Preciznija kalibracija nekih skala daljine u astrofizici

PMF, Novi Sad

Branislav Vukotić
naučni saradnik
Astronomska opservatorija, Beograd
bvukotic@aob.rs

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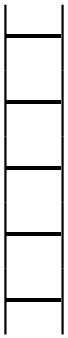
Određivanje daljina

- Rastojanja i veličine u Sunčevom sistemu
- Zvezdana paralaksa
- Spektroskopska paralaksa
- Cefeide u Galaktičkim jatima
- Cefeide u bliskim galaksijama
- Supernove Ia u bliskim i udaljenim galaksijama
- Barionske akusticne oscilacije

... i razne druge kalibracione relacije: Tali-Fišer, Faber-Džekson, sjaj-dijametar relacije itd.

Upotreba kalibracionih relacija



uzorak kalibratora

+

metod kalibracije

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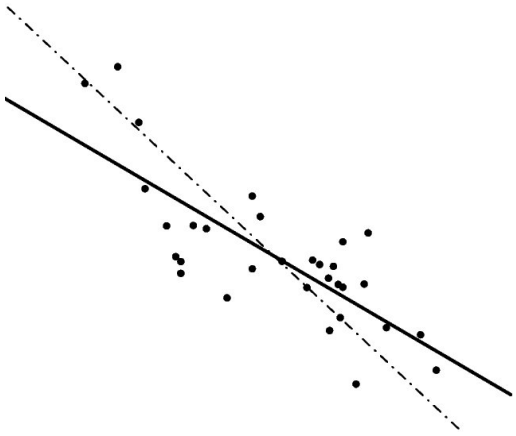
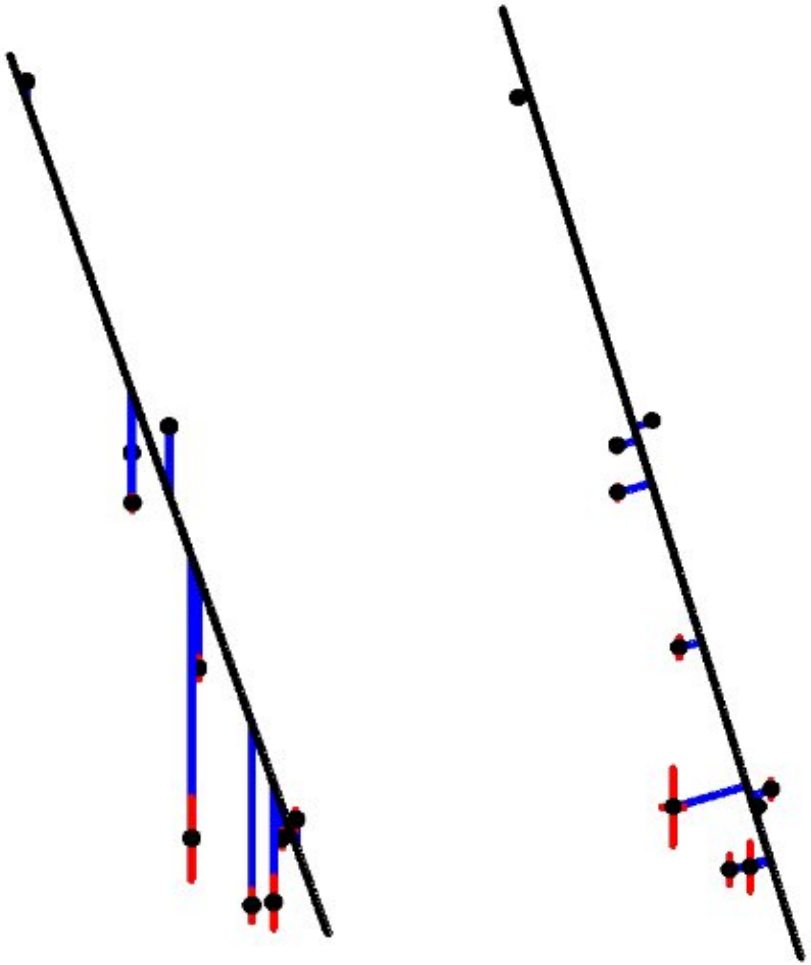
$\Rightarrow$

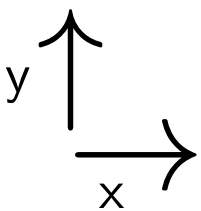


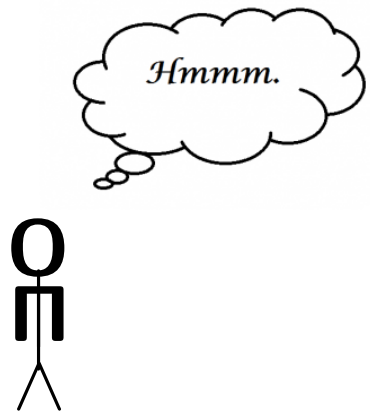
Metod kalibracije

$$d = \frac{|y_i - a - bx_i|}{\sigma_{y_i}}, \quad d = \frac{|y_i - a - bx_i|}{(\sigma_{y_i}^2 + \sigma_{x_i}^2 b^2)^{0.5}}$$

$$y = a + b * x$$







$\Sigma = AD^{-\beta}$ za kalibracioni uzorak Galaktičkih OS

Table 2
The Σ–D Fit Parameters for a Calibration Sample of 60 Galactic SNRs and Different Regression Methods

Fit	β	$\Delta\beta$	$\log A$	$\Delta\log A$	Average Fractional Error
OLS($Y\|X$)	2.2840	0.3282	−17.0028	0.4895	0.824
OLS($X\|Y$)	5.0375	0.7465	−13.1820	1.0162	0.469
Orthogonal	4.8161	0.7218	−13.4877	0.9819	0.472
Bisector	3.1741	0.3335	−15.7641	0.4746	0.575
Arithmetic mean	3.7079	0.4282	−15.0209	0.5817	0.522
Geometric mean	3.4178	0.3536	−15.4256	0.4898	0.547

Note. We give β and A in relation $\Sigma_\nu = AD^{-\beta}$ as well as their errors.

$$(S, \theta) : \Sigma + kalib. \rightarrow d$$

$$\Omega = \frac{\theta^2 \pi}{4}$$

$$\Sigma = \frac{S}{\Omega}$$

$$D = \frac{d}{\theta}$$

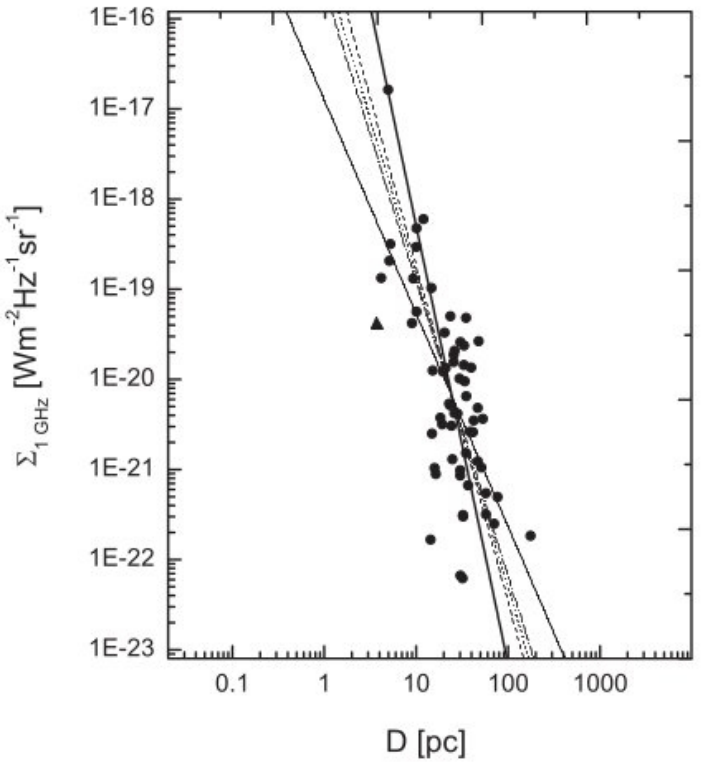


Figure 1. Surface brightness vs. diameter Σ–D relation at 1 GHz for shell SNRs obtained by using the distance calibrators in Table 1. The different methods for minimizing the distance of the data from a fitted line are presented. The two solid lines represent OLS($Y|X$) (thin line) and orthogonal regression (thick line). Dashed, dotted, and dash-dotted lines represent the arithmetic and geometric means of the OLS($Y|X$) and OLS($X|Y$) slopes and the OLS bisector, respectively. OLS($X|Y$) line, with a slope very similar to orthogonal regression, is omitted to avoid complicating the graph. G1.9 + 0.3, the youngest Galactic SNR that shows a flux density increasing with time (Green et al. 2008), is also shown (triangle), but it is not included in the calibration sample because it is still in the early (rising) free expansion phase of evolution (see Berezhko & Völk 2004).

Uzorak Galaktičkih planetarnih maglina

Table 1. Fit parameters values.

N/A	$\log \Sigma = A + \beta \log D$		$\log D = B + \alpha \log \Sigma$	
N/A	A	β	B	α
Vertical	-20.8 ± 0.4	-2.6 ± 0.4	-6.56 ± 0.7	-0.31 ± 0.04
Orthogonal	-21.1 ± 0.3	-3.1 ± 0.4	-6.68 ± 0.8	-0.32 ± 0.04

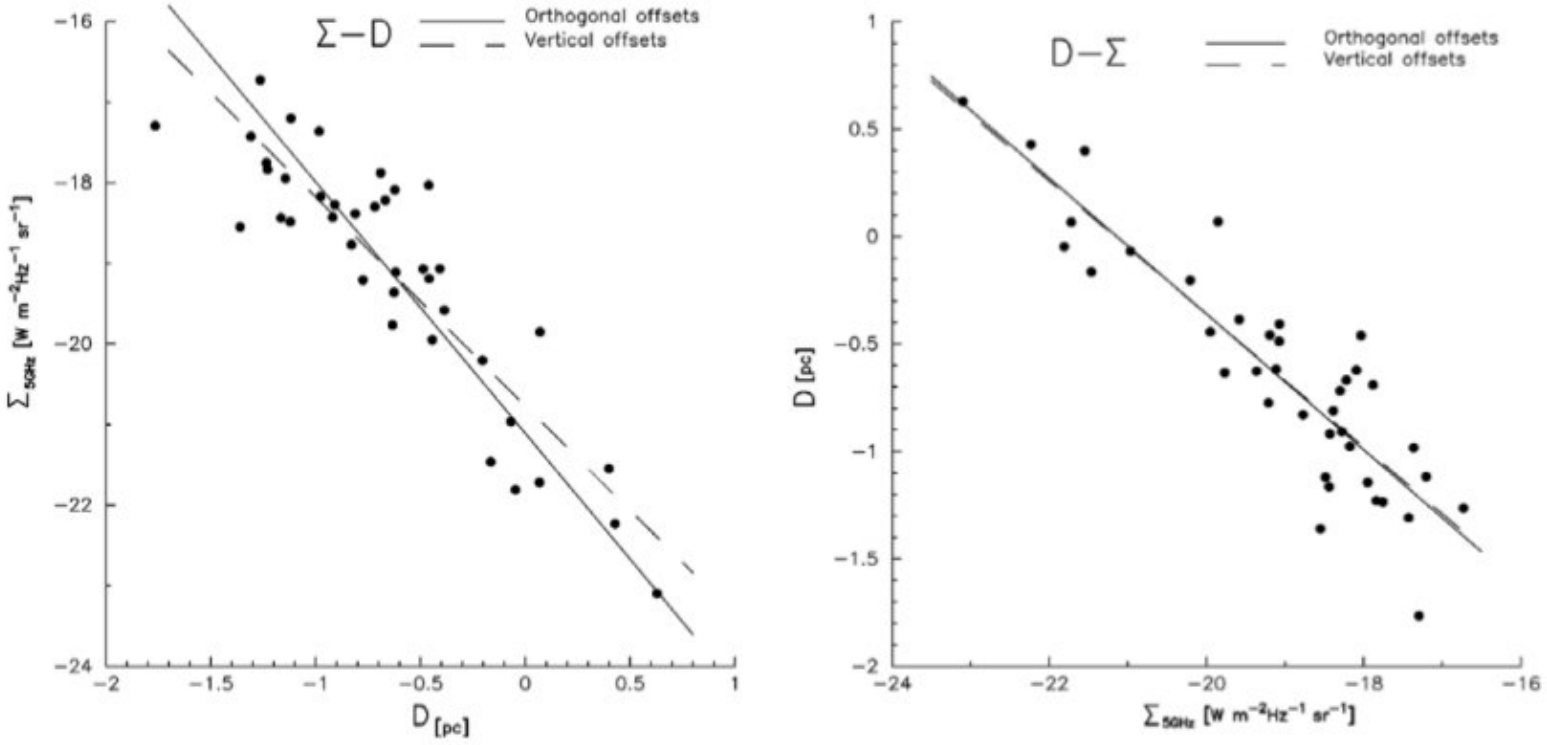
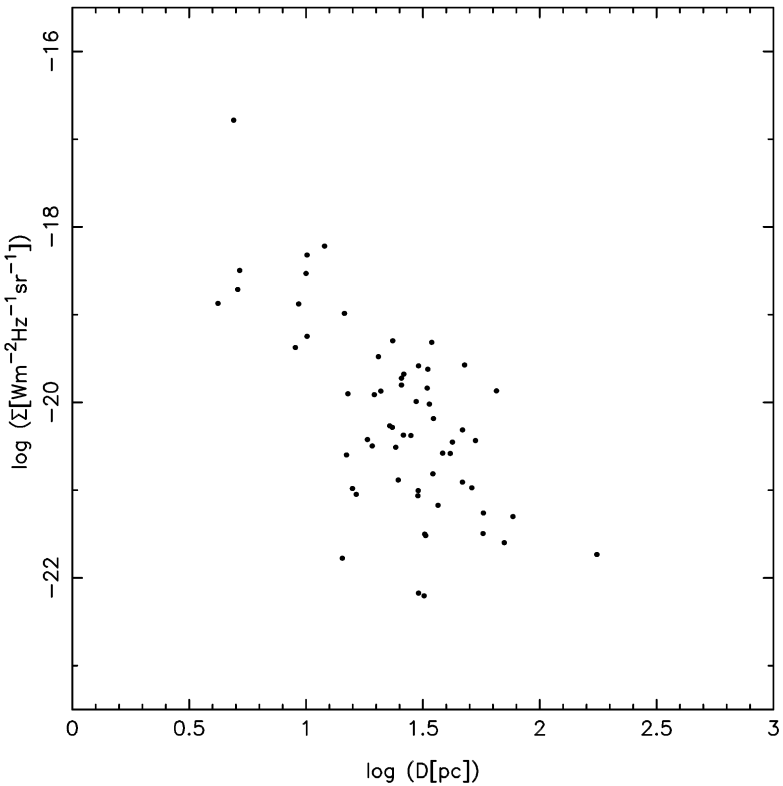
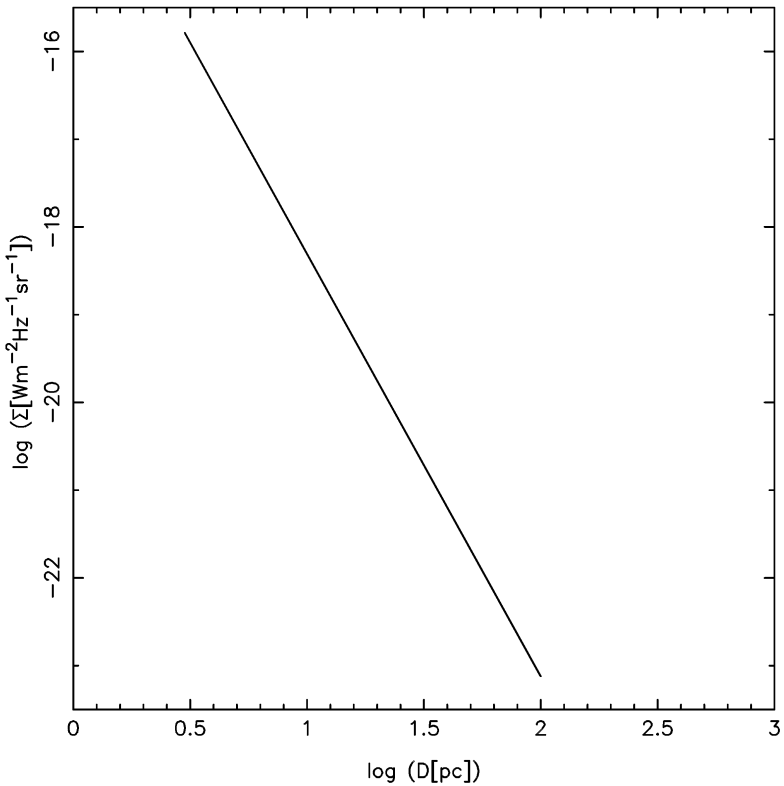


Figure 1. Calibration.

Ali...

Ostaci supernovih, a i planetarne magline, su veoma raznovrsni objekti: početni uslovi, oblik, sredina, itd.





Rekonstrukcija funkcije gustine verovatnoće kalibratora

1. Napraviti mrežu.
2. Plotovanje kalibratora i izračunavanje centroida kalibracionog uzorka.
3. MK uzorkovanje za ponavljanjem.
4. Izračunavanje centroida tako dobijenog uzorka.
5. Izračunavanje koordinata za plotovanje tog uzorka i plotovanje.
6. Ponoviti u koracima 3-5, dovoljan broj puta.

$$C = C_{\mathrm{d}} - C_{\mathrm{d}}^{\mathrm{cnt}} + C_{\mathrm{r}}^{\mathrm{cnt}}$$

$$N^{\mathrm{cnt}} = \left(\frac{(2n-1)!}{n!(n-1)!} \right)$$

Dobije se...

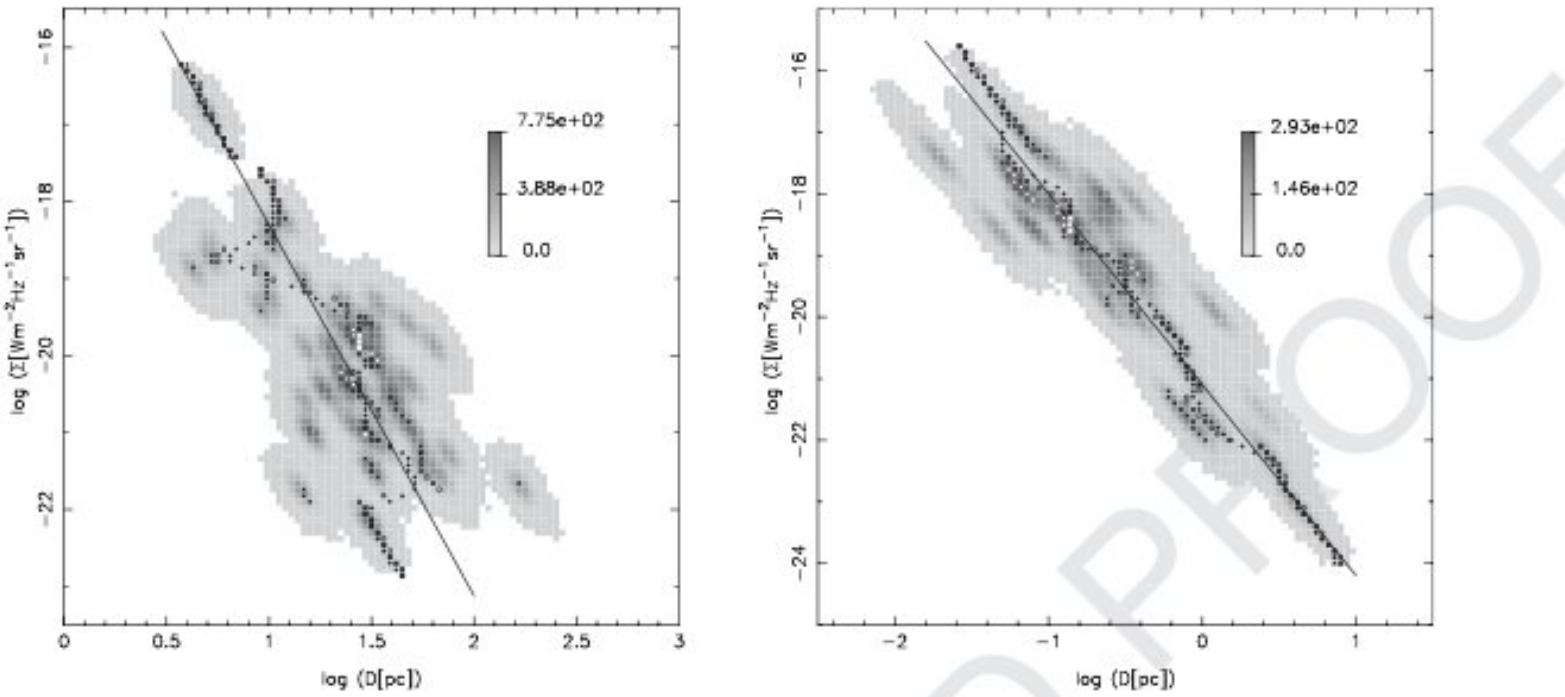


Figure 2. Greyscale reconstructed data PDF. The lattice of 100 × 100 cells is mapped on the variables range shown in the plot. The markers represent parameters of the distributions at fixed Σ values, along the D axis (rows of the plotted PDF matrix): mode – diagonal cross, median – open square and mean – cross. Left: 60 Galactic SNR sample from Pavlović et al. (2013). Right: 39 Galactic PNe sample from Stanghellini et al. (2008). The solid line represents the orthogonal offsets best-fitting line with parameters from corresponding works of Pavlović et al. (2013) and Vukotić & Urošević (2012).

PROOF

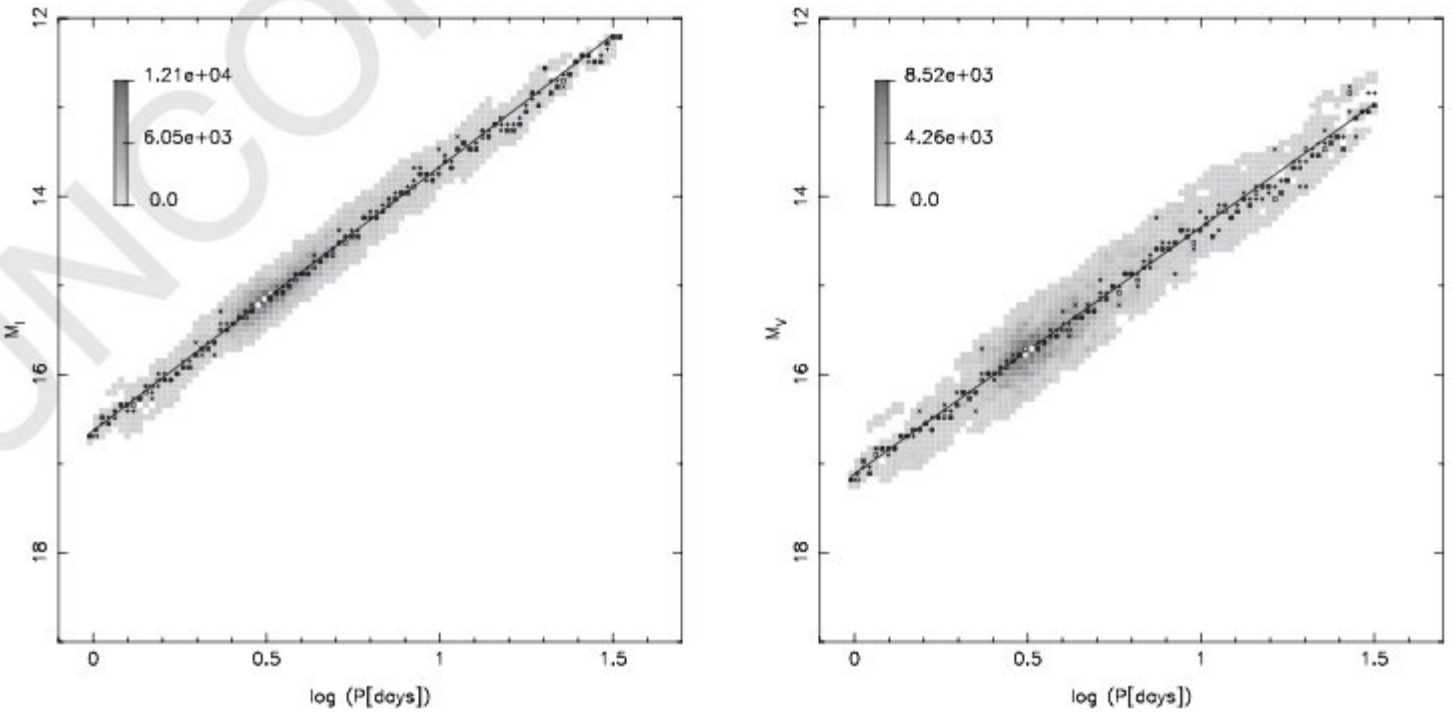


Figure 3. Greyscale reconstructed data PDF for an extinction corrected sample of fundamental mode LMC Cepheids from Ngeow et al. (2009). The lattice of 100×100 cells is mapped on the variables range shown in the plot. The markers represent parameters of the distributions at fixed P values, along the M axis (columns of the plotted PDF matrix): mode – diagonal cross, median – open square and mean – cross. Left: 1649 objects in the I band. Right: 1675 objects in the V band. The solid line represents the vertical offsets best-fitting line with parameters from corresponding work of Ngeow et al. (2009).

$$d = 10^{\left(1.0+\frac{m-M}{5.0}\right)}$$

Poređenje

$$\bar{f} = \frac{1}{N} \sum_{i=1}^{N} \left| \frac{d_{\mathrm{i}} - d_{\mathrm{i}}^{\mathrm{S}}}{d_{\mathrm{i}}} \right|$$

Sample	fit	$10^2 \times 10^2$			$10^3 \times 10^3$		
		mode	mean	median	mode	mean	median
SNRs, Pavlovic et al., 2013	47.21	33.15	38.76	35.70	30.60	37.07	35.49
PNe, Vukotic, Urosevic, 2012	48.64	44.13	44.33	43.58	40.42	41.72	43.04
Ceph I, Ngeow et al., 2009	4.84	4.92	4.76	4.77	4.78	4.44	4.56
Ceph V, Ngeow et al., 2009	7.55	7.83	7.31	7.38	7.80	6.96	7.16

Primer G12.0-0.1

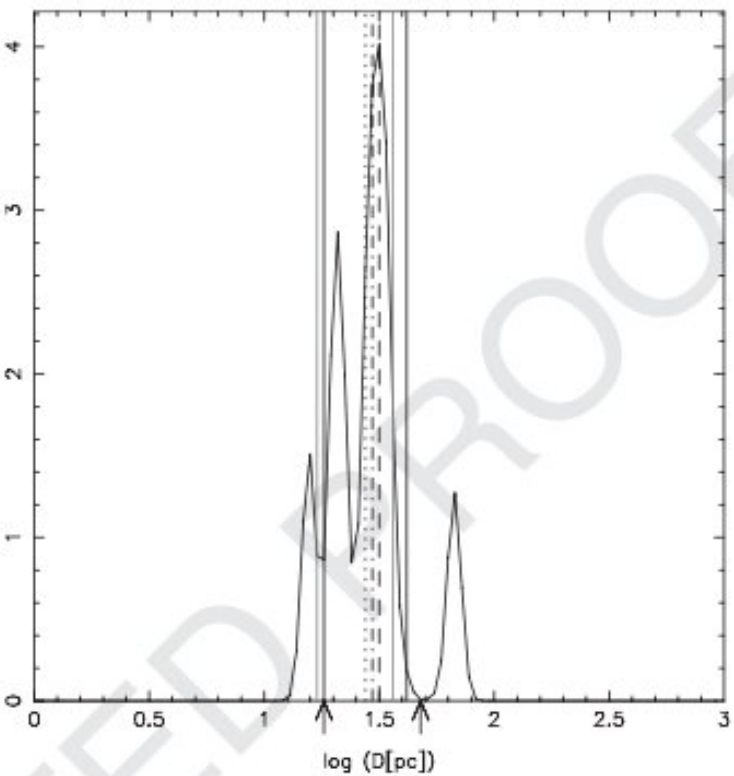
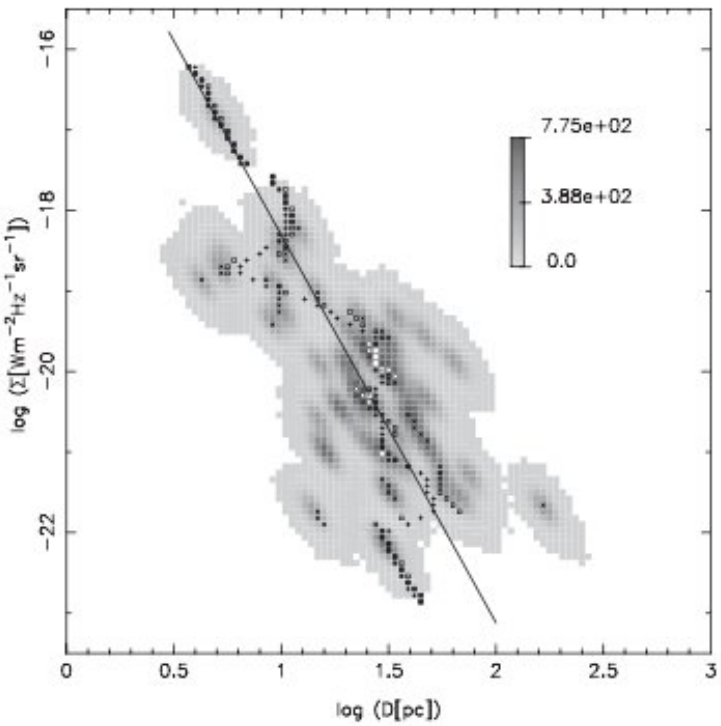


Figure 1. PDF of the diameter variable at the fixed value of $\log \Sigma = -19.98$ from the data sample PDF presented in the left-hand panel of Fig. 2. Mode, median and mean are presented with dashed, dash–dotted and dotted lines, respectively. The vertical black solid lines mark one standard deviation confidence interval. The vertical grey lines designate 75 per cent confidence interval around mean, biased towards higher PDF values, as explained in case (a) in Section 2.1. The arrows mark the 75 per cent confidence interval symmetric around median, as stated in case (b) in Section 2.1.

- Pavlovic et al. 2013. $\sim$ 11 kpc
- Yamauchi et al. 2014. $\sim$ 10 kpc
-
  - moda ->$\sim$ 15.5 kpc
  - sr. vred. ->$\sim$ 13.5 kpc
  - medijana ->$\sim$ 14.5 kpc



POČETAK !!!