

# The contribution of multi-channel pion-pion scattering in the final states of $\Upsilon$ -meson family decays

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## Collaboration

## Abstract content

In the analysis of data on decays of the  $\Upsilon$ -meson family -  $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi\pi$ ,  $\Upsilon(3S) \rightarrow \Upsilon(1S)\pi\pi$  and  $\Upsilon(3S) \rightarrow \Upsilon(2S)\pi\pi$  - the contribution of multi-channel  $\pi\pi$  scattering in the final-state interactions is considered. The analysis, which is aimed at studying the scalar mesons, is performed jointly considering the isoscalar S-wave processes  $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$ , which are described in our model-independent approach based on analyticity and unitarity and using an uniformization procedure, and the charmonium decay processes  $J/\psi \rightarrow \phi(\pi\pi, K\bar{K})$ ,  $\psi(2S) \rightarrow J/\psi(\pi\pi)$ . Results of the analysis confirm all our earlier conclusions on the scalar mesons. It is also shown that in the final states of the  $\Upsilon$ -meson family decays (except for the  $\pi\pi$  scattering) the contribution of the coupled processes, e.g.,  $K\bar{K} \rightarrow \pi\pi$ , is important even if these processes are energetically forbidden. This is in accordance with our previous conclusions on the wide resonances: If a wide resonance cannot decay into a channel which opens above its mass but the resonance is strongly connected with this channel (e.g. the  $f_0(500)$  and the  $K\bar{K}$  channel), one should consider this resonance as a multi-channel state with allowing for the indicated channel taking into account the Riemann-surface sheets related to the threshold branch-point of this channel and performing the combined analysis of the considered and coupled channels.

[1] Yu.S. Surovtsev et al., Nucl. Phys. B (Proc. Suppl.) 245 (2013) 259 [2] Yu.S. Surovtsev et al., J. Phys. G: Nucl. Part. Phys. 41 (2014) 025006 [3] Yu.S. Surovtsev et al., Phys. Rev. D 89 (2014) 036010

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