Determination of distances in SMC using stellar spectroscopy (092.D-0110)

Petr Hadrava,
Astronomical Institute, Academy of Sciences, Prague

CoIs: S. Štefl, R. Klement, C. Martayan,
J. Palouš, S. Ehlerová, A. Růžička

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Plan of the talk

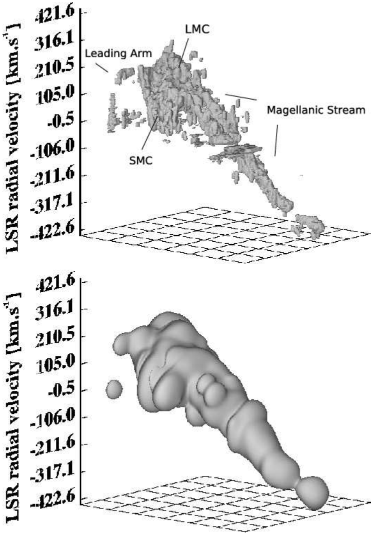
- Aims: Structure of Magellanic system
- Method: Binaries and Cepheids as primary distance markers
    - Physical principles
    - Disentangling of spectra
    - Cepheids
- Means: FLAMES multiobject spectrograph
- Results: Interstellar lines in SMC binaries

Structure of Magellanic System

Tidal interaction MW – LMC – SMC

(Růžička et al. 2007, A&A 461, 155)

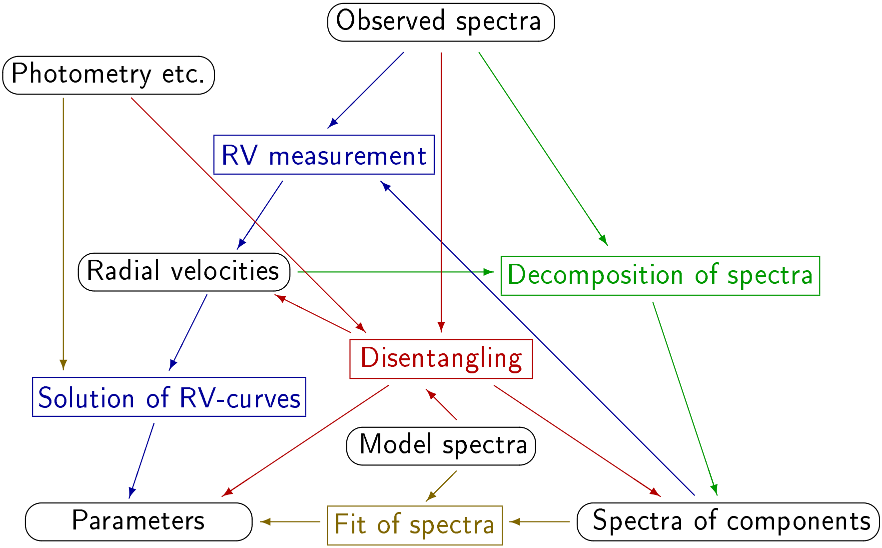
Stellar and gaseous component



Physical principles of distance determination

- Geometric methods $D = \frac{d}{\alpha}$
  spectroscopy $\Rightarrow$ RV $\Rightarrow$ d (standard rod)
  interferometry $\Rightarrow$ α; (MW only)

- Photometric methods $D = \sqrt{\frac{L}{4\pi f}} \sim 10^{0.2(m-M)}$
  $L \sim d^2 T_{\mathrm{eff}}^4$; (standard candle)
  or $L \simeq 4\pi(R_1^2 F(T_1, g_1) + R_2^2 F(T_2, g_2))$ (EBs)
  photometry $\Rightarrow$ $f, R_{1,2}/d$; (extinction)
  multicolour photometry or spectroscopy $\Rightarrow$ T_{eff}


Observed spectra
Photometry etc.
RV measurement
Radial velocities
Decomposition of spectra
Disentangling
Solution of RV-curves
Model spectra
Parameters
Fit of spectra
Spectra of components

Disentangling of spectra

1995 A&AS 114, 393
2012 IAUS 282, 351

$$I(x,t;p) = \sum_{j=1}^{n} I_j(x) * \Delta(x,t;p)$$

$$x \equiv c \ln\lambda/\lambda_0$$

$$\tilde{I}(y,t;p) = \sum_{j=1}^{n} \tilde{I}_j(y)\tilde{\Delta}(y,t;p)$$

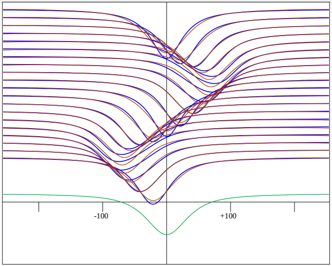
$$\Delta(x,t;p) = \sum_{j=1}^{n} I_j(x) * \delta(x - v_j(t;p)) \Rightarrow \tilde{\Delta}(y,t;p) = \exp(iyv_j(t;p))$$

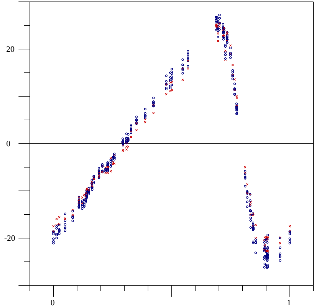
Disentangling of Cepheid pulsations

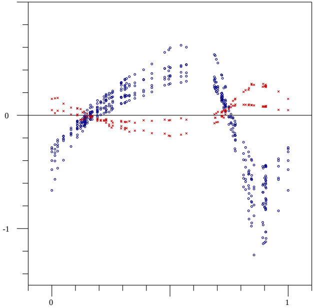
2009 A&A 507, 397

$$\Delta^k(x,t) = \int_s \mu^{k+1}\delta(x - v(s,t))d^2s$$

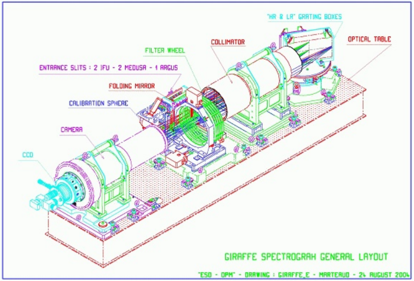
$$= \frac{2\pi R^2}{v_p^{k+2}} \left[x^{k+1}\right]_0^{v_p}$$



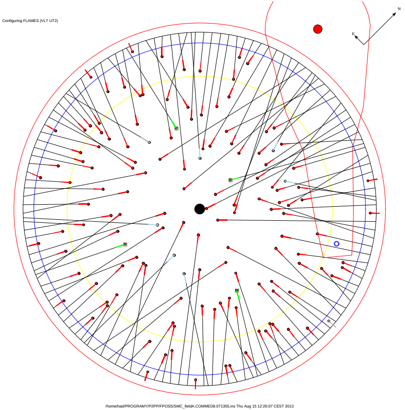


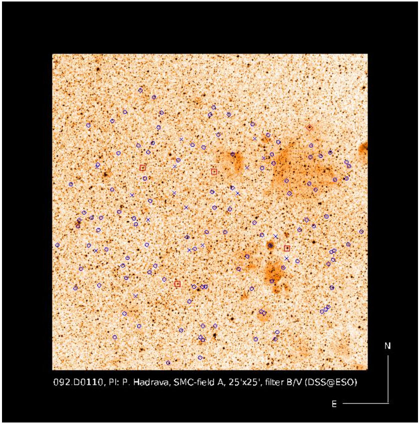


UVES + GIRAFFE MEDUSA at VLT UT2



FPOSS and finding charts





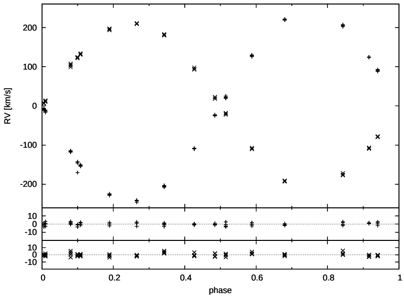
SMC SC-5 38089

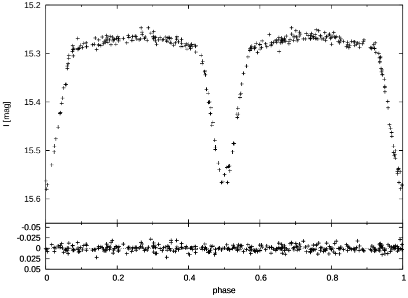
VLT – FLAMES/GIRAFFE spectroscopy and OGLE II photometry

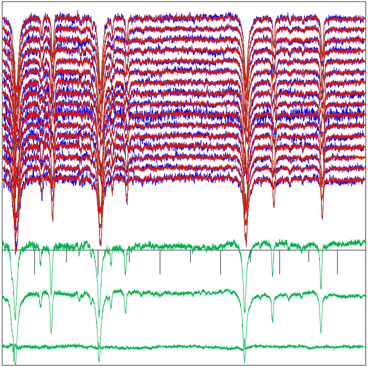
North+ 2010 A&A 520, A74 (072.A-0474)

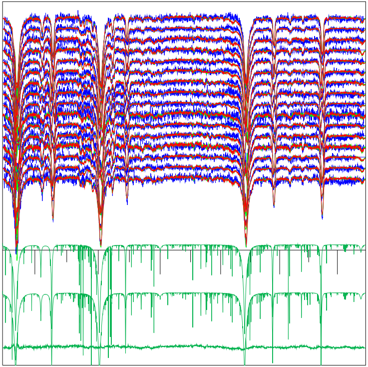
Klement 2012, Diploma thesis, MU Brno

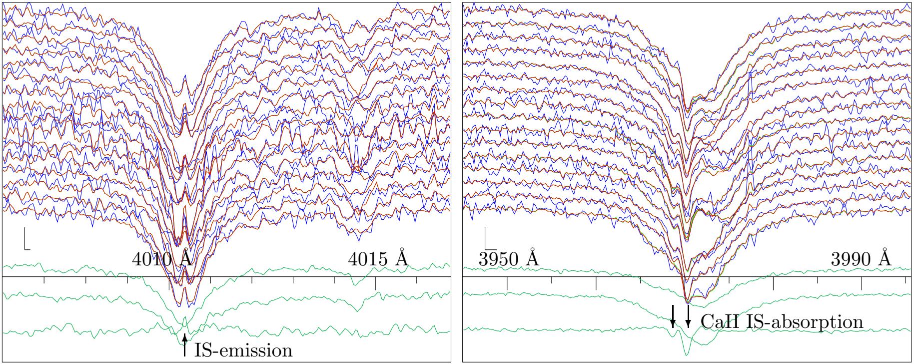
Hadrava+ 2013 IAU Symp. 289, 231

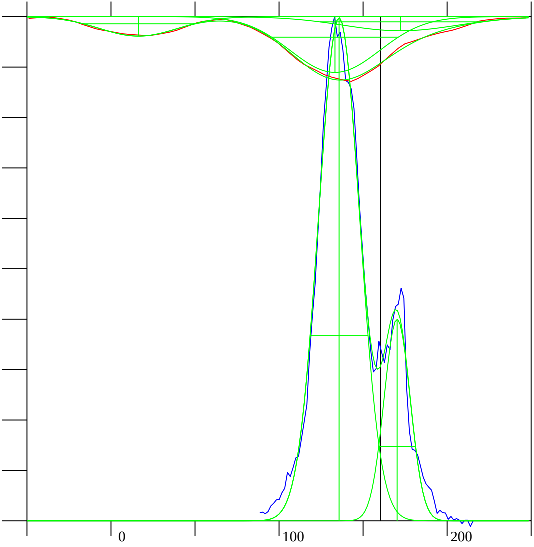









4010 Å
4015 Å
IS-emission
3950 Å
3990 Å
CaII IS-absorption


0
100
200

The end – thank you for your attention!