



VATICAN OBSERVATORY

# Why Do We Do Science?

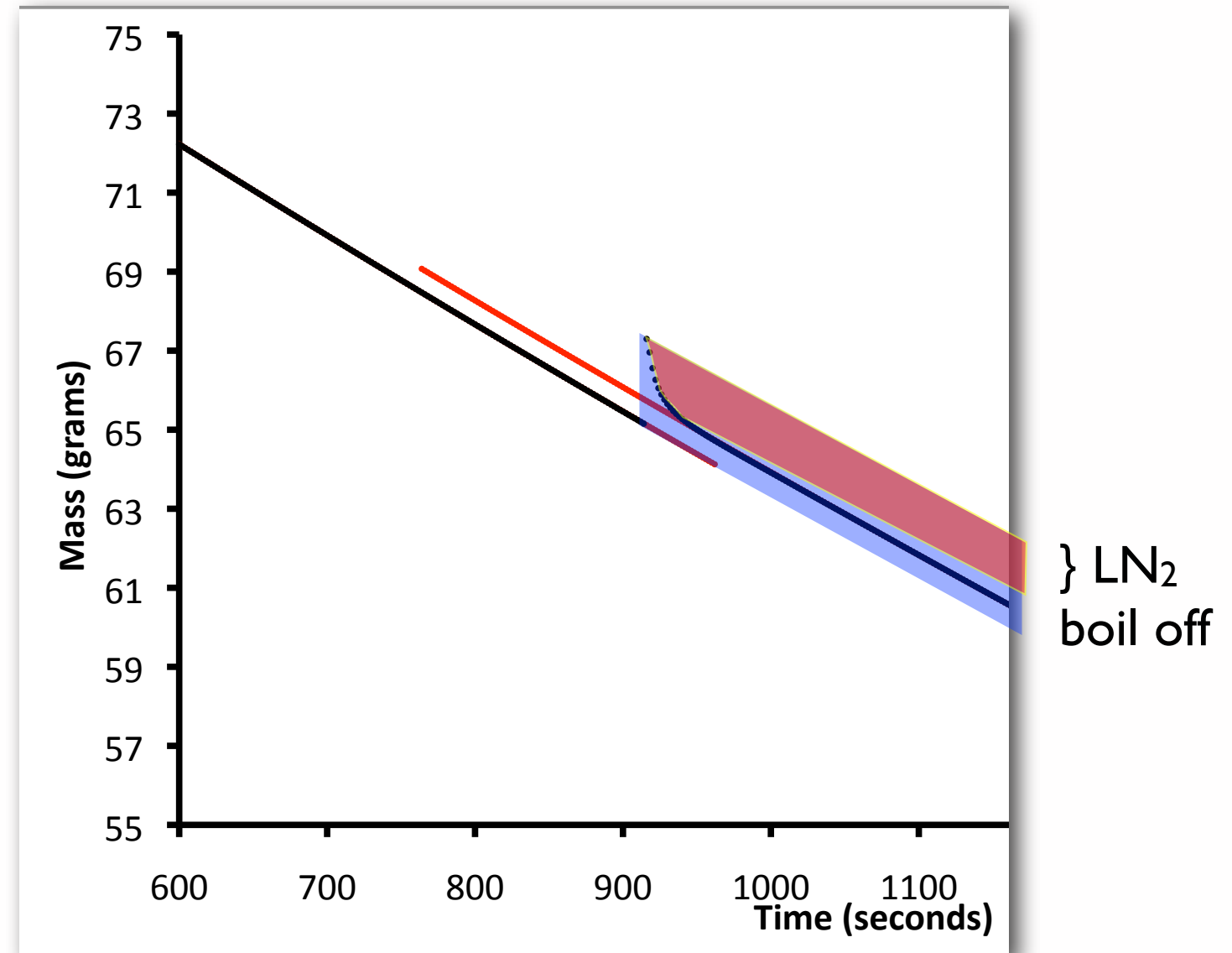
Br Guy Consolmagno SJ  
Vatican Observatory



L'Aigle meteorite



# A quick and dirty technique for measuring heat capacity







“What do I tell my mom?”







BLDG  
32

Tunnel below Building 26, MIT





from *The Fellowship of the Ring*





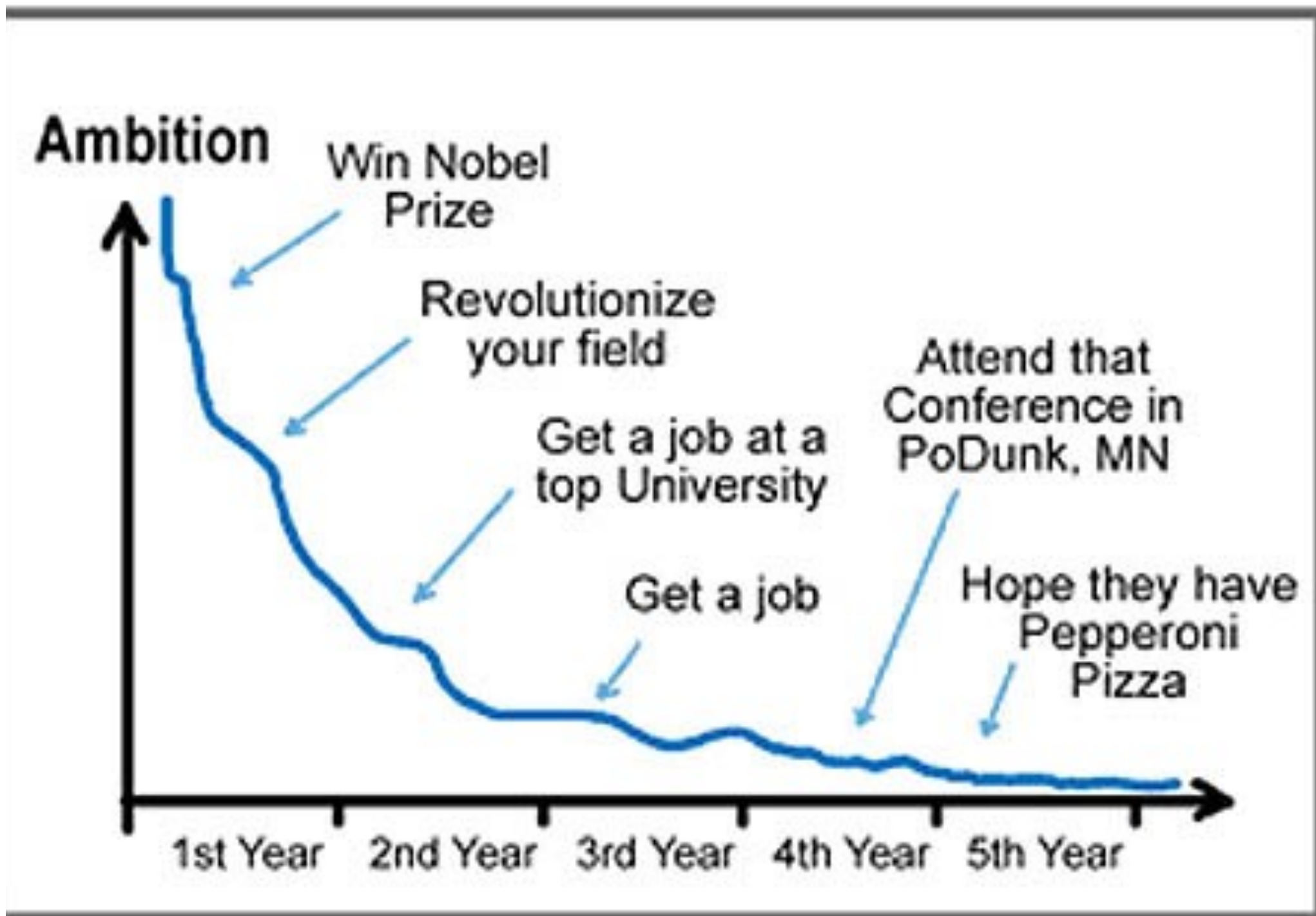
Vivek Pancoar, skiing instructor for Adventure Trekking in Auli. © Photo: Santosh Kunwar



# Hacky Sack



# How do you win this game?



JORGE CHAM © 2008



# How do you win this game?

- Approval others
- Tenure
- Grant money
- Prizes
- Fame
- Successful students
- Cited publications
- Academic freedom

*Are any of these ends in themselves?*



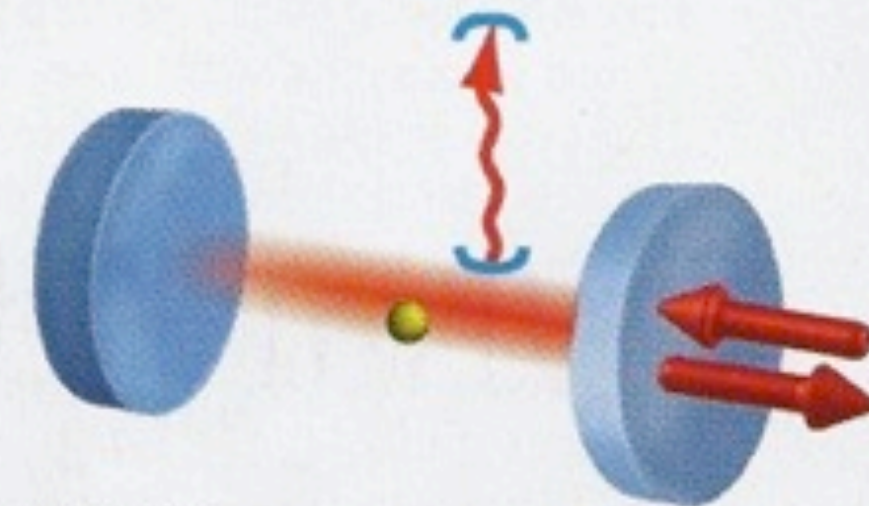
Network Driven Contagion Phenomena  
*D. Brockmann and D. Helbing*  
A model based on effective rather than geographical distance can reveal the origin, timing, and likely spread of epidemics.  
>> *Perspective p. 1330; Video*

## REPORTS

- 1343 **Detection of a Noble Gas Molecular Ion,  $^{36}\text{ArH}^+$ , in the Crab Nebula**  
*M. J. Barlow et al.*
- 1346 **Phosphorus in the Young Supernova Remnant Cassiopeia A**  
*B.-C. Koo et al.*  
Spectroscopic observations of the remains of stellar explosions confirm that argon-36 and phosphorus are produced in such energetic events.
- 1349 **Nondestructive Detection of an Optical Photon**  
*A. Reiserer et al.*  
An atom in a cavity can be used for the nondestructive detection of optical photons.
- 1351 **Effect of Collective Molecular Reorientations on Brownian Motion of Colloids in Nematic Liquid Crystal**  
*T. Turiv et al.*  
Colloidal particles in a nematic liquid crystal experience anomalous and anisotropic Brownian motion.  
>> *Perspective p. 1326*
- 1354 **Detection and Structure of HOON: Microwave Spectroscopy Reveals an O–O Bond Exceeding 1.9 Å**  
*K. N. Crabtree et al.*

- 1372 **Cryptic Variation in Morphological Evolution: HSP90 as a Capacitor for Loss of Eyes in Cavefish**  
*N. Rohner et al.*  
Preexisting but “hidden” variations in eye size provide a substrate for natural selection in fish reared in the dark.  
>> *News story p. 1304*
- 1375 **Progressive Specification Rather than Intercalation of Segments During Limb Regeneration**  
*K. Roensch et al.*  
Salamanders regenerate limb segments using the same molecular hierarchy observed in development.
- 1379 **EMRE Is an Essential Component of the Mitochondrial Calcium Uniporter Complex**  
*Y. Sancak et al.*  
A final but essential protein component involved in maintaining mitochondrial calcium levels is discovered.
- 1382 **Direct and Reversible Hydrogenation of  $\text{CO}_2$  to Formate by a Bacterial Carbon Dioxide Reductase**  
*K. Schuchmann and V. Müller*  
Enzymes from anaerobic bacteria can catalyze the storage of hydrogen in the form of formic acid.  
>> *Perspective p. 1329*
- 1385 **Genetic and Molecular Basis of Drug Resistance and Species-Specific Drug Action in Schistosome Parasites**  
*C. L. L. Valentim et al.*  
Mutations in a distinctive sulfotransferase are responsible for praziquantel resistance

pages 1330 & 1337



page 1349



# How do you win this game?

- Curiosity
- Pleasure in solving problems
- Pleasure in finding patterns
- Truth
- Love

*Are any of these ends in themselves?*

# How do you win this game?

- Approval of others
- Tenure
- Grant money
- Prizes
- Fame
- Academic freedom
- Successful students
- Cited publications

- Curiosity
- Pleasure in solving problems
- Pleasure in finding patterns
- Truth
- Love

*Would you sacrifice anything on list one to obtain anything on list two?*



## How do you win this game?

- Approval of others
- Tenure
- Grant money
- Prizes
- Fame
- Academic freedom
- Successful students
- Cited publications
- Curiosity
- Pleasure in solving problems
- Pleasure in finding patterns
- Truth
- Love

*Would you sacrifice anything on list two to avoid losing anything on list one?*

# Would you...

- Give up **Approval of others** to satisfy **Curiosity?** Or vice versa?
- Give up **Tenure** to satisfy **Love?** Or vice versa?
- Give up **Academic freedom** to satisfy **Pleasure in solving problems?** Or vice versa?
- Give up **Fame** to satisfy **Pleasure in finding patterns?** Or vice versa?
- Give up **Grant money** to satisfy **Truth?** Or vice versa?

*Where is your heart?*

*Where is your God?*

*What does this tell you about the sort of God you worship?*



- Internal motivations aren't enough
- ***Something*** is the ultimate criterion
- Lose sight of this criterion, and the work becomes meaningless...  
poorly done...until you lose it all



M64 (VATT)





The Crab Nebula (VATT)





The Trifid Nebula (Hubble)





Mon V838 (Hubble)





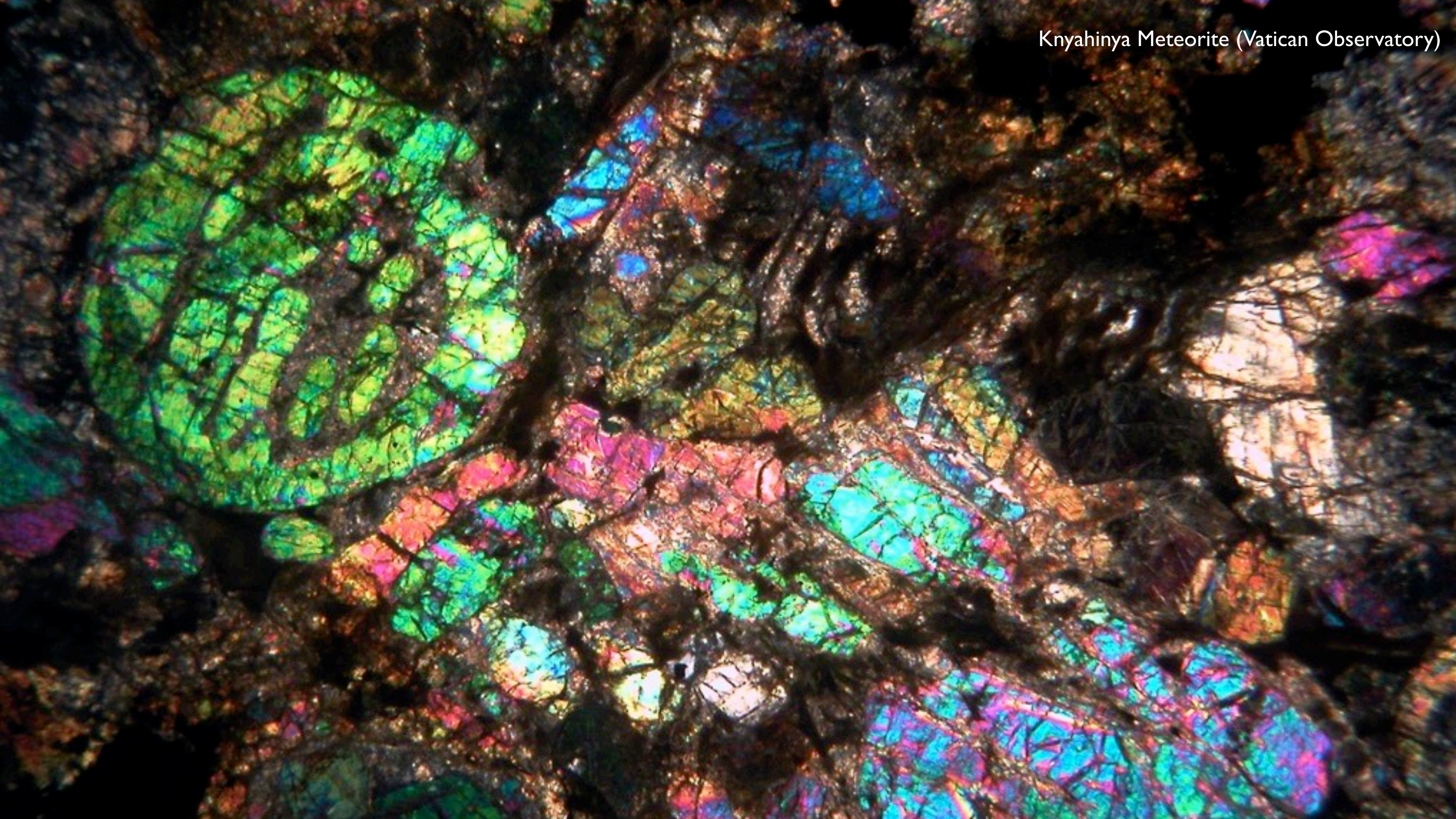
The Carina Nebula (Hubble)





NGC 5907 (Blackbird Obs.)







....and God said:

$$\epsilon_0 \oint \mathbf{E} \cdot d\mathbf{A} = \sum q$$

$$\oint \mathbf{B} \cdot d\mathbf{s} = \mu_0 \int \mathbf{J} \cdot d\mathbf{A} + \mu_0 \epsilon_0 \frac{d}{dt} \int \mathbf{E} \cdot d\mathbf{A}$$

$$\oint \mathbf{E} \cdot d\mathbf{s} = - \frac{d}{dt} \int \mathbf{B} \cdot d\mathbf{A}$$

$$\oint \mathbf{B} \cdot d\mathbf{A} = 0$$

....and there was light

GET YOUR DICK ON



NAMING PLUTO





Why do astronomy when there are people starving in the world?



Harvard Bridge between Boston and Cambridge, approaching MIT



1983

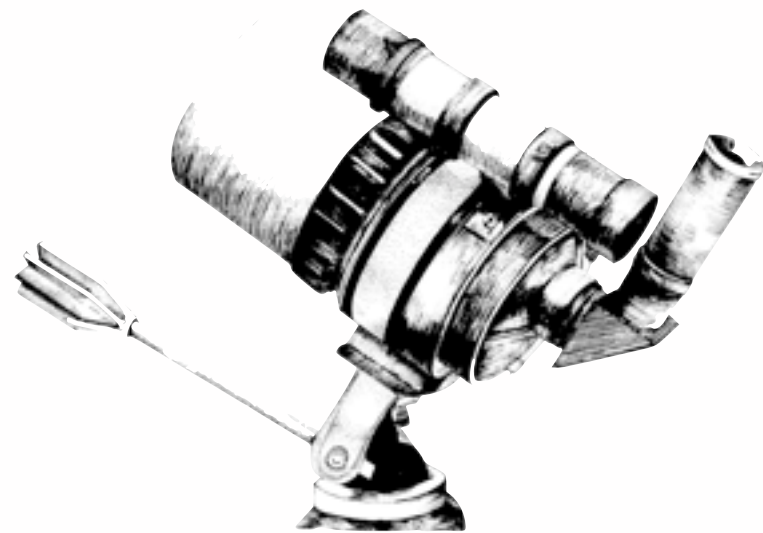






1985: Starehe Boys' Centre, Nairobi, at the visit of His Excellency President Daniel Arap Moi



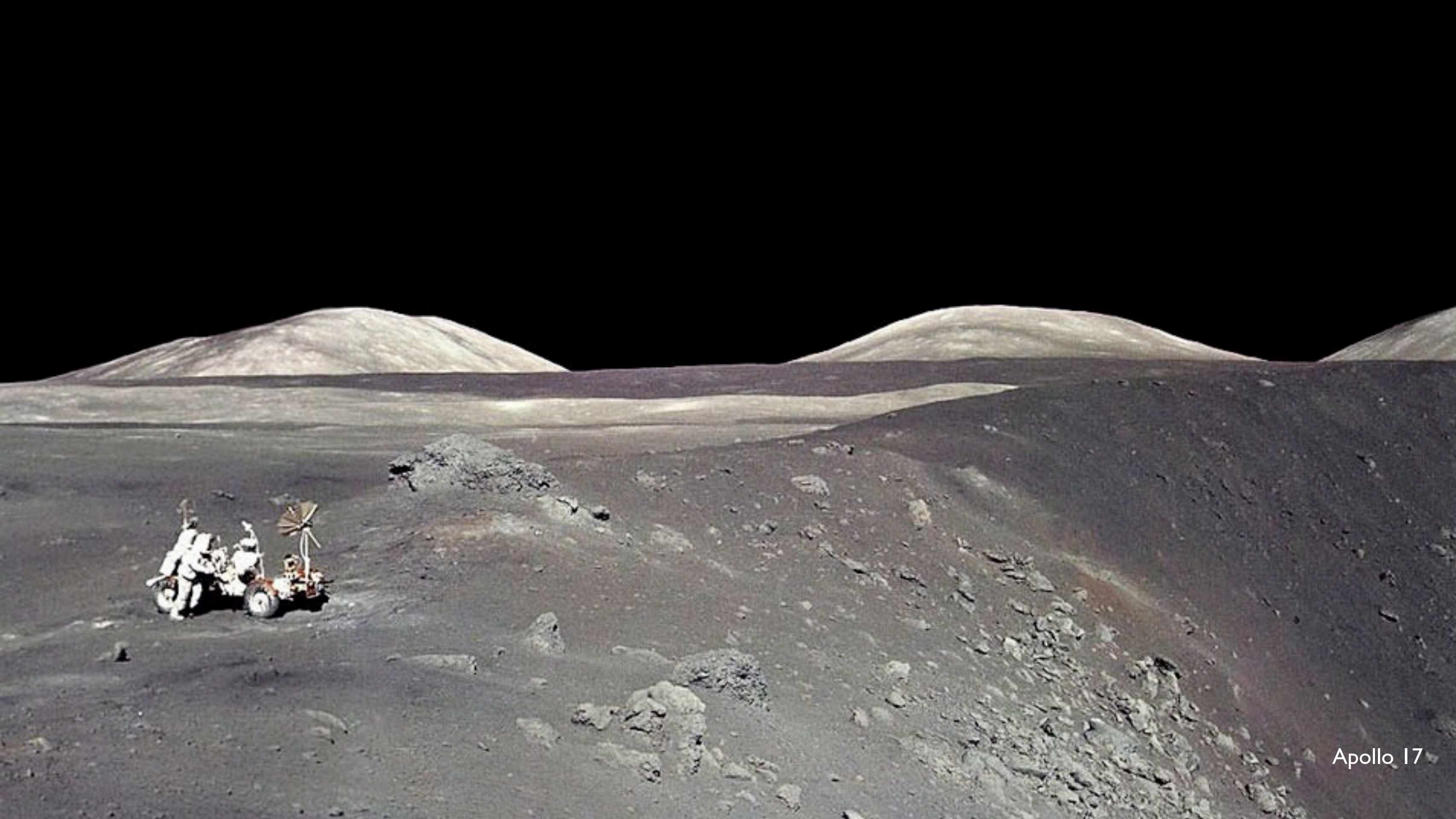






Jupiter (*image by Claudio Costa, Vatican Observatory*)

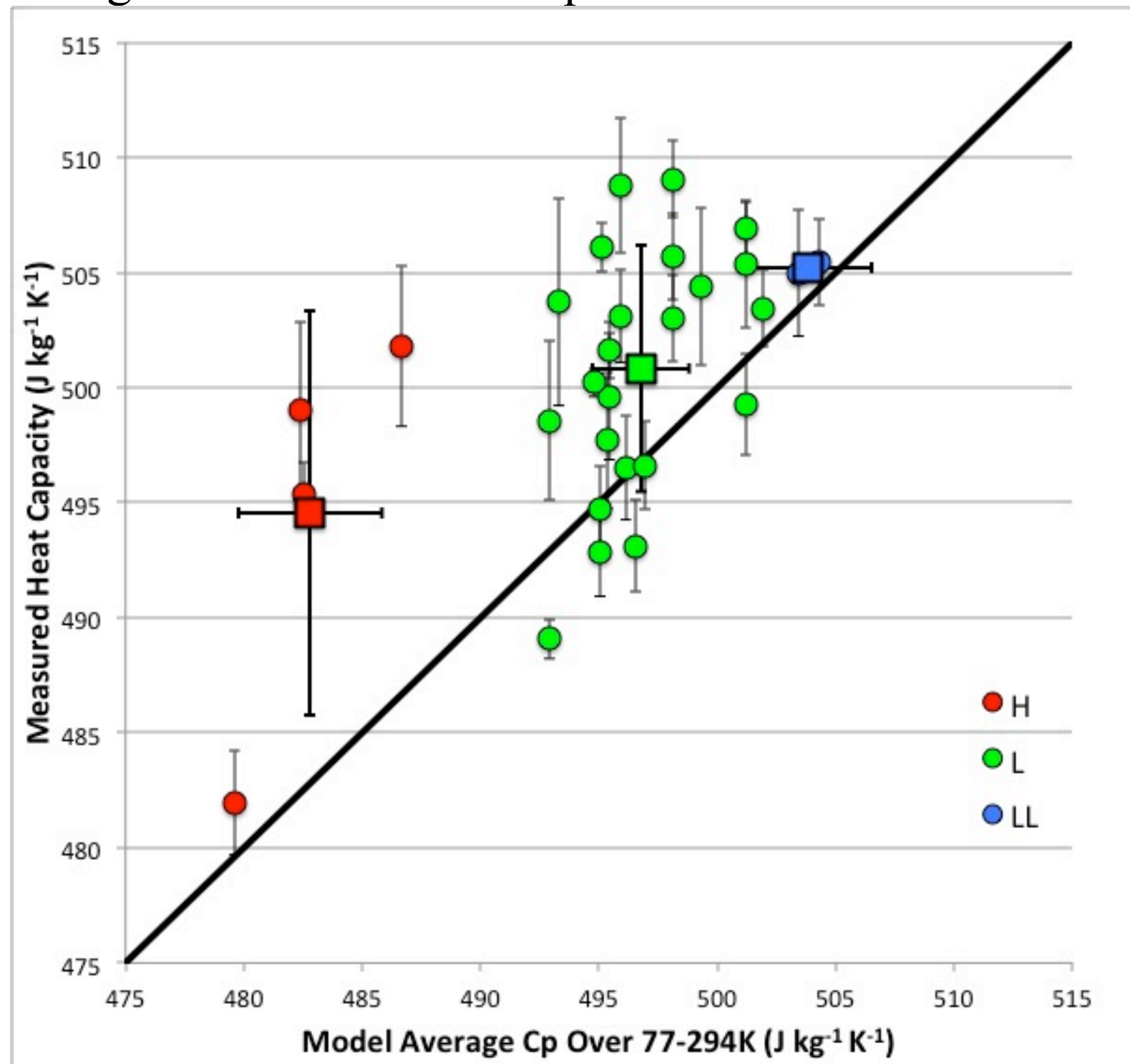




Apollo 17



nitrogen immersion technique.



**Fig. 1:  $C_p$  measured by LN2 immersion vs. model  $C_p$  at 175 K for OC falls.** Circles are individual stones. Squares represent averages.

greatest amount of metallic iron to v finds also have a higher  $C_p$  than fall This again is the result of terrest metallic iron, and also generally co duction in grain density characterist

175-K heat capacities for OC fa ited range of 481 to 524 J kg<sup>-1</sup> K<sup>-1</sup>, c stony meteorites [Fig. 2] and signif that of unweathered irons and meso LL heat capacities each occupy co ping ranges, with H having the low and LL the highest. The differences groups are almost entirely based i metallic iron content.

$C_p$  as a function of temperatu  $C_p(T)$  over the range 5-350 K for mens using the Quantum Design P these data, we fit a curve of t  $a+bT+cT^2+dT^{1/2}$  for each meteorit ure range 75-300K. We then co fecients of the curve for each of the



A FILM BY CHRISTOPHER NOLAN

# INTERSTELLAR





