

THE NATURE OF NEAR-EARTH ASTEROIDS
FROM THE STUDY OF THEIR THERMAL
INFRARED EMISSION

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Dipl.-Phys. Marco Delbo

Angefertigt am Institut fuer Weltraumsensorik und Planetenerkundung des
Deutschen Zentrums fuer Luft- und Raumfahrt e.V. in Berlin, Deutschland
und im Istituto Nazionale di Astrofisica – Osservatorio Astronomico di
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TABLE OF CONTENTS

Abstract	iv
Deutsche Zusammenfassung	viii
<i>Chapter 1</i>	<i>1</i>
Introduction	1
1.1 Asteroids	1
1.2 Main Belt Asteroids	2
1.3 Physical characteristics of Near Earth Asteroids and Near Earth Objects	5
1.4 The need of physical characterization of NEOs: statement of the problem	10
1.5 Scope of this work	12
<i>Chapter 2</i>	<i>13</i>
Sizes and albedos of asteroids: the radiometric method and asteroid thermal models	13
2.1 Foreword	13
2.2 Introduction	13
2.3 Asteroid surface temperatures	15
2.4 Calculation of the emitted thermal infrared flux	18
2.5 Constraints on diameter and albedo from the visible absolute magnitude	19
2.6 Radiometric diameters and albedos	19
2.7 Thermal models of asteroids	20
2.7.1 The Standard Thermal Model (STM)	20
2.7.2 The Fast Rotating Model (FRM)	22
2.7.3 The near-Earth asteroid thermal model (NEATM)	23
2.8 Uncertainties	26
2.8.1 Rotational variability effects and lightcurve correction of infrared fluxes	26
2.8.2 The actual temperature distribution differs from the modeled one	26
2.8.3 Accuracy of the H values	27
2.9 Thermophysical models	27
2.10 Summary	28
<i>Chapter 3</i>	<i>31</i>
Thermal infrared observations of near-Earth asteroids and data reduction	31
3.1 Foreword	31
3.2 Introduction	31
3.3 Thermal infrared ground based observations	33
3.4 Thermal IR photometry	36
3.5 Aperture photometry and photometric uncertainties	38

3.6	Data reduction of thermal IR data	39
3.7	Thermal infrared observations of NEAs: a method for accurate nod-set registering	42
3.8	Color correction	44
3.9	Thermal IR spectroscopy at the TIMMI2	45
3.10	Visible CCD observations at ESO: data reduction	49
3.11	The data set	50
3.11.1	Near-Earth asteroids observed at KECK	51
3.11.2	Near-Earth asteroids observed at ESO	52
3.11.3	Near-Earth asteroids observed at the NASA-IRTF	53
3.12	Summary	54

Chapter 4 57

Thermal model fits to thermal infrared data and derivation of albedos and diameters 57

4.1	Foreword	57
4.2	Introduction	57
4.2.1	Diameters, albedos and η -values derived from observations at Keck	58
4.2.2	Diameters, albedos and η -values derived from observations at ESO	59
4.2.3	Diameters, albedos and η -values derived from observations made at the NASA-IRTF	60
4.3	Comments on individual asteroids	60
4.3.1	15817 Lucianotesi (1994 QC)	61
4.3.2	2000 EV ₇₀	62
4.3.3	2001 HW ₁₅	62
4.3.4	25143 Itokawa (formerly known as 1998 SF ₃₆)	62
4.3.5	2001 LF	65
4.3.6	5381 Sekmeth	67
4.3.7	25330 (1999 KV ₄)	69
4.3.8	2002 AV ₄	70
4.3.9	5587 (1990 SB)	71
4.3.10	19356 (1997 GH ₃)	75
4.3.11	5604 (1992 FE)	75
4.3.12	37314 (2001QP)	76
4.3.13	33342 (1998WT ₂₄)	76
4.3.14	35396 (1997 XF ₁₁)	79
4.3.15	1580 Betulia	83
4.4	Physical characterization of NEAs: summary of results	85

Chapter 5 91

Analysis of results from thermal models: the observed albedo distribution of NEAs and the correlation of η with the phase angle 91

5.1	Foreword	91
5.2	The observed albedo distribution of NEAs	91
5.3	Phase angle dependence of the observed color temperature	95
5.3.1	NEAs with anomalous thermal properties ($\eta > 2$)	96

5.3.2	NEAs with “common” thermal properties	97
5.4	The infrared phase curve of NEAs with “common” thermal properties	98
5.5	Comparison of radiometric diameters with radar	100
5.6	On the recalibration of the STM for NEAs	105
5.7	Correlation of radiometric albedos with solar phase angle	108
5.8	Conclusions	109

Chapter 6 113

Estimate of the thermal inertia of NEAs and assessment of the accuracy of thermal models 113

6.1	Foreword	113
6.2	Introduction	113
6.3	Thermophysical model components	116
6.4	Thermal Inertia and the heat diffusion within spherical craters	117
6.5	Numerical simulations	120
6.6	Results of the simulations	124
6.6.1	Effects of thermal inertia and rotation rate on the theoretical dependence of the NEATM η -value with the phase angle	124
6.6.2	Effects of surface roughness on the theoretical dependence of the NEATM η -value with the phase angle	126
6.6.3	Combined effects of thermal inertia, rotation rate and surface roughness on the theoretical dependence of the NEATM η -value with the phase angle	127
6.7	The thermal inertia of NEAs	132
6.8	Implications for the Yarkovsky effect on kilometer and sub-kilometer size asteroids	138
6.9	Effects of surface roughness, thermal inertia and rotation rate on the accuracy of NEA radiometric diameters and albedos.	139
6.10	Conclusions	146

Chapter 7 149

Conclusion and future works 149

7.1	Conclusions	149
7.1.1	This work increases the number of NEAs with measured sizes and albedos by 54%	149
7.1.2	The observed NEAs are on average brighter than main belt asteroids	149
7.1.3	There is a trend of increasing albedo with decreasing size for observed S-type NEAs	150
7.1.4	The ambiguous taxonomic classifications of six asteroids have been clarified in the light of the new albedo values.	150
7.1.5	The apparent color temperature of the observed NEAs is phase angle dependent	150
7.1.6	The variation of the color temperature with phase angle depends on the albedo	151
7.1.7	The observed distribution of the color temperature with the phase angle can be explained in terms of thermal inertia and surface roughness	151
7.1.8	The best-fit thermal inertia of the observed NEAs is $550 \pm 100 \text{ J m}^{-2} \text{ s}^{-0.5} \text{ K}^{-1}$ or about 11 times that of the Moon	151
7.1.9	There are asteroids with anomalously low color temperature	152

7.1.10	The observed distribution of color temperature allows a calibration of thermal models for applications to NEAs	152
7.1.11	We have derived a quantitative assessment of the accuracy of thermal models and a correction function for the nominal results of the NEATM and the STM	153
7.2	Future works	153
7.2.1	Application of thermophysical models to NEAs	153
7.2.2	Study of the contribution of a selection bias in the observed trend of increasing albedo with decreasing size	154
7.2.3	Study the range of thermal and surface properties of NEAs by means of thermal infrared	154
REFERENCES		155
<i>Appendix A</i>		<i>113</i>
Observed thermal Infrared Fluxes of near-Earth asteroids		165
<i>Appendix B</i>		<i>113</i>
Colour correction factors for LWS, TIMMI2, MIRSI and MIRLIN filters		173
B.1	LWS at Keck 1 filters and color correction factors	173
B.2	TIMMI2 filters and color correction factors	176
B.3	MIRLIN filters and color correction factors	177
B.4	MIRSI filters and color correction factors	178
<i>Appendix C</i>		<i>179</i>
Thermal Infrared photometry: NOTES		179
LEBENS LAUF		181

LIST OF FIGURES

<i>Figure number</i>	<i>Page</i>
Fig. 1.1 Plot of the semi-major axis versus eccentricity for main belt asteroids. Note the presence of significant clumpings of objects already identified by Hirayama in 1819 as “families” and the Kirkwood gaps.	3
Fig. 1.2 Three-dimensional rendering of the shape model of the near Earth asteroid 433 Eros obtained by the NEAR-Schoemaker mission. This rendering has been calculated using the freely distributed computer program Wings 3-D.	6
Fig. 1.3 Histogram of the relative proportions of measured taxonomic properties for more than 300 NEOs listed in Table 1, Binzel et al. 2002.	8
Fig. 1.4 Two examples of reflectance spectra of asteroids along with their meteorites analogs. One explanation for the spectral mismatches is that space weathering processes affect the surfaces of the asteroids, altering them from their original spectral properties. Figure obtained from Clark et al., 2002.	9
Fig. 2.1 N-band a) and Q-band b) spectra of the thermal infrared emission of the near-earth asteroid 5587 (1990SB) observed on April 09, 2001 with the TIMMI2 installed at the 3.6m telescope, La Silla, ESO (Chile). This asteroid has a diameter of almost 4km.	13
Fig. 2.2 Observed thermal infrared fluxes of the NEA 5587 on the left and of the largest asteroid 1 Ceres. Note the noise affecting Q-band data which have been binned for increasing the signal to noise ratio. Continuous line is a black body fit to the infrared spectra.	14
Fig. 2.3 Dependence of the sub-solar temperature as a function of its heliocentric distance for an asteroid in instantaneous thermal equilibrium with sunlight at all points on its surface. For objects orbiting the Sun in the near-Earth space, the surface temperature is about 400K and the emitted thermal radiation peaks around 8 μm . However, the radiation of more distant asteroids shifts toward longer wavelength as their temperature decreases. The following parameters have been used to produce the plot: $A = 0.0393$ (corresponding to $p_V = 0.1$ and $G = 0.15$) emissivity = 0.9, and solar constant = 1373 W m^{-2} .	17
Fig. 2.4 Dependence of the sub-solar temperature of an asteroid as a function of the bolometric Bond albedo A . This dependence does not depend on the heliocentric distance of the body.	17
Fig. 2.5 Constraints on the albedo and effective diameter from thermal infrared observations and visible absolute magnitude. Solid line: curve defined by Eq. (2-15), dashed-line: curve defined by Eq. (2-16).	19
Fig. 2.6 As of Fig. 2.3, but T_{ss} is calculated for different value of the parameter η . Solid-line: $\eta=1.0$; dashed-line: $\eta=0.756$ as in the “refined” STM of Lebofsky and Spencer (1989); dotted-line: $\eta=0.6$, dashed- and dotted-line: $\eta=\pi$ which is the value used within the FRM.	25
Fig. 3.1 Atmospheric transmission above Mauna Kea, Hawaii. Note the narrow window at 5 μm (M band), the ozone absorption band at about 9.5 μm in the middle of the N band. The atmosphere is opaque between 13.5 and about 17 μm . Beyond 17 μm up to about 20-23 μm the Q band opens.	33
Fig. 3.2 A typical “chop-nod” observing sequence of a standard star obtained with the Thermal Infrared Multimode Instrument (TIMMI2) installed at the ESO 3.6m telescope at La Silla,	

- Chile. Although the star is very bright, its signal is completely buried in the background radiation. Only in the differential frames it becomes visible. 35
- Fig. 3.3 On the left, chopping and nodding throws at TIMMI2, MIRSI and MIRLIN for small source imaging and for spectroscopy. On the right chopping and nodding at the LWS at Keck. Note that the detector field of view is too small to contain both positive and negative beams. This figure was adapted from the TIMMI2 web site: (http://www.lis.eso.org/lasilla/Telescopes/360cat/timmi/images/quick_chop_nod.gif) 36
- Fig. 3.4 The ATV tool: on the left (a), ATV shows a mid-IR image of a standard star obtained with the TIMMI2 at the ESO 3.6 m telescope. On the right (b), the ATV aperture photometry plug-in used to analyze one of the four chop-nod channels. 40
- Fig. 3.5 Growth curves calculated for the one of the four chop-nod channels of a $11.7\mu\text{m}$ -image of the asteroid 2001 LF, observed on June 03, 2003 with TIMMI2 at the ESO 3.6 m telescope (image file name: 306030840.fits). On the left plot a background value of 0.497 counts yielded 1190 counts for the source in an aperture of 10 pixels of radius. On the right, a larger background value – i.e. 0.687 counts – subtracted over an increasing aperture radius causes the net flux of the source to decrease. Such background value yielded 844 counts for the source in an aperture of 10 pixel of radius. 41
- Fig. 3.6 On the right (a), strong smearing effect in the coadded LWS image of the asteroid 2002 CT₄₆ without registering. (b) the same dataset but registering of each nodeset before coadding was performed. The improvement in the S/N is clearly evident. Further, the registered PSF more similar to the standard stars PSFs resulting in an improved photometric accuracy. 42
- Fig. 3.7 The modulus of the cross correlation function between the instrumental PSF and frames registered with arbitrary shifts of the nod sets. Shown here is a 5×5 array of trials. The v_x and v_y values (see text) are indicated by the numbers at the bottom of each framelet. 43
- Fig. 3.8 Raw image of the N-band spectrum of the standard star HD123139 observed with the ESO 3.6m telescope and TIMMI2 46
- Fig. 3.9 The one-dimensional profile of the spectrum $S''_{profile}(x)$. It was obtained by summing up the contribution of all pixels along each row. 47
- Fig. 3.10 Raw extracted spectrum of the standard star HD123139. Note the characteristic ozone feature between pixels 110-190 48
- Fig. 3.11 N-band raw spectrum of the NEA 5587. Dotted vertical lines are drawn in correspondence to the bin extremes. The binning intervals were taken at the following detector columns (1 20), (21 40), (41 60), (61 80), (81 100), (101 120), (201 220), (221 240), (241 260), (261 290). 48
- Fig. 3.12 Histogram of the number of observations as a function of the absolute magnitude H of the target asteroids and the as a function of the solar phase angle. H values for each object are obtained from the MPC. 7 objects out of 32 were observed with different instrument and under different observing geometries. 54
- Fig. 4.1 Thermal model fits to observed infrared fluxes for 15817 Lucianotesi, 2000 EV₇₀ and 2001 HW₁₅ obtained at Keck and not included in Delbò et al. (2003) work. Continuous line: STM, dashed line: FRM; dotted line: NEATM with default η -value of 1.0 61

- Fig. 4.2 Synthetic lightcurve of the asteroid 1998 SF36 and the best fit to the observed V-band data. Measurements obtained on 9 April, 2001 have got a square symbol superimposed. The two lightcurves were composited on the 12.13 hours sidereal period basis. 63
- Fig. 4.3 Thermal models fit to the observed infrared flux for 25143 Itokawa. Continuous line: STM, dashed line: FRM; dotted line: NEATM with default η -value of 1.2 and 1.5 64
- Fig. 4.4 Thermal models fit to the 2001 LF data observed on June 03, 2003. No correction for lightcurve was applied. Continuous line: STM, dashed line: FRM; dotted lines: NEATM Note how, in this case, the fitted η -value is very close to its default value of 1.5 65
- Fig. 4.5 Observing sequence used to image 2001 LF in the Q-band at the 3.6 m telescope with TIMMI2. Q1_1 represent the first nod-set Q1_8 the eighth. The gray round patch indicates the position of the source moving on the detector array and below detection on each exposure. The black circle corresponds to the position of the object on 11.9 μ m-images where the asteroid was detected. 66
- Fig. 4.6 Thermal models fit to the 2001 LF data observed on June 02, 2003. Continuous line: STM, dashed line: FRM; dotted lines: NEATM In this case, the fitted η -value of 1.1 is lower than its default value of 1.5 66
- Fig. 4.7 The synthetic light curve (continuous line) fitted to the differential V magnitudes (squares) obtained on June 02, 2003 with WFI at 2.2m ESO/MPI telescope. Vertical lines are drawn in correspondence with the epoch of thermal infrared observations. 68
- Fig. 4.8 Thermal models fit to the 5381 Sekhmet data observed on June 02, 2003. No correction for the lightcurve has been performed in plot (a), whereas data points in plot (b) have been corrected for lightcurve. 69
- Fig. 4.9 Thermal model fits to multi-filter photometry of the NEA 1999 KV₄ obtained at the ESO 3.6m telescope. Continuous line: STM, dashed line: FRM; dotted line: NEATM with $\eta=1.0$ (the one closer to STM prediction) and with $\eta=1.2$. 70
- Fig. 4.10 Thermal model fits to multi-filter photometry of the NEA 2002 AV₄ obtained at the ESO 3.6m telescope. Continuous line: STM, dashed line: FRM; dotted line: NEATM. 71
- Fig. 4.11 Continuous line represent the synthetic lightcurve generated assuming the asteroid to be a triaxial ellipsoid with a geometric scattering law. Dashed line is the Pravec et al. lightcurve. Small squares are the DFOSC observations. Vertical lines are drawn in correspondence to the thermal infrared observations. Differential correction factors are of less than 0.2 magnitudes. 72
- Fig. 4.12 Thermal infrared photometry of the NEA 5587 obtained at ESO and thermal models fits. Continuous line: STM, dashed line: FRM; dotted line: NEATM. 72
- Fig. 4.13 The continuous sinusoidal line represents the visible lightcurve as in the case of Fig. 4.11. Vertical lines are drawn in correspondence with the epochs of the thermal spectroscopy measurements. 73
- Fig. 4.14 The binned spectrum of the NEA 5587 obtained at 05:46:41 UT on April 09, 2001 (first spectrum) and thermal models fits. Continuous line: STM, dashed line: FRM; dotted line: NEATM. 74
- Fig. 4.15 Thermal infrared photometry of the NEA 19356 obtained at ESO and thermal models fits. Continuous line: STM, dashed line: FRM; dotted line: NEATM. 75

- Fig. 4.16 Thermal model fits to N-band infrared data obtained at ESO. Continuous line represents the spectral energy distribution derived by the STM, dashed line that of the FRM and the dotted one is the NEATM. 76
- Fig. 4.17 Thermal model fits to N-band infrared data obtained at ESO. Continuous line represents the spectral energy distribution derived by the STM, dashed line that of the FRM and the dotted one is the NEATM. 77
- Fig. 4.18 Visible and thermal lightcurve of 33342 on December 2001. Filled diamonds are infrared relative magnitudes derived from $11.7\mu\text{m}$ -fluxes obtained on December 18, 2001. Empty diamonds represent $11.7\mu\text{m}$ magnitudes obtained on December 19, 2001 and empty squares those measured on December 21, 2001. Infrared magnitudes were composed on the basis of a 0.15415-days period. Continuous line is the R-band lightcurve derived from CCD observation of Pravec et al. (Pravec, personal communication, 2002). Thick dashed line is a sinusoidal fit with a period equal to half of that of the asteroid to infrared magnitudes. 78
- Fig. 4.19 Thermal model fits to multi-filter photometry of the NEA 33342 obtained at the NASA-IRTF. No correction for lightcurve was applied. Continuous line: STM, dashed line: FRM; dotted line: NEATM. Figures are drawn with the same y-axis scale. Note the clear variation of the apparent color temperature between the observing dates. 79
- Fig. 4.20 Thermal model fits to the observed flux of the asteroid 35396. Continuous line: STM, dashed line: FRM; dotted line: NEATM. 80
- Fig. 4.21 Lightcurve of the NEA 35396 at $11.7\mu\text{m}$ obtained with MIRSI@NASA-IRTF on November 05, 2002 (a) and on November 03, 2002 (b). The continuous line is a sinusoid function with period half of the rotational period of the asteroid fit to the measured relative magnitudes. The thicker dashed line is the V-band lightcurve of Pravec et al. Note the difference in amplitude and the phase shift. 82
- Fig. 4.22 Thermal models fit to the $11.7\mu\text{m}$ lightcurve-corrected data obtained with MIRSI@NASA-IRTF on November 05, 2002 (a) and on November 03, 2002 (b). Note in both data set the very high thermal flux measured at $4.9\mu\text{m}$. 83
- Fig. 4.23 The 5th-order polynomial fitted to the R-band magnitudes measured by Fernandez. 84
- Fig. 4.24 On the left thermal model fits to the observed infrared fluxes before applying lightcurve correction (see text). On the right lightcurve corrected fluxes. Continuous line: STM, dashed line: FRM; dotted line: NEATM. 84
- Fig. 4.25 The scientific relevance of this work in terms of newly derived NEA sizes and albedos. The histogram in blue shows the number of NEAs with measured size and albedo as a function of their diameter according to the Table 1 in Binzel et al. (2002) chapter on "Physical Properties of Near-Earth Objects" in Asteroids III. In red are shown new and refined diameters and albedos obtained from this work. 86
- Fig. 4.26 Increment in the number of NEAs with measured diameter and albedo as a function of their diameter. Note how this work contributes manly to the increment of our knowledge for the sub-kilometer population of NEAs. 87
- Fig. 5.1 Comparison of albedo distribution for the NEAs observed in this program (histogram a which contains 30 NEAs); all NEAs with radiometric reliable albedo (histogram b with 40 objects); SIMPS asteroids with diameter less than or equal to 10 km (c with 75 asteroids) and all SIMPS asteroids (d, with 2228 objects). In the first three histograms bins are 0.15-wide in

logarithmic albedo, whereas in the last one they are 0.05-wide in logarithmic albedo. In the case of NEAs and SMASSII-asteroids the taxonomic class is displayed.

92

Fig. 5.2 Plot of the geometric visible albedo versus diameter derived by NEATM for S-type NEAs. Taxonomic classes included are ‘S’, ‘Sq’, ‘Sr’ and ‘Sl’. The plot suggests a significant trend of increasing albedo with decreasing size. The trend may be due to a bias in favor of the discovery and characterization of high albedo objects. In the case of 433 Eros results are shown at lightcurve maximum and minimum.

93

Fig. 5.3 Best-fit beaming parameter, η , from the NEATM fits plotted against solar phase angle, α . The continuous line represents a linear fit, $\eta = (0.011 \pm 0.002)\alpha + (0.92 \pm 0.07)$ to all values of η . Filled diamonds with error-bars at $\eta > 2$ are those data points considered anomalous by Delbò et al. (2003). Filled triangles are the η -values for 5381 Sekmeth and the dashed line represent their linear fit: $\eta = (0.017 \pm 0.013)\alpha + (0.9 \pm 0.03)$. Open squares represent the η -values for 25330 (1999 KV₄). Significant deviations of η from the linear fit may be due to the effects of unusually high or low thermal inertia and/or surface roughness, and/or an irregular shape, influencing the surface temperature distribution presented to the observer. The “evening/morning” effect probably contributes to the scatter of the points (see text). The dotted curve represents the expected η values for an FRM-like asteroid, whereas the continuous one corresponds to the η -values derived by fitting NEATM to the infrared continuum of a perfectly conducting smooth sphere in thermal equilibrium with the solar radiation.

95

Fig. 5.4 Infrared phase curves for a spherical asteroid at the heliocentric distance of 1AU with a STM-like temperature distribution. However, the η -value is varied as a linear function of the phase angle α : $\eta = \beta_\eta \alpha + \eta_0$. See the text for further details.

99

Fig. 5.5: Comparison of STM diameters with radar ones as a function of the solar phase angle (a) and diameter (b) for those asteroids observed at phase angles less than or equal to 80° . For 433 Eros results are given at lightcurve maximum and at lightcurve minimum. A systematic error of -16% is evident between the two sets of data. The RMS fractional difference between the STM diameters and diameters derived from radar measurements is of 16%. No clear trend of the relative error with phase angle is evident. Error bars were calculated assuming a 15% uncertainty on STM radiometric diameters and 10% uncertainty on the radar one if such information was not available from the original source in the literature. The thick continuous line on plot (a) and (b) was obtained with a 6-elements central running box average. Plot (c) shows the histogram of the relative error distribution with superimposed the mean and the median values. Plot (d) shows how STM diameters are in good agreement with radar ones if asteroids 2100, 1580, 6489 and 33342 are removed from the sample.

101

Fig. 5.6 Comparison of FRM diameters with radar ones as a function of the solar phase angle (a) and diameter (b) for those asteroids observed at phase angles less than or equal to 80° . For 433 Eros results are given at lightcurve maximum and at lightcurve minimum. A systematic error of +35% is evident between the two sets of data. The RMS fractional difference between the FRM diameters and diameters derived from radar measurements is of about 40%. There is a clear trend of the relative diameter error with the phase angle and with the diameter. Error bars were calculated assuming a 15% uncertainty on FRM radiometric diameters and 10% uncertainty on the radar one if such information was not available from the original source in the literature. The thick continuous line on plot (a) and (b) was obtained with a 6-elements central running box average. Plot (c) shows the histogram of the relative error distribution with superimposed the mean and the median values.

103

- Fig. 5.7 Comparison of NEATM diameters with radar results as a function of the solar phase angle (a) and diameter (b) for those asteroids observed at phase angles less than or equal to 80° . For 433 Eros results are given at lightcurve maximum and at lightcurve minimum. A systematic error of +8% is evident between the two sets of data. The RMS fractional difference between the STM diameters and diameters derived from radar measurements is of about 20%. No clear trend of the relative error with phase angle and size is evident. Error bars were calculated assuming a 15% uncertainty on STM radiometric diameters and 10% uncertainty on the radar one if such information was not available from the original source in the literature. The thick continuous line on plot (a) and (b) was obtained with a 6-elements central running box average. Plot (c) shows the histogram of the relative error distribution with superimposed the mean and the median values. 104
- Fig. 5.8 Dependence of the STM-derived radiometric diameter at wavelengths of 5, 10 and 20 μm as a function of the beaming parameter η . Dashed line was obtained by fitting the STM simultaneously to 10 and 20 μm fluxes. 105
- Fig. 5.9 Infrared phase curves in terms of relative infrared magnitudes for a spherical asteroid calculated at 10 and 20 μm . Continuous line: NEATM with $\eta=0.011\alpha+0.9$ where α is the phase angle and η the beaming parameter (see text). Dashed line: STM for which $\eta=0.9$ was assumed. The 10 μm phase curve was obtained with a β_E -value of 0.015 mag/degree, whereas for the 20 μm curve β_E was set equal to 0.011 mag/degree. Those value were chosen to fit the NEATM phase curve in the range $0^\circ < \alpha < 30^\circ$. Dotted lines represent the phase curve of a NEATM-like asteroid with a fixed η -value of 0.9. 106
- Fig. 5.10 Plot of the geometric visible albedos versus solar phase angle for each radiometric observation. a) STM; b) FRM; c) NEATM. Continuous lines were calculated by taking the 5-elements-wide central moving average of the data points in each plot. 108
- Fig. 6.1 The model herewith implemented can handle spheres of with a small (a) or a large number of elementary triangular facets (b). General shapes can also be modeled as in the case of the radar model of the NEA 6489 Golevka (c). 116
- Fig. 6.2 Plot of the thermal parameter Θ as a function of the heliocentric distance. The thermal inertia, $\Gamma = 40 \text{ J m}^{-2} \text{ s}^{-1} \text{ K}^{-1}$, has a quasi-lunar like value. The bolometric bond albedo $A = 0.05$; emissivity $\epsilon = 1$ and asteroid sidereal rotation period $T_{\text{SID}} = 5$ hours. Note that for a given value of Γ and T_{SID} , NEAs have smaller values for Θ than objects more distant from the Sun. 118
- Fig. 6.3 The temperature of an equatorial tile of the spherical mesh monitored during the “warming up” phase. In this case the temperature of all the tiles of the mesh has been set equal to 0 K as starting conditions. After a few rotations the temperature stabilize within 0.5 K. 121
- Fig. 6.4 Diurnal temperature profiles for an object with sub-solar latitude equal to zero as a function of the thermal parameter Θ . 122
- Fig. 6.5 This plot allows the thermal parameter Θ to be estimated given the thermal inertia Γ and the asteroid rotational period in hours. From the bottom of the figure to the top, the lines refers to the following values of $\Gamma = [5, 25, 50, 100, 200, 400, 900, 2500, 5000] \text{ J m}^{-2} \text{ s}^{-1/2} \text{ K}^{-1}$. The typical lunar-like value for Γ is about $40\text{-}50 \text{ m}^{-2} \text{ s}^{-1/2} \text{ K}^{-1}$. 123
- Fig. 6.6 NEATM derived beaming parameter η as a function of the phase angle and thermal parameter Θ . The sun and the observer are in the equatorial plane of the synthetic asteroid. Different colors are used for different values of Θ : η -values derived for $\Theta=0.25$ are coded with black color; those obtained for $\Theta=0.50$ are coded with red; green is used for $\Theta=1.00$ with; blue for $\Theta=2.00$; pink for $\Theta=4.60$; light-blue for $\Theta=12.70$ and yellow for $\Theta=25.5$. Note

that there are two curves for each value of the thermal parameter Θ : continuous curves refer to those η -values derived by observing the morning side of the asteroid, whereas dashed-dotted curves indicate those η -values obtained observing the afternoon side. Curves obtained for $\Theta=0.025$ and 0.13 are not plotted since the derived η -values are constant with phase angle and their values between 1 and 1.05. The dotted black curve represents the expected η values for an FRM-like ($\Theta \rightarrow \infty$) asteroid.

124

Fig. 6.7 NEATM derived η parameter as a function of the phase angle and macroscopic surface roughness $\bar{\theta}$. The sun and the observer are in the equatorial plane of the synthetic asteroid. The thermal parameter Θ is equal to 0. Different colors are used for different values of $\bar{\theta}$: η -values derived for $\bar{\theta}=58^\circ$ are coded with black color; those obtained for $\bar{\theta}=36^\circ$ are coded with red; for $\bar{\theta}=20^\circ$ with green and for $\bar{\theta}=10^\circ$ with blue.

126

Fig. 6.8 Continuous line: diurnal temperature profiles for an equatorial tile of an object with sub-solar latitude equal to zero. Dashed-dotted line: diurnal temperature profiles for one of the four tiles on the floor of an equatorial crater with opening angle equals to 45° (a) and with opening angle equals to 90° (hemispherical crater).

127

Fig. 6.9 Combined effects of thermal inertia, rotation rate and surface roughness on the theoretical dependence of the NEATM η -value with the phase angle.

130

Fig. 6.10 Combined effects of thermal inertia, rotation rate and surface roughness on the theoretical dependence of the NEATM η -value with the phase angle.

131

Fig. 6.11 Verification of the hypothesis that η -values derived for asteroids observed from randomly oriented directions are limited by the “morning” curve M and the curve of zero thermal inertia N. The thermophysical model was run for three values of the sub-solar latitude B_{SS} . Crosses represent those η -values derived for asteroids with $B_{SS}=0^\circ$, asterisks for asteroids with $B_{SS}=30^\circ$ and diamonds for $B_{SS}=60^\circ$. Note how η -values collapse to the curve of zero thermal inertia as B_{SS} approaches 90° . Following our notation M is the curve with $\eta=\eta(-|\alpha|, \Theta, \bar{\theta})$, A that with $\eta=\eta(|\alpha|, \Theta, \bar{\theta})$ and N that with $\eta=\eta(|\alpha|, \Theta=0, \bar{\theta})$.

133

Fig. 6.12 Limiting curves which do not fit properly the observed η -values. See Fig. 6.13 caption for a description of the symbols.

134

Fig. 6.13 Limiting curves which DO fit the observed η -values. The values of the Θ and the $\bar{\theta}$ parameter used to draw the curves are shown on the upper left side of each plot. For each value

135

Fig. 6.14 Limiting η - α curves to fit observed η -values of 5381 Sekmeth. Those curves were calculated for $\Theta=4.4$ and $\bar{\theta}=36^\circ$

136

Fig. 6.15 Limiting η - α curves to fit observed η -values of 433 Eros. Those curves were calculated for $\Theta=1.0$ and $\bar{\theta}=20^\circ$

137

Fig. 6.16 Section of the STM relative albedo error function i.e. $(p_{V_STM}(\alpha, \Theta, \bar{\theta}) - p_{V_TM}) / p_{V_TM} \times 100$ at constant value of $\bar{\theta}$. The refined STM of Lebosfky and Spencer (1989) was used with constant $\eta=0.756$ and $\beta_E=0.01$ magnitude per degree. The function was numerically evaluated on a grid of ten degree of step size in α and at $\Theta=[0.13, 0.25, 0.40, 0.50, 1.00, 2.00, 4.60, 12.70, 25.5]$.

141

Fig. 6.17 Section of the STM relative albedo error function i.e. $(p_{V_STM}(\alpha, \Theta, \bar{\theta}) - p_{V_TM}) / p_{V_TM} \times 100$ at constant value of $\bar{\theta}$. In contrast to Fig. 6.16, here η is constant but equal to 0.95 and $\beta_E=0.015$ magnitude per degree, as described in section 5.6. The function was numerically

evaluated on a grid of ten degree of step size in α and at $\Theta=[0.13, 0.25, 0.40, 0.50, 1.00, 2.00, 4.60, 12.70, 25.5]$. 142

Fig. 6.18 Section of the NEATM relative albedo error function i.e. $(p_{V_NEATM}(\alpha, \Theta, \bar{\theta}) - p_{V_TM}) / p_{V_TM} \times 100$ at six different constant values of $\bar{\theta}$. The function was numerically evaluated on a grid of ten degree of step size in α and at $\Theta=[0.13, 0.25, 0.40, 0.50, 1.00, 2.00, 4.60, 12.70, 25.5]$ 143

Fig. 6.19 Distribution of the albedo relative error as a function of the η -value for asteroid observed at phase angle between -40 and 40 degrees (a) and at phase angle larger than 40° or smaller than -40° . 146

Fig B.1 Transmission curves for the filters installed at the LWS (Wirth & Campbell, personal communication, 2000). In the case of the M filter, the curve is the product of the transmission of the filter with that of the atmosphere and the optics of the instrument. 175

A mio padre e mia madre

