

## Journal Club (Shannon Whitlock)

### Instructions:

Each session consists of a 20-25 minute summary of the papers to be presented by students of the network followed by a 20-25 minute group discussion. All COHERENCE fellows (ESRs) must participate. In each session, five (5) students have been assigned to make a presentation. Each presentation is divided into 5 mini-presentations of ~5 minutes each. It will introduce the topic and summarize the main results of two papers. An exception is the third session which will have 6 02c or technological applications. Reference to the landmark theoretical and experimental papers should be made, and the two papers that will be discussed should be put in the context of previous work.

The second and third speakers will summarize paper 1. Speaker 2 will introduce the main results of the paper, focusing on the experimental methods and the description of figure 1 (and figure 2 if there are more than 3 figures in total). Speaker 3 will summarize the results presented in the remaining figures and conclude on the main results of the paper.

The fourth and fifth speakers will discuss the details of paper 2, following the same division as above. Each speaker should prepare 3-5 slides in advance in pdf format so they can be easily merged into one presentation. Below I have provided a list of additional papers relevant to each topic, however I encourage everyone to do their own research and find any literature which may help you form a deeper understanding of the topics. To get the most out of our discussions, everyone should have read at least the 6 topical papers before the discussion.

Electronic versions of all papers are available below.

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## TOPIC 1: Rydberg polaritons and atom light interactions (Tuesday 02.07.2013)

**Paper 1.** Peyronel et al, "Quantum nonlinear optics with single photons enabled by strongly interacting atoms", *Nature*, 488, 57 (2012). . See also News and Views by T. Walker "Strongly interacting photons", *ibid*.

**Paper 2.** C. S. Hofmann et al, "Sub-Poissonian statistics of Rydberg interacting dark state polaritons", *Phys. Rev. Lett.*, 110, 203601 (2013)

**Slides.** "Rydberg polaritons and atom-light interactions", Hannes Busche, Vladislav Gavryusev, Wildan Abdussalam, Maria Martinez Valado, Andrew Wade

### *Additional information:*

Supplementary information to the article "Quantum nonlinear optics with single photons enabled by strongly interacting atoms", *Nature*, 488, 57 (2012)

V. Parigi et al, "Observation and Measurement of Interaction-Induced Dispersive Optical Nonlinearities in an Ensemble of Cold Rydberg Atoms" *Phys. Rev. Lett.*, 109, 233602 (2012)

D. Maxwell et al, "Storage and control of optical photons using Rydberg polaritons", *Phys. Rev. Lett.*, 110, 103001 (2013)

L. Li, Y. O. Dudin and A. Kuzmich, "Entanglement between light and an optical atomic excitation", *Nature* (online) (2013). See also News and Views by M. Weidemüller "Spooky action gets collective", *Nature*, *ibid*.

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## TOPIC 2: Coupling Rydberg atoms with surfaces (Wednesday 03.07.2013)

- Paper 1.** S. D. Hogan et al, "Driving Rydberg-Rydberg transitions from a coplanar microwave waveguide", Phys. Rev. Lett., 108, 063004 (2012)
- Paper 2.** H. Hattermann et al, "Detrimental adsorbate fields in experiments with cold Rydberg gases near surfaces", Phys. Rev. A., 86, 022511 (2012)

### *Additional information:*

Tauschinsky et al, "Spatially resolved excitation of Rydberg atoms and surface effects on an atom chip", Phys. Rev. A, 81, 063411 (2010)

Gleyzes et al, "Quantum jumps of light recording the birth and death of a photon in a cavity", Nature, 446, 297 (2007)

Sorenson et al, "Capacitive Coupling of Atomic Systems to Mesoscopic Conductors", Phys. Rev. Lett., 92, 063601 (2004)

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## TOPIC 3: Rydberg molecules (Thursday 04.07.2013)

- Paper 1.** Bendkowsky et al, "Observation of ultralong-range Rydberg molecules", Nature, 458, 1005 (2009). See also the News and Views article by C. H. Greene "The little molecule that could", *ibid.* and S. D. Hogan and F. Merkt, "A New Perspective on the Binding Power of an Electron", Chem. Phys. Chem., 10, 2931, (2009)
- Paper 2.** W. Li et al, "A homonuclear molecule with a permanent electric dipole moment", Science, 334, 1110 (2011). See also the interview in the Royal Society of Chemistry magazine 'Chemistry World'  
<http://www.rsc.org/chemistryworld/News/2011/November/24111103.asp>

### *Additional information:*

C. H. Greene, A. S. Dickinson and H. R. Sadeghpour, "Creation of polar and nonpolar ultra-long-range Rydberg molecules", Phys. Rev. Lett., 85, 2458 (2000)

V. Bendkowsky et al, "Rydberg trimers and excited dimers bound by internal quantum reflection", Phys. Rev. Lett., 105, 163201 (2010)

J. Tallant et al, "Observation of blueshifted ultralong-range Cs<sub>2</sub> Rydberg molecules", Phys. Rev. Lett., 109, 173202 (2012)

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## List of speakers

<b>ESR</b>	<b>Affiliation</b>	<b>Topic</b>	<b>Speaker</b>
Hannes Busche	Durham	1	1
Vladislav Gavryusev	Heidelberg	1	2
Maria Martinez Valado	Pisa	1	4
Andrew Wade	Aarhus	1	5
Heiner Saßmannshausen	Zürich	2	1
Mike Kohlhoff	Oxford	2	2
Adrian Sanz Mora	Dresden	2	3
Julian Naber	Amsterdam	2	4
Marco Mattioli	Innsbruck	2	5
Anita Gaj & Przemyslaw Bienias	Stuttgart	3	1 * extended
Henning Labuhn	Paris	3	2
Guan Wu	Hamburg	3	3
Riccardo Faoro	Paris	3	4
Jack Leonard	Graefelfing	3	5

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