INSTITUT FOR FYSIK OG ASTRONOMI
DET NATURVIDENSKABELIGE FAKULTET
AARHUS UNIVERSITET

IFA – NYT UGE: 18

INSTITUT FOR FYSIK OG ASTRONOMI
AARHUS UNIVERSITET
Department of Physics and Astronomy, University of Aarhus

Naturvidenskabelig kvalifikationseksamen
Forskeruddannelsens Del A

FYSIK

Kandidat:	Niels Buhl
Vejledere:	Karsten Riisager, Hans Fynbo, Sune N. Jespersen
Ekstern censor:	Per Hedegård
Intern censor:	Aksel S. Jensen
Eksaminatorer:	Steen Brøndsted Nielsen og Alberto Imparato
Tid og sted:	7. maj kl. 13:15 i lokale 1525-229
Emne:	**Insight into Brain Microstructure with Diffusion Weighted NMR**

STUDENTERKOLLOKVIUM

Titel: Kernekraft
Ved: Sune Dupont
Vejleder: Jens Ulrik Andersen

Tid: Mandag den 4. maj kl. 14.15
Sted: Fysisk Auditorium

I disse tider stiger verdens energibehov voldsomt, ikke mindst pga. udviklingen i Kina og Indien. Langt den største del af denne energi kommer fra fossile brændsler, men disse vil ikke vare evigt. Hvad gør vi så? En mulighed er at anvende kernekraft. Kollokviet vil give en introduktion til hvorledes kernekraft fungerer og der vil blive set på fordele og ulemper. Desuden vil vi se frem mod nye reaktortyper, hvor passiv sikkerhed og lille affaldsmængde spiller en stor rolle. Endvidere kommer vi ind på hvem der udnytter teknologien og hvad der gøres for at forhindre spredningen af atomvåben.

AMO PHYSICS SEMINAR

AMO
Atomic
Molecular
Optical

Tomas Baer

Chemistry Department, University of North Carolina, USA

Photoelectron photoion coincidence studies with electron velocity focusing. The road to ± 0.1 kJ/mol thermochemistry

Time: Monday, May 4, 10.15 to 11.00

Place: Fysisk Auditorium

Threshold photoelectron photoion coincidence (TPEPICO) is used to energy select reactant ions in order to study the dissociation dynamics (rates, branching ratios to various products, product energy distributions) of polyatomic ions. Analysis of the ion time of flight distributions and breakdown diagrams using the statistical theory of unimolecular dissociation permits modeling multiple parallel and sequential dissociation steps, and thus permits extracting quantitative onset energies for higher energy dissociation channels. A recent implementation of this experiment at the Swiss Light Source (SLS) has improved the electron resolution to ± 1 meV, which will lead to 0.1 kJ/mol thermochemistry. Among the molecules investigated at the SLS are the sequential dissociation of $MCl4^+$ to M^+ + 4Cl, (M = Sn and Ge). The heat of formation of the neutral MCl4 can be determined by using the final products as an energy anchor.

Peter Staanum and Nicolai Nygaard

Coffee, tea and bread rolls will be served at 10.05

AMO PHYSICS SEMINAR

A tomic M olecular O ptical

Guido Pupillo

Institut für Theoretische Physik, Universität Innsbruck, Austria

Quantum phases of atoms and molecules with strong long-range interactions

Time: May 7, 15.15 to 16.00

Place: Fysisk Auditorium

Heteronuclear polar molecules prepared in the electronic and vibrational ground state and cold gases of Rydberg-excited alkali atoms provide examples of systems where long-range dipole-dipole interactions can dominate the system dynamics.

In this talk we present recent theoretical results on the possibility of realizing quantum phases of matter with strong long-range interactions in the cold atom/molecule context, with a focus on dipole-dipole interactions. These phases include supersolid phases in the mesoscopic and thermodynamic regimes, as well as crystalline phases of cold Rydberg atoms and polar molecules.

Peter Staanum and Nicolai Nygaard

Coffee, tea and cake will be served at 15.05

IOP PUBLISHING PHYSICA SCRIPTA
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Nuclear and particle physics applications of the Bohm picture of quantum mechanics

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Abstract
Aproximation methods for calculating individual particle/field motions in spacetime at the quantum level of accuracy (a key feature of the Bohm picture (BP) of quantum mechanics) are studied. This sharply illuminates not only the deep quantum structures underlying any observable quantum statistical laws of motion of particles and fields in spacetime, but also how the continuous merging of the so-called classical and quantal modes of description actually occurs, with no breaks anywhere. Modern textbook presentations of Quantum Theory are used throughout, but only to provide the necessary, already existing, tested formalisms and calculational techniques. New coherent insights, reinterpretations of old solutions and results, and new (in principle testable) quantitative and qualitative predictions can be obtained on the basis of the BP that complete the standard type of postdictions and predictions. Most of the dead wood still cluttering discussions on the meaning of Quantum Theory and the role of the BP is by-passed. We shall try to draw attention to the physics of this unfortunately hardly known novel formulation of Quantum Theory by giving additional illustrative examples inspired from the daily practices of contemporary Nuclear and Particle Physics, subjects that as yet have not been thoroughly reinterpreted within the BP. These fields of research offer excellent oppurtunities for explaining and illustrating the significance of time in quantum transitions, as well as the closely related features of quantum non-locality and quantum wholeness, as hard physical facts. We claim that in addition we can obtain a substantial gain in predictive powers of the underlying, all-encompassing, Quantum Theory.

PACS numbers: 03.65, 23.40.−s, 23.60.+e, 28.20.−v

The Galaxy Disk in Cosmological Context
Proceedings IAU Symposium No. 254, 2008
J. Andersen, J. Bland-Hawthorn & B. Nordström, eds.

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The Galactic Disk-Halo Transition – Evidence from Stellar Abundances†

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Abstract. New information on the relations between the Galactic disks, the halo, and satellite galaxies is being obtained from elemental abundances of stars having metallicities in the range $-1.5 < [\mathrm{Fe/H}] < -0.5$. The first results for a sample of 26 halo stars and 13 thick-disk stars observed with the ESO VLT/UVES spectrograph are presented. The halo stars fall in two distinct groups: one group (9 stars) has $[\alpha/\mathrm{Fe}] = 0.30 \pm 0.03$ like the thick-disk stars. The other group (17 stars) shows a clearly deviating trend ranging from $[\alpha/\mathrm{Fe}] = 0.20$ at $[\mathrm{Fe/H}] = -1.3$ to $[\alpha/\mathrm{Fe}] = 0.08$ at $[\mathrm{Fe/H}] = -0.8$. The kinematics of the stars are discussed and the abundance ratios Na/Fe, Ni/Fe, Cu/Fe and Ba/Y are applied to see if the "low-alpha" stars are connected to the thin disk or to Milky Way satellite galaxies. Furthermore, we compare our data with simulations of chemical abundance distributions in hierarchically formed stellar halos in a ΛCDM Universe.

Keywords. stars: abundances, Galaxy: disk, Galaxy: halo, Galaxy: evolution

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Inflationary trispectrum from graviton exchange

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Abstract. We compute the connected four-point correlation function of the primordial curvature perturbation generated during inflation with standard kinetic terms, where the correlation is established via exchange of a graviton between two pairs of scalar fluctuations. Any such correlation yields a contribution to the scalar trispectrum of the order of the tensor to scalar ratio r. This contribution is numerically one order of magnitude larger than the one previously calculated on the basis of scalar perturbations interacting at a point and satisfies a simple relation in the limit where the momentum of the graviton which is exchanged becomes much smaller than the external momenta. We conclude that the total non-linearity parameter generated by single-field models of slow-roll inflation is at maximum $|\tau_{\rm NL}| \sim r$.

Keywords: inflation, physics of the early universe, cosmological perturbation theory

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Astronomy & Astrophysics

The Building the Bridge survey for $z = 3$ Lyα emitting galaxies

II. Completion of the survey⋆

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ABSTRACT

Context. We have substantial information about the kinematics and abundances of galaxies at $z \approx 3$ studied in absorption against the light of background QSOs. At the same time we have already studied 1000s of galaxies detected in emission mainly through the Lyman-break selection technique; however, we know very little about how to make the connection between the two data sets.
Aims. We aim at bridging the gap between absorption-selected and emission-selected galaxies at $z \approx 3$ by probing the faint end of the luminosity function of star-forming galaxies at $z \approx 3$.
Methods. Narrow-band surveys for Lyman-α (Lyα) emitters have proven to be an efficient probe of faint, star-forming galaxies in the high-redshift universe. We performed narrow-band imaging in three fields with intervening QSO absorbers (a damped Lyα absorber and two Lyman-limit systems) using the VLT. We target Lyα at redshifts 2.85, 3.15, and 3.20.
Results. We find a consistent surface density of about 10 Lyα-emitters per square arcmin per unit redshift in all three fields down to our detection limit of about 3×10^{41} erg s^{-1}. The luminosity function is consistent with what has been found by other surveys at similar redshifts. About 85% of the sources are fainter than the canonical limit of $R = 25.5$ for most Lyman-break galaxy surveys. In none of the three fields do we detect the emission counterparts of the QSO absorbers. In particular we do not detect the counterpart of the $z = 2.85$ damped Lyα absorber towards Q2138−4427. This implies that the DLA galaxy is either not a Lyα emitter or is fainter than our flux limit.
Conclusions. Narrow-band surveys for Lyα emitters are excellent for probing the faint end of the luminosity function at $z \approx 3$. There is a very high surface density of this class of objects; yet, we only detect galaxies with Lyα in emission, so the density of galaxies with similar broad band magnitudes will be substantially higher. This is consistent with a very steep slope of the faint end of the luminosity function as has been inferred by other studies. This faint population of galaxies is playing a central role in the early Universe. There is evidence that this popualtion is dominating the intergrated star-formation activity, responsible for the bulk of the ionising photons at $z \gtrsim 3$ and likely also responsible for the bulk of the enrichment of the intergalactic medium.

Key words. cosmology: observations – galaxies: quasars: individual: BRI 1346 – galaxies: quasars: individual: BRI 1202−0725 – galaxies: quasars: individual: Q 2138−4427 – galaxies: high-redshift

1. Introduction

Strong arguments (Fynbo et al. 1999; Haehnelt et al. 2000; Schaye 2001; Rauch et al. 2008; Barnes & Haehnelt 2008) indicate that there is very little overlap between emission selected galaxies (primarily Lyman-break galaxies, LBGs, Steidel et al. 2003) and absorption selected galaxies (primarily the damped Lyman-α absorbers, DLAs Wolfe et al. 2005). The simple reason for this is that LBG samples are continuum flux limited and that the current flux limit of $R \approx 25.5$ is not deep enough to reach the level of typical absorption selected galaxies. This is unfortunate as we then know little about how to combine the detailed information on abundances and kinematics inferred from observations of DLAs with the information about colours and luminosities of high-z galaxies detected in emission.

In 2000 we started a survey aiming at bridging the gap between emission and absorption selected galaxies. The goal of the survey was to detect faint $z \approx 3$ galaxies using narrow-band imaging selection of Lyman-α (Lyα) emitters (LAEs) and in this way bridge the gap between the DLAs and the LBGs. During the 1990ies and early 2000s it was established that LAEs can be used to select high-z galaxies (e.g. Møller & Warren 1993) and that this method easily traces significantly deeper into the luminosity function than what is possible with spectroscopic samples of LBGs (e.g. Cowie & Hu 1998; Fynbo et al. 2001). In our survey we targeted the fields of QSOs with intervening DLAs primarily to be able also to search for the galaxy counterparts of the DLAs, but also to anchor the fields to known structures at the targeted redshifts. The first paper of the survey was published by (Fynbo et al. 2003, hereafter Paper I), where we presented the results from two of the three targeted fields. Since then the study of

⋆ Based on observations collected at the European Organisation for Astronomical Research in the Southern Hemisphere, Chile, under programs 67.A-0033, 267.A-5704, 69.A-0380, 70.A-0048, and 072.A-0073.

*Specialized i*NANO lecture

- open to all

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Title: Laboratory Investigations of the Thermal and Non-Thermal Processing of C6H6 Adsorbed on Surfaces of Astrophysical Relevance

Time: Thursday May 7th 2009 at 13.15

Location: Building 1525, room 323

Abstract:

Polycyclic aromatic hydrocarbons (PAHs) are an important class of carbon bearing molecule in the interstellar medium (ISM). As much as 20% of galactic carbon may be locked up in these molecules [1]. Large PAHs, along with other carbon species, are thought to account for the carbonaceous contribution to the interstellar grain population. Given their stability, afforded by their aromatic nature, it is also likely that smaller PAHs will exist within the icy mantles that form around grains in the cold, dense interstellar medium. It is therefore important to understand how these molecules interact with the surfaces of both grains and adsorbed layers of H2O ice. During the lifetime of an interstellar cloud the ices are likely to be processed, both thermally during cloud warm-up, and non-thermally as a result of irradiation by cosmic rays, low energy electrons and UV photons.

Benzene (C6H6) has been used as an experimentally convenient analogue of PAHs on which to conduct experiments that probe these processes. A thin film of amorphous silica (SiO2), deposited using electron beam evaporation, has been used to represent the surface of a silicate dust grain. AFM reveals a gross surface morphology reminiscent of that of interplanetary dust particles (IDPs) which are thought to bear some resemblance to interstellar grains. Temperature programmed desorption (TPD), along with simple kinetic modelling, has been used to study the thermal desorption kinetics C6H6 desorbing from both the bare silica surface, and an ASW ice layer. The kinetics are shown to be strongly affected by the nature of the underlying substrate [2].

UV photon irradiation experiments have been used to study the non-thermal desorption of C6H6 from model grain surfaces [3]. We have found evidence for energy transfer from the C6H6 molecules to the ice matrix, leading to H2O desorption. From the time-of-flight (ToF) of desorbing molecules, translational energies have been obtained, suggesting that both C6H6 and H2O desorb with translational temperatures far in excess of the grain temperature. The presence of highly energetic molecules will have important consequences for the subsequent gas-phase chemistry. Low energy electron irradiation of C6H6 adsorbed

on both silica and ASW has also been studied. Efficient C6H6 desorption is observed in the latter case, which suggests this desorption process may play a role on grains with H2O dominated ice mantles.

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