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Preface

This is an example of “frontmatter”, which comes before the main text of the book.

Chapter 1

(1981.)

, 4 1981. X

1.1

A, u U f F.

$$Au = f, \quad u \in U, \quad f \in F \tag{1.1}$$

u , f – A. f u, . .

– . –, , . . , , . , .

. “ , , .” [@@, - 1967]. (1.1), . , , . . [@@ - 1965]. . - , . ( ) – , [@@ - 1958]. .

1.2

1.2.1

$$Au \equiv \int_a^b K(x-t)u(t)\,dt = f(x), \quad c \le x \le d, \tag{1.2}$$

-, . A - $K(t)$, .
:

@@Eddington-1913 [@@, - 1959]. t — , x — , $s = x - t$ — , $u(t)$, $f(x)$ — , $b = -a = \infty$,
$K(s) = \dfrac{1}{\sqrt{2\pi}\sigma} e^{-\frac{s^2}{2\sigma^2}}$ —

[@@-1959]

t — , x — , $s = x - t$ — , $u(t)$, $f(t)$ — . $u(t) = N(v)$, $n(r)$ r :

$$n(r) = \left|\frac{\partial v}{\partial r}\right| N(v).$$

$b = -a = \infty$, $K(s)$ — . $f(x)$.

() **[@@van deHulst-1941, - 1970]**

- :

$$Au \equiv \int_0^{2pi} \int_{-\pi/2}^{\pi/2} K(\alpha' - \alpha, \delta' - \delta) \cos\delta I(\alpha, \delta)\,d\delta\,d\alpha = I_*(\alpha', \delta') \tag{1.3}$$

I — , I_* — , K — , α— , δ — .

1.2.2 I

[@@, - 1959]

$t = r$ — , $x = m$ — , $u(t) = D(r)$ — , $f(x) = A(m)$ — m, $K(x,t) = r^2\varphi(m + 5 - 5\lg r - a(r)$, $\varphi(M)$ — , $a(r)$ — .

:

$$Au \equiv \int_a^b K(x,t)u(t)\,dt = f(x), \quad c \le x \le d, \tag{1.4}$$

$a = 0, b = d = -c = \infty$.

$$p(m)A(m) = \int_a^b D(r)\varphi(m + 5 - 5\lg r - a(t))r\,dr, \tag{1.5}$$

$p(m)$ — m.

[@@ - 1954]

XOY , x , , x, y — , XOY.
x', y' — . $u(x,y)$ $f(x',y')$

$$\int_0^\infty \int_{-\infty}^\infty K(x'-x, y, y')u(x,y)\,dx\,dy = 2\pi y'^2 f(x',y'), \quad -\infty < x' < \infty, \quad 0 \le y',$$

$$\text{K(x,y,z)} = \left[1 - \left(\frac{2yz}{x^2+y^2+z^2}\right)^2\right]^{-1/2}. \tag{1.6}$$

1.2.3

[@@, , - 1978]

, . i- , $l_i(\triangle)$, $\triangle$ — . I_i — $d\sigma$, φ_i — , i- , . ξ ρ I II . S — .

$$\iint\limits_{S(\triangle)} I_2(\rho)\varphi_1(\xi)\,d\sigma = 1 - l_1(\triangle), \iint\limits_{S(\triangle)} I_1(\rho)\varphi_2(\xi)\,d\sigma = 1 - l_2(\triangle). \tag{1.7}$$

,

$$2\pi \sum_{i=1}^{2} \int\limits_0^{r_i} I_i(\rho)\rho\,d\rho = 1, \tag{1.8}$$

r_i — .

I , (), II — , “” ()( ):

$$I_2(\rho) = I_2^{\circ}\left(1 - \kappa + \kappa\sqrt{1 - \frac{\rho^2}{r_2^2}}\right), \quad 0 \le \kappa \le 1 - - - , \tag{1.9}$$

$$\varphi_2(\rho) = \begin{cases} 1, & 0 \le \rho \le r_2, \\ 0, & r_2 < \rho. \end{cases} \tag{1.10}$$

Chapter 2

1982 , 03.11.1982 . ( )

2.1

ń , , ż [@@, – 1967].

$$Au = f, \quad f \in F, \quad u \in U \tag{2.1}$$

f u F U , A – , U F.
u , f – A. f u, . f g. 1.1 , U, . – , .
, , , , .
1.1 , ..

$$u = A^1 f, \tag{2.2}$$

(,), . u , , . – u , , , ...
, . (, .) , , .
, . *1.1* . -, . , . , . -, . () , . . , . -, , . .
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. ( ), . , .
( ). . ( ). – , . (, –) , , .
—- , , . , , . , . [].

: (. experimentum – ,) , .

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2.2

, , . - . .
(), . , , .. [@@1979].

2.2.1

$z(x,u)$, u_i. $x1,...,x_n$, $v_1,...,v_n$ z, $w_1,...,w_n$, $n > m$, : u,

$$S(u) = \sum i1n w_i[v_i z(x_i,u)]^2 \tag{2.3}$$

.

$$J^1(u)J(u)y(u) = f \tag{2.4}$$

f $y(u)$ $\sqrt{w_i}v_i, \sqrt{w_i}z(x_i,u)$, $J(u)$ $\frac{\partial y_k(u)}{\partial u_i}$ i- k- . (@@3) (@@1).
, $z(x,u)$, v w_i.
$z(x,u)$ u ( ) (@@3) (–) . , .

$$C_u = f$$

C nm , . nm U nm V,

$$C = UDV^T$$

D nm ; d_{ii} C.

$$D_y = g,$$

$y = V^T u \;\; g = U^T f, \;\; u = Vy.$
FORTRAN 4 [@@, , - 1980]

[@@.. , .. , .. , 22.10.1980, S. Aarseth, E.L.Turner, J.R. Yott].
[@@.. -1980,.. ..].
.

I (–):

$$\int_a^b K(x,t)u(t)\,dt = f(x), \quad c \le x \le d \tag{2.5}$$

[1]:

- ;
- ;
- ;
- ;
- ;
- .

[1] - .

2.2.2

$$\frac{du}{dt} = g(u,t), u(t_o) = u_o \tag{2.6}$$

$u, g -$.

.

- a) (, ,) [@@. – 1966, . , . , . , .. – .] b) [@@.. , .. , .. , ..].
- .
- [@@, , , , ,].

. . [@@ - 1979]. , , , , , . , , ... - ńż , . [@@ - 1981].

- . , , . . , , , . , , .

. . – – .

. , , .

N

, (@@S) $3N$ $g = \Phi, u = (r_1, ..., r_n)$. . - r_i :

$$\Phi(r_i) = +G \sum_{i+j=1}^{N} \frac{m_j}{\sqrt{(r_i - r_j)^2 + \varepsilon^2}}, \tag{2.7}$$

$G -$, $m_j -$, ε) – softening parameter .

:

$$\triangle\Phi = -4\pi GV, \tag{2.8}$$

$V -$, $\triangle$ - . - .

[@@.. , .. , ..] ( ) [@@R.W. Hockney, F. Hohl, R. Wielen, M. Lecan, S.J. Aarseth, J.R. Yott, P. Bierman, P. Bouvier].

.

- N. . -, (, - -). -, ... -, , .
- -, (, ,).
- [.. , .]. ( ).

( ). , , [@@.. , . , . . , . , ..].

, ńż [@@.. , . , .. , .. , ...].

2.3

, - . , – .

$$n = 2b^{m1}(b1)(P_L + P_U + 1) + 1, \tag{2.9}$$

b — ( ), m — ( ), P_U — , P_L – .

$$\left|\frac{\bar{t} - t}{\bar{t}}\right| [S\bar{t}] \leq \left[\frac{1}{2\alpha_1} b^{1-m}\right] \leq \frac{1}{2} b^{1-m}, \tag{2.10}$$

$b = 16, m = 14, P_U = 63, P_L = 64 \Rightarrow n \approx 1.7 * 10^{19}$

$$S\bar{t} \leq \frac{2^{-}53 \approx 1.11 * 10^{-}16}{m = 14} < \frac{2^{-}21 \approx 4.8 * 10^{-}7}{m = 6}$$

, (S . .
2 :

1. $0.22 + 0.033 + 0.0044 = 0.25$,
   $0.0044 + 0.033 + 0.22 = 0.26$
2. $0.90 * (0.90 + 0.14) = 0.90 * 1.0 = 0.90$,
   $(0.90 * 0.90) + (0.90 * 0.14) = 0.81 + 0.13 = 0.94$

—- ( ).

ń - - , , , ż
—[@@, . 36].

ń , . - , , ; , . , , : , . , , , , , ż
—[@@. , .243].

, .

2.4

1. Aarseth J.S., Lecar M. Computer Simulation of Stellar Systems. – Ann.Rev.Astron. Astrophys vol. 13, p.1-21, 1975.
2. . , ., 1974.
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4. .., .. . – .: ,. 46-62, , , 1981.
5. ., ..., 36, 5-6,, . 341-469, 1968.
6. .. . – .: , . 139-142.
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8. . .- .: , . 329-340, .-., 1978.
9. ., ., . . . , ., 1980
10. . . (). . , ., 1979.
11. .., .., .. . , ., 1978.

2.5

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Chapter 3

15 04.02.1986

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. . Fixsterne 20 . 1718 (, , -). , [@@, 1954] , .
, , Φ, t ( ). . − . .. . , . .
. , R, Q, Z , , $z = 0$, . , , . − , . .

0

0.1
, , I - , .
.

3.1

[@@, 1968, .72] , − , : ń – !ż
– . Bertil Lindblad (1895-1965) [@@, 1977].
1927 – , 1948 – 1952 .. .
1926 . , ( ), , .

1-2-3-4 ( )

5
$\omega = V/R \quad R.$
$P \quad \mathfrak{T}2m0 \ (R, 0) \ EP :$
:
$(-) \quad , \quad .$
.

$\mathfrak{T} < 2\Phi, .. \ E > 0,$
$(\ \Phi = 0,$
$\mathfrak{T}2\Phi, .. \ E0,$
$. \quad I.$

3.2 -

(2). . (R, Z) (

. . .. , .. , ... , 1977
.. . ., 32, 5, 332-368, 1953
. . .: . , .1962, 39-132
.. . , .1958
.. , , .1954
. . ., , , .1968
. . , ., 1948