Changes in Avogadro's Number over Time

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Web version and the Binary Mole is at http://pages.swcp.com/~jmw-mcw/binary_mole.htm

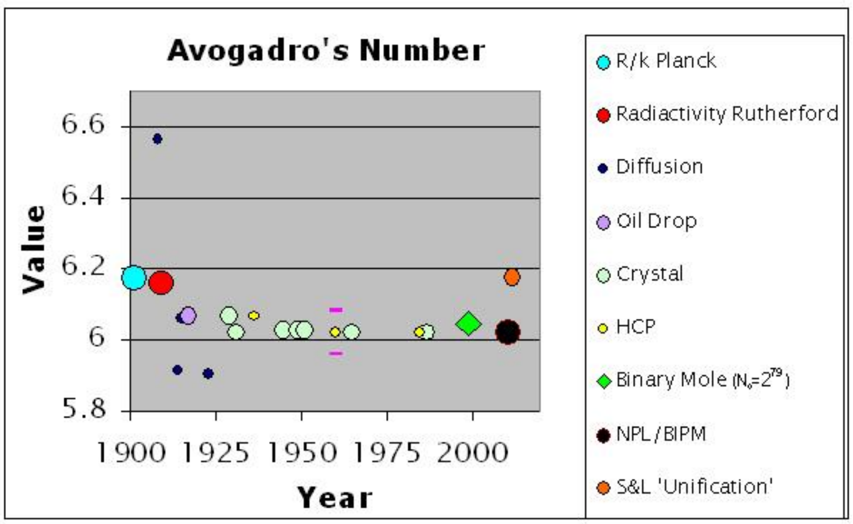
Abstract

ALL of the methods to determine Avogadro's Number should give the same value! The x-ray crystallography method has commanded the quest since the 1930's. Defining the ninth digit via x-ray crystallography when the second or third digit differs from that of other methods is counter to the scientific approach for seeking the correct answer.

DISCUSSION

Scientists strive for accuracy, but often mistake precision for it. Currently the effort is to look for the ninth or tenth decimal place of Avogadro's number while relating it to the arbitrarily defined mass of a chunk of metal in France. Better that they should base it on all scientific methods and look for the convergence of all to a single value at least to 4 digits.

A brief look at the changes in the value of Avogadro's number with time and methodology is given in the figure below with the sources listed in a table further down.



The crystal and NPL/BIPM values are driven by the definition of the kilogram with the HCP values following suit. Other than the widely variant diffusion values, the values from the other approaches indicate that the x-ray derived values are too low.

ALL of the methods should give the same value of Avogadro's Number!

The numbers of 28Si atoms in those highly polished, "kilogram" spheres are certainly well-determined. With the "proper" value of Avogadro's Number, a "proper" value of the kilogram can be obtained.

Redefining the kilogram via [Kilogram → x-ray Avogadro's Number → Kilogram] is circular reasoning.

A good history of Avogadro's Number is at: http://depa.fquim.unam.mx/amyd/archivero/Avogadro%5C's_Number_17614.pdf
Also (Feb 2013) http://www.nist.gov/director/vcat/upload/International-Metrology-and-the-Redefinition-of-the-Kilogram.pdf Consensus?

Year	Source	Method	Value/10^23
1873	J D van der Waals	Early	11
1908	J Perrin	Early	6.7
1914	T Fletcher	Early	6
1890	W RRontgen	Film	7
1890	J W S Rayleigh	Film	6.08
1924	PL du Nouy	Film	6.004
1901	M Planck	R/k	6.175
1909	E Rutherford	α-particle theory	6.16
1908	A Einstein	Diffusion theory	6.56
1914	I Nordlund	Diffusion in fluids	5.91
1915	A Westgreen	Diffusion in fluids	6.06
1923	TWShaxby	Diffusion in fluids	5.9
1903	HA Wilson	Oil drop method	9.3
1904	J JThomson	Oil drop method	8.7
1917	RA Millikan	Oil drop method	6.064
1929	R T Birge	Crystal	6.064 4
1931	J A Bearden	Crystal	6.019
1945	R T Birge	Crystal	6.023 38
1949	M E Straumanis	Crystal	6.024 03
1951	JWM DuMond	Crystal	6.025 44
1965	J A Bearden	Crystal	6.022 088
1987	R D Deslattes	Crystal	6.022 134
2011	NPL/BIPM	Crystal (kilogram & 28Si)	6.022 140 78
1936	Handbook Chem & Physics		6.064
1960	Handbook Chem & Physics		6.02
1985	Handbook Chem & Physics		6.022 045
1996	JM Williams Binary Mole	Halving decay to whole unit	6.044 629 098 073 145 873 530 88
2012	Seshavatharam & Lakshminarayan http://vixra.org/pdf/1209.0106v1.pdf	"Unification?" Rest mass - Gravity	6.174 407 621

Note the near identity of Millikan's 6.064 1917 oil drop value, and Birge's 6.0644 1929 crystal value; the 1936 HCP reflects these. Note, now, the 0.041 drop in Birge's 6.0644 crystal value to 6.02338 in 1945. The change from the oxygen standard to carbon-12 did not occurred until 1967 with the International Committee for Weights and Measures and until 1971 with the General Conference on Weights and Measures. Avogadro's Number then began to hone in on 6.0221. Not surprisingly, the current 2010 CODATA Faraday (coulombs/mole) divided by the current e-charge (coulombs/electron) give 6.022 141 293, as the mole is based on the current definition of the kilogram and thus circular reasoning.

There is much intertwining of physical property values with Avogadro's Number being common to many. Hence, "adopting a concrete value" for some properties forces other properties to have "preordained" values. Avogadro's Number has thus been "directed".

Planck's "constant" was "1.2% greater" in 2010 (6.62606957(29) $\times 10^{-34}$ Js: 2010 CODATA) than it was in 1901 (6.55 $\times 10^{-34}$ Js: copy of Planck's paper at http://bourabai.kz/articles/planck/planck1901.pdf); their ratio and the current Avogadro's Number give an Avogadro's Number of 6.092 that is in line with values (6.1; average of Planck, Rutherford, Millikan, Birge) until the 1930s. It is interesting that, while Planck's papers in the early 1900's are referenced in a history of Planck's Constant (http://iopscience.iop.org/0034-4885/76/1/016101/pdf/0034-4885_76_1_016101.pdf), Planck's 1901 Constant value is not plotted in Fig 2 of that reference that spans 1900 to 2020. From the plot of Planck's Constant in Fig 2 of that reference and the plot of Avogadro's Number in this paper, it appears that these two physical "constants" have simply been reciprocally changed: [(new product)/(old product)] = [(**6.62606957*6.022141**)/(**6.55***6.1**)] = 0.999. Did Planck also make a mistake as has been attributed to others before the jump in Planck's Constant around 1930 in the history account? What was deemed so untouchable that these two were reciprocally treated?

Considering all of the changes in many of the physical units over the last century, I suggest that Avogadro's Number, thus the mole, be a very simple expression and have a value between the old and current values. **$N_o=2^{79}$** is such an expression. Its full value is **6.044629098073145873530880E23** for the fine stuff and standards while **6.0446E23** for the rough stuff. Measured properties then fall in step.