Practical round. Problems to solve

αβ-8. Jupiter. Analysis of observational data of Jupiter and its moons

Observational data of Jupiter and its moons are given on separate sheets.
Your answers (measured values, results of calculations, used formulas) must be written in corresponding tables.

A. See separate sheet.

B. Equatorial rotational period and radius

Two CCD images of Jupiter are shown in Figs. 2 and 3. The vertical lines in figures marks the position of the projection of Jupiter's rotation axis (we assume it is perpendicular to the line of sight). The rotation period can be obtained from horizontal shifts of stable atmospheric features located relatively close to the equator.

B.1. What time interval in seconds (**dt**) separate these images?
B.2. One feature useful for measurements is already marked "**1**". Select and mark two additional features as "**2**" and "**3**" in both pictures.
B.3. Measure distances from the central vertical line to the marked features in both images ($\mathbf{x_1}$ and $\mathbf{x_2}$, respectively) and to the Jupiter limb at the feature's latitude ($\mathbf{L_x}$).
B.4. Calculate the rotational angle (ϕ) for each feature.
B.5. Calculate the averaged value of rotational angle (ϕ**_avg**).
B.6. Calculate the rotational period ($\mathbf{P_{Je}}$), in hours.
B.7. Calculate Jupiter's equatorial radius ($\mathbf{R_{Je}}$), in km.

C. Mass and density

Figs. 4-6 display observations of three Jupiter moons obtained during five successive nights in September 2011. Abscissa in those figures is time of observation measured in hours from the beginning of the observing session. Ordinate is the angular distance (in angular minutes) of the moon from the center of Jupiter at the moment of observation. The equatorial radius of Jupiter in the angular seconds is also given for some moments.

C.1. Estimate the period of revolution of each Jupiter's moon ($\mathbf{P_m}$), in hours.
C.2. Estimate the semimajor axis of the orbit of each Jupiter's moon expressed in Jupiter's equatorial radii (**a_Je**) and convert it into meters (**a**).
C.3. Use your mesurements of each moon to calculate the mass of Jupiter ($\mathbf{M_J}$) independently.
C.4. Calculate the averaged value of Jupiter mass ($\mathbf{M_J}$**_avg**).
C.5. From Jupiter image estimate the ratio of Jupiter's polar and equatorial radii ($\mathbf{R_p/R_e}$).
C.6. Calculate the mean radius of Jupiter ($\mathbf{R_J}$**_avg**).
C.7. Calculate the density of Jupiter ($\boldsymbol{\rho_J}$).