Graphite Cones and Spheres from Gooderham, Ontario
(with G.W. Robinson, S. Dimovski, and Y. Gogotsi)

Acknowledgements: Jeffrey Meyer & Robert Hudyma
Reflected Polarized Light

Compare molybdenite
Cone-Helix Model of Graphite Spherules in Cast Iron

Compare to MoS$_2$
Reflected Polarized Light
SEM photos by S. Dimovski
Positive Wedge Disclination


\[ \alpha = 2 \sin^{-1}(1 - \theta / 360^\circ) \]
Low Energy (001) Twist Grain Boundaries in Graphite

Graphene sheet and lattice coincidences

W. Bollmann
Phil Mag (1962, 1967)

Animations by Dr. Sue Hill (MTU)
(001) Twist Grain Boundaries in Graphite
30° Rotation:

~1-mm crystals.
Sterling Mine, Ogdensburg, NJ
How many apex angles should we expect?

\[ \alpha = 2 \sin^{-1}(1 - \theta / 360^\circ) \]
Apex-Angle Histogram

- Apex angle [degrees]
  - 60°: 3 pentagons
  - 38.9°: 4 pentagons
  - 83.6°: 2 pentagons
  - 112.9°: 1 pentagon

Frequency [%]
- 0%
- 1%
- 2%
- 3%
- 4%
- 5%
- 6%
- 7%
- 8%
- 9%
- 10%
- 11%
- 12%
- 13%
- 14%
- 15%
Polished cross-section of graphite sphere.

Compare to MoS$_2$
Another Surprise:
Some spheres have basal planes aligned radially.
“Protocones” and faceted cones from Gooderham, Ontario.

FESEM images by S. Dimovski
More Cones- From Kola Peninsula, Russia

FESEM image by S. Dimovski