The Finnish Graduate School in Astronomy and Space Physics Summer School 2007:

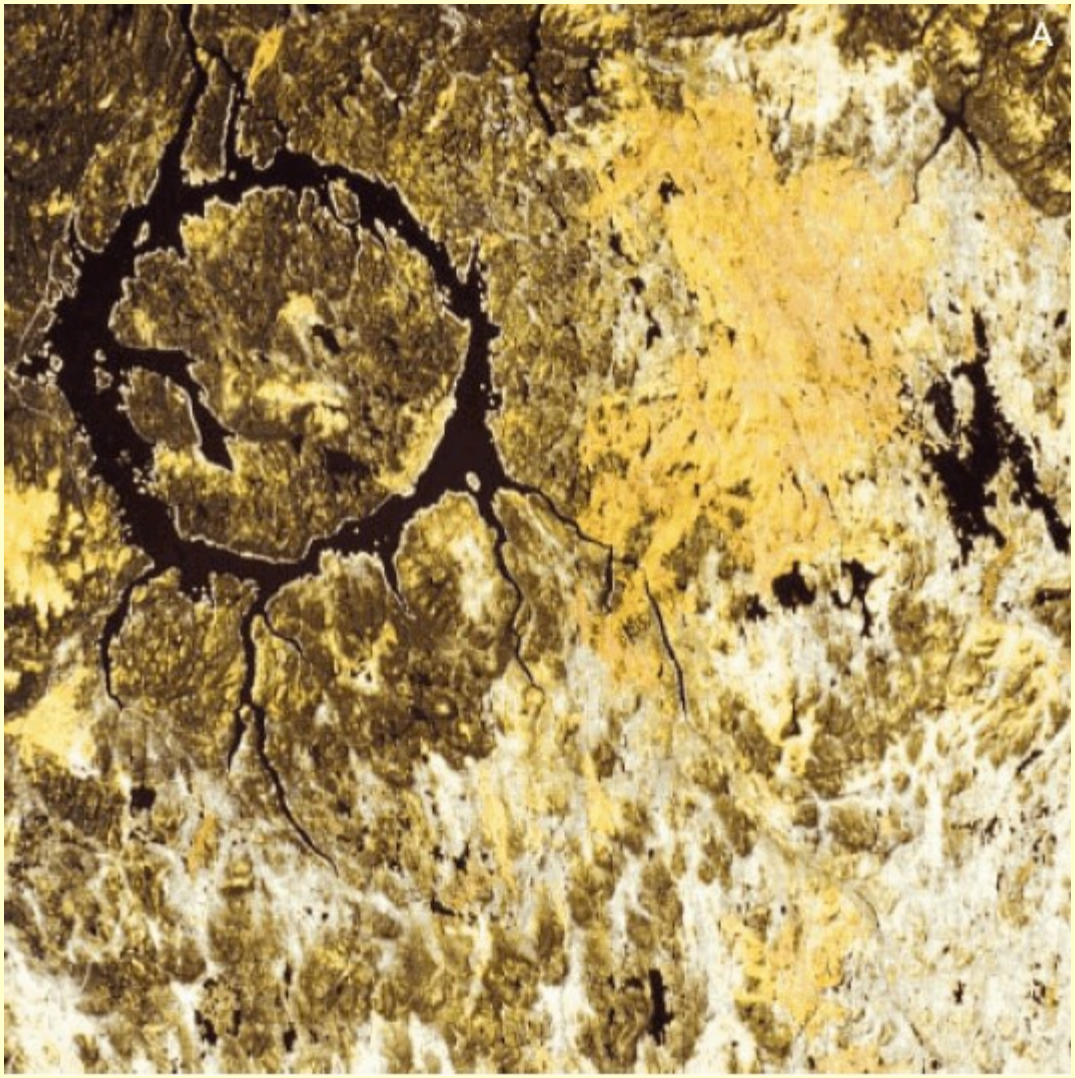
Time Series Analysis

Part VIII. Exercises

Group A

- Time point series with weights and errors in timing.
- Who killed disnosaurs, if not lensed light?

Manicouagan, diameter 100 km



Space to live

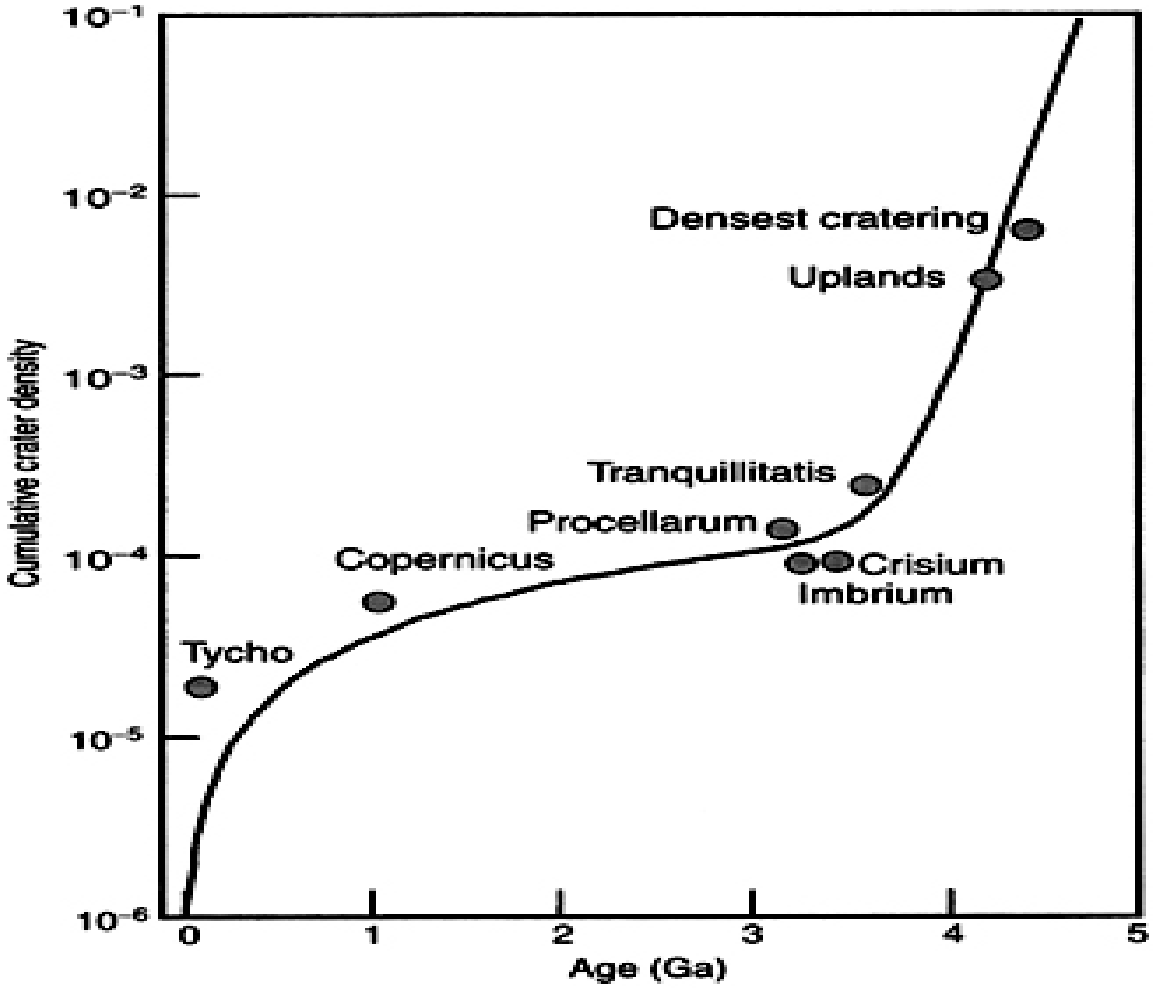
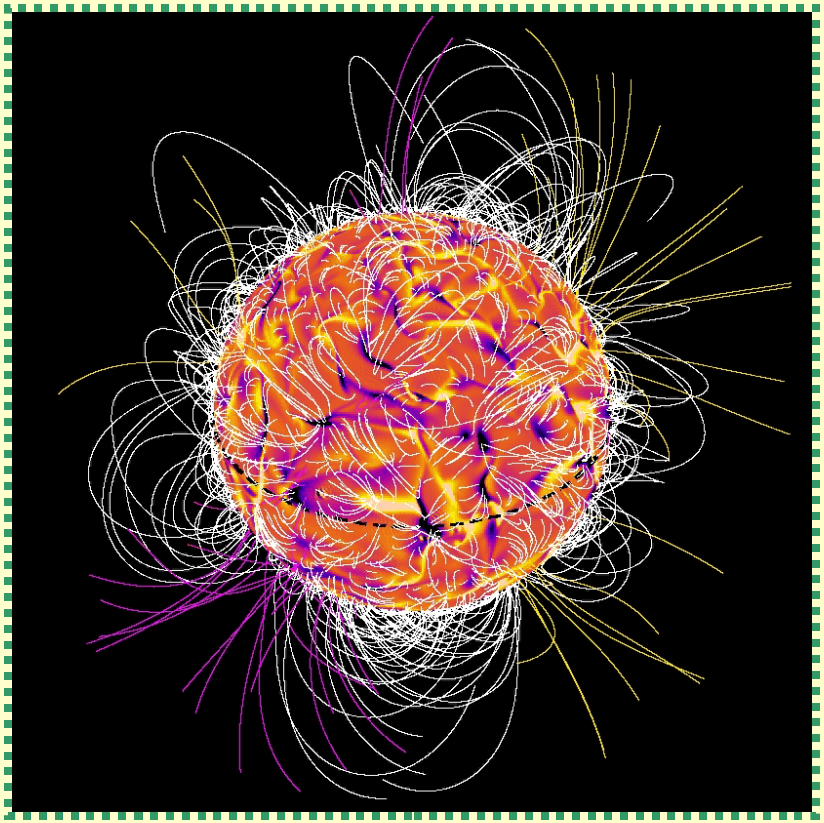


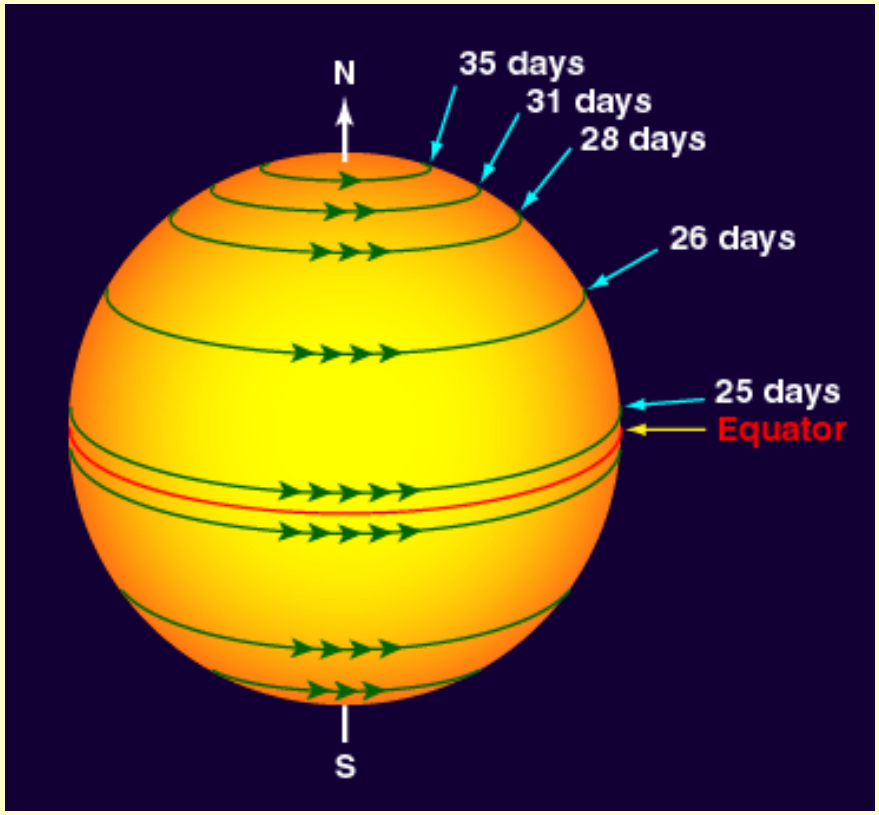
FIGURE 5.1 The inferred bombardment history of the Moon in terms of cumulative density of cratering since the formation of the Moon about 4500 million years ago. Note the intense rate of early cratering, before about 4000 million years, which then declines with the formation of the huge maria, of which four are listed here. Thereafter, the rate of impacts gradually falls off, with a steep decline from about 1000 million years ago. In this interval infrequent giant collisions include those that led to the formation of Copernicus and Tycho. (Reprinted from *Icarus*, vol. 92, C. F. Chyba, Terrestrial mantle siderophiles and the lunar impact record, pp. 217–233, fig. 1, copyright (1991), with permission of Elsevier Science, and also the author.)

Name	Location	Diameter	Age (years)	Coordinates
Boltysh	Ukraine	24 km	65.17 ± 0.64 million	48°45'N 32°10'E
Dellen	Sweden	19 km	89.0 ± 2.7 million	61°48'N 16°48'E
Dobele	Latvia	4.5 km	290 ± 35 million	56°35'N 23°15'E
Gardnos	Norway	5 km	500 ± 10 million	60°39'N 9°0'E
Granby	Sweden	3 km	about 470 million	58°25'N 14°56'E
Gusev	Russia	3 km	49.0 ± 0.2 million	48°26'N 40°32'E
Ilumetsa	Estonia	0.08 km	> 2000	57°58'N 27°25'E
Ilyinets	Ukraine	8.5 km	378 ± 5 million	49°7'N 29°6'E
Iso-Naakkima	Finland	3 km	> 1 billion	62°11'N 27°9'E
Jänisjärvi	Russia	14 km	700 ± 5 million	61°58'N 30°55'E
Kaali	Estonia	0.11 km (largest of 9)	4000 ± 1000	58°24'N 22°40'E
Kaluga	Russia	15 km	380 ± 5 million	54°30'N 36°12'E
Kamensk	Russia	25 km	49.0 ± 0.2 million	48°21'N 40°30'E
Kärdla	Estonia	4 km	about 455 million	59°1'N 22°46'E
Karikkoselkä	Finland	1.4 km (or 2.4 km?)	about 230 million	62°13'N 25°15'E
Karla	Russia	10 km	5 ± 1 million	54°55'N 48°2'E
Keurusselkä	Finland	30 km	< 1.8 billion	62°8'N 24°36'E
Kursk	Russia	6 km	250 ± 80 million	51°42'N 36°0'E
Lappajärvi	Finland	23 km	73.3 ± 5.3 million	63°12'N 23°42'E
Lockne	Sweden	7.5 km	455 million	63°0'N 14°49'E
Logoisk	Belarus	15 km	42.3 ± 1.1 million	54°12'N 27°48'E
Lumparn	Finland	9 km	about 1 billion	60°9'N 20°6'E
Mien	Sweden	9 km	121.0 ± 2.3 million	56°25'N 14°52'E

Fieldwork on Tuesday!

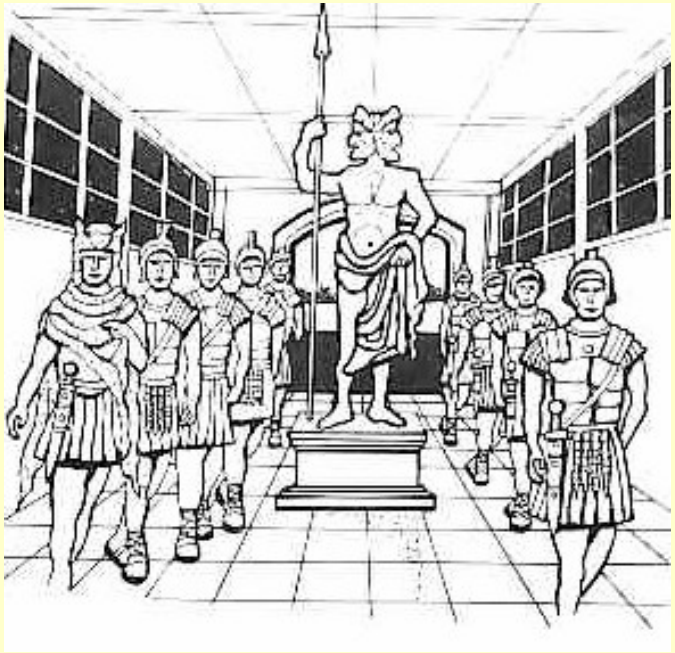
Group B





- Flip-flop or differential rotation?
- Can we find out from photometry?


SENATVS
POPVLVSQVE ROMANVS
DIVO TITO DIVI VESPASIANI F.
VESPASIANO AVGVSTO



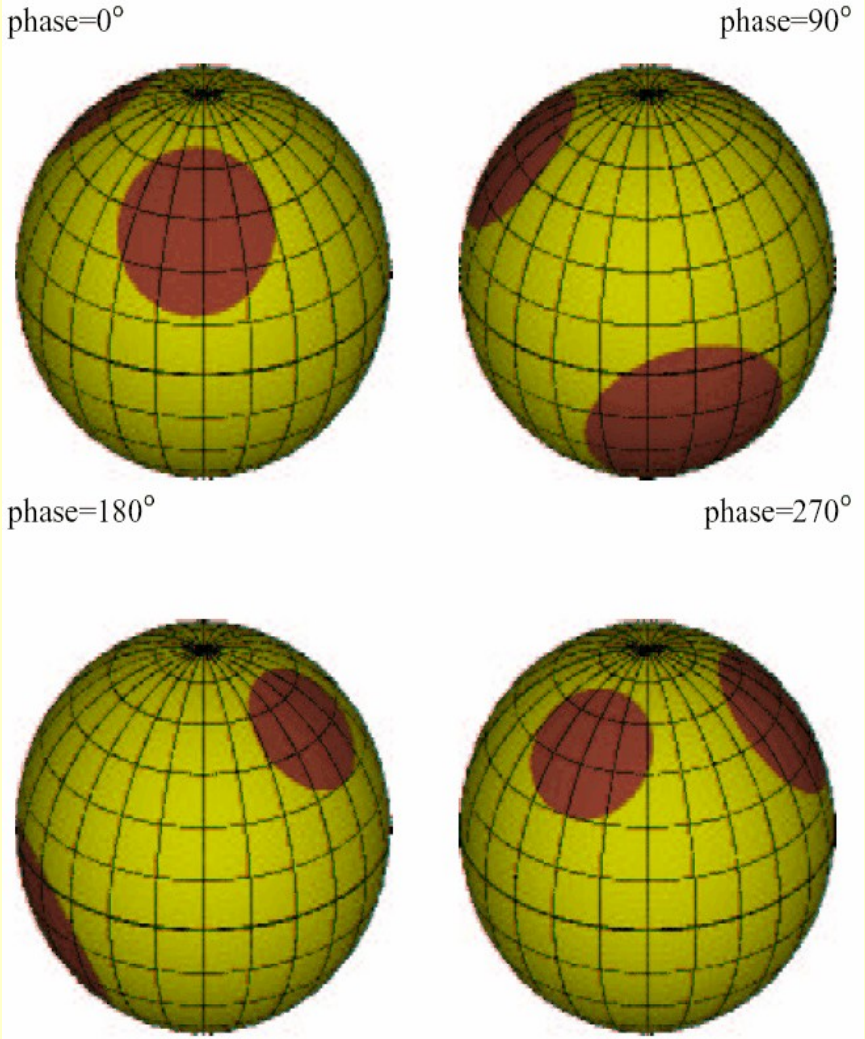
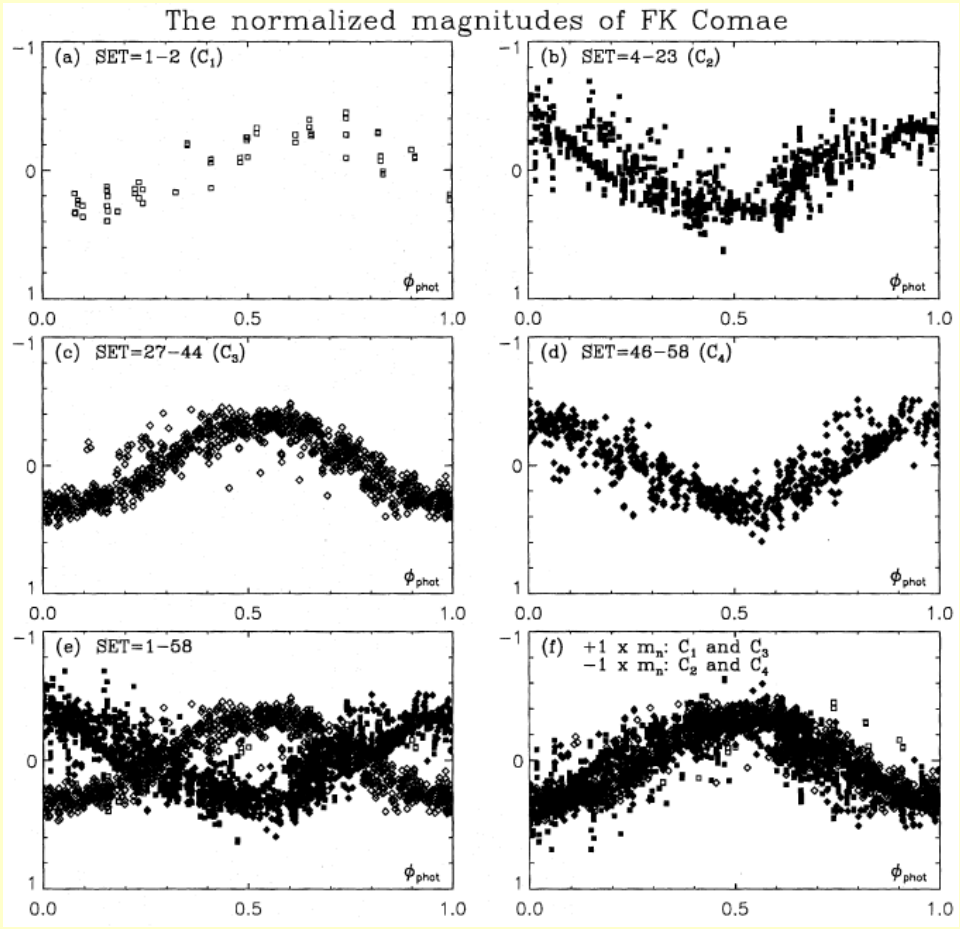


Fig. 4. Spots on σ Gem. *Povray* visualisation of the result from simple modelling, during one stellar rotation at 0°, 90°, 180° and 270° phases. Rotation goes from right to left. Outputs are from SPOTMODEL.

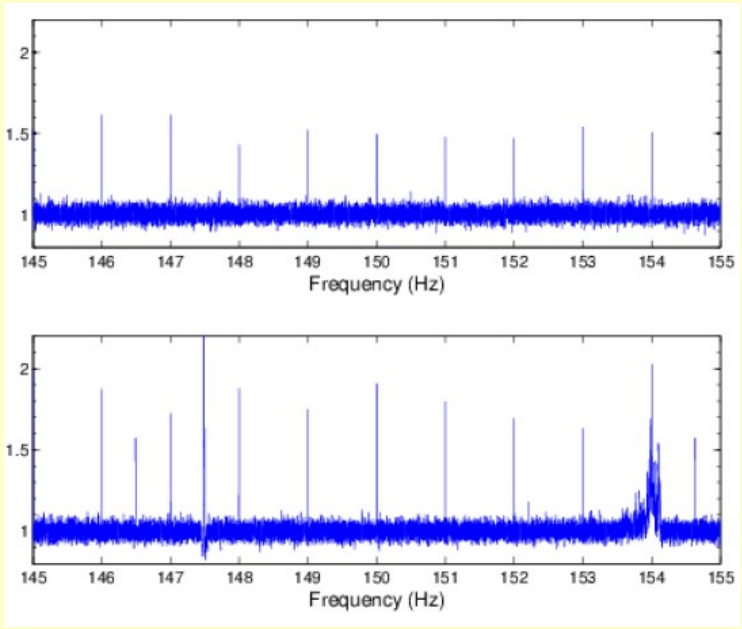


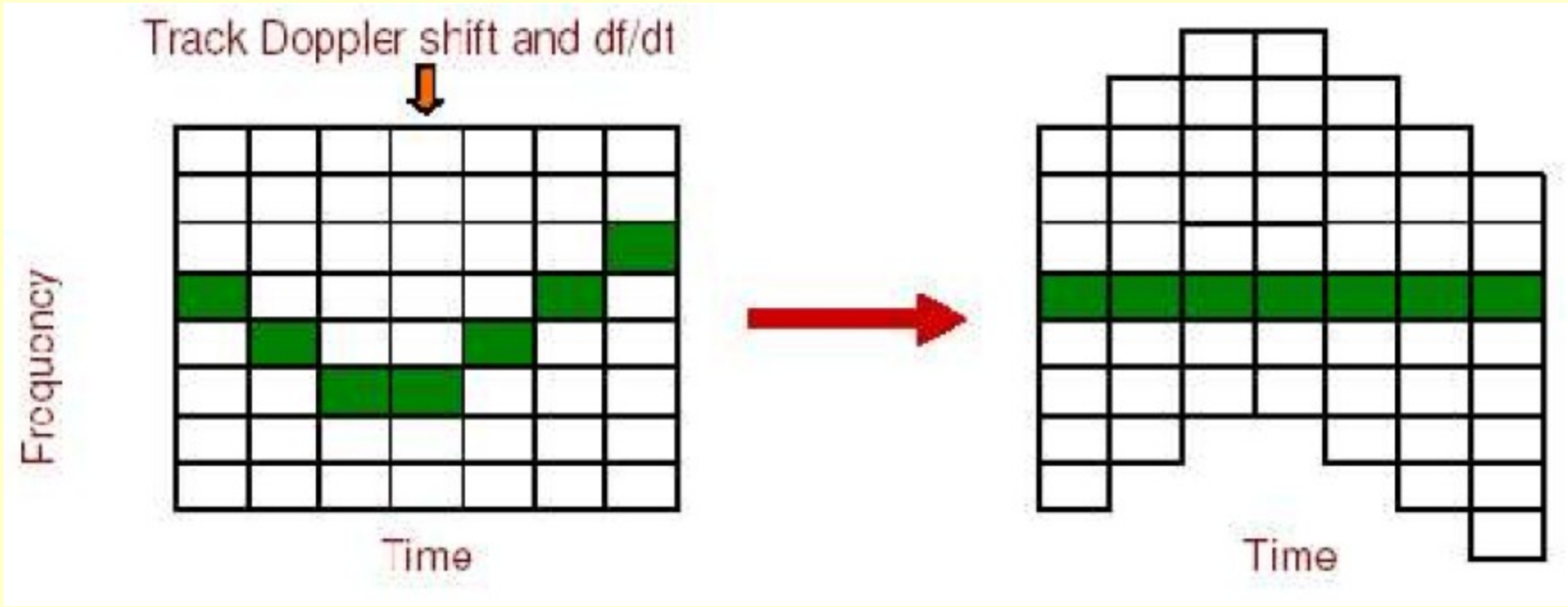
Group C

$$S^2 = \frac{1}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (y_i - y_j)^2 =$$

$$= \frac{1}{N-1} \sum_{i=1}^{N} (y_i - \mu)^2.$$

- Nonparametric hunt for changing frequencies.
- Can we beat the Doppler effect?


2
1.5
1
145 146 147 148 149 150 151 152 153 154 155
Frequency (Hz)
2
1.5
1
145 146 147 148 149 150 151 152 153 154 155
Frequency (Hz)


Track Doppler shift and df/dt
Frequency
Time
Time