



# MISTRAL BL status and Scientific Applications

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## Scientific case

MISTRAL will be devoted to cryo-tomography in the water window and multi-keV spectral regions (E: 270 eV – 2600 eV) for biological applications. In addition to tomography, spectroscopic imaging (a series of 2D images over a range of X-ray wavelengths) at several X-ray absorption edges (such as C, N, O, Ca & S K-edges and Ti, Fe, Cu, Mg & P L-edges) would also be possible.

The Transmission X-ray Microscope will work from 270 eV to 1200 eV. A single-reflection elliptical glass capillary condenser will focus monochromatic light on to the sample, which will be at cryo-temperature. The transmitted signal will be collected by an objective Fresnel zone plate and a magnified image will be delivered to a CCD camera. The expected spatial resolution in 2D is 30 nm and 50 nm for a tomography. An upgrade to higher energies (i.e. phase contrast at 2600 eV) will be possible in the future.

## Transmission X-ray Microscope



- Cryo-tomography of biological samples
- Spectroscopic imaging

## Beamline installation

### Variable-Line-Spacing Plane-Grating Monochromator

- Set required energy
- Deliver monochromatic light to the reflective capillary condenser
- Keep the exit slit in focus for any value of the included angle
- Correct the coma and spherical aberration of the system.

### Horizontal Focusing Mirror (2<sup>nd</sup> mirror in KB geometry)

Reflect in the horizontal plane and focus light from the source on to the PGM exit slit.

### Vertical Focusing Mirror (1<sup>st</sup> mirror in KB geometry)

Reflect in the vertical plane and focus light from the source on to the monochromator entrance slit.

### Exit Slit

### Diagnostics

Vertical refocusing of entrance slit virtual image on to the exit slit.

### Vertical Refocusing Mirror

### Entrance Slit

### Diagnostics

Monitor beam position, size and flux.

### JJ Slit

Set light polarization.

### White Beam Diag. 2-Jaw Vert. Aperture

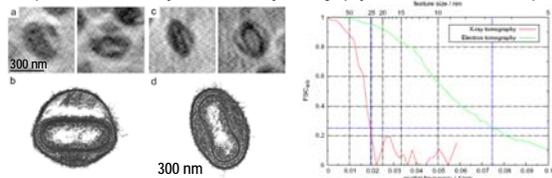
Scan beam. Monitor position, size and flux of beam

## Scientific applications

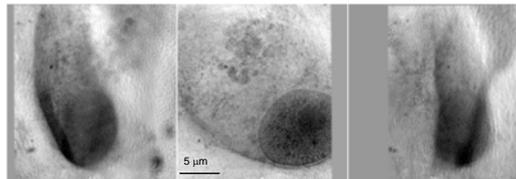
### X-Ray Cryo-Tomography (X-c-Tomo) investigation of PtK2 cell organelles reorganisation during Vaccinia virus infection

FJ Chichón, E Pereiro, S. Heim, P Guttman, G Schneider, JL Carrascosa

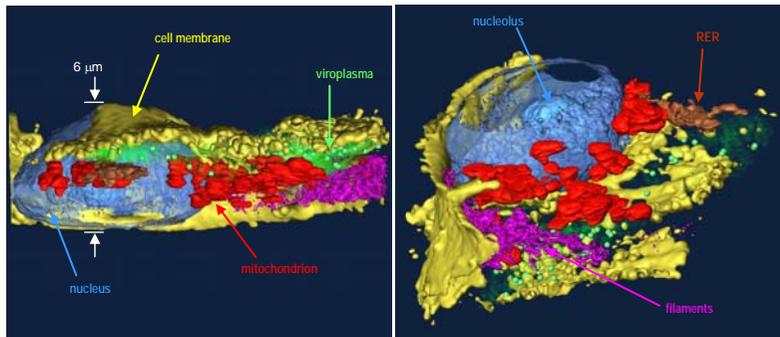
Comparison between X-ray and electron cryo-tomography of isolated Vaccinia virus particles.



Tilt series (-60°, 0°, 79°) of PtK2 cells infected with Vaccinia virus.



Segmentation images of PIK2 cells infected with Vaccinia virus showing cell membrane, nucleus, nucleolus, mitochondria, RER, filaments and viroplasma.



## Schedule

MISTRAL Beamline was installed in April-May 2010.  
 TXM installation in September 2010.  
 Open to users in fall 2011.

## Ref.

- E. Pereiro, J. Nicolás, S. Ferrer, M.R. Howells, J. Synchrotron Radiation 16, 505 - 512 (2009).
- JL. Carrascosa, FJ. Chichón, E. Pereiro, MJ. Rodríguez, JJ. Fernández, M. Esteban, S. Heim, P. Guttman, G. Schneider, J. Structural Biology 168, 234 - 239 (2009).