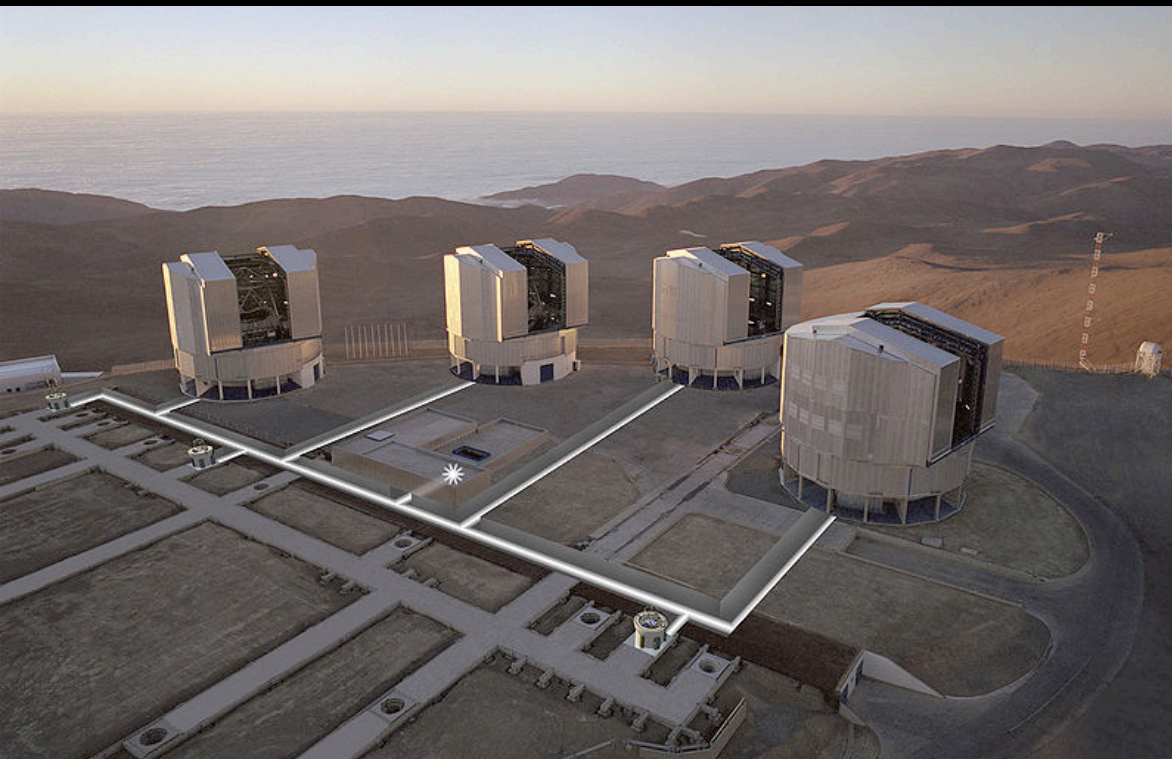
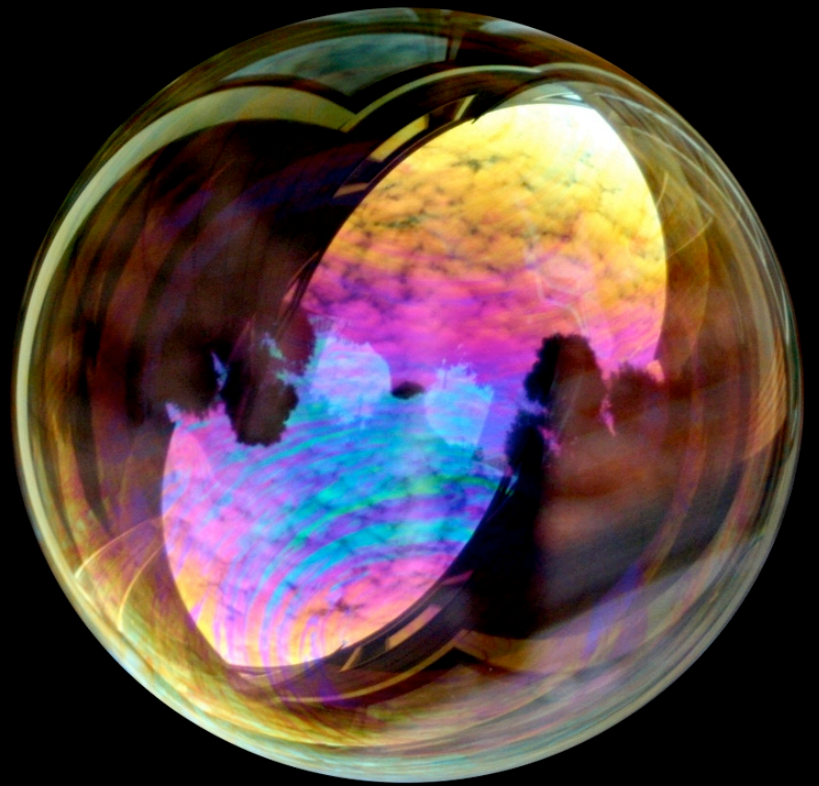
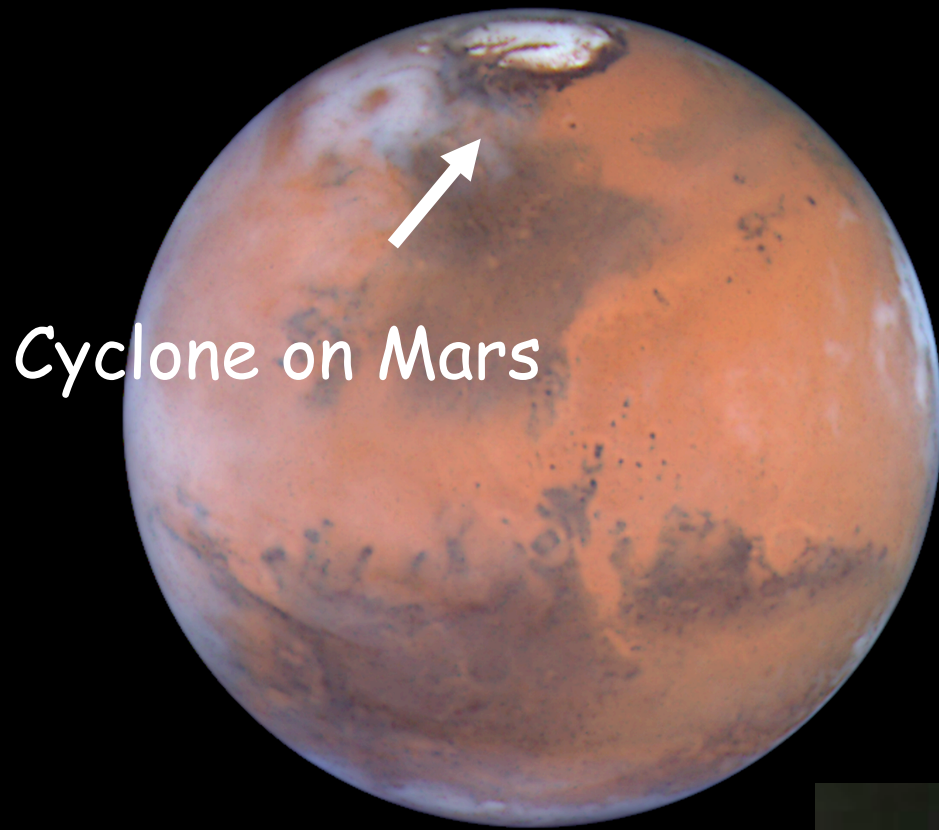


What  
soap bubbles  
and  
telescopes  
have in  
common?



Very Large Telescope  
Interferometer - ESO



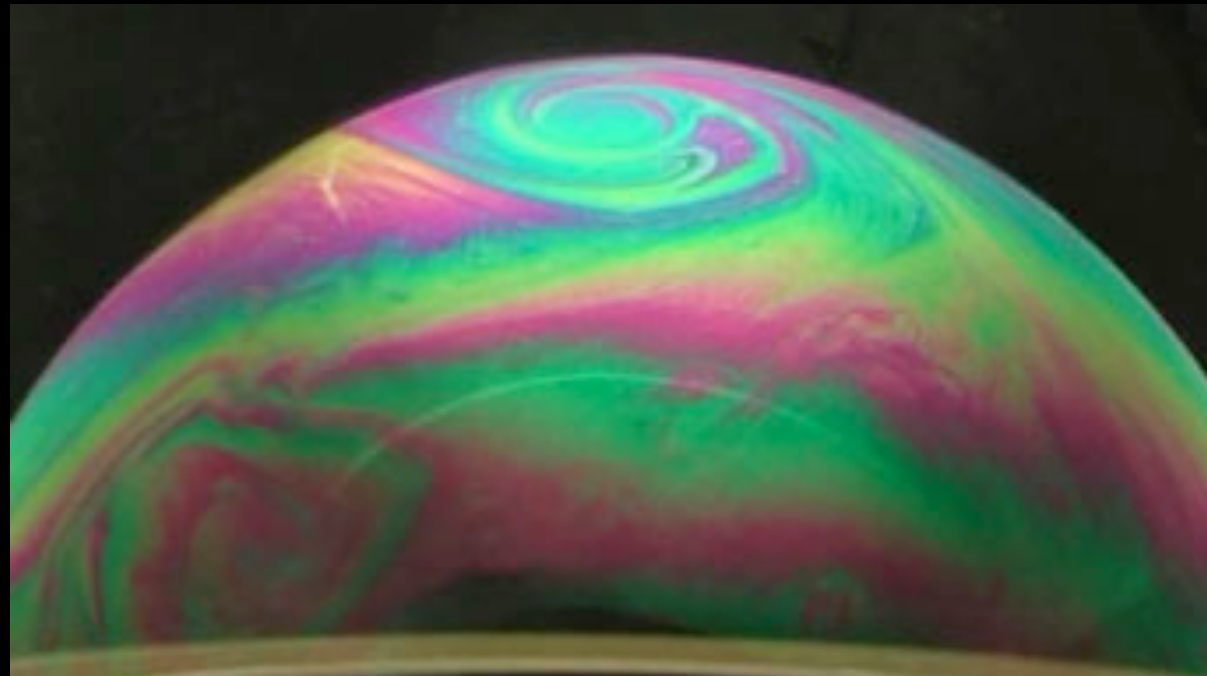


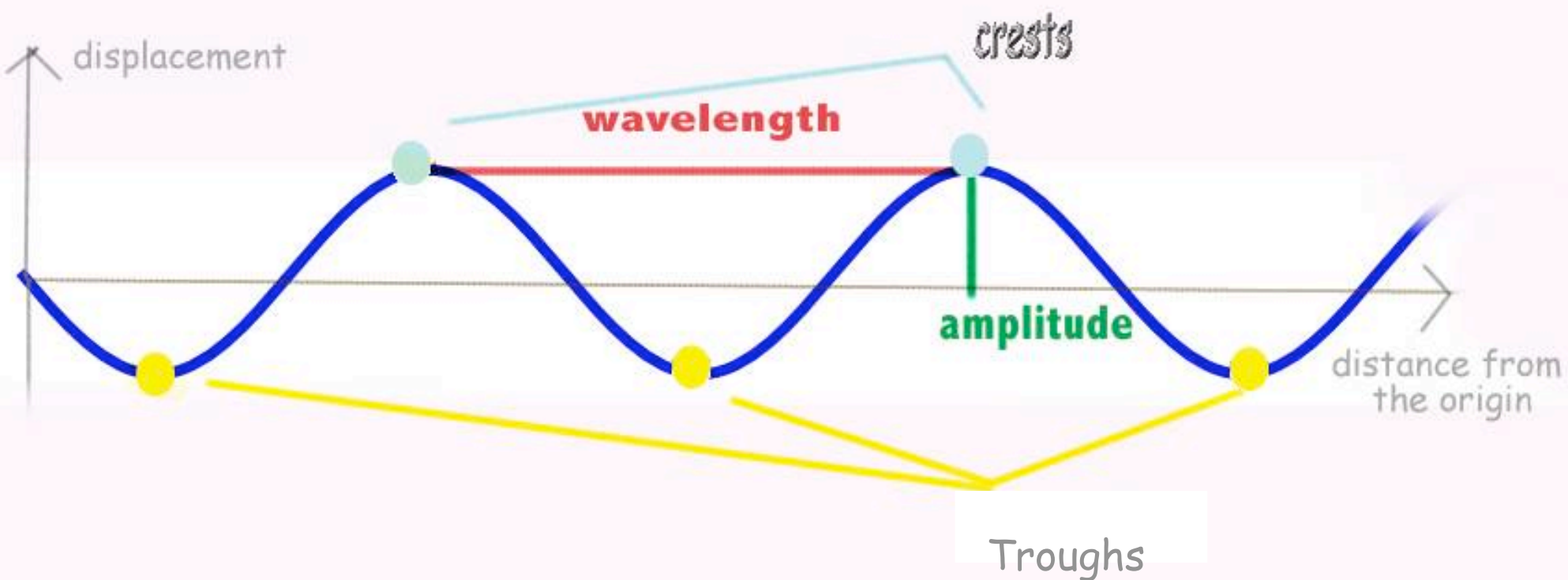
Cyclone on Mars



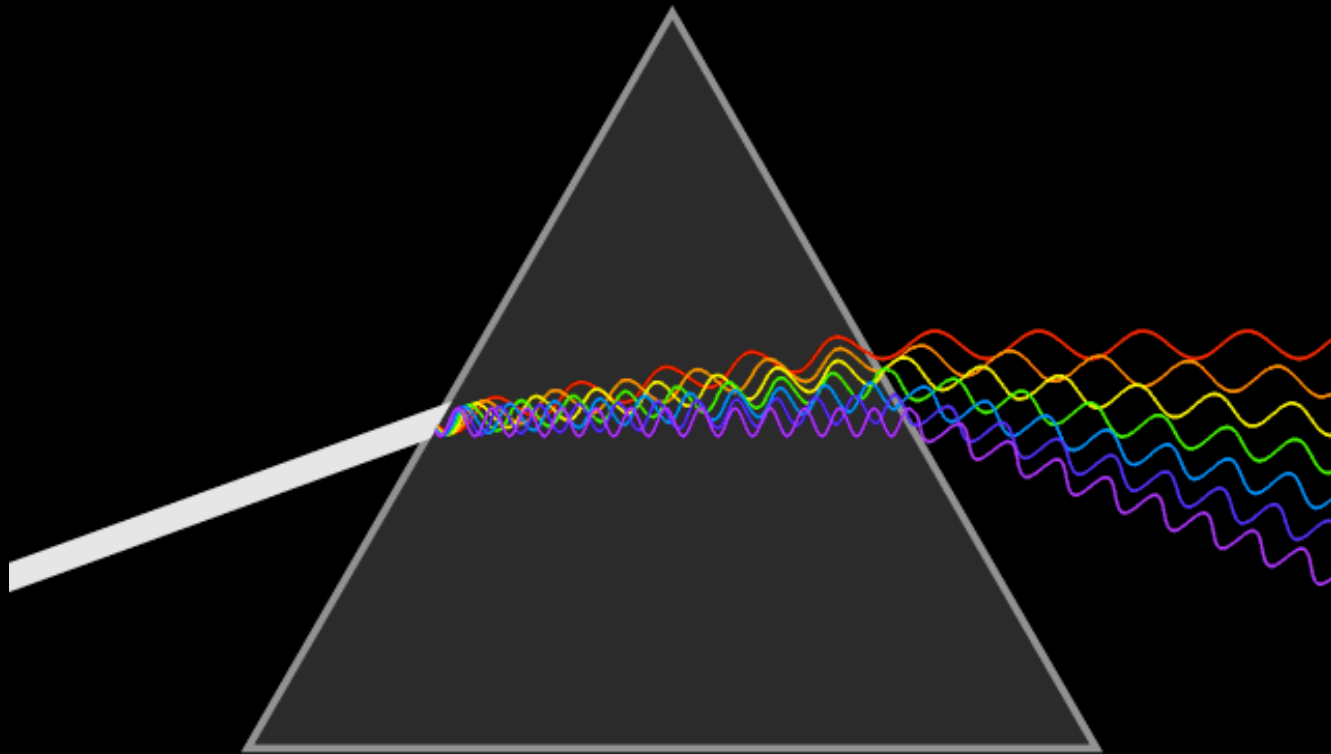
Cyclone on Earth

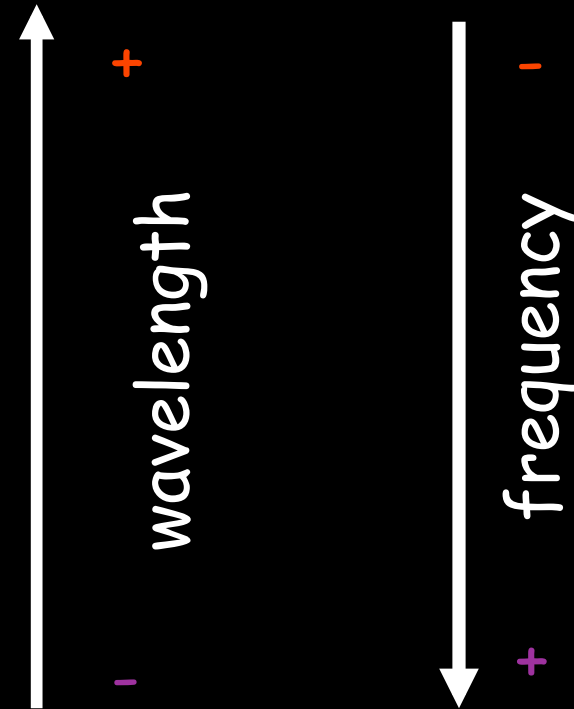
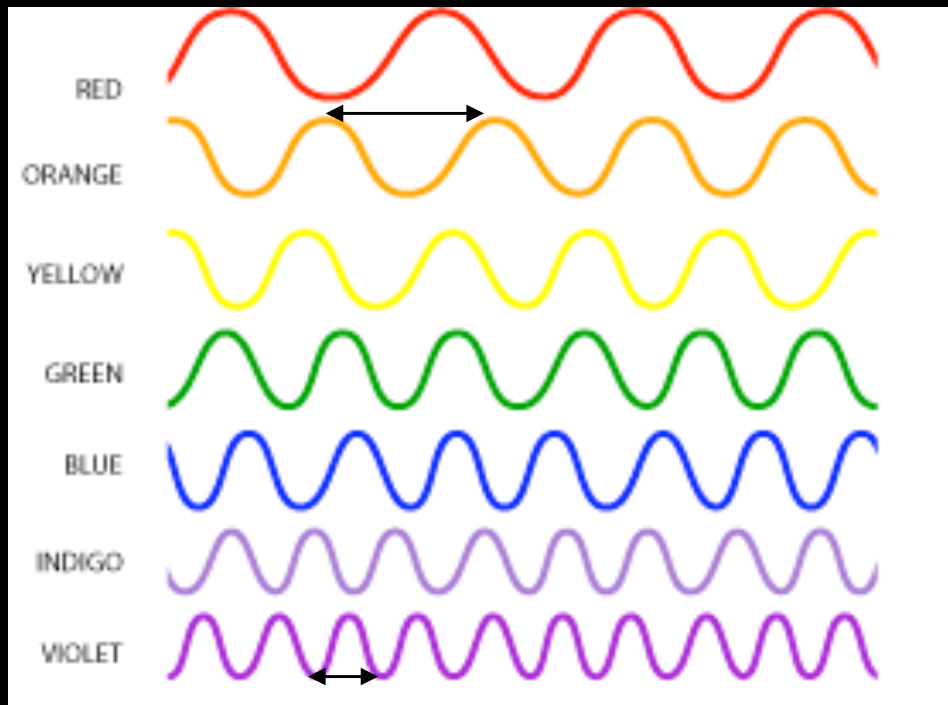
Soap bubble







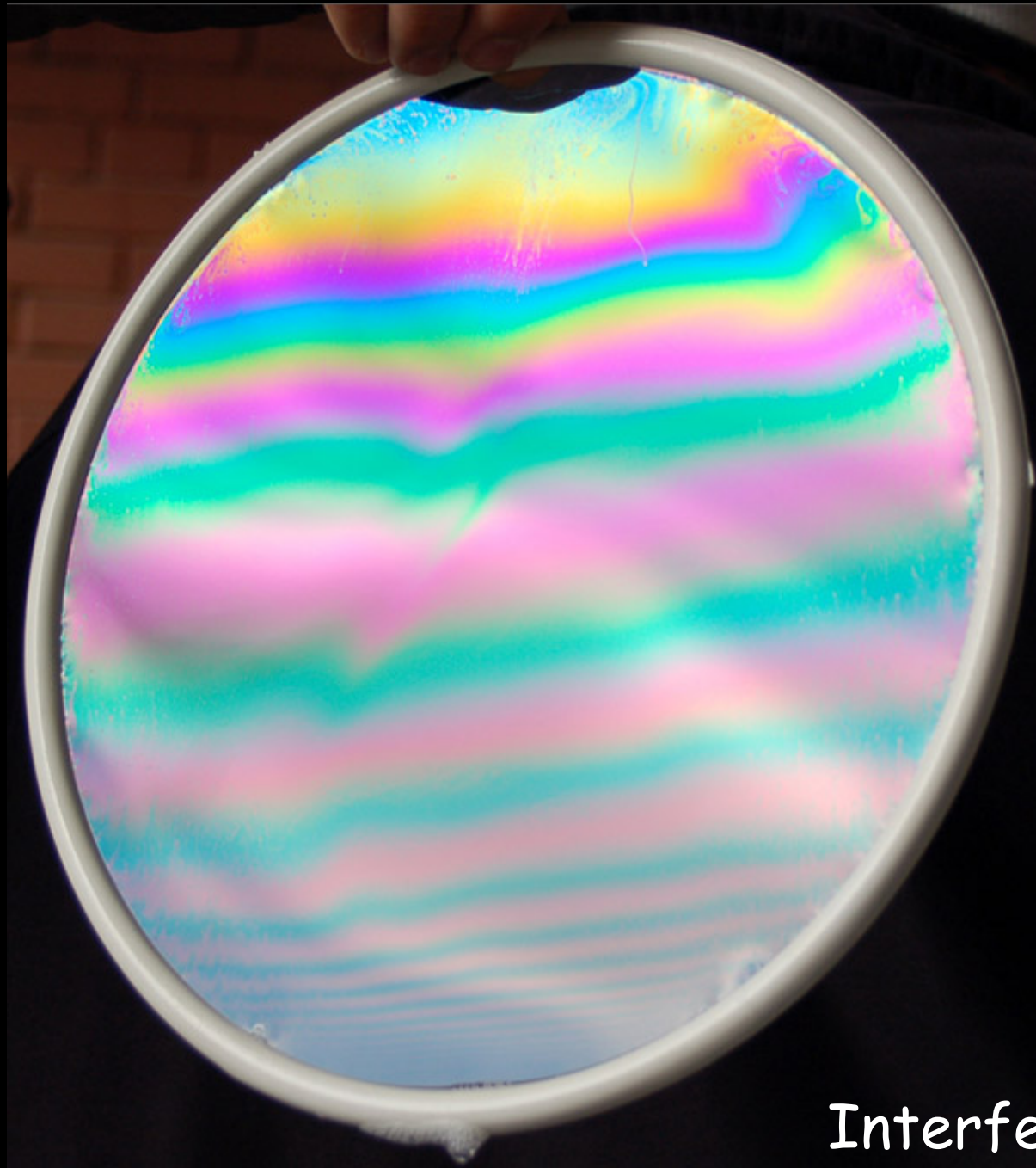




**Red:** about 700 billionths of a meter

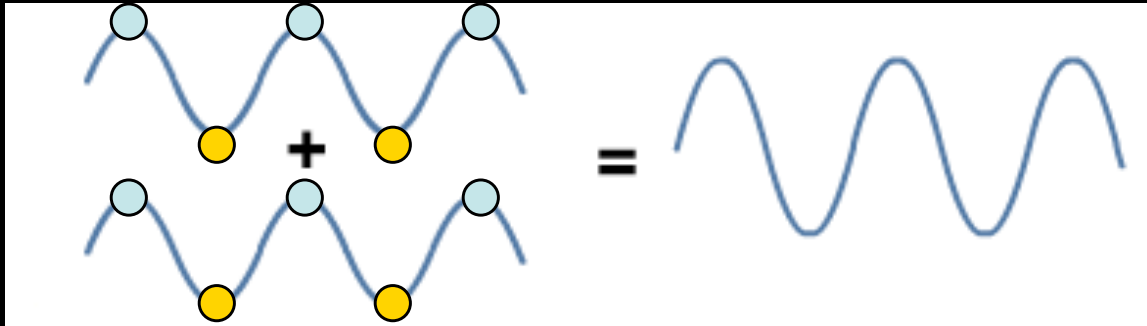
**Violet:** about 400 billionths of a meter



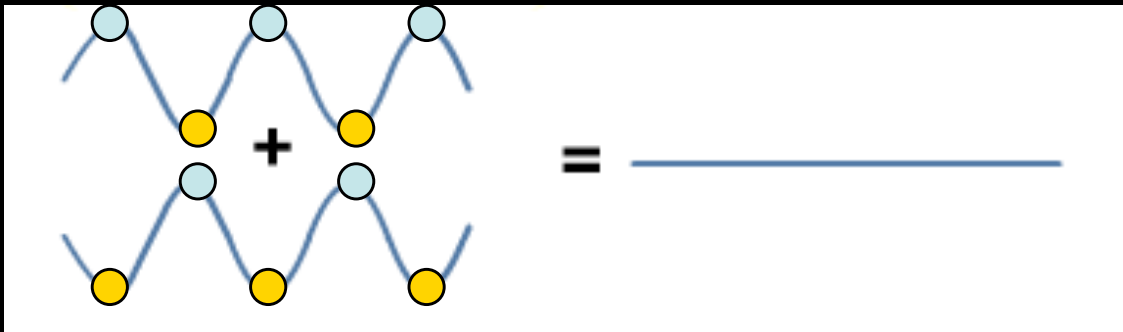


Interference!

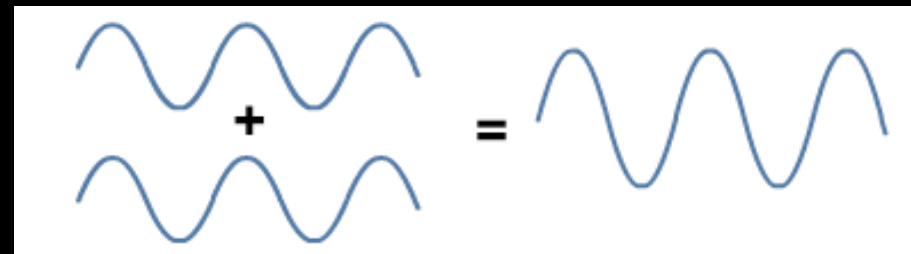
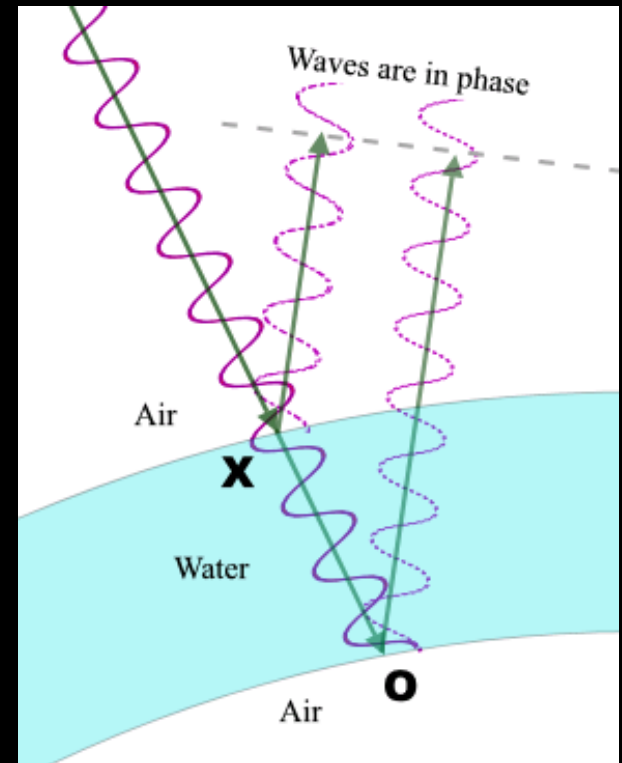
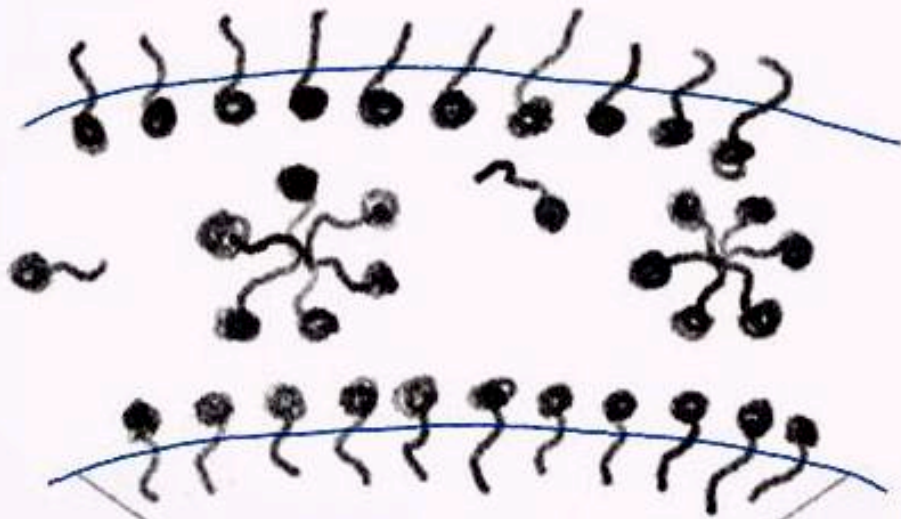
# Interference



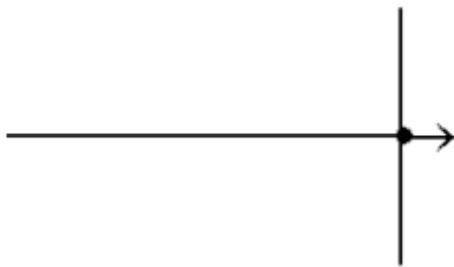
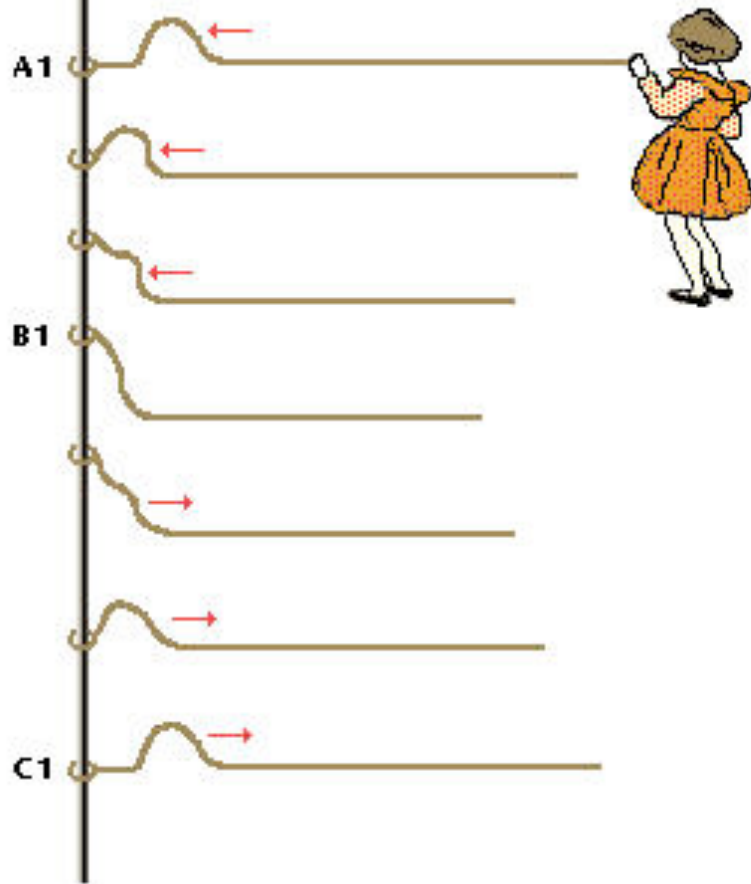
CONSTRUCTIVE



DESTRUCTIVE

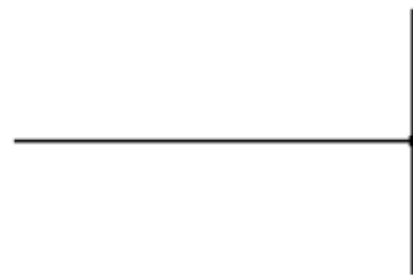
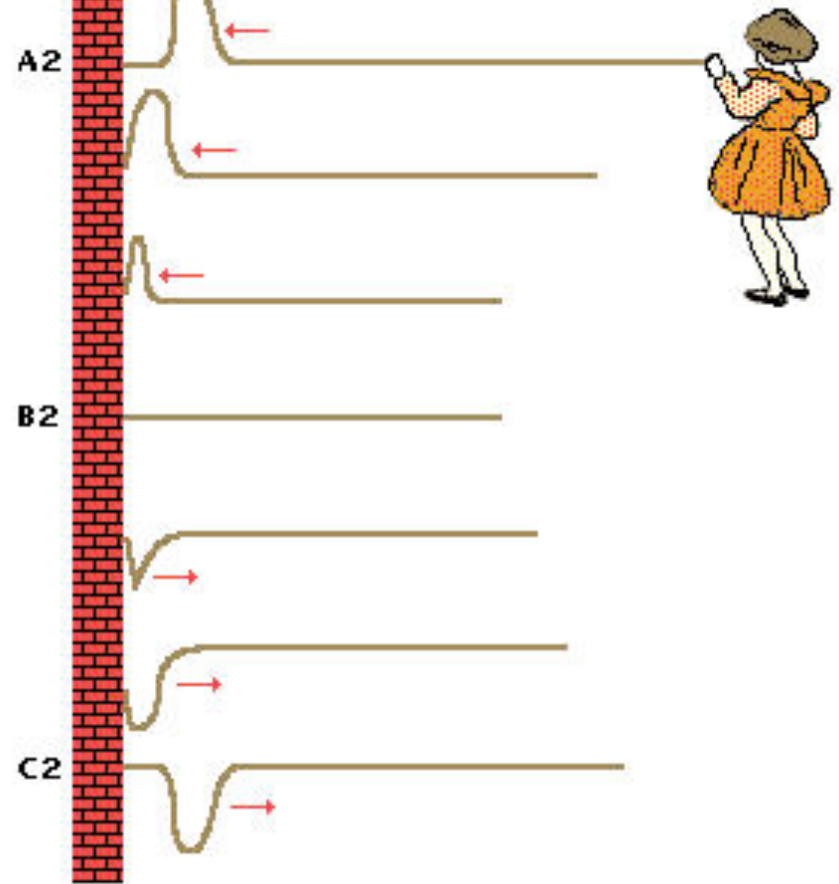


**Pulse reflecting from a free end**



*isvr*

**Pulse reflecting from a fixed end**

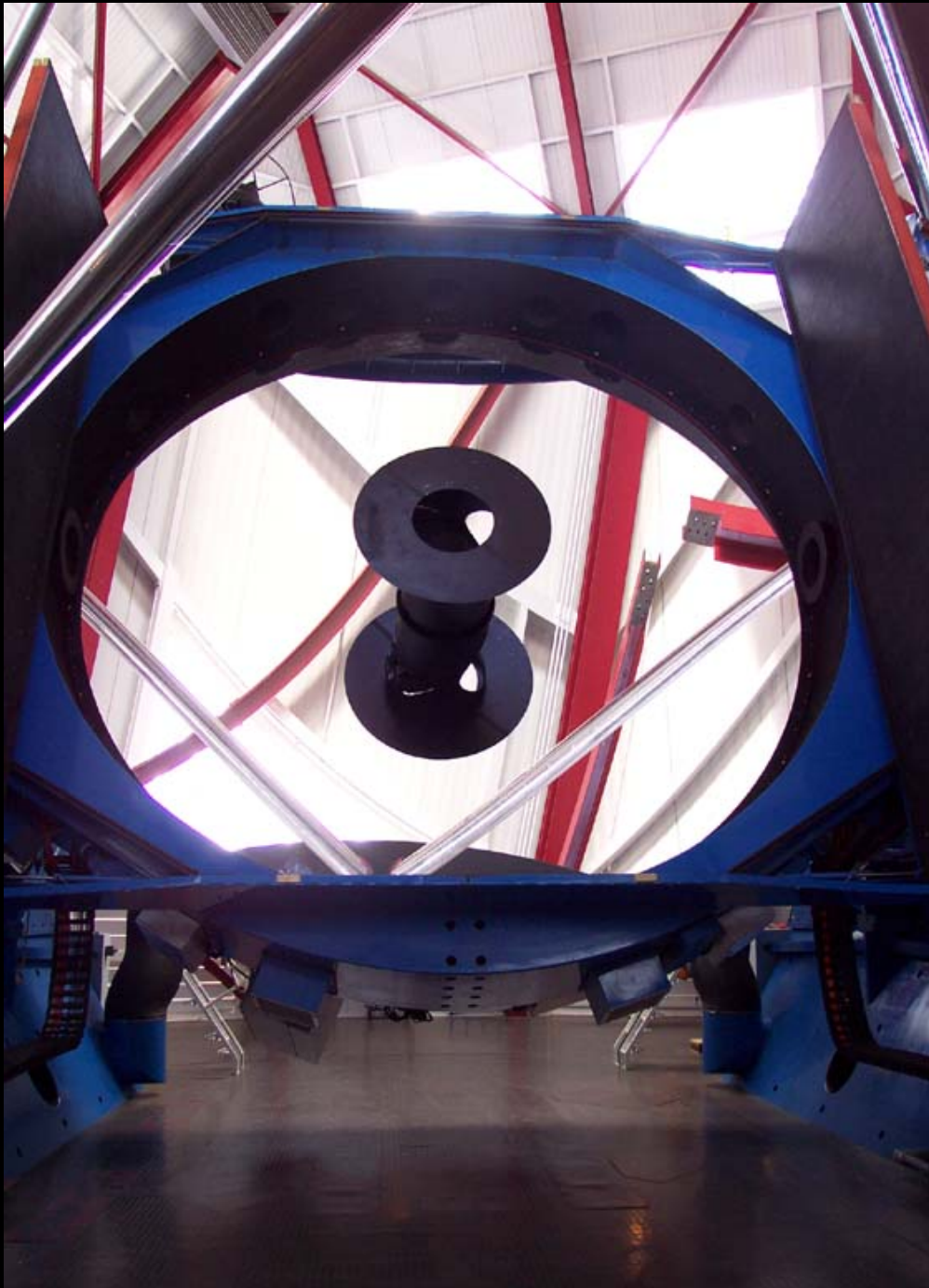


*isvr*

# CLUES

- 1) Thin sandwich
- 2) Black  $\rightarrow$  destructive interference

# REFLECTION



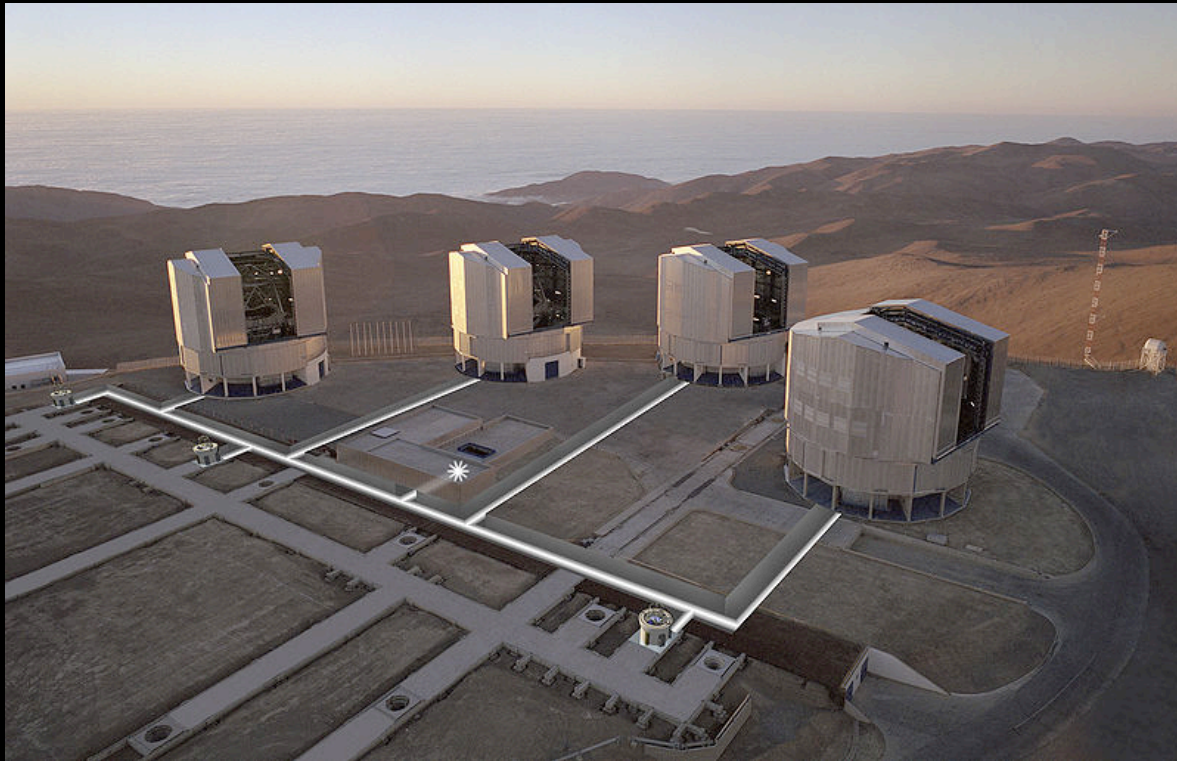
Optical reflecting  
Telescopes

← Magellan Telescope, Chile

Carnegie Institution,  
University of Arizona,  
Harvard University,  
University of Michigan,  
and

Massachusetts Institute of Technology

# Interference



← ESO Very Large Telescope Interferometer - Chile



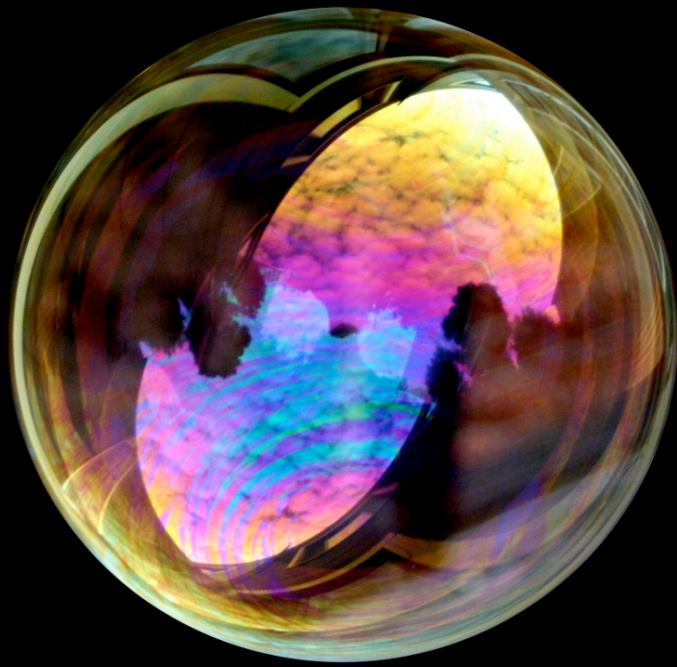
NRAO Very Large Array  
New Mexico (USA)



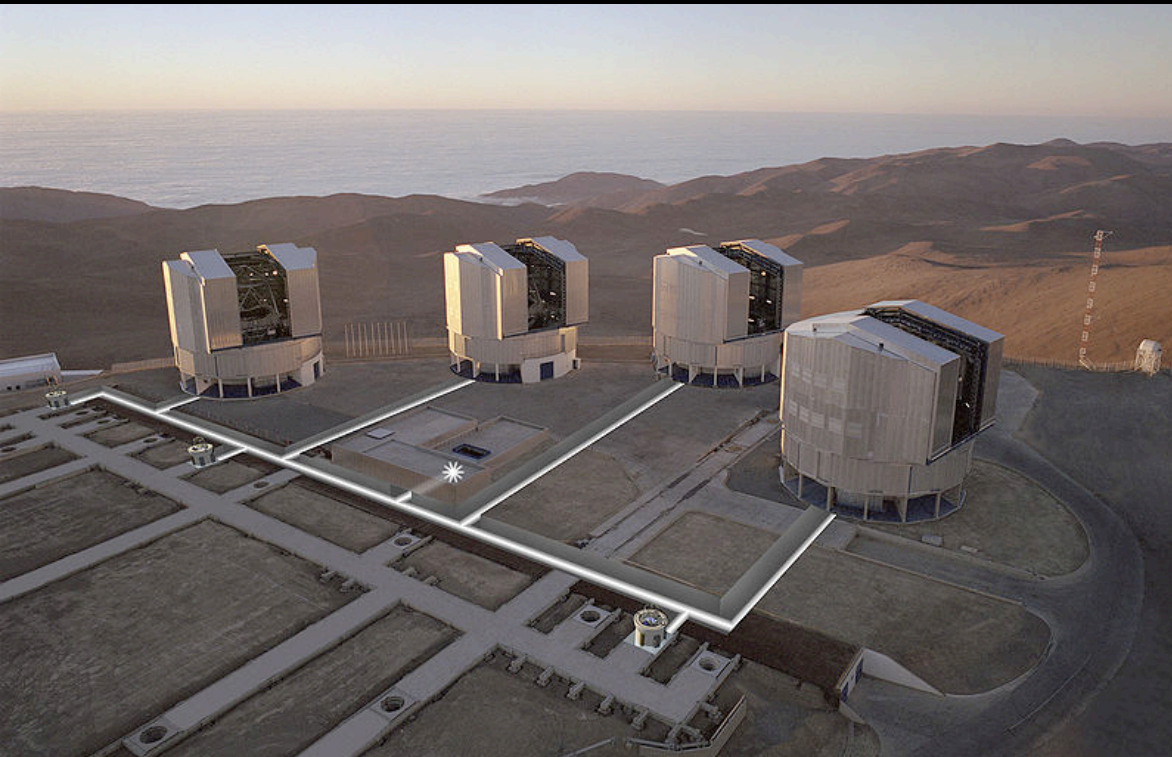


ALMA, Chile - international collaboration!  
66 ANTENNAE [www.almaobservatory.org](http://www.almaobservatory.org)



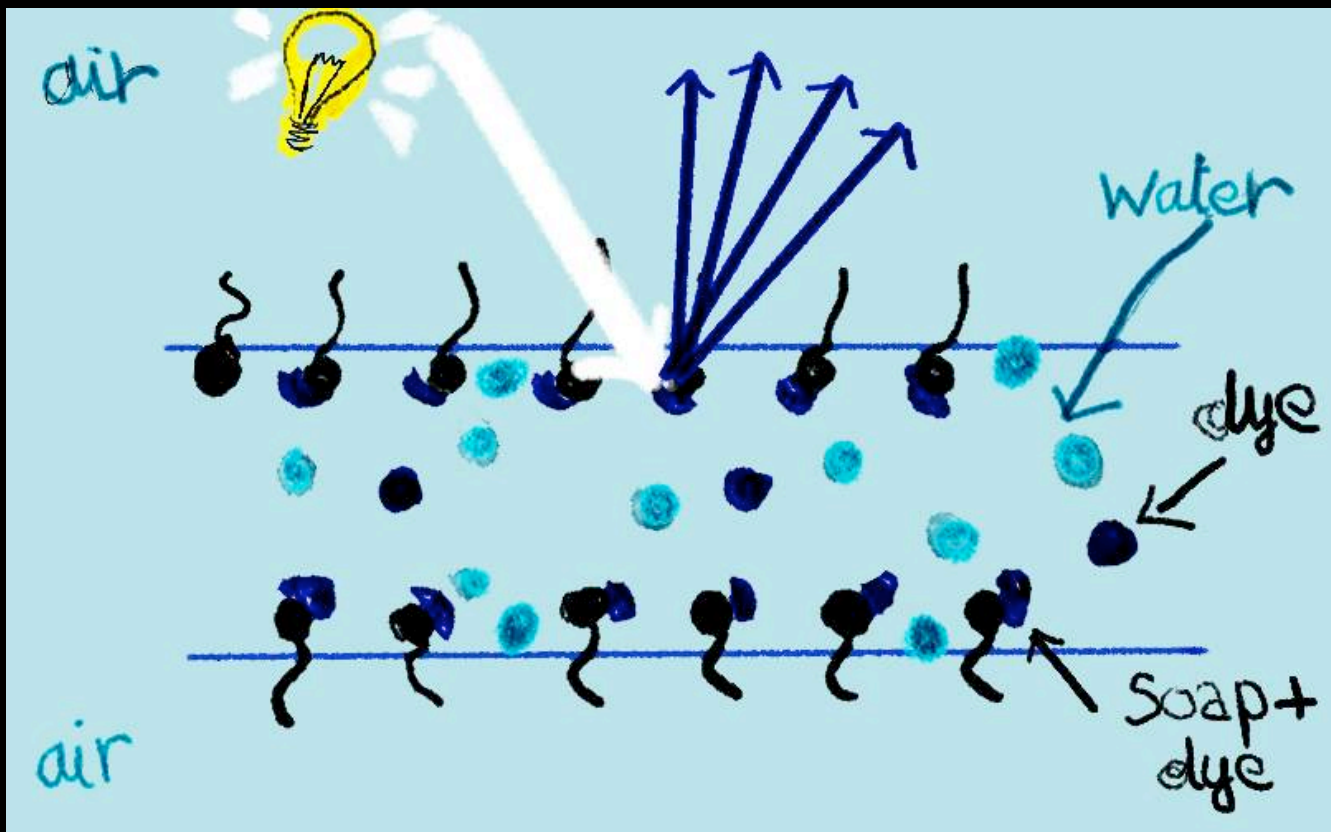


# INTERFERENCE

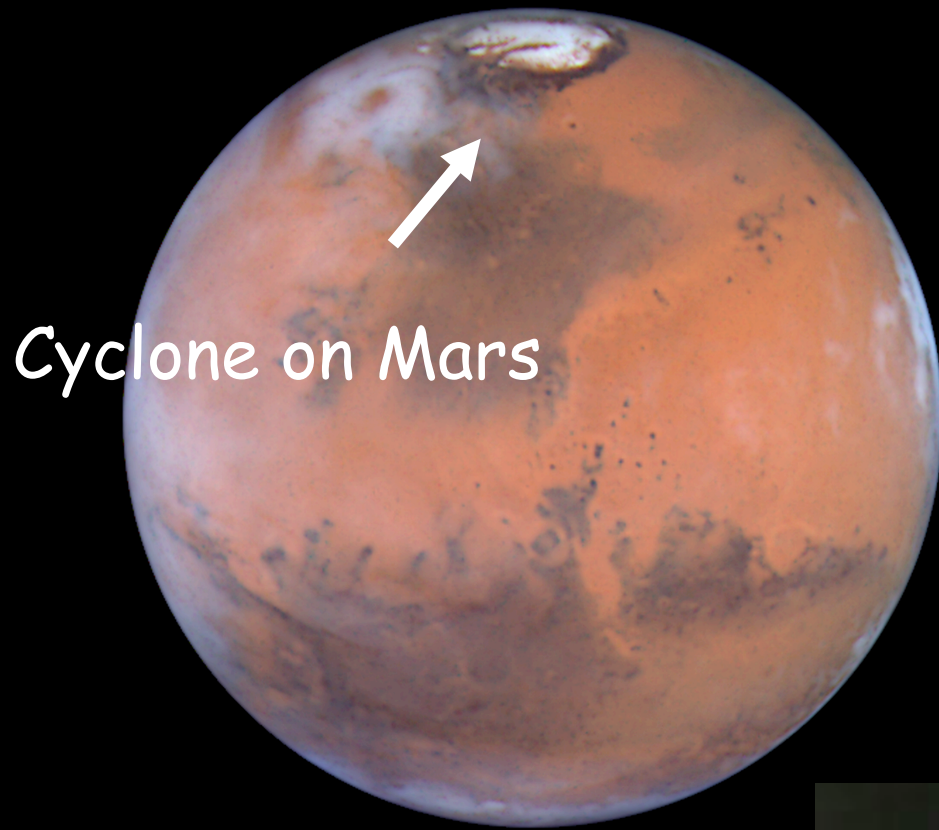


Very Large Telescope  
Interferometer - ESO

# Zubbles: the colored bubbles!



[www.zubbles.com](http://www.zubbles.com)

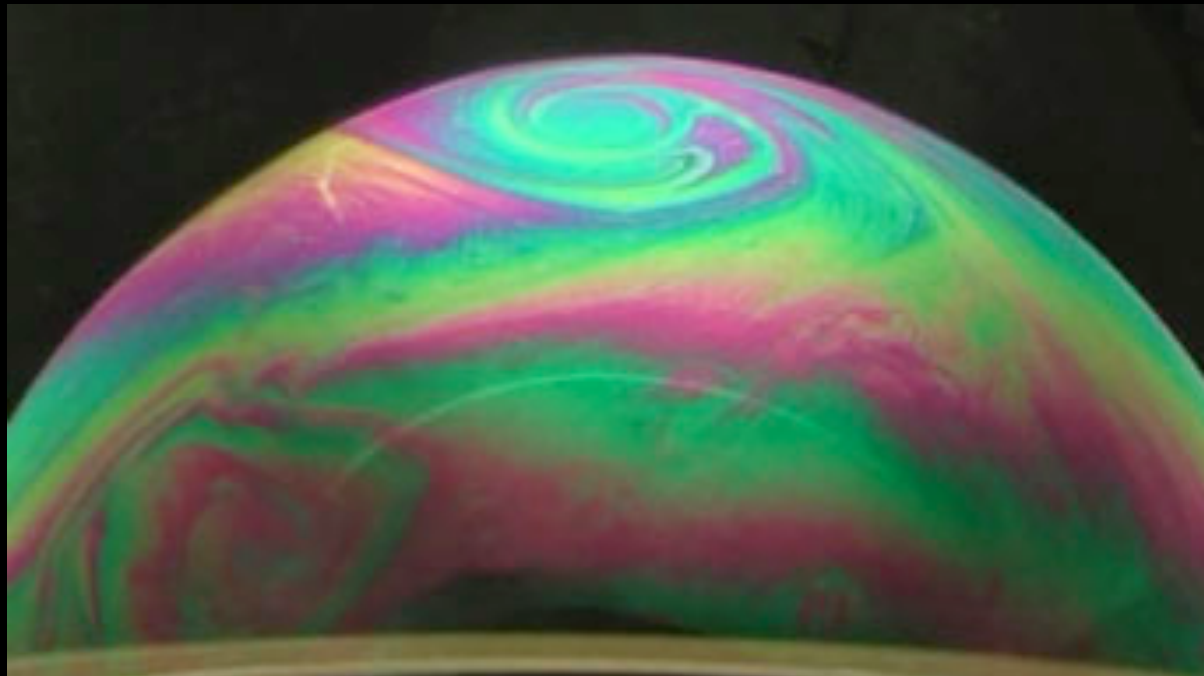


Cyclone on Mars



Cyclone on Earth

Soap bubble



A HUGE THANK YOU TO

Ted Ducas, Walter Lewin, Dick Larson and Liz Murray, Craig Milanesi, Jane & Neil Pappalardo, Mike Stevens, the astrograds and Balu'