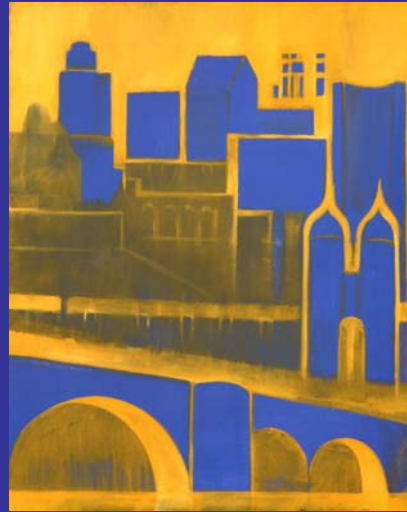


Jan 1, 2010

*Letizia Mancino*



# **Superresolution Light Microscopy 2010: “Molecular Galaxies“ of the Cell Nucleus\***

**C. Cremer**

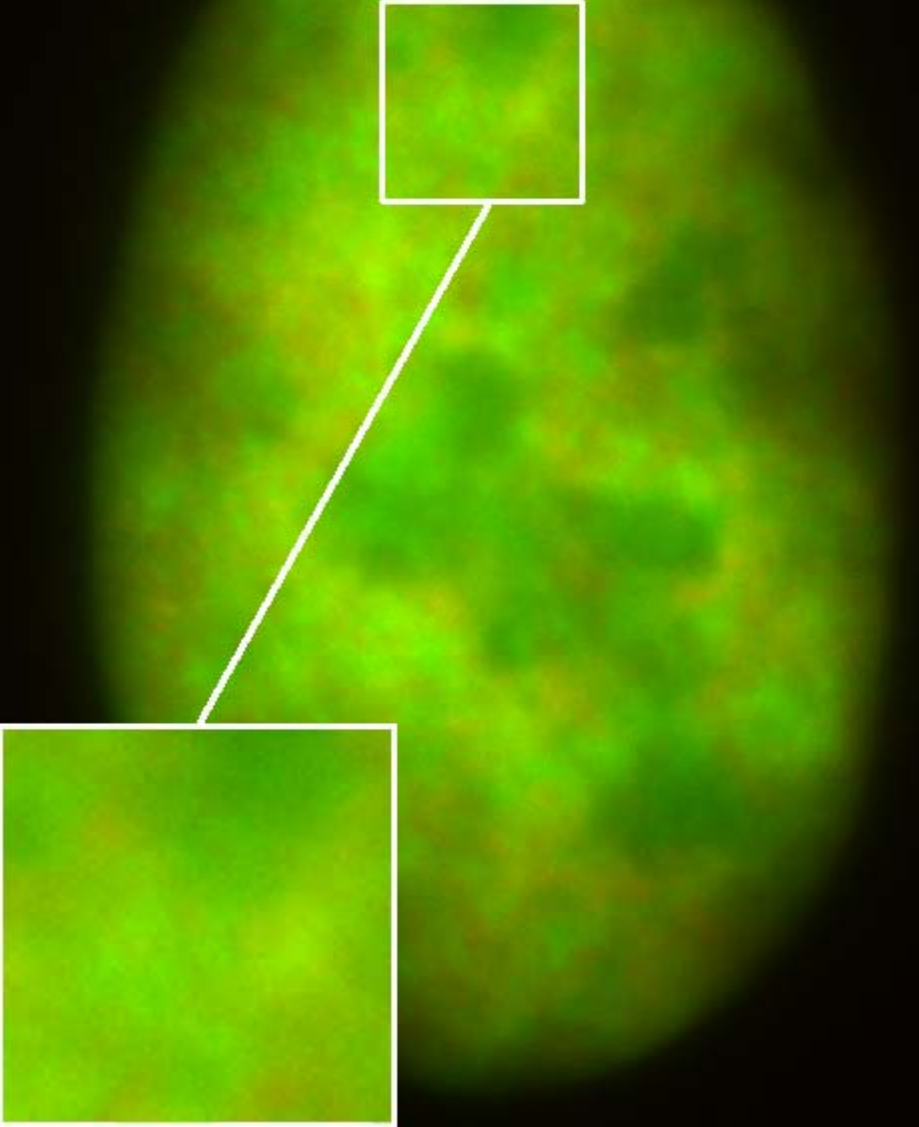
**Kirchhoff-Institut für Physik & Institut für Pharmazie und Molekulare  
Biotechnologie/Bioquant-Zentrum, Universität Heidelberg**

**Institute for Molecular Biophysics/The Jackson Laboratory, ME**

*\*seen with the KIP Nanoscope (“SMI Vertico“)*

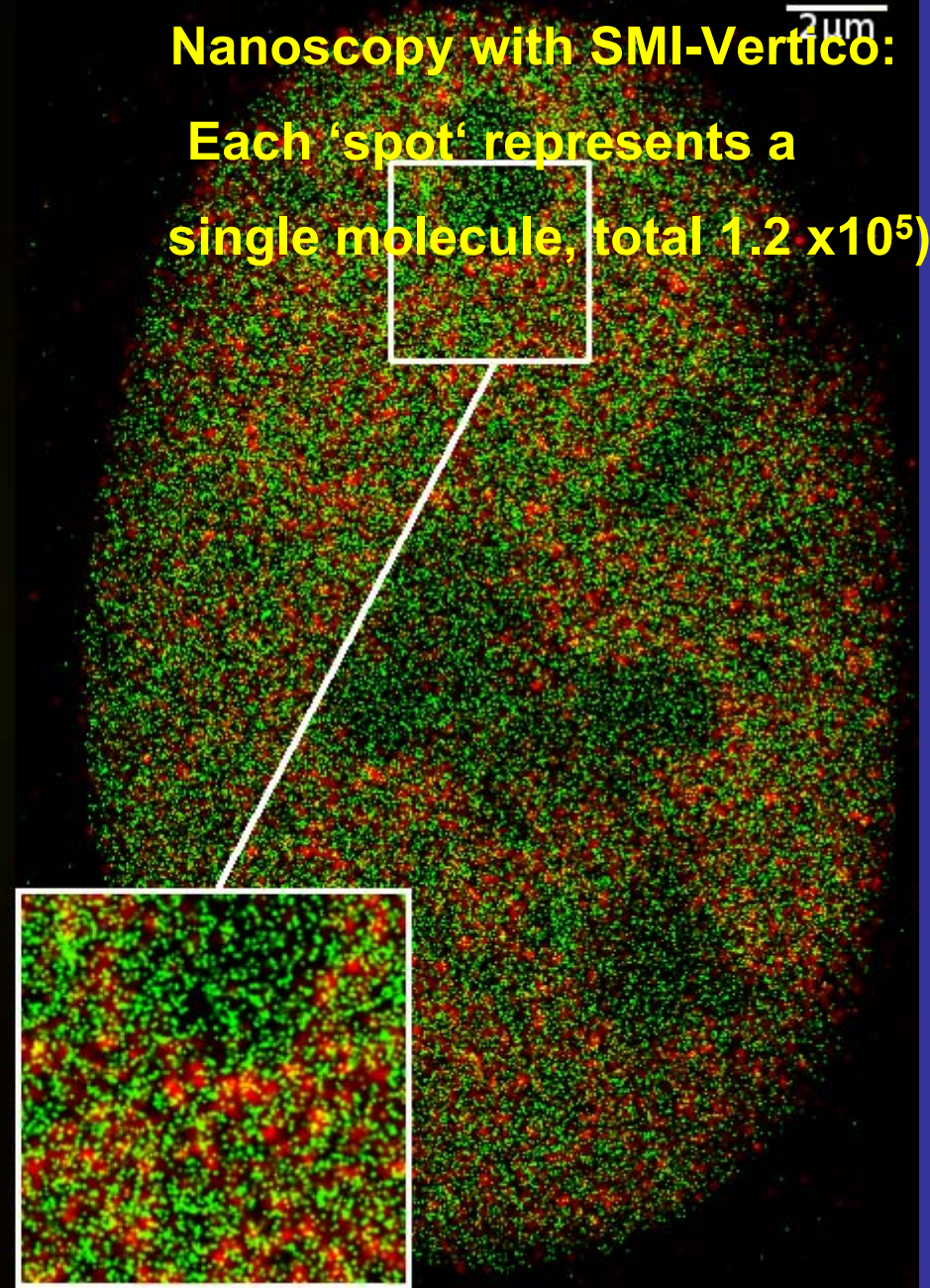
## Conventional Epifluorescence

*(best optical resolution, Abbe-Limit)*



## Nanoscopy with SMI-Vertico:

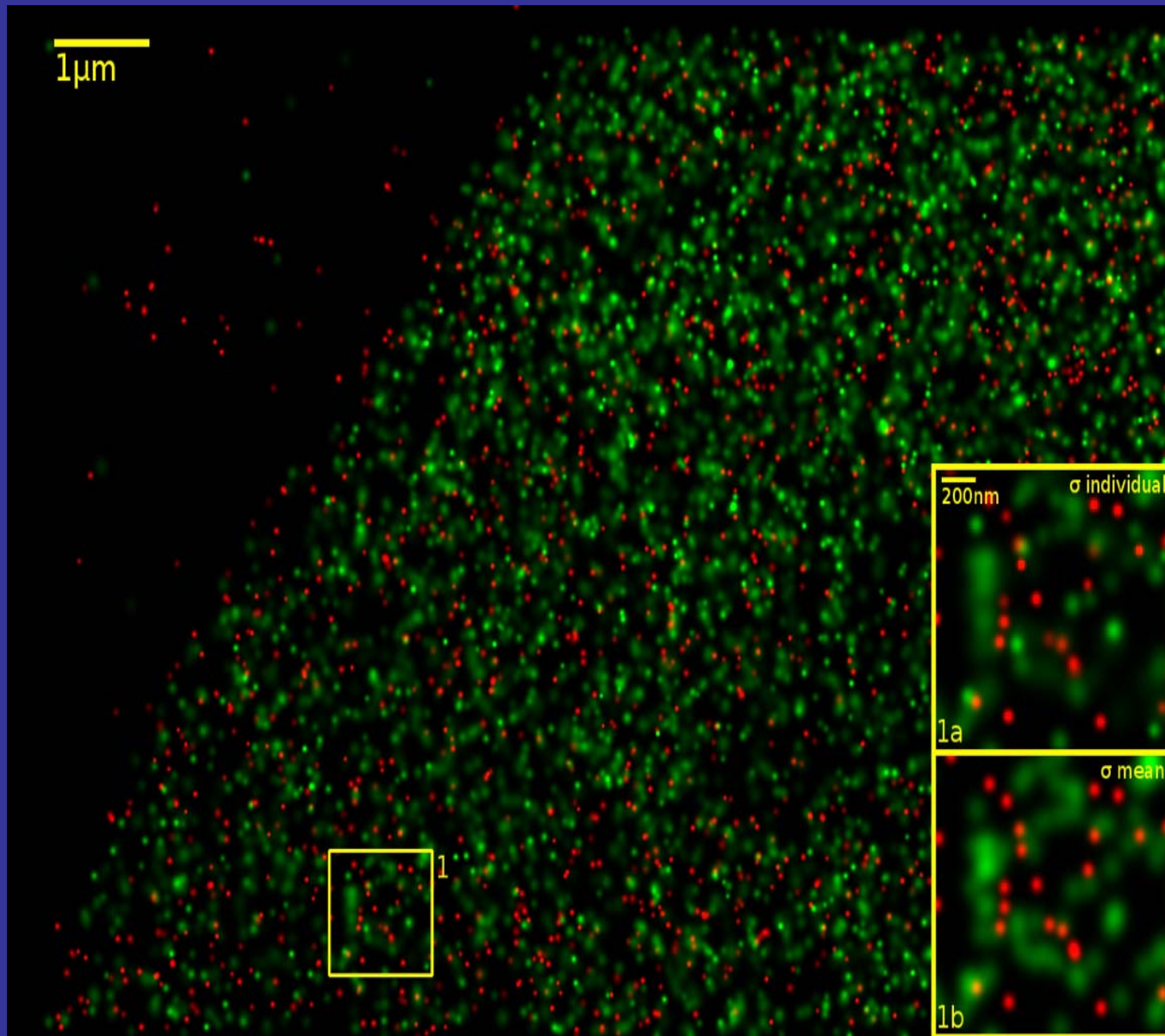
Each 'spot' represents a single molecule, total  $1.2 \times 10^5$



Red: H2A proteins; Green: Snf2H proteins (green)

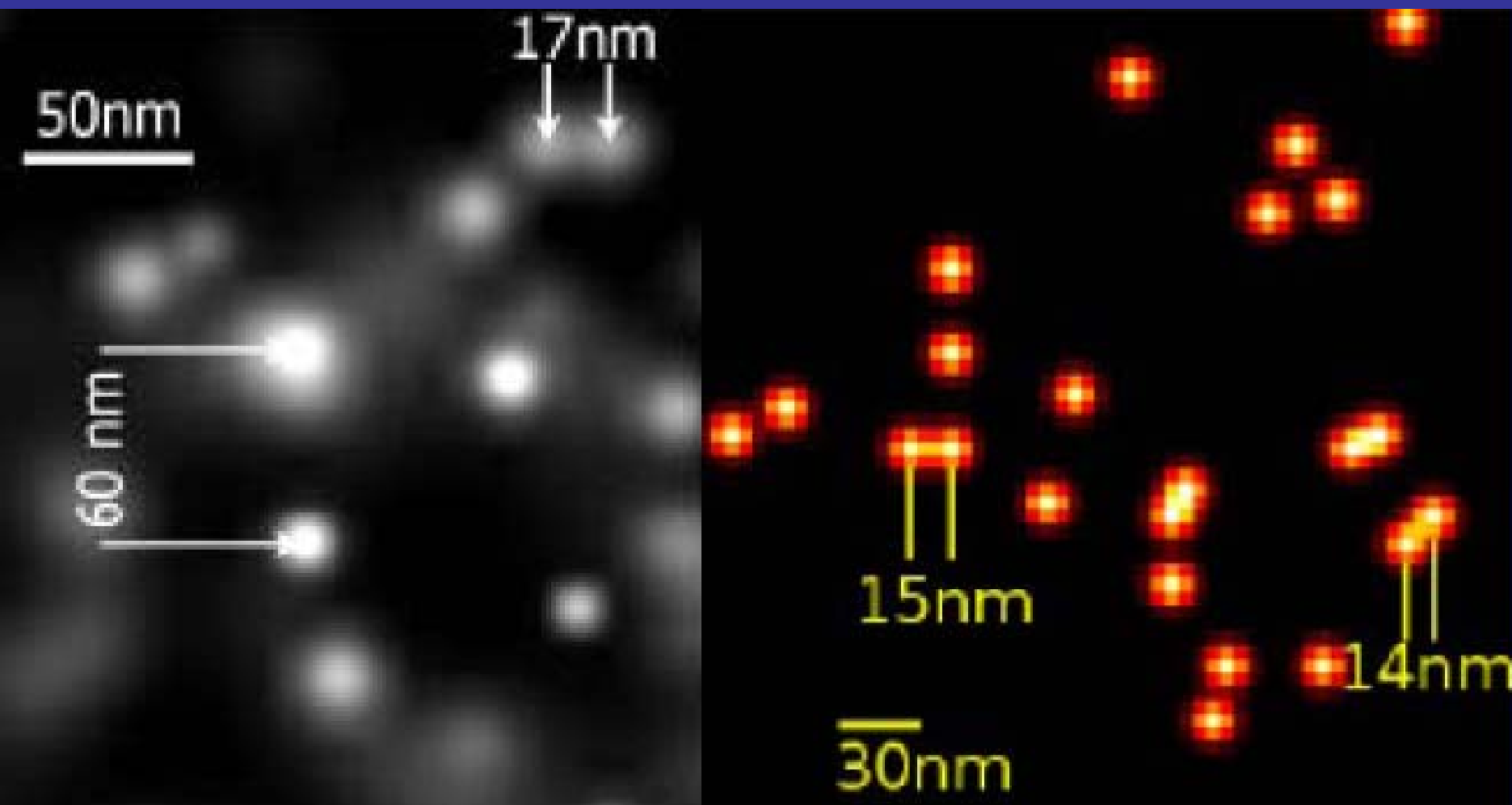
Gunkel et al. 2009

# Nanoscopy (SMI-Vertico) of Nuclear Proteins labelled with two standard Fluorochromes (Detail)



*M. Gunkel et al.,  
2009*

# A Deep Look into the Cellular Galaxy of Molecules



**Left: SPDM of individual emGFP-histone (H2B) molecules in a human cell nucleus. Right: SPDM of individual YFP-protein molecules in a human cell membrane.  $\lambda_{\text{exc}} = 488 \text{ nm}$ .**

# Comparison of Optical Resolution

## Hubble Telescope:

Optimum conditions\*: If Hubble looked at the Earth - from its orbit of approx.  $L = 600$  km - this would in theory correspond to a resolved distance of  $\Delta s = 0.3$  meter:  $\alpha_{Hubble} = \Delta s/L = 5 \times 10^{-7}$  (0.1 arcsec)

## KIP-Nanoscope:

Optimum conditions: A distance of  $\Delta s = 10$  nm between 2 single molecules can be detected; This would correspond to a visual angle of  $\alpha_{nano} = 1 \times 10^{-8} / 0.25 = 0.4 \times 10^{-7}$  ( $\sim 0.01$ arcsec)



Hubble Telescope

## References

- *P. Lemmer et al. (2008) SPDM: Light microscopy with single-molecule resolution at the nanoscale. Applied Physics B 93: 1-12*
- *P. Lemmer et al. (2009) Using Conventional Fluorescent Markers for Far-field Fluorescence Localization Nanoscopy allows Resolution in the 10 nm Regime. J. of Microscopy 235: 163 – 171*
- *R. Kaufmann et al. (2009) SPDM – Single Molecule Superresolution of Cellular Nanostructures. Proc. SPIE 7180, 71850 –J – 71850J-19*
- *M. Gunkel et al. (2009) Dual Color Localization Microscopy of Cellular Nanostructures. Biotechnology J.4: 927 – 938.*