



American Astronomical Society
Advocates for science since 1899

Science Policy Development and Dusty Galaxies

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First, a little Alphabet Soup

- **American Astronomical Society (AAS)**
 - Non-profit professional organization that I worked for this summer
- **National Academy of the Sciences (NAS)**
 - “Advisers to the nation on science, engineering, and medicine.”
- **Rising Above the Gathering Storm (RAGS)**
 - NAS 2005 report on the importance of Science and Technology and America’s continued ability to compete.
- **American Competitiveness Initiative (ACI)**
 - President Bush’s 2006 State of the Union response to RAGS recommendations
- **Preserving America’s Competitive Edge (PACE) Acts**
 - Senate Bill S. 2197 proposed by Senator Domenici (R-NM) to answer the challenges presented in RAGS, and implement parts of the President’s ACI
- **Research and Development (R&D)**
- **Science and Technology (S&T)**
- **Science and Engineering (S&E)**
- **Science Technology Engineering and Mathematics (STEM)**
- **Intergalactic (IG)**
- **Near Infrared (NIR)**
- **Astronomy Education Board (AEB)**
- **Image Reduction Analysis Facility (IRAF)**



20th Century Benefits from Science and Technology

Electricity	Automotive	Aeronautics	Water Supply/Distribution
Electronics	Radio	Television	Agriculture
Computers	Telephony	Air Conditioning	Refrigeration
Highways	Aerospace	Internet	Imaging
Lasers	Fiber Optics	Healthcare	Household Appliance
Nuclear	Petroleum	Petrochemicals	High Performance Materials

The “largest economic influence is in the productivity gains that follow the adoption of new products and technologies.”

D.J. Wilson. Is embodied technology change the result of upstream R&D? Industry-level evidence. Review of Economic Dynamics 5(2)(2002):342-362. Taken from NAS, “Rising Above the Gathering Storm,” Prepublication copy February 2006, chapter 2, p. 10.

Plus other innovations in Chemistry, Biology, Physics, Astronomy, Geophysics, and Engineering

Why is reform needed?

- **Falling** US share in global exports leading to negative trade balance in high-technology products
- **Constant** rate of S&E publication between 1988 and 2001, while other nations **increase** by up to 40%
- Focus on near-term research; **neglect** of long-term and discovery-based research.
- R&D as a share of GDP **declining**
- **Low-ranking scores** of high students in math and science, compared to their peers in the world
- **Small percentage** of students earning degrees in the sciences at the university level.



RAGS concluded that, while doing well today, the US economy “may not fare as well in the future without government intervention.”

RAGS recommends reforms in:

K-12 Education

Research

Higher Education

Immigration

Patents and Taxes



ACI: 2006 State of the Union Address



The President responded to the RAGS Report with the following specific objectives, under the American Competitiveness Initiative:

- 300 grants to schools to implement research-based math curricula and interventions
- 10,000 more scientists, students, post-doctoral fellows, and technicians provided opportunities to contribute to the innovation enterprise
- 100,000 highly qualified math and science teachers by 2015
- 700,000 advanced placement tests passed by low-income students
- 800,000 workers getting the skills they need for the jobs of the 21st century

Education
Immigration
Workforce Training
Energy



PACE: Senate Bill 2197

Education

Tax Incentives

Energy



- creation of specialty schools in math and science
- summer internship programs at National Laboratories,
- under-graduate and graduate level fellowships
- scholarships for STEM students
- creation of the ARPA-E, specifically focusing on energy and dependable energy creation.
- Scholarships for mathematics and science teachers,
- increased financial incentives for non-profit entities committed to training AP and IB teachers
- creation of a National Clearinghouse of Mathematics and Science teaching materials,
- increased funding of High-Risk, High-Payoff research,
- increased funding for NASA, NSF, DOE, and DOD,
- improvement of the immigration system for students and researchers,
- creation of tax incentives for innovation, research and education.



AAS Educational Objectives

1. Training the next generation of astronomers to be successful scientific researchers
2. Training the next generation of astronomers to be successful educators
3. Research on the teaching and learning of astronomy
4. Increasing the scientific literacy of all and sharing the excitement of astronomy
5. Increasing the participation of underserved populations in astronomy

My task?

Write a Position Paper



Goal:

Distribution of position paper to AAS members

Results: Completed Position Paper

Approved by the AAS Executive Office

En-route through to review by the AEB

Conclusions:

AAS educational goals are well-aligned with the recommendations of the RAGS report, ACI, and PACE Acts



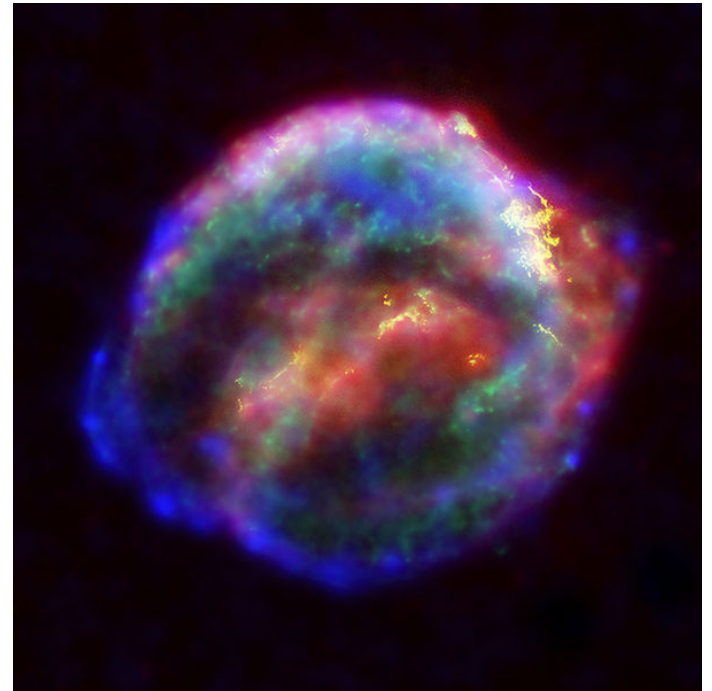
PART II: Dust

- 1) Why do we care about dust in galaxies?
 - Supernovae
 - Extinction (reddening)
- 2) How do we map dust?
- 3) What did we find?

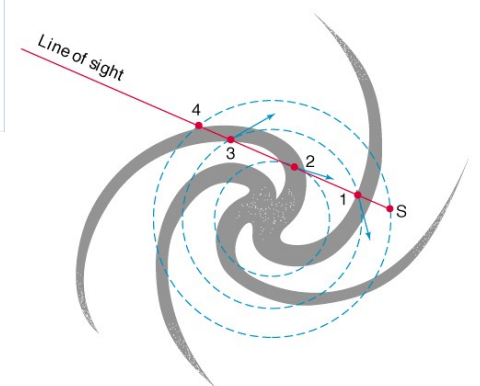


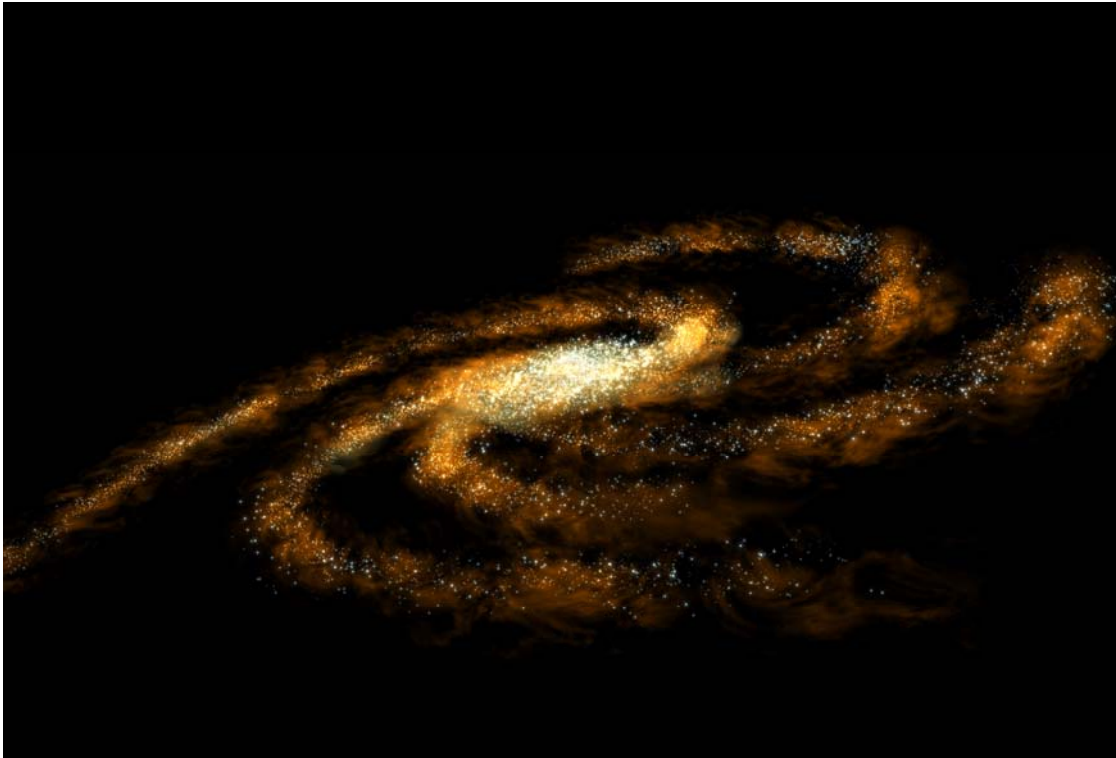
Supernovae (in brief)

- Type **SNIa** as Standard Candles
 - White dwarf/Red Giant pair
 - $E=mc^2$
 - Chandrasekhar mass limit
 - 1.4 solar masses
 - Dark Energy (accelerating expansion of the universe)
- **SNIa** position in galaxy affects its ability to be used as a standard candle: dust!



Kepler's Supernova (SN1604)





Milky Way Galaxy

Supernovae are primarily located
in the arms of galaxies

- Dust is concentrated in the spiral arms of galaxies.
- Dust has a scale height of 100pc normal to the galactic plane in both directions, and increases to 8kpc approaching the Galactic center relative to the sun's position.
- The slope of extinction curve increases with dust density.
- The closer the galaxy is to face-on, the lower the extinction.
- Dust can lead to a systematic error in SN1a observations.



HOW DO WE FIND THE DUST?

Filter	center (A)	width (A)
B	4400 A	1080 A
V	5500 A	1000 A
R	6600 A	1170 A
H	~1.21 μm	.26 μm
J	~1.65 μm	.29 μm
K	~2.18 μm	.41 μm

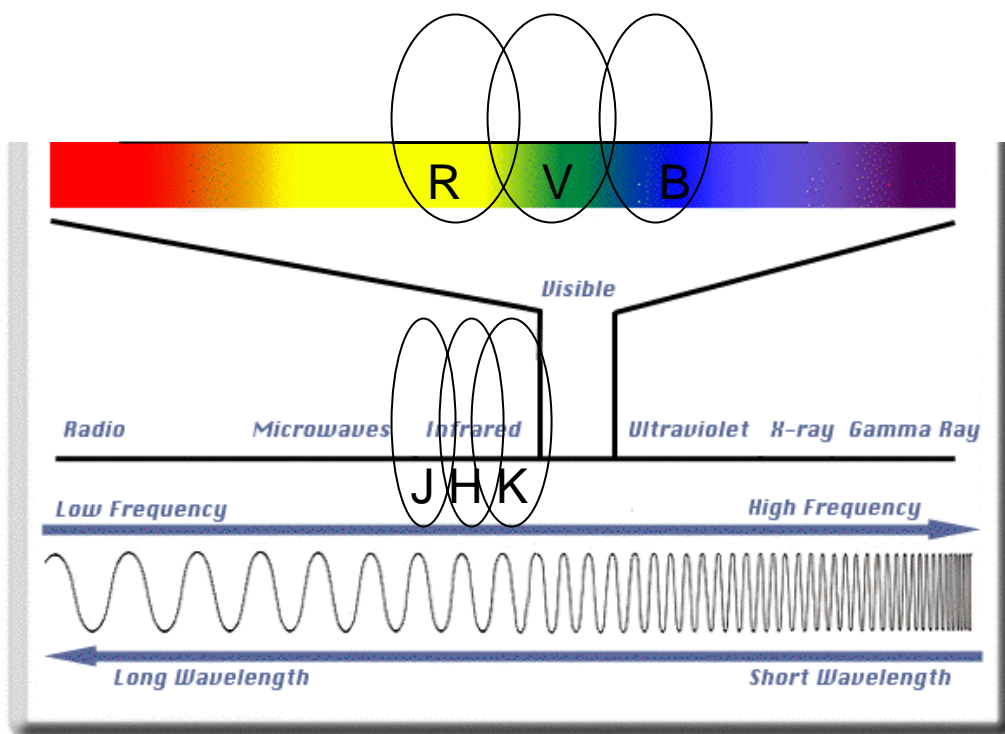
1 A = .0001 μm

We use different filters to get different wavelengths of light.

more blue = less dust

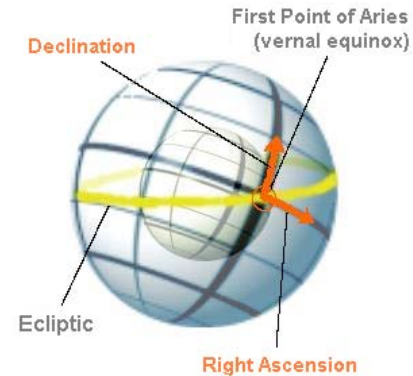
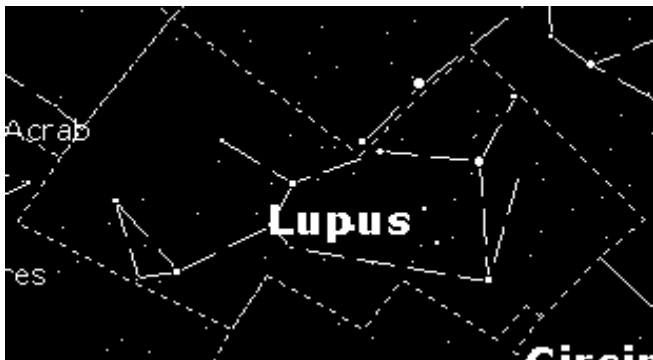
$$\text{Magnitude (m): } m_B - m_V = -2.5 \log (f_B/f_V)$$

measured in ergs/cm²/s/Hz





Galaxy ic4402



Spiral Galaxy: ic4402

Located in Constellation: Lupus

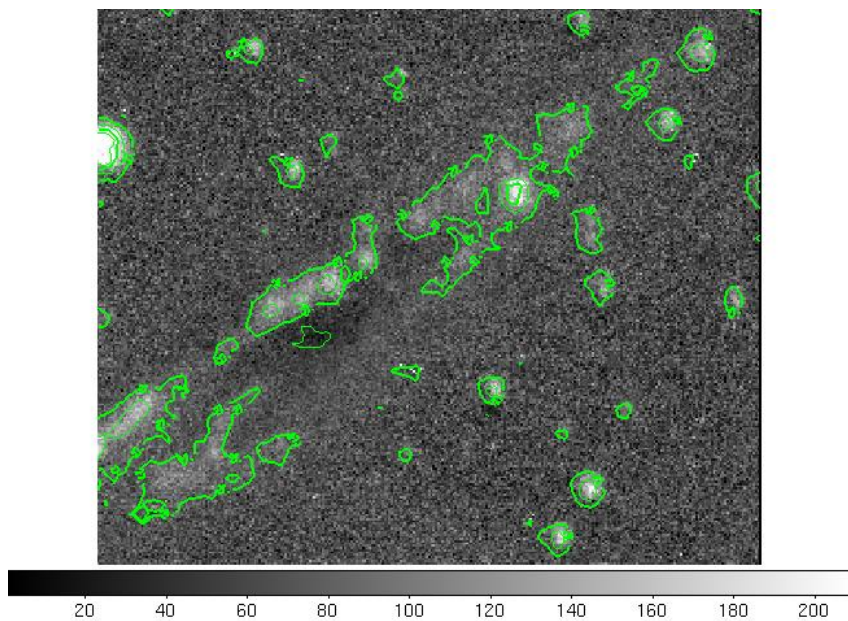
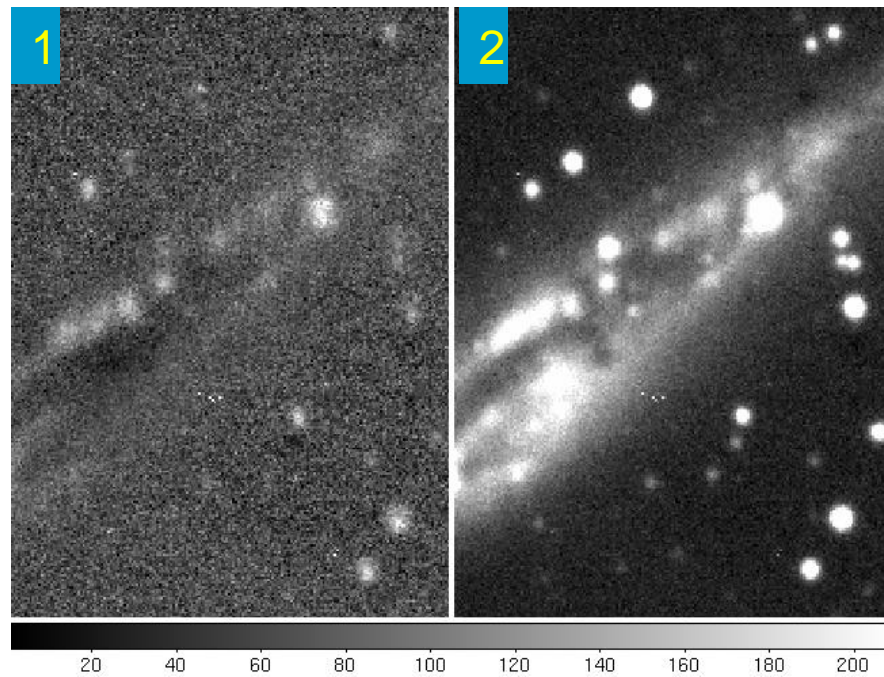
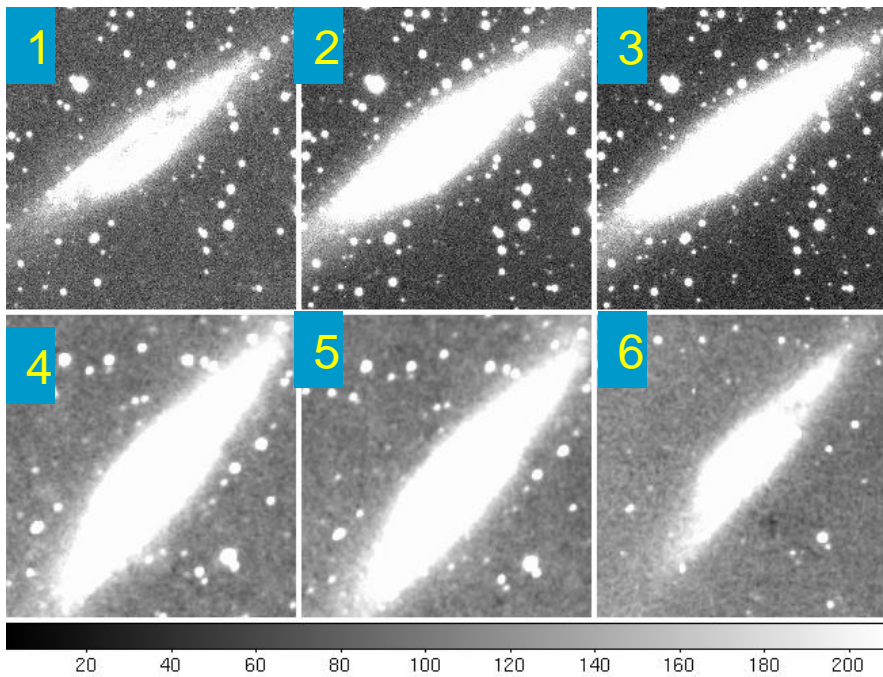
Magnitude: 12.1

Dimensions: 4.2'x0.9'

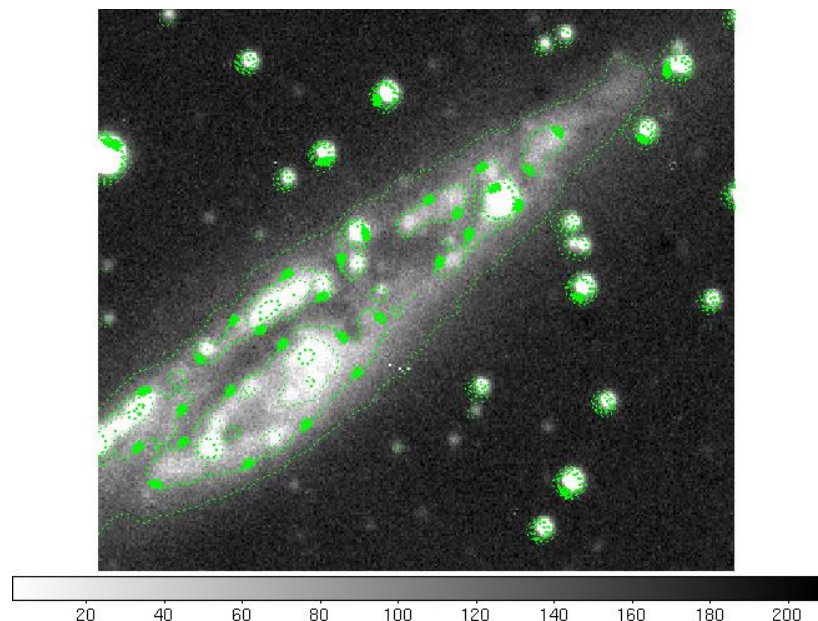
Right Ascension: 14h 21m 21.1s

Declination: $-46^{\circ} 18'$

View: near edge-on ($\sim 70^{\circ}$)



BV contour map, blown-up



BK contour map, blown-up

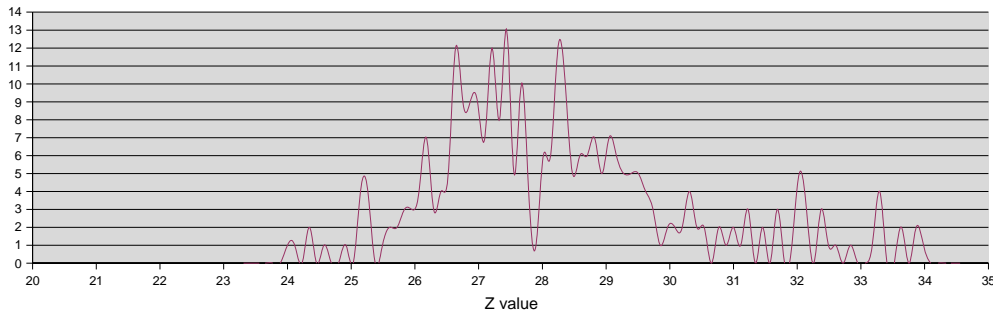


WHAT DID WE FIND?

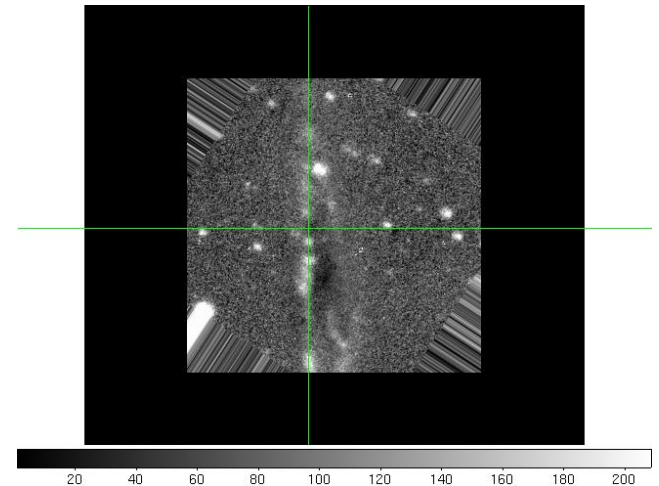
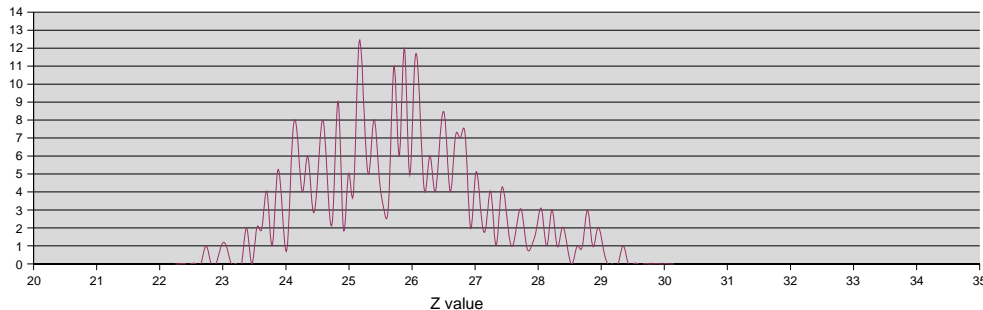
- Is the dust symmetrical?
- How high is the distribution?

- We can see clear dust lanes in the B-V, B-R, B-J, and B-K filtered images
- The dust distribution does not appear symmetrical
 - Inclination of the disk ?
- Height of distribution TBA

BV rotate 57 cut 1 Histogram



BV Rotate 57 cut 2 Histogram



I learned....

- How to effectively present resources to a variety of audiences
- Astronomy and Physics are not the same!
- Learning the program (IRAF) takes a lot longer than actually doing the calculations.
- A lot about the state of Science and Technology as well as about astronomy!
- A million different acronyms!

Pictures!



it was astronomical!



absolutely stellar

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QUESTIONS?



