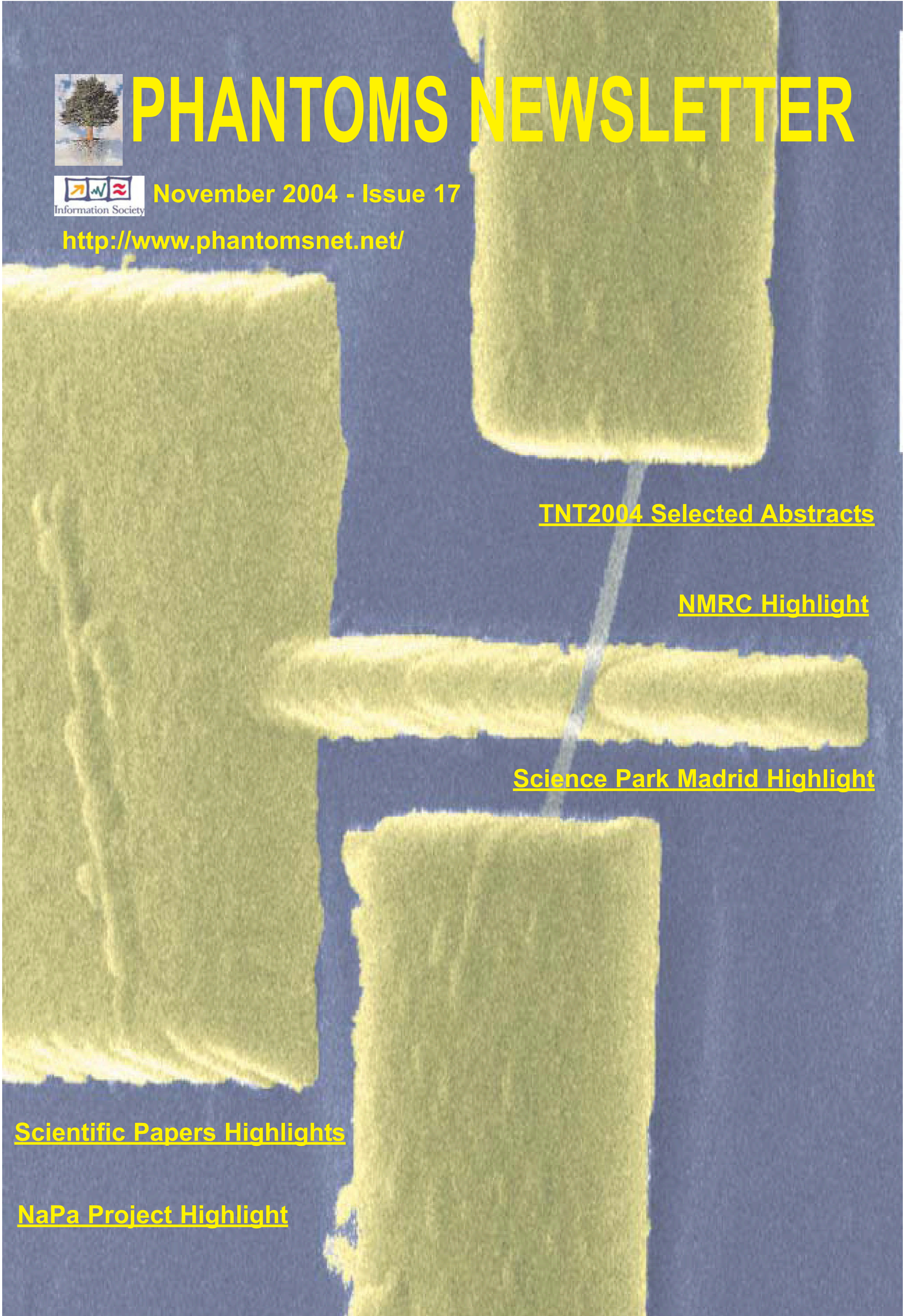

PHANTOMS NEWSLETTER

Information Society

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TNT2004 Selected Abstracts

NMRC Highlight

Science Park Madrid Highlight

Scientific Papers Highlights

NaPa Project Highlight

Local Nanomechanical Motion of the Cell Wall of *Saccharomyces cerevisiae*. Scientists from the University of California, Los Angeles recently reported[1] that the cell wall of *Saccharomyces cerevisiae* (Baker's Yeast) exhibits extremely small and local motions in the kHz range. Living cells were first mechanically trapped in fluid and imaged with the atomic force microscope (AFM). Utilizing the sensitivity of the cantilever as a nanoscale motion sensor, the researchers placed the AFM tip on the surface of the cell wall to probe the nanoscale motion characteristics of the wall. Surprisingly, it was found that the cell wall exhibited oscillatory motion with an average amplitude of ~3 nm and a temperature dependent frequency between 0.8 – 1.6 kHz. Furthermore, the motion was observed to cease after exposure to the well known metabolic inhibitor sodium azide. These findings strongly suggested that the motion was a metabolically driven process. To investigate this further the observed frequencies (ν) can be plotted as their natural log versus inverse temperature. Assuming an Arrhenius relationship, the slope of the line is proportional to the activation energy (E_a) of the process where $Ln[\nu] = Ln[\nu_0] - E_a/RT$. It was found that the activation energy (~ 58 kJ/mol) fell in the range of molecular motors such as Kinesin and Myosin. Investigating the speed of the motion (by multiplying the average amplitude of the motion by the frequency) the researchers found strong agreement between the observed speeds and typical speeds of molecular motors. Strong evidence supports the theory the observed motion is driven by molecular motors however the findings also suggest the motion is not the product of a single motor but a collection of motors. The motion was found to have an active force of at least 10 nN by increasing the contact force until there was a decrease in amplitude. The magnitude of the forces observed (~10nN) suggests concerted nanomechanical activity is operative in the cell. The findings of this study are significant because it demonstrates that the probing of cellular nanomechanical activity can be non-invasive and accomplished without the use of chemical dyes, fluorescent markers or quantum dots. The technique not only reveals a new aspect of yeast cell biology (the nanomechanical activity of the cell wall) but relates cellular nanomechanics to internal biological processes.

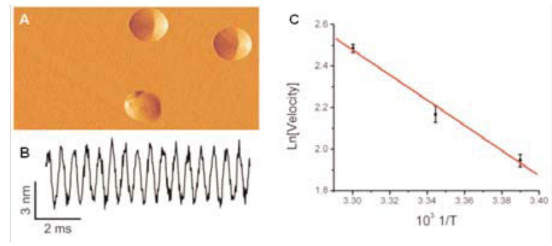

Figure 1. A) Typical deflection mode AFM image of living yeast cells in fluid mechanically trapped in round pores of a polycarbonate filter. B) Typical motion observed at 30C which has amplitudes of ~ 3nm and a frequency of 1.6 kHz. C) Plotting the natural log of the frequencies versus the inverse temperature allows the determination of an activation energy of 58 kJ/mol assuming an Arrhenius relationship. Images taken from Pelling et al. *Science*. **305**, 1147 (2004).

[1] A. E. Pelling, S. Sehati, E. B. Gralla, J. S. Valentine and J. K. Gimzewski (Department of Chemistry and Biochemistry, University of California, Los Angeles). *Science*. **305**, 1147 (2004).

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Photonic Properties of Strongly Correlated Colloidal Liquids. In this letter we show that short-range-order induced Bragg backscattering resonances can lead to a strong wavelength dependence of the optical transmission of colloidal liquids. By tuning the interaction potential between nanoparticles we are able to control the degree of order or disorder and thus explore photonic properties in a completely new regime. Short-range structural order induces an enhancement of the scattering strength while at the same time the total transmission shows strong wavelength dependence, reminiscent of a photonic crystal. In full analogy to electron propagation in some macroscopically disordered (or liquid) metals the scattering cross section becomes anisotropic (thus using high refractive index particles, such systems could open an alternative pathway to localization of light).

The unusual properties of photonic liquids might also lead to interesting applications. They could be used as tuneable optical filters and switches, for example in windows that change from opaque to clear. Nanoparticle based sunscreen lotions on the other hand require efficient blocking of UV light while retaining a high transparency for visible wavelengths. As shown in the figure photonic liquids are much better optical filters compared to random particle assemblies. Preliminary results from our lab using nanoparticles that scatter strongly in the UV (ca. 50nm diameter, data not shown) confirm this and have raised much interest at the TNT 2004 meeting in Segovia in September.

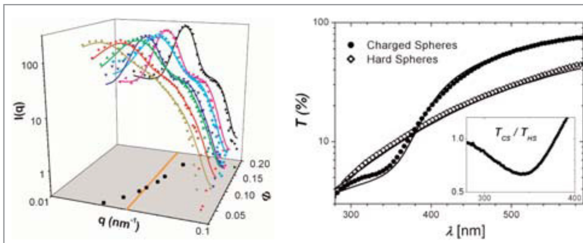

Figure Left: Structural analysis with neutron scattering for different particle volume fractions ϕ. Right: Transmission wavelength dependence for a suspension of 240nm diameter polystyrene particles. Experimental values for charged spheres (solid symbols) and hard spheres (open symbols), Φ = 9.8%. Cell thickness L=2mm.

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