



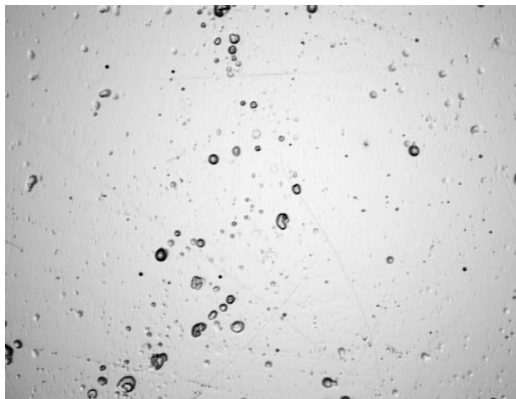
**MoEDAL**

**Recap: 16 aug**

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# Summary

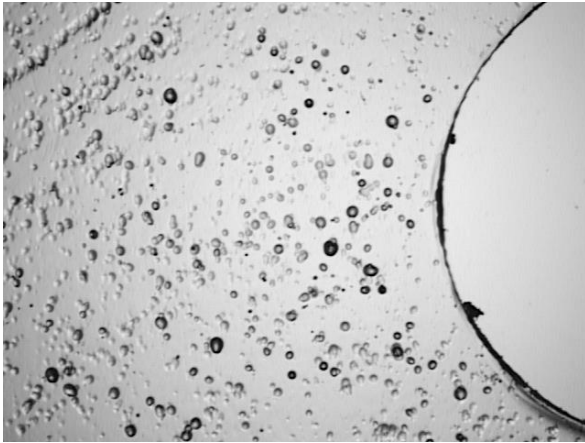
- Studying Makrofol foil
  - Large Background, many pits in the images
  - Want to find etch pits passing through the foil
  - Want technique that can scale up
- 



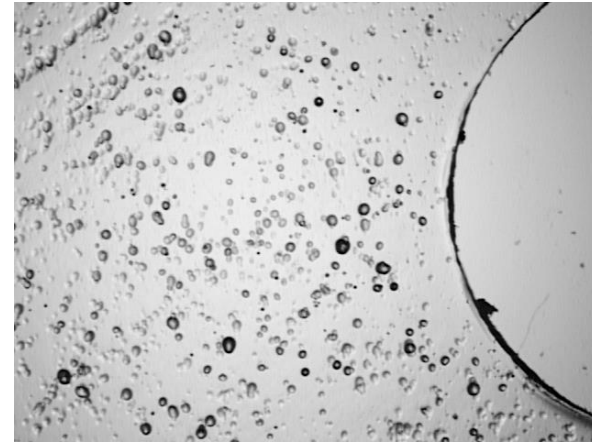
- Unlike low background, thicker makrofol, there is not much spatial separation between entry, and exit holes. I.e., not automatically distinct.
- Are Holes correlated, or just an overlapping cluster?
- Cannot control with precision whether front or back focal plane is being imaged

# Front / Back comparison

'Correct Alignment' - (foil numbering up)



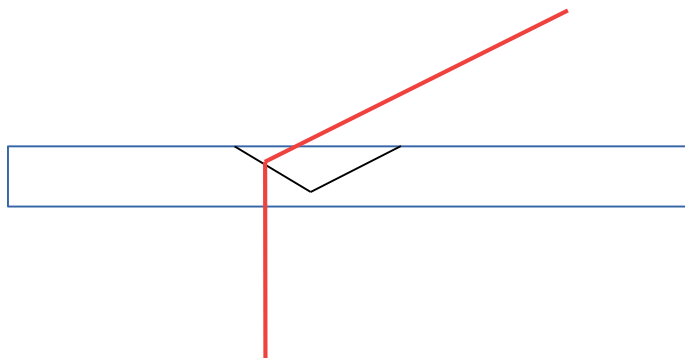
Reverse alignment – (with image flipped)



- 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

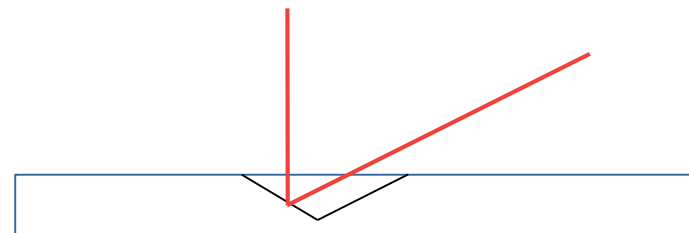
# Scattering / Transmission

- Want to Find a Front Back asymmetry
- Dark Spots are caused when backlighting is scattered away from the lens.

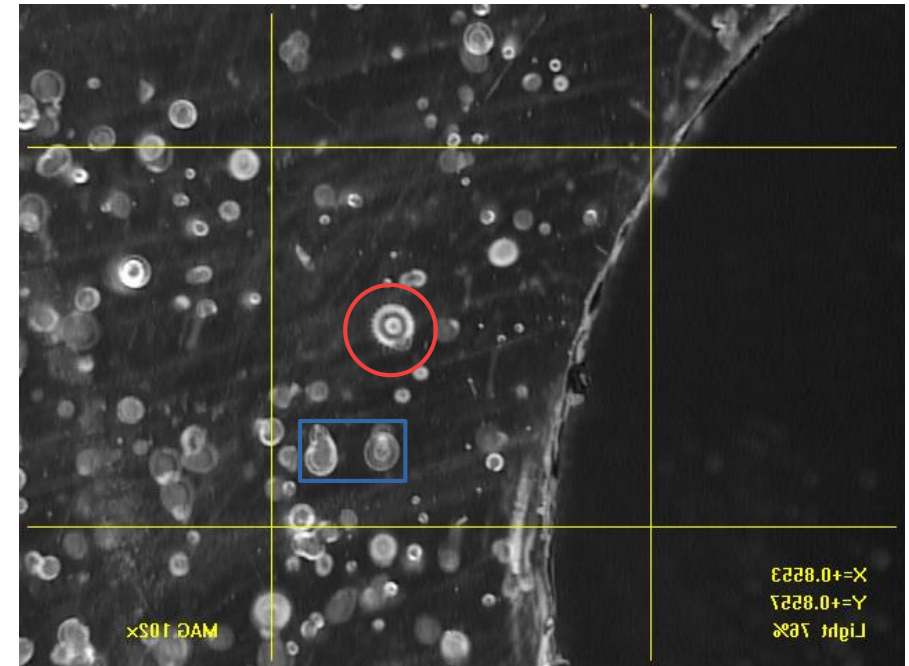
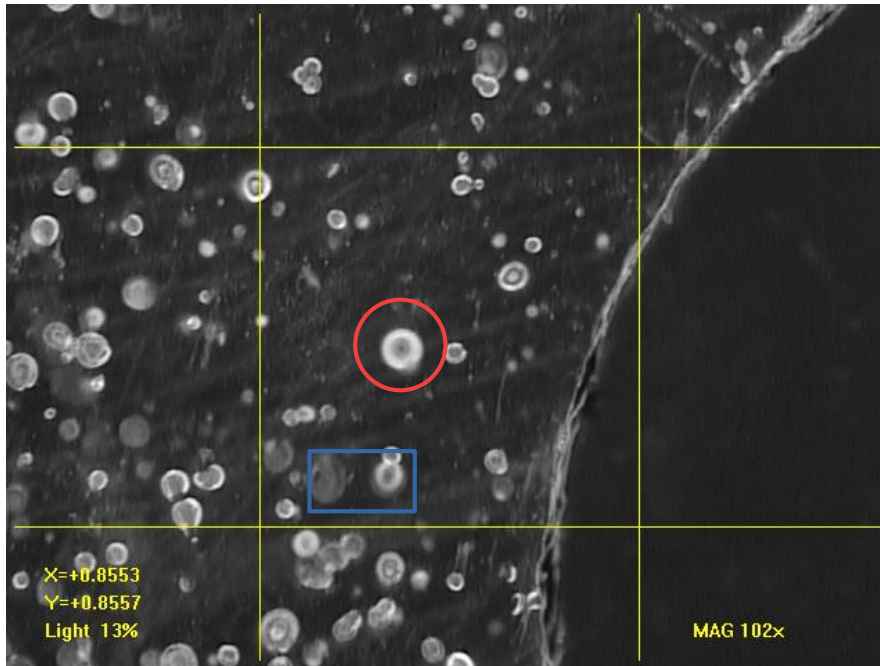


## HYPOTHESIS:

Halo lighting on front surface holes will cause additional illumination due to light scattering INTO the lens



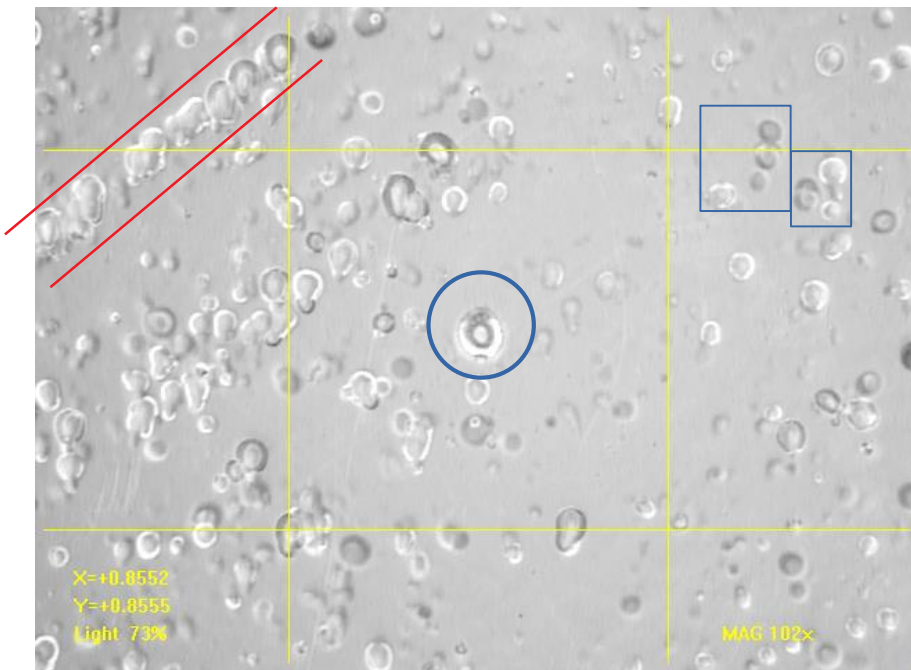
# Halo lighting



- 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

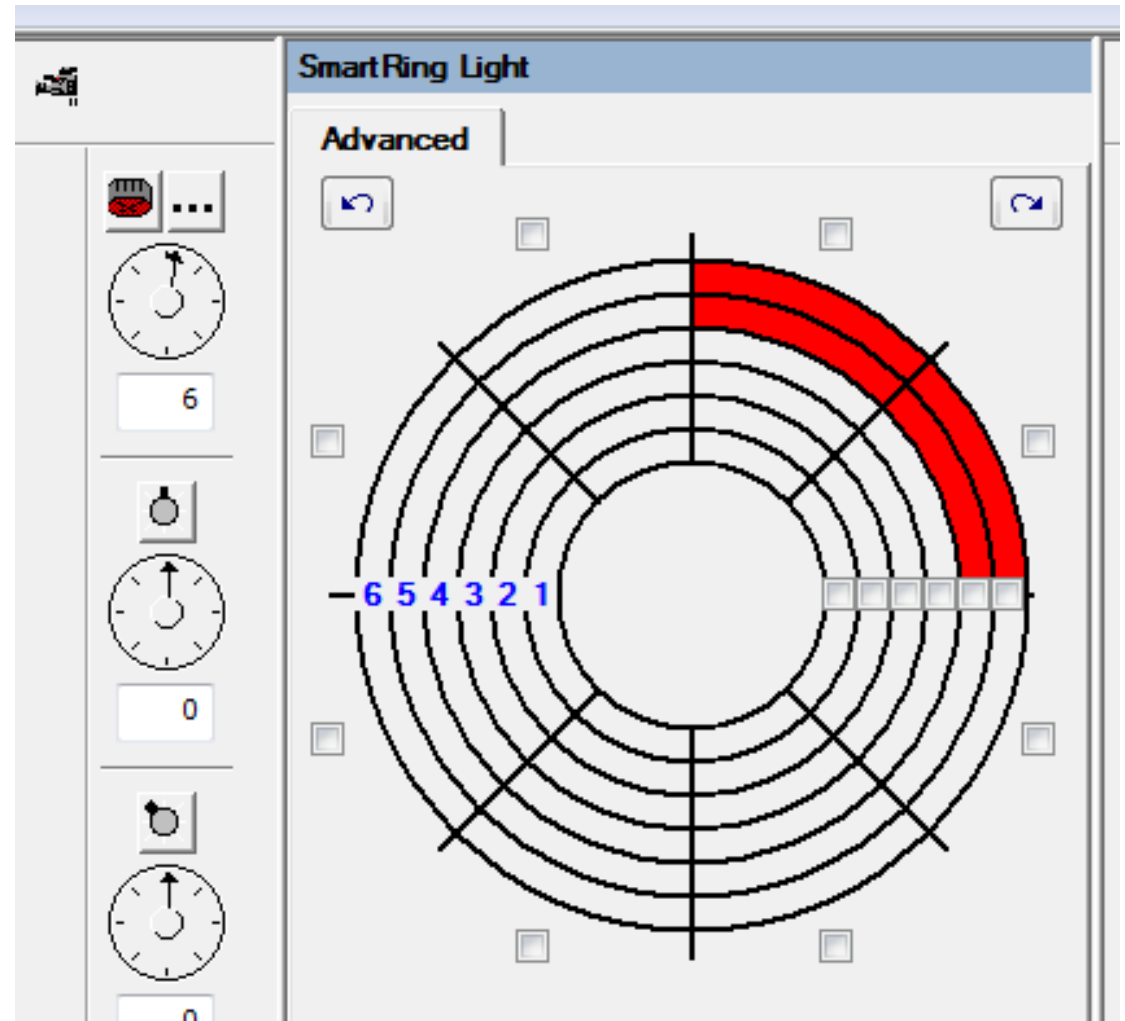
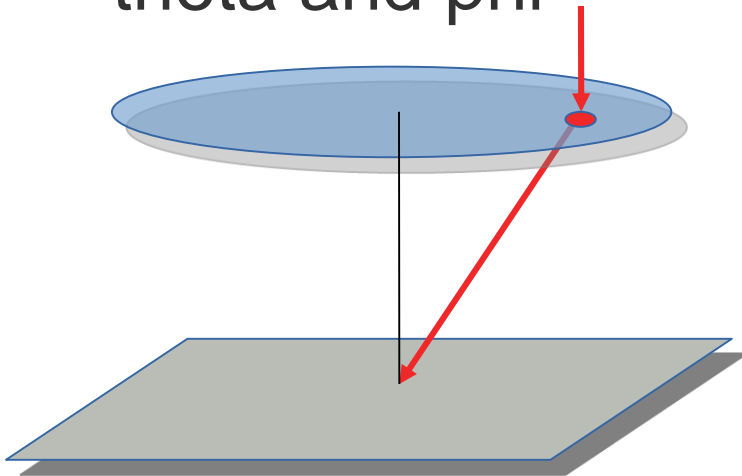
# Halo, + backlighting

- 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

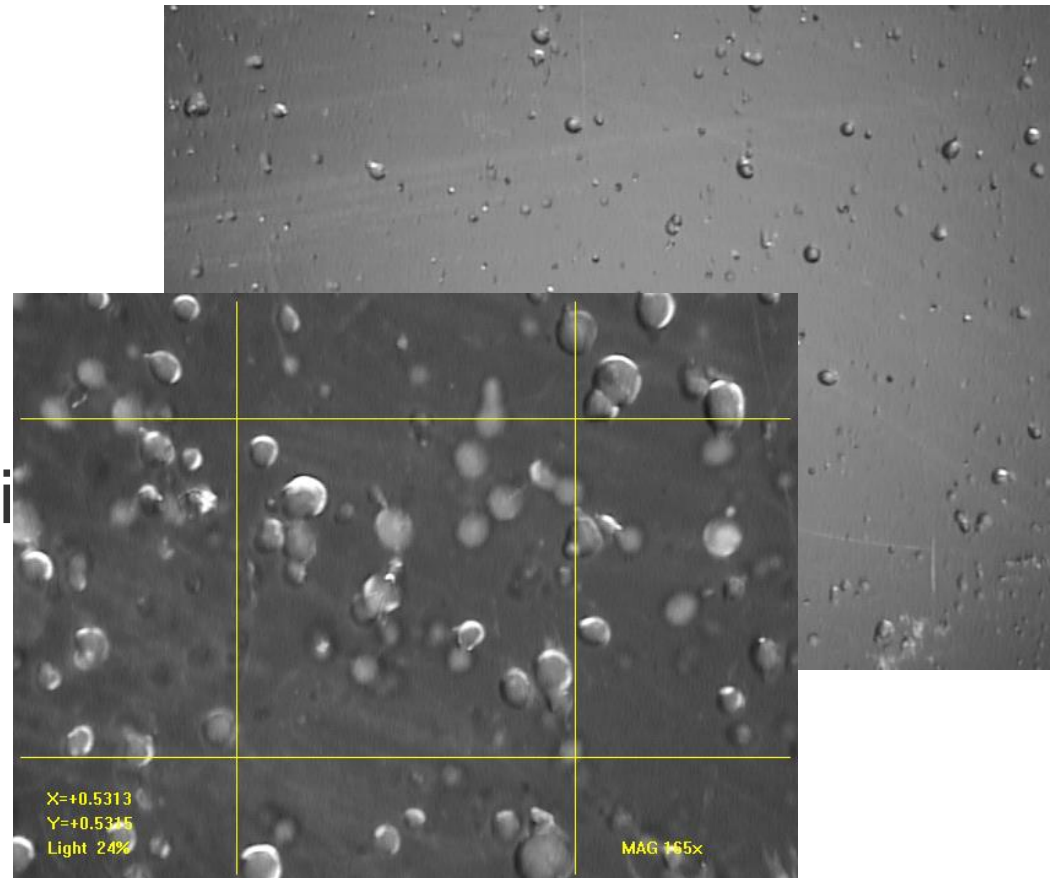
- 4<sup>th</sup> Illumination
- LED grid
- Passes through Fresnel lens
- I.e., Can control theta and phi





# Fresnel illumination

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

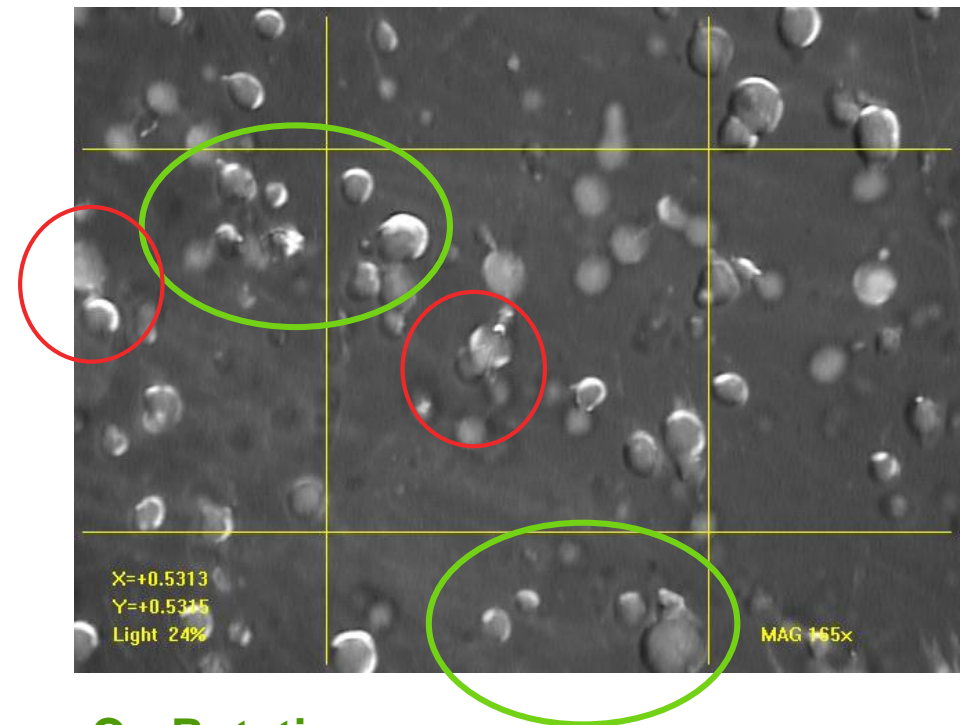




# Holes

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

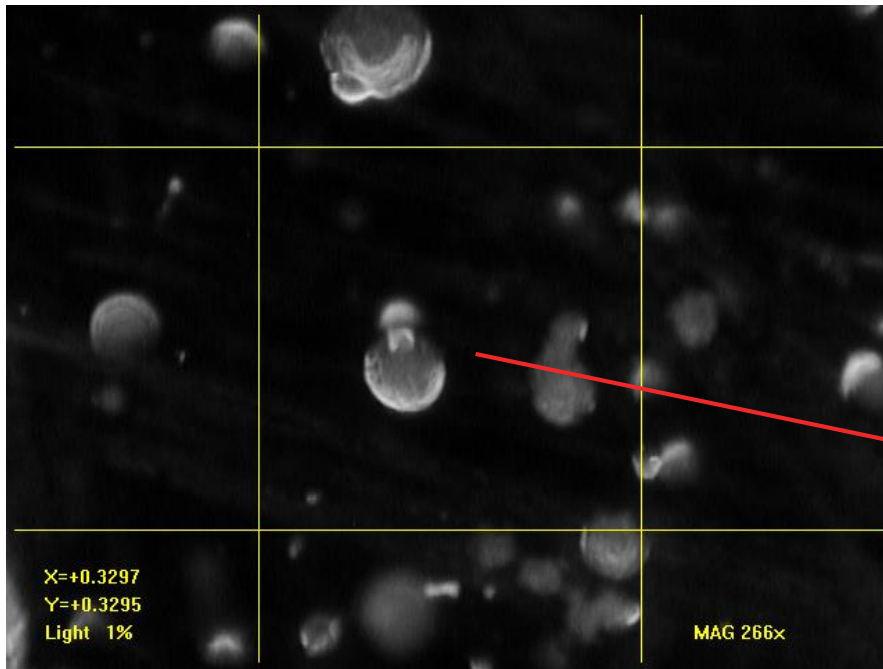


**Co-Rotating**

**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.



**MoEDAL**

**Next Steps : 16 aug**

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# ML: Data

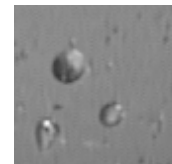
- 441 images(640x480)  
X 10 channels
- Will cut down and hand pick 'baby food' simple training examples, ie one pit
- Build up to multiple pits etc..

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