



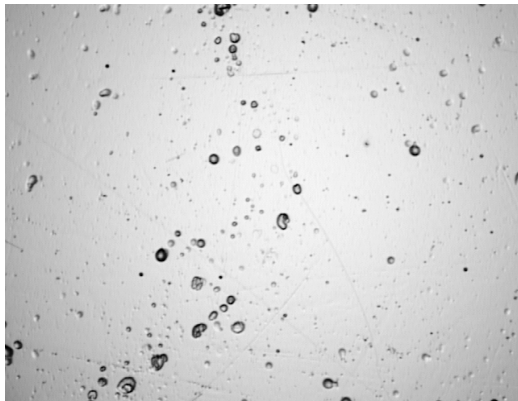
MoEDAL

Recap: 16 aug

L.Millward@qmul.ac.uk

Summary

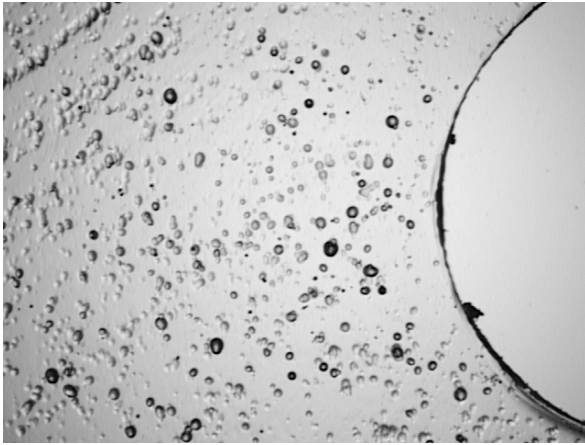
- Studying Makrofol foil
 - Large Background, many pits in the images
 - Want to find etch pits passing through the foil
 - Want technique that can scale up
-



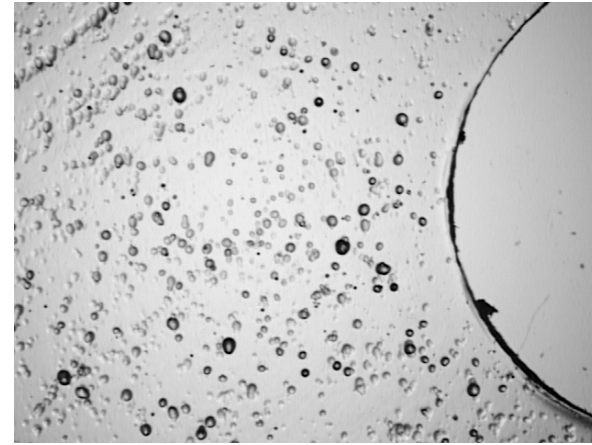
- Unlike low background, thicker makrofol, there is not much spatial separation between entry, and exit holes. I.e., not automatically distinct.
- Are Holes correlated, or just an overlapping cluster?
- Cannot control with precision whether front or back focal plane is being imaged

Front / Back comparison

'Correct Alignment' - (foil numbering up)



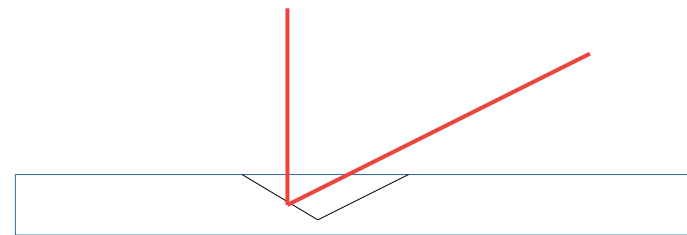
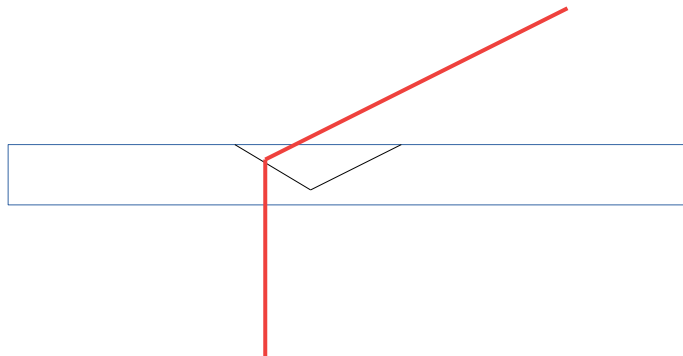
Reverse alignment – (with image flipped)



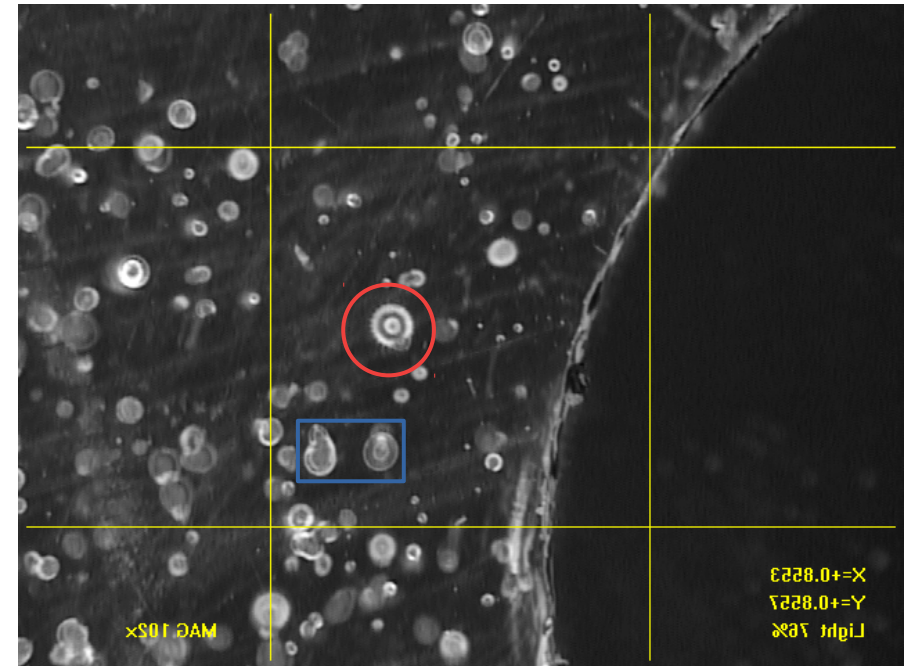
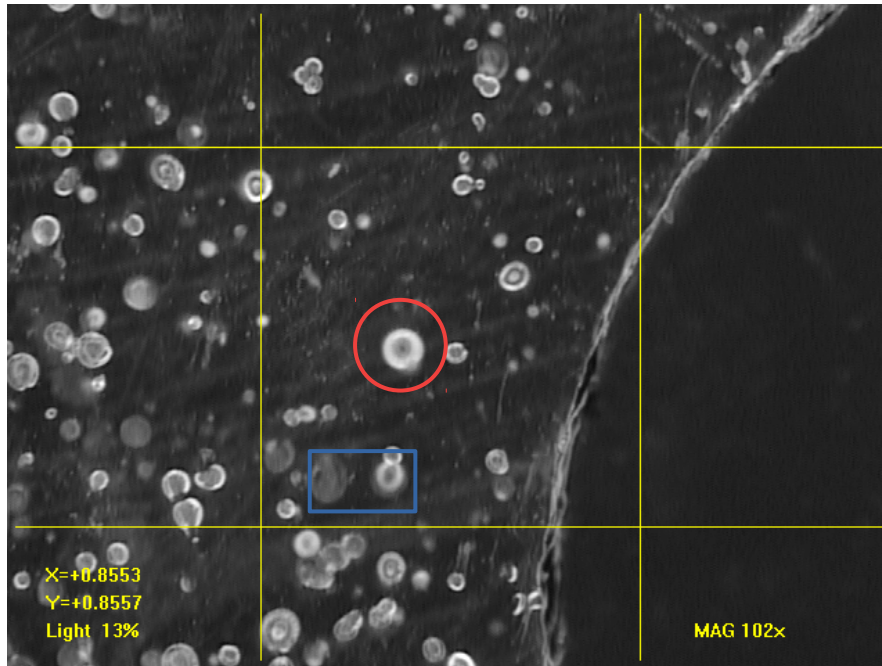
- Front and Back images are symmetrical
- Want to break symmetry and tell which holes appear on the front surface, and which appear on the back
- Also; Some holes appear darker, others lighter. Mechanism for this? Scattering

Scattering / Transmission

- Want to Find a Front Back asymmetry
- Dark Spots are caused when backlighting is scattered away from the lens.
- HYPOTHESIS: Halo lighting on front surface holes will cause additional illumination due to light scattering INTO the lens



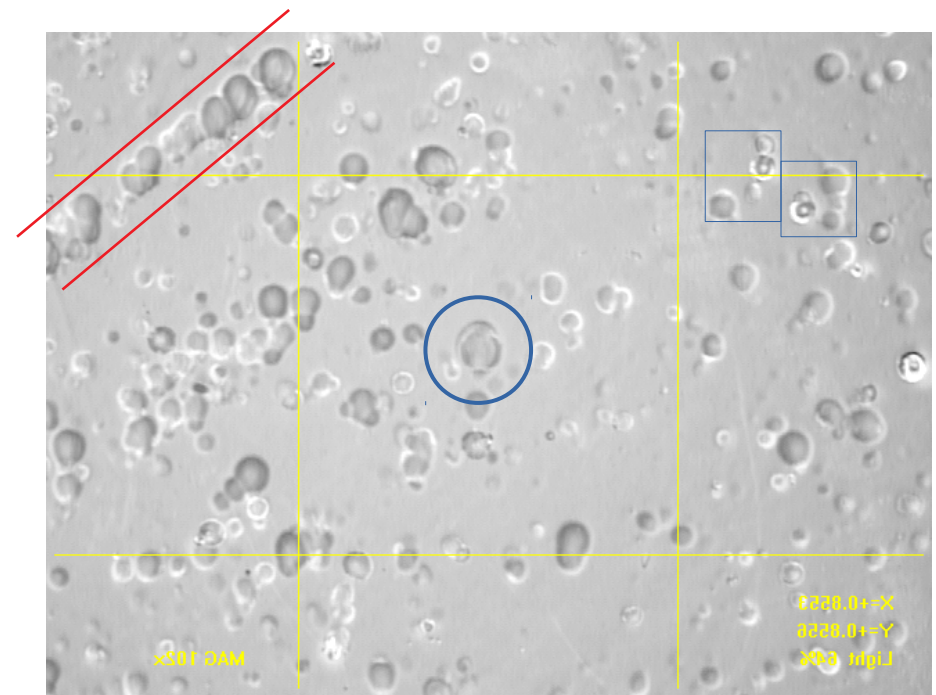
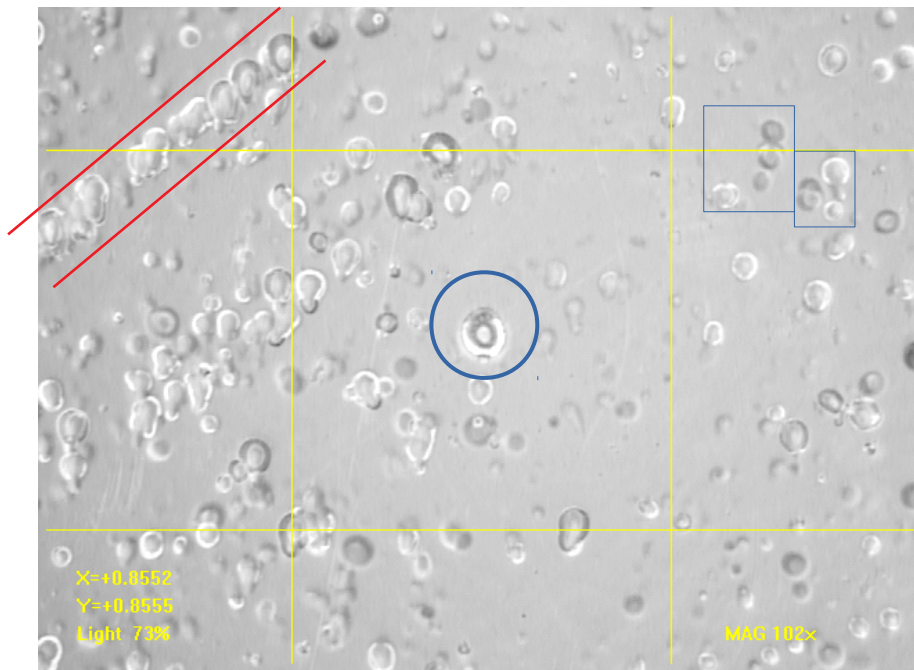
Halo lighting



- Illumination from LED ring / halo
- Can break symmetry for some holes/pits
- Cant reliably answer question:
 - Does this etch-pit pass all the way through?
 - Or is it just look the same on both sides

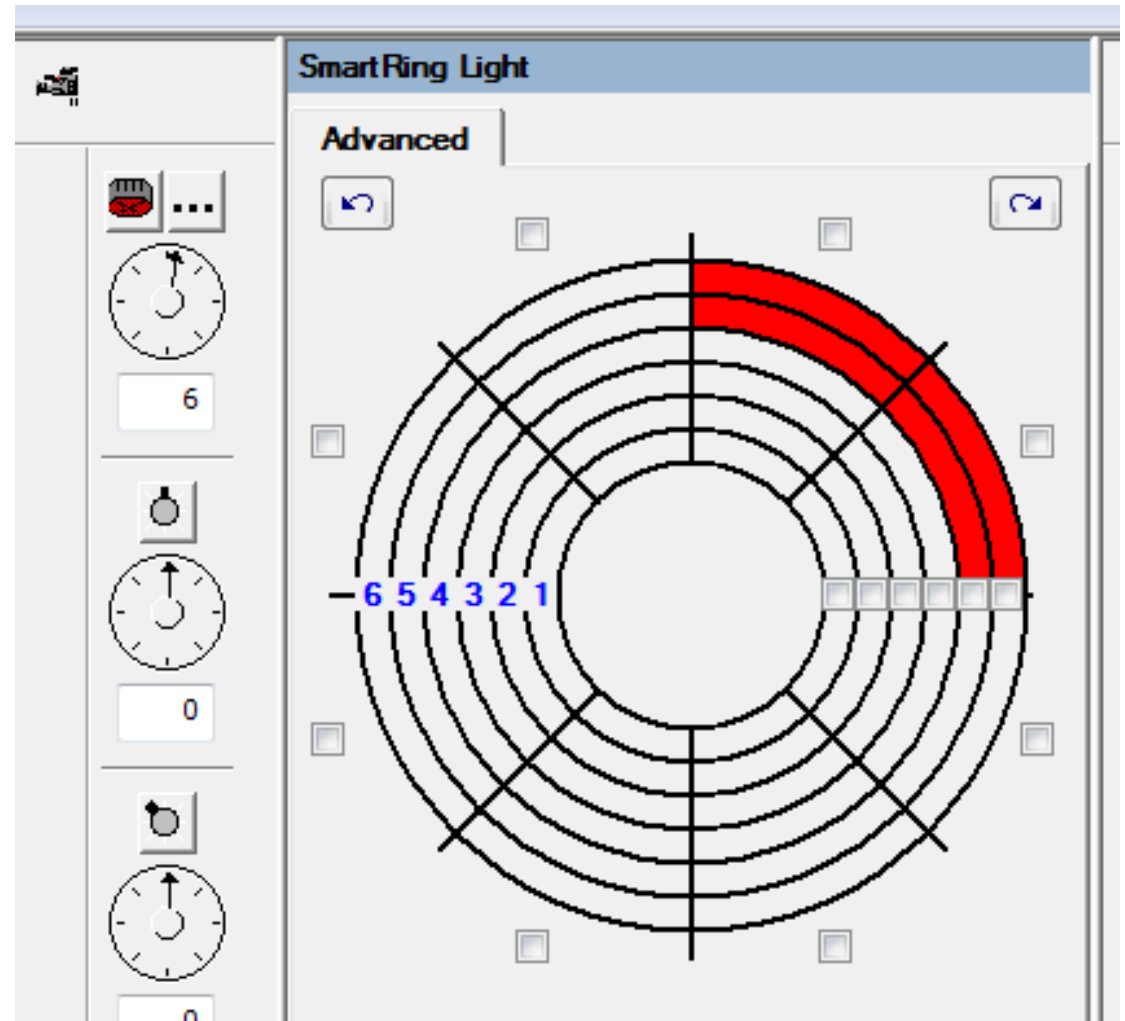
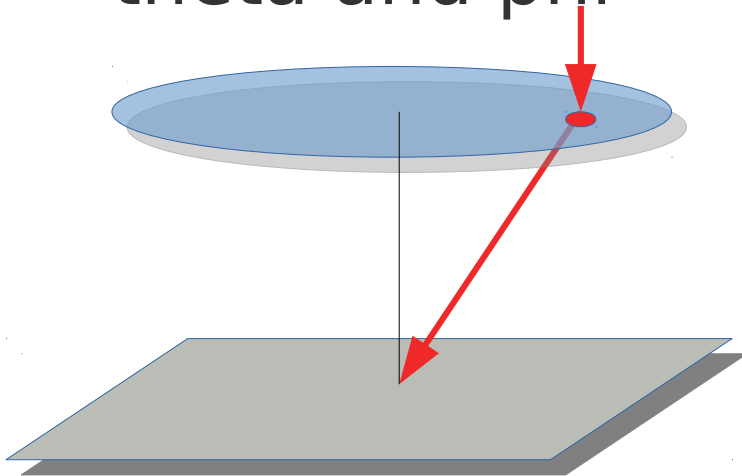
Halo, + backlighting

- Line – probably a scratch or common event, thus expect holes to appear on the same side. Side reversal flips bright / dark features, supporting hypothesis
- Combining mixture of Halo lighting and Backlighting, helps obscure small scratches / smudges.
- Halo Lighting provides edge illumination



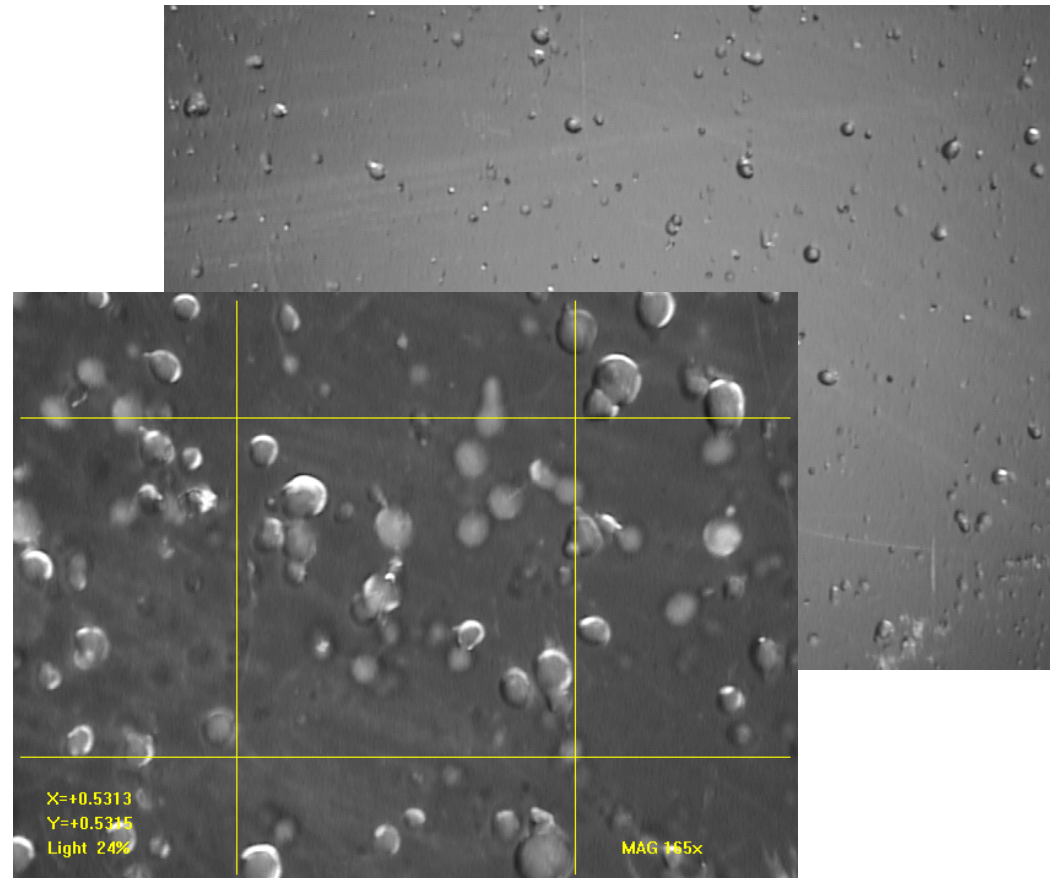
Fresnel illumination

- 4th Illumination
- LED grid
- Passes through Fresnel lens
- I.e., Can control theta and phi



Fresnel illumination

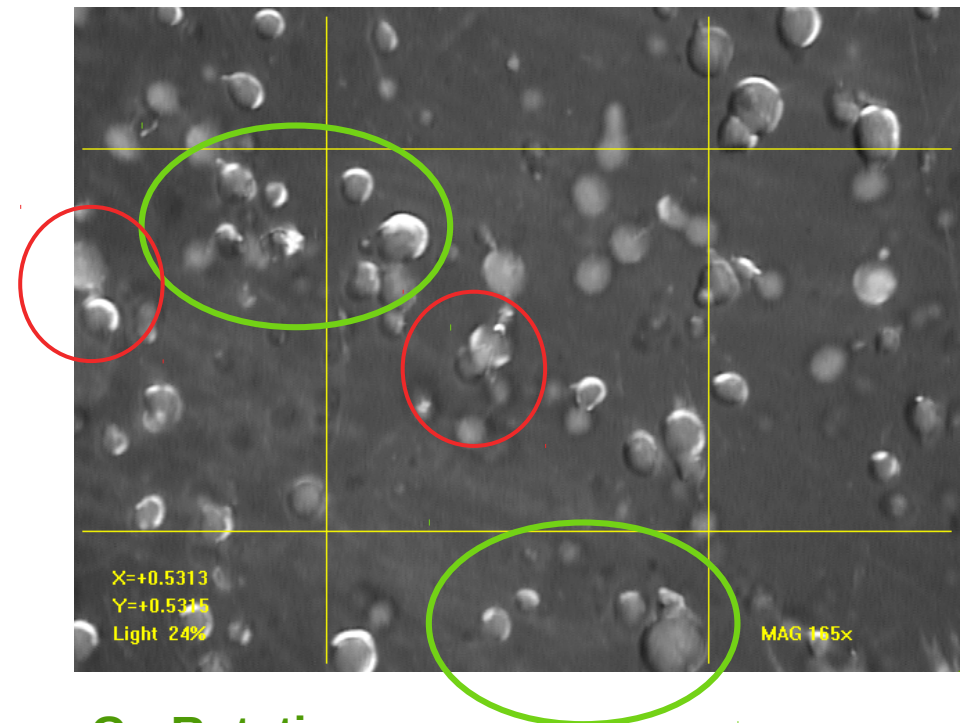
- Imaged Locations from 8 different, angles in phi, for more information about each edge.
- Stacked images into \gif
- Illumination rotates around the edge of an etch pit



Holes

Can potentially see illumination in the 'tube' connecting front – back holes

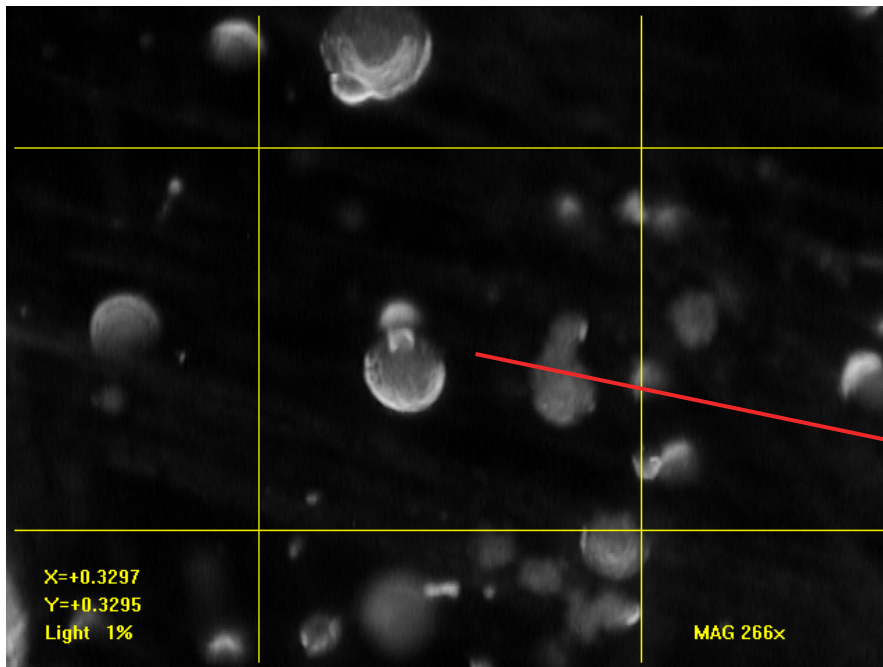
- Surface etch-pits 'Rotate'
- Clustered etch-pits rotate in Phase
- Etch-pits on opposite surface rotate in Anti-Phase
- Pits passing through have dipole like pattern



Co-Rotating

Counter - Rotating
Dipole - like

Holes: Another example



- At high magnification you can see the illumination coming from inside the 'tube' connecting the two pits
- Studying several of these holes in detail at different focal depths through the foil
- Tube present at all depths
 - Yet no depth at which it is all simultaneously in focus
 - ie, object appearing on both sides, distinct from front and back pits.



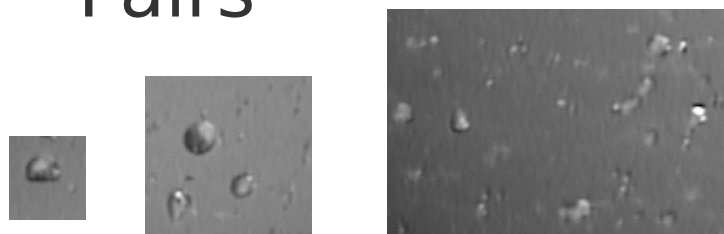
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Next Steps : 16 aug

L.Millward@qmul.ac.uk

ML: Data

- 441 images(640x480)
X 10 channels
- Will cut down and hand pick 'baby food' simple training examples, ie one pit
- Build up to multiple pits etc..
- Train to recognise basic features
- Front surface pit
- Back surface pit
- Pairs



ML : Labels and Training



Can use regression techniques to get positions / transform representation

ie, Particle physics type data
Tuples / Vectors of objects

- When basic filters are reliable, can look at convolution on whole image
- Assisted labelling/
Reinforcement Learning
ie, Find candidates, we assess if they are good or bad. Faster than manually labelling from scratch.
- Unsupervised learning
Auto-encoders - Find compressed representation
ie, pit position, type, likelihood



Suggestions

- What are MoEDAL's thoughts / Plans?
- Helsinki status
- Is our conceptualisation of the problem correct? Are we missing / ignoring something Big