Description

In computations of Vlasov gas flow accreted onto a moving black hole time-critical operation is computation of the function:

$$X(\xi,\varepsilon,\lambda)=\lambda\int_{\xi}^{\infty}\frac{d\xi'}{\xi'^2\sqrt{\varepsilon^2-U_\lambda(\xi')}}, \tag{1}$$

where:

$$U_\lambda(\xi)=\left(1-\frac{2}{\xi}\right)\left(1+\frac{\lambda^2}{\xi^2}\right). \tag{2}$$

Many possible methods can be used to evaluate (1) numerically. For example, it can be expressed either by combination of elliptic integrals, or as inverse of Weierstrass $\wp$ function. This is known to be slow and prone to errors. Fast alternative might be e.g. direct numerical integration by dedicated or general algorithm or multidimensional interpolation. However, any other method is acceptable, as long as it can be used in other calculations (Mathematica in particular) as a code or library function.

Goal of the project is to develop, benchmark, compare and finally select the fastest method to compute (1). Precision should be at level of machine precision, but less accurate results are also of interest, if they provide significant increase in speed.