Subject: Re: Physical constants in IDL with !CONST
Posted by Paul Van Delst[1] on Tue, 18 Dec 2012 23:13:37 GMT
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Cool.

From my "Fundamental_Constants" module (still stuck at the 2006 CODATA numbers. Yoicks!):

```
  ! Standard atmosphere
  ! Symbol:P0,  Units:Pa,  Rel.Uncert.(ppm): exact
  ! ---------------------------------------------
  REAL(fp), PARAMETER :: STANDARD_ATMOSPHERE = 101325.0_fp

  ! Standard temperature
  ! (ice point of water, NOT triple point)
  ! Symbol:T0,  Units:Kelvin,  Rel.Uncert.(ppm): exact
  ! ------------------------------------------------
  REAL(fp), PARAMETER :: STANDARD_TEMPERATURE = 273.15_fp
```

The others I would add are derivatives (as are some in your main list), but what the hell:

```
  ! First Planck function constant
  ! Symbol:c1,  Units:W.m^2.sr^-1,  Rel.Uncert.(ppm): 0.078
  !
  !   c1 = 2.h.c^2
  !
  !      = 1.191042722(93)e-16
  ! ------------------------------------------------------
  REAL(fp), PARAMETER :: C_1 = &
    TWO * PLANCK_CONSTANT * SPEED_OF_LIGHT**2


  ! Second Planck function constant
  ! Symbol:c2,  Units:K.m,  Rel.Uncert.(ppm): 1.7
  !
  !         h.c
  !   c2 = -----
  !          k
  !
  !      = 1.4387752(25)e-02
  !
  ! -------------------------------------------
  REAL(fp), PARAMETER :: C_2 = &
```

```
    PLANCK_CONSTANT * SPEED_OF_LIGHT / BOLTZMANN_CONSTANT


  ! Molar volume of an ideal gas at standard
  ! temperature and pressure
  ! Symbol:Vm,  Units:m^3/mol,  Rel.Uncert.(ppm): 1.7
  !
  !        R.T0
  !   Vm = ------
  !         P0
  !
  !      = 2.2413996(39)e-02
  ! ------------------------------------------------
  REAL(fp), PARAMETER :: STP_MOLAR_VOLUME = &
    MOLAR_GAS_CONSTANT * STANDARD_TEMPERATURE / STANDARD_ATMOSPHERE


  ! Loschmidt constant: The number density of one mole
  ! of an ideal gas at standard temperature and pressure
  ! Symbol:n0,  Units:m^-3,  Rel.Uncert.(ppm): 1.7
  !
  !        N(A).P0
  !   n0 = ---------
  !         R.T0
  !
  !        N(A)
  !      = ------      .....(1)
  !         Vm
  !
  !      = 2.6867775(47)e+25
  !
  ! -----------------------------------------------------
  REAL(fp), PARAMETER :: LOSCHMIDT_CONSTANT = &
    AVOGADRO_CONSTANT / STP_MOLAR_VOLUME
```

I use these daily in my conversions of the various units of
concentrations of gases in the atmosphere.

Well, except for the first and second Planck constants - those are for
computing Planck radiances.

cheers,

paulv

On 12/18/12 17:34, Chris Torrence wrote:

> Hi all,
>
> I'm adding a new system variable to IDL, called !CONST. So far, it's an IDL structure containing the following physical constants, in MKS units. All of these values (except for !const.pi, .e, .phi, and .R_earth) are taken from the "2010 CODATA Recommended Values," from NIST.
>
> Name Description Value
> alpha Fine structure constant 7.2973525698 x 10-3
> c Speed of light in a vacuum 299792458 m/s
> e Euler's number 2.7182818284590452
> ev elementary charge e, 1 electron volt 1.602176565 x 10-19 C
> eps0 electric vacuum permittivity 8.854187817 x 10-12 F/m
> F Faraday constant NAe 96485.3365 C/mol
> G Gravitation constant 6.67384 x 10-11 m3/kg/s2
> gn Earth standard gravity 9.80665 m/s2
> h Planck constant 6.62606957 x 10-34 J s
> hbar h/(2pi) 1.054571726 x 10-34 J s
> k Boltzmann constant R/NA 1.3806488 x 10-23 J/K
> me electron mass 9.10938291 x 10-31 kg
> mn neutron mass 1.674927351 x 10-27 kg
> mp proton mass 1.672621777 x 10-27 kg
> mu0 magnetic vacuum permeability 12.566370614 x 10-7 N/A2
> Na Avogadro constant NA 6.02214129e23 mol-1
> phi golden ratio 1.6180339887498948
> pi Pi 3.1415926535897932
> R molar gas constant 8.3144621 J/mol/K
> R_earth Earth radius (spherical) 6370997.0 m
> re classical electron radius 2.8179403267 x 10-15 m
> rydberg Rydberg constant Rinf 10973731.568539 m-1
> sigma Stefan-Boltzmann constant 5.670373 x 10-8 W/m2/K4
> u unified atomic mass unit 1.660538921 x 10-27 kg
>
> Here's my question: What am I missing? Are there any physical
> constants that most people would find useful for their day-to-day
> work. The key is "most" people - nothing too esoteric, or limited to
> a single scientific discipline, etc.
>
> Thanks!
>
> -Chris
> ExelisVis

> p.s. please limit your comments to !CONST. Our new
> widget system team is currently hard at work in a secret underground
> bunker, and cannot be disturbed.

Subject: Re: Physical constants in IDL with !CONST
Posted by Craig Markwardt on Wed, 19 Dec 2012 07:49:25 GMT
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On Tuesday, December 18, 2012 5:34:53 PM UTC-5, Chris Torrence wrote:
> Here's my question: What am I missing? Are there any physical constants that most people would find useful for their day-to-day work. The key is "most" people - nothing too esoteric, or limited to a single scientific discipline, etc.

That's a nice idea. I would suggest some form of traceability field, a string, like 'CODATA2010', so people know the source of the data. After all, when CODATA2013 comes out and you update IDL, your "constants" will change, right? At least with some kind of traceability, people can figure out why the results of their programs changed.

I would suggest a few additions. The mass of the Sun and Earth. Also the definition of the astronomical unit "au". The most recent versions are here:
http://maia.usno.navy.mil/NSFA/IAU2009_consts.html
The table gives the adopted 2009 International Astronomical Union values, including "GMsun" and "GMearth". You would divide those values by your value of Newton's G. There are TCB-, TDB- and TT-compatible values, but for your purposes you can use TCB (and document that choice).

Craig

Subject: Re: Physical constants in IDL with !CONST
Posted by lecacheux.alain on Fri, 21 Dec 2012 09:57:56 GMT
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Le mercredi 19 décembre 2012 00:13:37 UTC+1, Paul van Delst a écrit :
> Cool.
>
>
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>
>
>
>   ! Standard temperature
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>   ! (ice point of water, NOT triple point)
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>   ! Symbol:T0, Units:Kelvin, Rel.Uncert.(ppm): exact
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>   ! --
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>
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>
>   !   = 1.191042722(93)e-16
>
>   ! --
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>
>   TWO * PLANCK_CONSTANT * SPEED_OF_LIGHT**2
>
>
>
>
>
>
>
>   ! Second Planck function constant

```
>
>    ! Symbol:c2,  Units:K.m,  Rel.Uncert.(ppm): 1.7
>
>    !
>
>    !        h.c
>
>    !   c2 = -----
>
>    !         k
>
>    !
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>
>    !
>
>    ! ------------------------------------------
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>    REAL(fp), PARAMETER :: C_2 = &
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>
>
>
>
>
>    ! Molar volume of an ideal gas at standard
>
>    ! temperature and pressure
>
>    ! Symbol:Vm,  Units:m^3/mol,  Rel.Uncert.(ppm): 1.7
>
>    !
>
>    !        R.T0
>
>    !   Vm = ------
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>
>
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>
>     !
>
>     !         N(A).P0
>
>     !   n0 = ---------
>
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>
>     !
>
>     !         N(A)
>
>     !      = ------      .....(1)
>
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>
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Why not, simply, change the existing !Radeg and !Dtor constants to double ?
That should not imply any important loss of compatibility.

For the rest, the !CONST initiative looks pretty useful to me. Please only not to be too specific to a particular scientific discipline!

alain.
