3. the exponential screening, dependent on two parameters: the power n and the screening radius R:

$$V_c^R(r) = \frac{e^2}{r} e^{-(\frac{r}{R})^n} \ . \tag{7}$$

In this case

$$v_c^R(p', p, x', x) = \frac{e^2}{2\pi^2} \int_0^{2\pi} d\phi \int_0^{\infty} dr \frac{\sin(qr)}{q} e^{-(\frac{r}{R})^n} \equiv \frac{e^2}{2\pi^2} \int_0^{2\pi} d\phi \frac{I_{n,R}(q)}{q} \ , \tag{8}$$

where the function $I_{n,R}(q) = \int_0^{\infty} dr \sin(qr) e^{-(\frac{r}{R})^n}$

For the value of $n = 1$ the integration over r can be performed analytically resulting in

$$v_c^R(p', p, x', x) = \frac{e^2}{\pi} \frac{1}{\sqrt{(p'^2 + p^2 - 2pp'x + \frac{1}{R^2})^2 - 4p'^2 p^2 (1 - x')(1 - x)}} \ . \tag{9}$$

For $n > 1$ a two-dimensional numerical integration is required to obtain $v_c^R(p', p, x', x)$. Due to strong oscillations of the integrand in (8) the big number of integration r-points is needed to achieve sufficient precision. This significantly increases the computer time needed for the t-matrix calculation, which has to be done on a big grid of p, p', x and x' points. Typically, we solve the Lippmann-Schwinger equation (1) using 120 p-points and 190 x-points for the sharply cut off potential and 95 p-points with 130 x-points for other screenings, what requires over 1.5×10^8 calculations of the $v_c^R(p', p, x', x)$ function. The integration over ϕ in (8) can be performed with relatively small number of ϕ-points and thus the whole numerical difficulty is shifted to calculation of $I_{n,R}(q)$. In order to speed it up we use the following method: in the first step we prepare the $I_{n,R}(q)$ on a grid of 300 q-points in the range of 0-100 fm^{-1}. In order to calculate the integral over r we use the Filon's integration formula [12] which is dedicated to integrals of the product of the sine (or cosine) with some nonoscillatory function $f(x)$. The upper limit of integration r_{max} is chosen sufficiently large so that the integrand approaches zero ($e^{-(\frac{r_{max}}{R})^n} = 10^{-20}$). Since the resulting function $I_{n,R}(q)$ undergoes changes of 10 orders of magnitude in a rather small region of q, it is very difficult to handle it properly in further interpolations and integrations. A way out is to perform interpolations for the ratio $I_{n,R}^{ratio}(q) = I_{n,R}(q)/I_{1,R}(q)$ with analytically known $I_{1,R} = \frac{q}{q^2 + R^{-2}}$. Variation of that ratio $I_{n,R}^{ratio}(q)$ is much more restricted, as shown in Fig.1, and we use its polynomial representation to get $I_{n,R}^{ratio}(q)$ at any value of q. For each value of n and R we divide the interpolation region into some optimal number of intervals, optimizing their length as well as degree of the polynomial. Typically we have 6 intervals while the degree of the polynomial varies between 6 to 12. This allows us to describe the oscillating function $I_{n,R}^{ratio}(q)$ with a sufficiently high precision, what is exemplified in Fig. 1 for n=3 and R=120 fm. In addition to the solid line