign aiming at the press was launched. A Danish press release was prepared and issued in collaboration with the Niels Bohr Institute communications office, an international press release was prepared and issued in collaboration with ESO, supplementary material (animation in TV quality, high resolution images, background story) was posted at the Centre web site, and key science journalists were contacted directly. This large effort turned out to pay off very well, resulting in e.g.: TV-appearances in Danish prime time ("TV-Avisen" and "TV2 Nyhederne"), numerous articles in the main Danish and international news papers, interviews to radio (e.g., DR P1 magazine "Videnskabens Verden"), and the first Nature podcast.

The Centre has committed itself to writing a series of 6 articles in the popular science magazine "Naturens Verden" and the first 3 articles (on the dark Universe, on supernovae, and on gamma-ray bursts) appeared in 2005.

Using the above occasions, the pre-existing widespread network with science journalists has been further developed, strengthened, and used to brand DARK and cosmology as an interesting and vital area of basic science. See Appendix 7 for a full list of the Centre's extensive outreach activities in 2005.

Ved underskriften bekræftes det, at beretning og regnskab med tilhørende noter og oversigter indeholder alle oplysninger, som vedrører årets aktiviteter i Danmarks Grundforskningscenter for Kosmologi ved Københavns Universitet.

Jens Hjorth

København 29. marts 2006

Appendix 1: Events 2005

- 1 Jan 2005 As the Niels Bohr Institute organization is restructured, the future Centre formally becomes one of 12 well-defined research units
- 1 June 2005: IT manager Brian L. Jensen starts work on setting up the Centre's IT infrastructure
- 1 Aug 2005: Jesper Sommer-Larsen starts 1-yr contract on numerical simulations
- Aug 2005: The contract between DG, KU and DARK is signed
- 1 Sep 2005: The Centre starts its activities in the research unit's premises at the time
- 1 Sep 2005: The Centre hosts a reception for its international GRB collaborators in Santorini to mark the opening
- 1 Sep 2005: Jesper Sollerman arrives from Stockholm to take up 5-yr contract
- 1 Sep 2005: Jesper Sollerman awarded one of the Danish National Bank apartments in Nyhavn
- 21 Sep 2005: Jesper Sollerman receives the 2005 Anna-Greta and Holger Crafoord fund award for work in the field of cosmology
- 1 Oct 2005: Closing date for applications for NBI/DARK lectureship in theoretical cosmology
- 1 Oct 2005: Chloé Féron arrives from Toulouse to start her PhD studies
- 1 Oct 2005: Christina Thöne arrives from Munich to start her PhD studies
- 1 Oct 2005: Troels Haugbølle takes up 6-month postdoc appointment on SZ simulations
- 6 Oct 2005: Publication of three Nature papers on short GRBs makes the cover to Nature
- 1 Nov 2005: Anja C. Andersen takes up permanent position at the Niels Bohr Institute to work full time at the Centre
- 1 Nov 2005: Dong Xu arrives from Nanjing to start his PhD studies
- 17 Nov 2005: Anja C. Andersen delivers the keynote speech at the University of Copenhagen 'årsfest'
- 25 Nov 2005: Unofficial DARK party marking the move into new premises
- 29 Nov 2005: Official inauguration of the Centre
- 1 Dec 2005: Maximilian Stritzinger arrives from Munich to take up 2-yr postdoc on supernova physics
- 2 Dec 2005: Anja C. Andersen receives EC Descartes Prize for science communication
- 6 Dec 2005: Tamara M. Davis arrives from Sydney to take up 2-yr postdoc on supernova cosmology
- 14—17 Dec 2005: Conference: "Cosmology 2005 – A reality check"
- 21 Dec 2005: ESO VLT Large Programme on GRB host galaxies approved (PI Jens Hjorth)
- 23 Dec 2005: Discovery of short GRBs named 2005 Breakthrough of the Year #4 by Science Magazine
- 23 Dec 2005: Discovery of origin of short and long GRBs named best Danish research achievement 2005 by Danish weekly Ingeniøren

Appendix 2: Visiting scientists 2005

Prof. Susanne Höfner (U. Uppsala, S)	18 Aug – 3 Sep 05
Dr. Marianne Vestergaard (Steward Observatory, USA)	5 – 15 Sep 05
Dr. Andreas O. Jaunsen (U. Oslo, N)	21 – 22 Sep 05
Dr. Marceau Limousin (OMP Toulouse, F)	22 – 23 Sep 05
Dr. Andrew Levan (U. Hertfordshire, UK)	13 Sep 05
Dr. Stephanie Courty (U. Iceland, IS)	1 – 4 Nov 05
Prof. Nial Tanvir (U. Hertfordshire, UK)	7 – 9 Nov 05
Prof. Gunnlaugur Björnsson (U. Iceland, IS)	25 Nov 05
Prof. Vincenzo Antonuccio (U. Catania, I)	28 – 30 Nov 05
Ms. Danka Paraficz (Nordic Optical Telescope, ES)	3 Dec – 17 Dec 05
Prof. Vincenzo Antonuccio (U. Catania, I)	5 Dec – 4 Jan 06
Dr. Laura Portinari (U. Turku, SF)	2 – 8 Dec 05
Dr. Håkon Dahle (U. Oslo, N)	6 – 8 Dec 05
Prof. Steve Allen (Caltech, USA)	14 – 17 Dec 05
Prof. Nial Tanvir (U. Hertfordshire, UK)	14 – 17 Dec 05
Prof. Richard Ellis (Palomar Observatory, USA)	14 – 17 Dec 05
Prof. Jean-Paul Kneib (LA Marseille, F)	15 – 17 Dec 05
Prof. Steen Hannestad (U. Aarhus, DK)	14 – 17 Dec 05
Dr. Marianne Vestergaard (Steward Observatory, USA)	15 Dec 05 – 4 Jan 06
Dr. Sune Toft (Yale, USA)	20 Dec 05 – 8 Jan 06
Dr. Bo Milvang-Jensen (Max Planck Institut EP, D)	22 Dec 05
Dr. Thomas Greve (Caltech, USA)	22 Dec 05

Appendix 3: Travel, talks and visits

“GRBs: the first three hours”, Santorini, Greece (29 Aug – 2 Sep 2005): Jens Hjorth, Jesper Sollerman (Talk), Kristian Pedersen, José María Castro Cerón (Talk: “First look at GRB hosts with Spitzer”), Páll Jakobsson (Talk), Christian Hededal (Talk).

“ANGLES school on Gravitational Lensing and Galaxy Dynamics”, Jodrell Bank Observatory, UK (2 – 3 Sep 2005): Árdís Éliasdóttir, Michal Michalowski, Danuta Paraficz.

“European Radio Interferometry School”, Manchester, UK (4 - 9 Sep 2005): Árdís Éliasdóttir, Michal Michalowski, Danuta Paraficz.

“From galaxies to large-scale structure”, Crafoord Symposium, Lund, Sweden (19 Sep 2005): Kristian Pedersen.

“The structure of the Universe and the future of cosmology”, Crafoord Symposium, Stockholm, Sweden (20 – 21 Sep 2005): Jens Hjorth, Anja Andersen, Johan Fynbo, Jesper Sollerman.

Observing run, Paranal Observatory, Chile (3 - 6 Oct 2005): Jesper Sollerman.

“Extragalactic and Galactic ISM Modelling in an ALMA Perspective”, Onsala Space Observatory, Sweden (13 - 15 Oct 2005): Anja C. Andersen.

Research visit, MPA, Garching, Germany (host: O. Möller), 17 – 25 Oct 2005: Árdís Éliasdóttir.

“Astronomidagar”, U. Uppsala (21 Oct 2005): Jesper Sollerman.

“Liv i Universet”, Niels Bohr Institute (2 Nov 2005): Anja C. Andersen.

Observing run at the Danish 1.5m telescope, La Silla, Chile (5 – 21 Nov 2005): Chloé Féron, Christina Thöne.

Research visit, Institute of Theory and Computation (ITC), Harvard, USA (6-11 Nov 2005): Jesper Sommer-Larsen (Talk: "X-ray emission from hot disk galaxy halos, Ly α emission from forming galaxies, and "fossil" galaxy groups").

Research visit, Caltech, Pasadena, USA (12-20 Nov 2005): Jesper Sommer-Larsen (Talk: "X-ray emission from hot disk galaxy halos, Ly α emission from forming galaxies, and "fossil" galaxy groups").

Collaboration meeting on the DEMON satellite proposal, Graz, Austria (14 - 18 Nov 2005): Michal Michalowski.

Festforelæsning ved KU (17 Nov 2005): Anja C. Andersen (Talk: “Kosmisk støv - Livets kilde”).

XMM Time Allocation Panel meeting, Vienna, (23 – 24 Nov 2004): Jesper Sollerman.

“Gamma Ray Bursts in the Swift Era”, Washington DC, USA (29 Nov – 2 Dec 2005): Páll Jakobsson (Talk: “GRB 050814 at $z = 5.3$ and the redshift distribution of Swift GRBs”).

Research visit, Institute of Theoretical Astrophysics, U. Oslo, Norway (hosts: Andreas O. Jaunsen, Jan-Erik Ovaldsen), 5 – 8 Dec 2005: Chloé Féron, Christina Thöne.

Observing run, La Silla Observatory, Chile (6 – 7 Dec 2006): Johan Fynbo.

Research visit, ESO Chile (host: Cedric Ledoux), 7 – 9 Dec 2005: Johan Fynbo

NOT Town meeting “The mid and long term future of the Nordic Optical Telescope”, Niels Bohr Institute (20 Dec 2005): Johan Fynbo (Talk), Jesper Sollerman (Talk), Kristian Pedersen, Jens Hjorth.

Appendix 4: “Cosmology 2005 – A reality check”

This appendix includes the program and participants list for the conference jointly organized by NORDITA, NBI and DARK 14 – 17 Dec 2005.

14 December (Wednesday)

8:30-9:15		REGISTRATION
9:15-9:30		Briefing
9:30-10:10	Richard Ellis	Observational Probes of Dark Energy
10:10-10:50	Slava Mukhanov	Inflation
10:50-11:30		TEA/COFFEE
11:30-12:10	Subir Sakar	What have we learnt about inflation from WMAP
12:10-12:50	Steve Allen	Dark energy constraints from the cluster X-ray mass
12:50-14:30		LUNCH
14:30-15:10		GONG SHOW I
15:10-15:50	Piero Ullio	Dark matter review
15:50-16:30		TEA/COFFEE
16:30-17:10	Nial Tanvir	Dark matter searches in M31

15 December (Thursday)

9:00-9:40	David Lyth	Primordial non-gaussianity
9:40-10:20	Pavel Naselsky	Non-gaussianity of the CMB
10:20-11:00		TEA/COFFEE
11:00-11:40	David Langlois	Conserved non-linear quantities in cosmology
11:40-12:20	Anne Davis	Brane inflation, cosmic D-strings and zero modes
12:20-14:00		LUNCH
14:00-14:40	Andrew Liddle	Cosmological model selection
14:40-15:20		GONG SHOW: 2
15:20-16:00		TEA/COFFEE
16:00-16:40	Lars Bergström	Detecting dark matter with GLAST
16:40-17:20	Guenter Sigl	Cosmological aspects of ultra high energy cosmic rays
17:20-18:00	Dominik Schwarz	Anomalies of the low-l microwave sky

16 December (Friday)

9:00-9:40	Andrei Linde	Inflation and String Cosmology
9:40-10:20	Robert Brandenberger	String Gas Cosmology
10:20-11:00		TEA/COFFEE
11:00-11:40	Tirthabir Biswas	Asymptotically free gravity and the big bounce
11:40-13:20		LUNCH
13:20-14:00	Ruth Durrer	Fluctuations of the luminosity distance
14:00-14:40		GONG SHOW: 3
14:40-15:20		GONG SHOW: 4
15:20-16:00		TEA/COFFEE
16:00-16:40		GONG SHOW: 5
16:40-17:30		GONG SHOW: 6

17 December (Saturday)

9:00-9:40	Steen Hannestad	Neutrino cosmology
9:40-10:20	Jean-Paul Kneib	Cluster Lensing
10:20-11:00		TEA/COFFEE
11:00-11:40	Anne M Green	Structure formation on small (subgalactic) scales

GONG SHOW: 1
Huitzu Tu
Alessio Notari
David Mota
Michael Gustafsson

TBA
Can Inflation solve the hierarchy problem?
Large scale structure in Bekenstein's theory of relativistic MOND
Gamma-ray Spectra from Dark Matter

GONG SHOW: 2
Asko Jokinen
Filippo Vernizzi
Andrii Neronov
Alabidi Laila

Nongaussianity from massless preheating
Non-linear perturbations and non-Gaussianities
Sterile neutrino dark matter and X-ray observations
Inflation Models and Observation

GONG SHOW: 3
Natalia Shuhmaher
Aleksandr Zheltukhin
Marcus Berg
Salvatore Capozziello

Heterotic Brane Gas
Lorentz Invariance
String Corrections in Brane Inflation
PPN-Limit of Higher order gravity inspired by Scalar-Tensor analogy

GONG SHOW: 4
Tuomas Multamäki
Dirk Puetzfeld
Tomi Koivisto
Morad Amarzguoui

TBA
Post-Newtonian Cosmology
Cosmic acceleration in the Platini formulation of modified gravity
An inhomogeneous alternative to dark energy

GONG SHOW: 5
Marceau Limousin
Torsten Bringmann
Jakob Jönsson
Haakon Dahle

Galaxy-galaxy lensing results on cluster galaxies from a ground based survey
Final state radiation and its relevance for WIMP detection
Correcting SN Magnitudes for Gravitational Lensing
Constraining cluster abundances with gravitational lensing

GONG SHOW: 6
Karl Andersson
Tamara Davis
Linda Östman
Aurelien Fraisse
Sami Nurmi

Modeling X-ray emission from clusters of galaxies
Supernova Ia diversity - standardising the candles
Estimating dust extinction from quasar observations
Limits on Defects Formation in Hybrid Inflationary models
Non-Gaussianity in Curvaton Models with Nearly Quadratic Potential

Name

Aleksandr Zheltukhin
Alexander Sellerholm
Anders Basbøll
Anders Pinzke
Andreas Jaunsen
Andrei Linde
Andrew Liddle
Andrii Neronov
Anja C. Andersen
Anne Green

Organization

Fysikum, Stockholm University
Fysikum, Stockholm university
IFA Århus
Stockholm University, Fysikum
Institute of theoretical astrophysics
Stanford University
Astronomy Centre, University of Sussex
INTEGRAL Science Data Center
Dark Cosmology Center
University of Nottingham

Anne-Christine Davis	DAMTP, Cambridge University
Antti Vaihkonen	Helsinki Institute of Physics
Anupam Mazumdar	NORDITA
Ardis Eliasdóttir	NBI DARK
Are Raklev	IFT, University of Bergen
Arturo Stabile	University of Salerno
Asko Jokinen	Nordita
Aurelien Fraisse	Princeton University
Axel Brandenburg	Nordita
Balasundaram Rajasekar	Anna University
Bengt EW Nilsson	Fundamental physics
Bo-Sture Skagerstam	Department of Physics
Brian Lindgren Jensen	DARK, NBI
Camille Plag	Universite de Tours
Cecilia Marini Bettolo	KTH Fysik
Chloe Feron	DARK
Christian Busk Hededal	IDA/DARK - NBI
Christina Thöne	DARK, NBI
Daniel Sunhede	Dept of Physics, University of Jyväskylä
Danuta Paraficz	DARK, NBI
Darach Watson	DARK
David Kofron	Institute of Theoretical Physics, Charles University
David Langlois	APC
David Lyth	Lancaster University
David Mota	Institute of Theoretical Astrophysics, University of Oslo
Desiree Della Monica Ferreira	Niels Bohr Institute - DARK Dark Cosmology Centre
Dietrich Bodeker	University of Bielefeld
Dirk Puetzfeld	ITA University of Oslo
Dominik Schwarz	University of Bielefeld
Dong Xu	DARK, NBI
Eduardo Oscar Escobar Hidrobo	Scientific Art Director
Edvard Mortsell	Stockholm Observatory
Erik Lundström	Stockholm university Fysikum
Filippo Vernizzi	Helsinki Institute of Physics
Franco Calzavara	nbi astronomisk observatorium
Gorm Krogh Johnsen	Department of Physics, University of Oslo
Guenther Sigl	APC, Paris 7 and GReCO, IAP
Göran Östlin	Stockholm Observatory
Haakon Dahle	Institute of Theoretical Astrophysics
Hans Ulrik Nørgaard-Nielsen	Danish National Space Center
Huitzu Tu	IFA Århus
Iiro Vilja	Department of physics, University of Turku
Ingunn Wehus	university of oslo
Jakob Jonsson	Stockholm University
Jakob Nordin	Stockholm University, Fysikum

Jacob Trier Frederiksen	Stockholm Observatory
Jan-Erik Ovaldsen	Institute of Theoretical Astrophysics
Janne Hogdahl	Helsinki Institute of Physics
Janne Holopainen	tuorla observatory
Jean-Paul Kneib	LAM
Jens Hjorth	DARK, NBI
Jens Melinder	Stockholm Observatory
Jens Oluf Andersen	Institute of Physics
Jerome Chenevez	DNSC
Jesper Sollerman	DARK
Jesper Sommer-Larsen	DARK
Johan Fynbo	DARK Cosmology Centre
Jose Maria Castro Ceron	Niels Bohr Institutet DARK
Josefine Selj	University of Oslo, astrophysics
Jostein Riiser Kristiansen	ITA, University of Oslo
Kari Enqvist	University of Helsinki
Karl Andersson	Fysikum, Stockholm University
Kim Nilsson	ESO
Kimmo Kainulainen	University of Jyväskylä
Kristian Pedersen	Dark Cosmology Centre
Laila Alabidi	Lancaster University
Lars Bergstrom	Fysikum, Stockholm universitet
Linda Ostman	Fysikum, Stockholm University
Lung-Yih Chiang	NBI
Malcolm Fairbairn	Stockholm University
Marceau Limousin	dark cosmology centre
Marek Biesiada	Department of Astrophysics and Cosmology, University of Silesia
Matt Hayes	Stockholm OBSERVATORY
Michael Blomqvist	Stockholm Observatory
Michael Gustafsson	Fysikum, Stockholm University
Michael Linden-Voernle	Tycho Brahe Planetarium
Michal Michalowski	NBI, Astronomical Observatory
Morad Amarzguioui	Institute for Theoretical Astrophysics
Narit Pidokrajt	Fysikum, Stockholm University
Natalia Shuhmaher	McGill
Niels Obers	Niels Bohr Institute
Ole Bjaelde	Institut for Fysik og Astronomi
Oystein Elgaroy	Institute of theoretical astrophysics, University of Oslo
Pall Jakobsson	DARK, NBI
Pasi Nurmi	Tuorla Observatory
Pavel Naselsky	NBI
Pekka Heinämäki	Tuorla Observatory
Per Osland	University of Bergen
Per Rex Christensen	Niels Bohr Institute
Peter Laursen	NBI

Petter Callin	University of Oslo
Piero Ullio	SISSA/ISAS
Poul Olesen	NBI
Pratika Dayal	University of Sussex
Rahman Amanullah	Department of physics, Stockholm University
Rene Fleron	Ørsted*DTU
Richard Ellis	California Institute of Technology
Romain Perriot	universite de Tours
Ruth Durrer	University of Geneva, DPT
Salvatore Capozziello	Dept. of Physics, University of Naples
Sami Nurmi	University of Helsinki
Samuel Belliard	Universite de Tours
Signe Riemer-Sorensen	NBI DARK
Silvio Orsi	KTH Fysik
Slava Mukhanov	LMU, Munich
Sohrab Rahvar	Sharif University of Technology
Staffan Kihlstedt	Astronomical observatory
Steen Hannestad	Department of Physics and Astronomy, University of Aarhus
Subir Sarkar	University of Oxford
Taia Kronborg	Universite de Tours
Tamara Davis	DARK, NBI
Teppo Mattsson	Helsinki Institute of Physics
Teresa Riehm	Stockholm University, Department of Astronomy
Thorir Sigurdsson	University of Akureyri
Tirthabir Biswas	McGill University
Tomas Dahlen	Department of Physics, Stockholm University
Tomi Koivisto	Helsinki Institute of Physics
Torsten Bringmann	SISSA
Troels Harkmark	Niels Bohr Institute
Troels Haugbølle	Dark Cosmology Centre
Tuomas Multamäki	University of Turku
Vappu Reijonen	Helsinki Insitute of Physics
Vesa Muhonen	Helsinki Institute of Physics
Vladimir Markov	Petersburg Nuclear Physics Institute
Yngvild Linnea Andalsvik	Department of Physics, University of Oslo
Öystein Rudjord	Department of physics, University of Oslo

Appendix 5: External funding 2005

Villum Kann Rasmussen Foundation	
Salary 1 month Tamara Davis	35 kDKK
Instrument Center for Danish Astrophysics	
Salary 4 months Kristian Pedersen	170 kDKK
Salary 2.7 months José María Castro Cerón	87 kDKK
Salary 4 months Páll Jakobsson	140 kDKK
Salary 3 months Christian Hededal	105 kDKK
Salary 4 months Kristin Kruse Madsen	130 kDKK
FUR research school	
Salary 1.3 months José María Castro Cerón	43 kDKK
EC FP5 RTN: Gamma-ray bursts: An enigma and a tool	
Salary 4 months Darach Watson	150 kDKK
RC FP6 MC RTN: ANGLES	
Salary 4 months Árdís Elíasdóttir	130 kDKK
Travel etc.	20 kDKK
NORDITA	
Salary 2 months Anja C. Andersen	75 kDKK
ESO	
Salary 4 months Kim Nilsson	130 kDKK
Total	1215 kDKK

Appendix 6: Publications 2005

DARK affiliates are indicated in bold face.

A ‘clean’ list of research papers which appeared in the refereed, international literature in 2005 (excluding papers published before Sep 2005 and excluding papers with no Centre affiliation):

1. **J. Hjorth, J. Sollerman**, J. Gorosabel, J. Granot, S. Klose, C. Kouveliotou, J. Melinder, E. Ramirez-Ruiz, R. Starling, B. Thomsen, M. I. Andersen, **J. P. U. Fynbo, B. L. Jensen**, P. M. Vreeswijk, **J. M. Castro Cerón, P. Jakobsson**, A. Levan, **K. Pedersen**, J. E. Rhoads, N. R. Tanvir, **D. Watson**, & R. A. M. J. Wijers: “GRB 050509B: Constraints on Short Gamma-Ray Burst Models”, *Astrophysical Journal* **630**, L117-L120 (2005).
2. L. Christensen, **J. Hjorth**, & J. Gorosabel: “Photometric Redshift of the GRB 981226 Host Galaxy”, *Astrophysical Journal* **631**, L29-L32 (2005).
3. L. Binette, G. Magris C., Y. Krongold, C. Morisset, S. Haro-Corzo, J. A. de Diego, H. Mutschke, & **A. C. Andersen**: “Nanodiamond Dust and the Far-Ultraviolet Quasar Break”, *Astrophysical Journal* **631**, 661-677 (2005).
4. D. B. Fox, D. A. Frail, P. A. Price, S. R. Kulkarni, E. Berger, T. Piran, A. M. Soderberg, S. B. Cenko, P. B. Cameron, A. Gal-Yam, M. M. Kasliwal, D.-S. Moon, F. A. Harrison, E. Nakar, B. P. Schmidt, B. Penprase, R. A. Chevalier, P. Kumar, K. Roth, **D. Watson**, B. L. Lee, S. Shectman, M. M. Phillips, M. Roth, P. J. McCarthy, M. Rauch, L. Cowie, B. A. Peterson, J. Rich, N. Kawai, K. Aoki, G. Kosugi, T. Totani, H.-S. Park, A. MacFadyen, & K. C. Hurley: “The afterglow of GRB 050709 and the nature of the short-hard γ -ray bursts”, *Nature* **437**, 845-850 (2005).
5. N. Gehrels, C. L. Sarazin, P. T. O'Brien, B. Zhang, L. Barbier, S. D. Barthelmy, A. Blustin, D. N. Burrows, J. Cannizzo, J. R. Cummings, M. Goad, S. T. Holland, C. P. Hurkett, J. A. Kennea, A. Levan, C. B. Markwardt, K. O. Mason, P. Meszaros, M. Page, D. M. Palmer, E. Rol, T. Sakamoto, R. Willingale, L. Angelini, A. Beardmore, P. T. Boyd, A. Breeveld, S. Campana, M. M. Chester, G. Chincarini, L. R. Cominsky, G. Cusumano, M. de Pasquale, E. E. Fenimore, P. Giommi, C. Gronwall, D. Grupe, J. E. Hill, D. Hinshaw, **J. Hjorth**, D. Hullinger, K. C. Hurley, S. Klose, S. Kobayashi, C. Kouveliotou, H. A. Krimm, V. Mangano, F. E. Marshall, K. McGowan, A. Moretti, R. F. Mushotzky, K. Nakazawa, J. P. Norris, J. A. Nousek, J. P. Osborne, K. Page, A. M. Parsons, S. Patel, M. Perri, T. Poole, P. Romano, P. W. A. Roming, S. Rosen, G. Sato, P. Schady, A. P. Smale, **J. Sollerman**, R. Starling, M. Still, M. Suzuki, G. Tagliaferri, T. Takahashi, M. Tashiro, J. Tueller, A. A. Wells, N. E. White, & R. A. M. J. Wijers: “A short γ -ray burst apparently associated with an elliptical galaxy at redshift $z = 0.225$ ”, *Nature* **437**, 851-854 (2005).
6. **J. Hjorth, D. Watson, J. P. U. Fynbo**, P. A. Price, **B. L. Jensen**, U. G. Jørgensen, D. Kubas, J. Gorosabel, **P. Jakobsson, J. Sollerman, K. Pedersen**, & C. Kouveliotou: “The optical afterglow of the short γ -ray burst GRB 050709”, *Nature* **437**, 859-861 (2005).
7. **J. P. U. Fynbo**, J. Gorosabel, A. Smette, A. Fruchter, **J. Hjorth, K. Pedersen**, A. Levan, I. Burud, K. Sahu, P. M. Vreeswijk, E. Bergeron, C. Kouveliotou, N. Tanvir, S. E. Thorsett, R. A. M. J. Wijers, **J. M. Castro Cerón**, A. Castro-Tirado, P. Garnavich, S. T. Holland, **P. Jakobsson**, P. Møller, P. Nugent, E. Pian, J. Rhoads, B. Thomsen, **D. Watson**, & S. Woosley: “On the Afterglow and Host Galaxy of GRB 021004: A Comprehensive Study with the Hubble Space Telescope”, *Astrophysical Journal* **633**, 317-327 (2005).
8. **K. Pedersen, Á. Elíasdóttir, J. Hjorth**, R. Starling, **J. M. Castro Cerón, J. P. U. Fynbo**, J. Gorosabel, **P. Jakobsson, J. Sollerman, & D. Watson**: “The Host Galaxy Cluster of the Short Gamma-Ray Burst GRB 050509B”, *Astrophysical Journal* **634**, L17-L20 (2005).
9. P. Natarajan, B. Albanna, **J. Hjorth**, E. Ramirez-Ruiz, N. Tanvir, & R. Wijers: “The redshift distribution of gamma-ray bursts revisited”, *Monthly Notices of the Royal Astronomical Society* **364**, L8-L12 (2005).
10. **J. Sollerman**, G. Óstlin, **J. P. U. Fynbo, J. Hjorth**, A. Fruchter, & **K. Pedersen**: “On the nature of nearby GRB/SN host galaxies”, *New Astronomy* **11**, 103-115 (2005).

Scientific correspondence:

*1. Darach Watson, Anja C. Andersen & Jens Hjorth: "Mysterious disappearance of female investigators", *Nature* **436**, 174 (2005).

Popular papers:

*1. **Kristian Pedersen, Anja C. Andersen, Johan P. U. Fynbo, Jens Hjorth, Jesper Sollerman**: "Det mørke univers", *Naturens Verden* nr 5, s 34. (2005).

*2. **Jesper Sollerman, Anja C. Andersen, Johan P. U. Fynbo, Jens Hjorth, Kristian Pedersen**: "Supernovaer kaster nyt lys over mørk energi", *Naturens Verden* nr 7/8, s 2 (2005).

*3. **Jens Hjorth, Anja C. Andersen, Johan P. U. Fynbo, Kristian Pedersen, Jesper Sollerman**: "Gammaglimt – eksplosioner fra universets ungdom", *Naturens Verden* nr 11/12, s 55 (2005)

*4. **Kristian Pedersen, Jens Hjorth, Johan P. U. Fynbo, Jesper Sollerman**: "Korte gammaglimt afsløret efter lang tids søgen", *Kvant* nr 5, s 34 (2005).

*5. **Kristian Pedersen**: "Røntgenstråling fra kosmos: Galaksedannelse set i et nyt lys", *Carlsbergfondets Årsskrift*, s 54 (2005).

*6. **Kristian Pedersen**: "Mørkt stof", *Weekendavisen*, 48, 2/12 (2005).

Appendix 6: Public outreach activities

Date	Activity	Place	DARK persons
Sep 6	Star gazing	Hareskoven Lilleskole	Anja
Sep 8	Popular TV talk at DK4	DK4 studios	Kristian
Sep 8	Popular talk for “Københavns Astronomiske Forening”	Tycho Brahe Planetarium	Kristian
Sep 9	“Fortællerum fra Himlen”, 4. and 6. class	Tuse Skole	Anja
Sep 12	Article in “Almanakken”, KU, ”Fra støv til liv”	-	Anja
Sep 13	Talk at conference: “Fremtidens Naturfag for Naturfagslærere	Middelfart	Anja
Sep 14	Talk at conference: “Fremtidens Naturfag for Naturfagslærere	Experimentarium	Anja
Sep 15	TV recording in relation to EU Descartes outreach prize	Rundetårn+Ekperimentarium	Anja
Sep 16	Interview by “Weekendavisen” about female researchers	NORDITA	Anja
Sep 28	Popular talk at “fællestime”, “Liv i universet”	Fredericia Gymnasium	Anja
Sep 28	Popular talk “Liv i universet”, for ”Horsens Astronomiske Forening”	Horsens Bibliotek	Anja
Oct 4	Popular talk for UNF, København, ”Nyt lys over det mørke univers”	H.C. Ørsted Institutet	Kristian
Oct 5	Interview to ”TV-Avisen” and ”TV2 Nyhederne” on short gamma-ray burst	Rockefeller	Jens+Kristian
Oct 5	Press releases on discovery of optical afterglow from short gamma-ray burst	DARK/NBI, ESO	Jens+Kristian +Jesper
Oct 6	Articles about the discovery of optical afterglow from short GRBs	Politiken, Berlingske, Weekendavisen	Kristian+Jens
Oct 6	”Fortællerum fra Himlen”, 3.,4.,5., and 6. class	Flakkebjerg skole	Anja
Oct 6	Popular talk at ”Fællestime”: “Liv i universet”	Næstved Gymnasium	Anja
Oct 6	“Kend din arbejdsplads”	Rockefeller	Johan

Oct 9	”Et stykke blå himmel”	Artikel i Weekendavisen	Anja
Oct 17-18	3 workshops about spectroscopy at “H.C.Ø. Dage” for “gymnasium students	Rockefeller	Johan+Brian
Oct 18	Popular talk at “H.C.Ø. dage” for “gymnasium” students	H.C. Ørsted Institutet	Kristian
Oct 22	Videnskabens Verden, DR P1, interview about short gamma-ray bursts	Rockefeller	Kristian
Oct 24	”Fortællerum fra Himlen”, 3.,4.,5., and 6. class Nørre Åby skole	Nørre Åby skole	Anja
Nov 2	Popular talk ”Liv i universet” on the occasion of the World Physics Year	NBI	Anja
Nov 2	Interview to”Radioavisen” about the star Betelgeuse becoming a supernova	Rockefeller	Kristian
Nov 3	Referee in DTU cubesat competition	DTU	Anja
Nov 4	Popular talk	Falkonergårdens Gymnasium	Johan
Nov 5	Talk and participation in “Astronomisk Studenter Forening”s annual ”hyttetur”	Brorfelde Observatory	Johan
Nov 8	Talk and project presentations for astronomy ”Gymnasium” teachers	Rockefeller	Kristian+Johan
Nov 9	”Videnskabscafé” for physics/chemistry and science/technology	Tømmerum Fri- og Efterskole	Anja
Nov 11	Referee in DTU cubesat competition	DTU	Anja
Nov 14	”Fortællerum fra Himlen”, 7. and 5. classes	Lyngby	Anja
Nov 14	Talk “Liv i universet”	VUC Roskilde	Anja
Nov 17	Talk “Liv i universet” for gymnasium physics class from Munkensdam Amtsgymnasium	DARK	Anja
Nov 17	Talk “Kosmisk støv – livets kilde” at ”KU Årsfest”	KU Nørregade	Anja
Nov 18	Talk about galaxy formation, 3.g Munkensdam Amtsgymnasium	Rockefeller	Johan
Nov 18	Talk about dark matter, 3.g Munkensdam Amtsgymnasium	Rockefeller	Kristian

Nov 22	”Erhvervspraktikanter” visiting DARK	Rockefeller	Kristian
Nov 23	Popular talk about galaxy formation	Esbjerg	Johan
Nov 26	Phone interview to “Middagsradioavisen” about landing of Hayabusa on asteroid	-	Anja
Nov 28	“Fortællerum fra Himlen”, two shows for 3.,4.,5., and 6. class	Nydamskolen, Sønderjylland	Anja
Nov 29	Speak to Galathea 3 expedition web-site	www.galathea2.dk	Anja
Dec 2	Article in “Weekendavisen” about dark matter: ”Usynlig tilstedeværelse”	-	Kristian
Dec 2	Article in “Weekendavisen” about the opening of DARK	-	-
Dec 2	Anja receives EU Descartes communications prize	London	Anja
Dec 3	Articles in “Berlingske” and “Ingeniøren” about EU Descartes public outreach prize to Anja	-	-
Dec 8	DR P1 radio interview about receipt of EU Descartes prize	Radiohuset	Anja
Dec 6	Guest in “Viden Om” on Hubble Space Telescope discoveries	TV-Byen	Anja
Dec 12	Article in “Universitetsavisen” about the DARK opening	-	Kristian
Dec 14	Interview by “Nordjyske”	Rockefeller	Anja
Dec 16	Interview in “TV-Avisen” about Cosmology conference	Rockefeller	Kristian
Dec	Article in “Kvant” about discovery of optical afterglow from short GRB	-	Kristian, Jens, Johan, Jesper
Dec 21	Interview in “TV2 Morgen” about public outreach	TV2 studios Copenhagen	Anja
Dec	Article in “Kvant” on establishing NorWip	-	Anja
Dec	Guest in “Viden Om” on Hubble Space Telescope discoveries	DR	Anja
Dec 24	Interview by Berlingske	-	Anja
Dec 31	Interview by BT	-	Anja