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Analytical solution to integro-differential equations via complex maps in domains of contour integrals

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A simple model for QCD dynamics in which the DGLAP integro-differential equation may be solved analytically has been considered in our previous papers arXiv:1611.08787 [hep-ph] and arXiv:1906.07924 [hep-ph]. When such a model contains only one term in the splitting function of the dominant parton distribution, then Bessel function appears to be the solution to this simplified DGLAP equation. To our knowledge, this model with only one term in the splitting function for the first time has been proposed by Blümlein in arXiv:hep-ph/9506403. In arXiv:1906.07924 [hep-ph] we have shown that a dual integro-differential equation obtained from the DGLAP equation by a complex map in the plane of the Mellin moment in this model may be considered as the BFKL equation. Then, in arXiv:1906.07924 we have applied a complex diffeomorphism to obtain a standard integral from Gradshteyn and Ryzhik tables starting from the contour integral for parton distribution functions that is usually taken by calculus of residues. This standard integral from these tables appears to be the Laplace transformation of Jacobian for this complex diffeomorphism. We find out certain important points for further development of this strategy. We verify that the inverse Laplace transformation of the Laplace image of the Bessel function may be represented in a form of Barnes contour integral. We consider other integro-differential equations which may be solved analytically by this method.

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