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Graphical Comparison of Atomic Sizes with Bohr Radii and Covalent Radii for all the Elements

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Abstract: Ten years ago, the author published in this Journal a paper entitled: “Atomic, ionic and Bohr radii linked via the Golden Ratio for elements including lanthanides and actinides”. This article is a short supplement where the data in the above paper have been used to draw to scale the sizes of all the elements of the Periodic Table with the atomic Bohr radius and the atomic covalent radii. A graphical comparison of the sizes of all the elements of the Periodic Table with the two radii have been presented here in Tables 1 -3.

Introduction

The author [1,2] has published earlier the relation between the Bohr radii ($a_{B.A}$) and covalent radii d(A) = d(AA)/2 for all the elements of the Periodic Table. It was shown [1,2] that the two radii are related by simple functions of the Golden ratio (f). This short paper brings for the first time a graphical comparison of the sizes of all Elements with the atomic Bohr radii, $a_{B.A}$ and the covalent radii, d(A) using the data in [1].

Method, calculation and results:

The ground state Bohr radius, $a_{B.A}$ of an atom (A) was calculated (see [1] and the literature therein for all the details) from its first ionization potential (I_A) using the relation,

$$a_{B.A} = (e/2\kappa I_A) \quad \ldots \quad (1)$$

where e is the electric charge and κ is the electric constant. The covalent radii,

$$R_{cov} = d(A) = d(AA)/2 \quad \ldots \quad (2)$$

were calculated [1,2] as half the single bond length, d(AA). Here, the data in [1] have been used to present for the first time a graphical comparison of the sizes of the elements with the Bohr radii and covalent radii for all the elements of the Periodic Table. The graphs are presented in Table 1 (Group A), Table 2 (Group B) and Table 3 (Lanthanides and Actinides).

References:

1. R. Heyrovska, International J. Sci., 04 (2013):63 – 68, and the literature therein.
2. R. Heyrovska, International J. Sci., 02 (2013), 82-92, and the literature therein.

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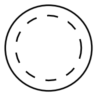
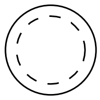
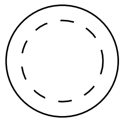
Table 1. Group A Elements: circles (--) $a_{B,A}$ Bohr radii and (—) d(A) covalent radii

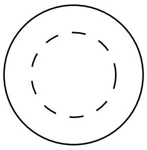
1A

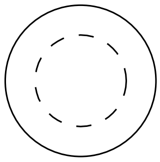
H
$a_{B,A}$: 0.53
d(A): 0.37


Li
$a_{B,A}$: 1.34
d(A): 1.75


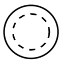
Na
$a_{B,A}$: 1.40
d(A): 1.83


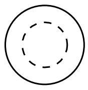
K
$a_{B,A}$: 1.66
d(A): 2.26


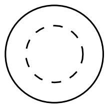
Rb
$a_{B,A}$: 1.72
d(A): 2.79


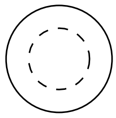
Cs
$a_{B,A}$: 1.85
d(A): 3.02


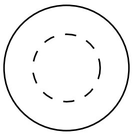
2A

Be
$a_{B,A}$: 0.77
d(A): 1.11


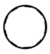
Mg
$a_{B,A}$: 0.94
d(A): 1.60


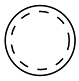
Ca
$a_{B,A}$: 1.18
d(A): 1.98


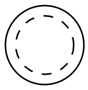
Sr
$a_{B,A}$: 1.26
d(A): 2.15


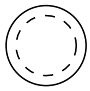
Ba
$a_{B,A}$: 1.38
d(A): 2.51


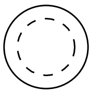
3A

B
$a_{B,A}$: 0.87
d(A): 0.89


Al
$a_{B,A}$: 1.20
d(A): 1.43


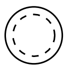
Ga
$a_{B,A}$: 1.20
d(A): 1.60


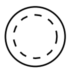
In
$a_{B,A}$: 1.24
d(A): 1.63


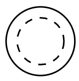
Tl
$a_{B,A}$: 1.18
d(A): 1.70


4A

C
$a_{B,A}$: 0.64
d(A): 0.71

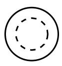

Si
$a_{B,A}$: 0.88
d(A): 1.18


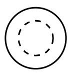
Ge
$a_{B,A}$: 0.91
d(A): 1.23


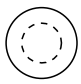
Sn
$a_{B,A}$: 0.98
d(A): 1.41


5A

N
$a_{B,A}$: 0.50
d(A): 0.55


P
$a_{B,A}$: 0.69
d(A): 1.11


As
$a_{B,A}$: 0.74
d(A): 1.25


Sb
$a_{B,A}$: 0.84
d(A): 1.45


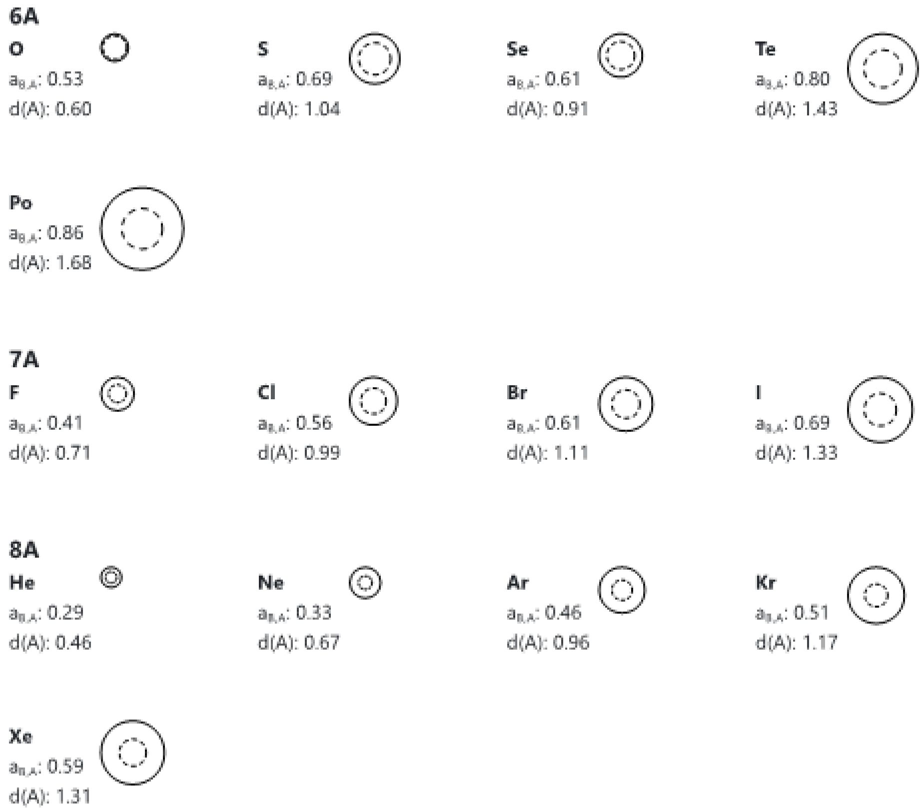
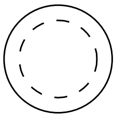
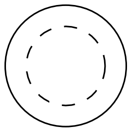
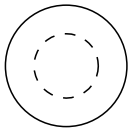

6A
O
$a_{B,A}$: 0.53
d(A): 0.60
S
$a_{B,A}$: 0.69
d(A): 1.04
Se
$a_{B,A}$: 0.61
d(A): 0.91
Te
$a_{B,A}$: 0.80
d(A): 1.43
Po
$a_{B,A}$: 0.86
d(A): 1.68
7A
F
$a_{B,A}$: 0.41
d(A): 0.71
Cl
$a_{B,A}$: 0.56
d(A): 0.99
Br
$a_{B,A}$: 0.61
d(A): 1.11
I
$a_{B,A}$: 0.69
d(A): 1.33
8A
He
$a_{B,A}$: 0.29
d(A): 0.46
Ne
$a_{B,A}$: 0.33
d(A): 0.67
Ar
$a_{B,A}$: 0.46
d(A): 0.96
Kr
$a_{B,A}$: 0.51
d(A): 1.17
Xe
$a_{B,A}$: 0.59
d(A): 1.31

Table 2. Group B Elements: circles (--) $a_{B,A}$ Bohr radii and (—) d(A) covalent radii

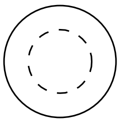
1B

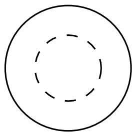
Cu
$a_{B,A}$: 0.93
d(A): 1.28


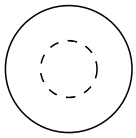
Ag
$a_{B,A}$: 0.95
d(A): 1.44


Au
$a_{B,A}$: 0.78
d(A): 1.44


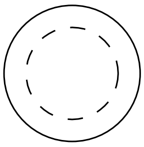
2B

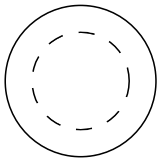
Zn
$a_{B,A}$: 0.77
d(A): 1.33


Cd
$a_{B,A}$: 0.80
d(A): 1.49


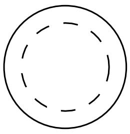
Hg
$a_{B,A}$: 0.69
d(A): 1.50


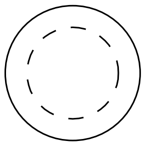
3B

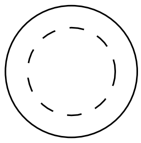
Sc
$a_{B,A}$: 1.10
d(A): 1.61


Y
$a_{B,A}$: 1.16
d(A): 1.78


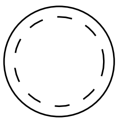
4B

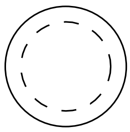
Ti
$a_{B,A}$: 1.05
d(A): 1.45


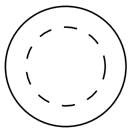
Zr
$a_{B,A}$: 1.09
d(A): 1.59


Hf
$a_{B,A}$: 1.05
d(A): 1.56


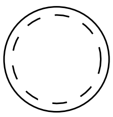
5B

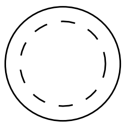
V
$a_{B,A}$: 1.07
d(A): 1.31


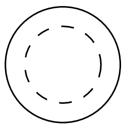
Nb
$a_{B,A}$: 1.07
d(A): 1.43


Ta
$a_{B,A}$: 0.95
d(A): 1.43


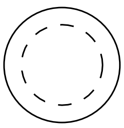
6B

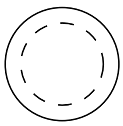
Cr
$a_{B,A}$: 1.06
d(A): 1.25


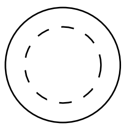
Mo
$a_{B,A}$: 1.02
d(A): 1.36


W
$a_{B,A}$: 0.92
d(A): 1.37


7B

Mn
$a_{B,A}$: 0.97
d(A): 1.37


Tc
$a_{B,A}$: 0.99
d(A): 1.35


Re
$a_{B,A}$: 0.92
d(A): 1.37


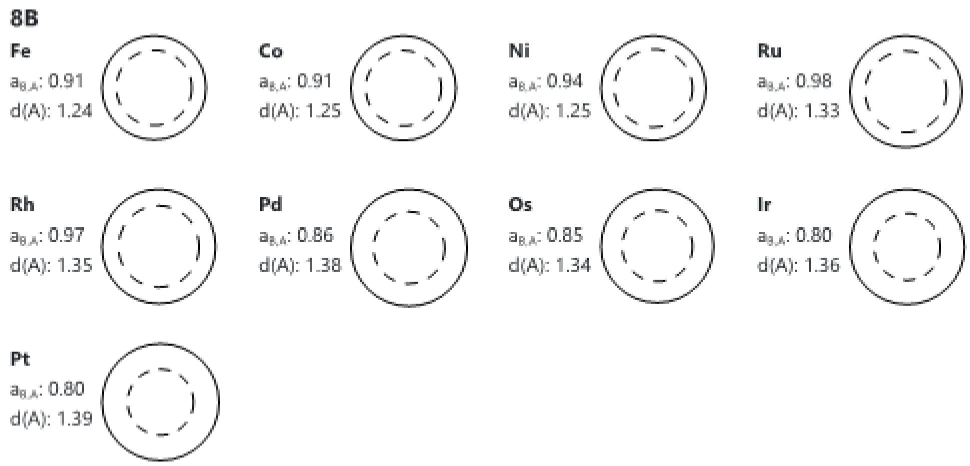
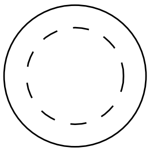
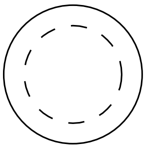
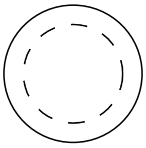

8B
Fe
$a_{B,A}$: 0.91
d(A): 1.24
Co
$a_{B,A}$: 0.91
d(A): 1.25
Ni
$a_{B,A}$: 0.94
d(A): 1.25
Ru
$a_{B,A}$: 0.98
d(A): 1.33
Rh
$a_{B,A}$: 0.97
d(A): 1.35
Pd
$a_{B,A}$: 0.86
d(A): 1.38
Os
$a_{B,A}$: 0.85
d(A): 1.34
Ir
$a_{B,A}$: 0.80
d(A): 1.36
Pt
$a_{B,A}$: 0.80
d(A): 1.39

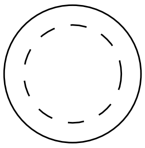
Table 3. Ln and An Elements: circles (--) $a_{B,A}$ Bohr radii and (—) d(A) covalent radii

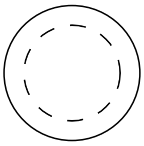
3B

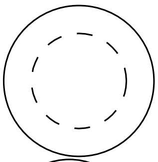
La
$a_{B,A}$: 1.29
d(A): 1.87


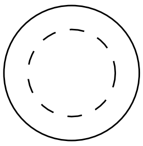
Ce
$a_{B,A}$: 1.30
d(A): 1.83


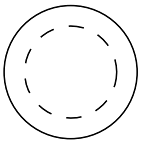
Pr
$a_{B,A}$: 1.32
d(A): 1.82


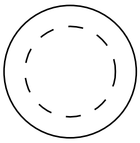
Nd
$a_{B,A}$: 1.30
d(A): 1.81


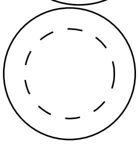
Sm
$a_{B,A}$: 1.28
d(A): 1.79


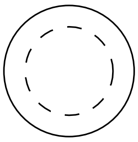
Eu
$a_{B,A}$: 1.27
d(A): 1.99


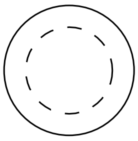
Gd
$a_{B,A}$: 1.17
d(A): 1.79


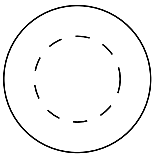
Tb
$a_{B,A}$: 1.23
d(A): 1.76


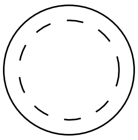
Dy
$a_{B,A}$: 1.21
d(A): 1.75


Ho
$a_{B,A}$: 1.20
d(A): 1.74


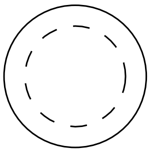
Er
$a_{B,A}$: 1.18
d(A): 1.73


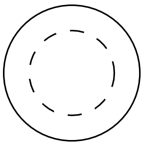
Tm
$a_{B,A}$: 1.16
d(A): 1.72


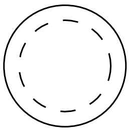
Yb
$a_{B,A}$: 1.15
d(A): 1.94


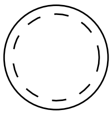
Lu
$a_{B,A}$: 1.33
d(A): 1.72


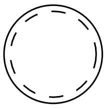
3B

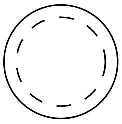
Ac
$a_{B,A}$: 1.34
d(A): 1.88


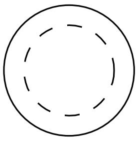
Th
$a_{B,A}$: 1.14
d(A): 1.80


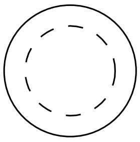
Pa
$a_{B,A}$: 1.22
d(A): 1.61


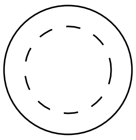
U
$a_{B,A}$: 1.16
d(A): 1.39


Np
$a_{B,A}$: 1.15
d(A): 1.31


Pu
$a_{B,A}$: 1.19
d(A): 1.51


Am
$a_{B,A}$: 1.21
d(A): 1.73


Cm
$a_{B,A}$: 1.20
d(A): 1.74


Bk
$a_{B,A}$: 1.16
d(A): 1.70


Cf
$a_{B,A}$: 1.15
d(A): 1.69