Subject: Physical constants in IDL with !CONST
Posted by chris_torrence@NOSPAM on Tue, 18 Dec 2012 22:34:53 GMT
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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 Russell Ryan on Thu, 20 Dec 2012 03:07:09 GMT
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Sounds cool and is a good idea. What if you have four tags:

name
description
value
unit

so you could have
!const={name:'c',description:'speed of light',value:2.99d10,unit:'cm/s'}

-Russell

On Tuesday, December 18, 2012 5:34:53 PM UTC-5, Chris Torrence wrote:
> Hi all,
>
>
>
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> Na Avogadro constant NA 6.02214129e23 mol-1
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Subject: Re: Physical constants in IDL with !CONST
Posted by jeffnettles4870 on Thu, 20 Dec 2012 03:36:24 GMT
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Chris,

If you're going to put pi in there, which we already have in !pi, you might also consider putting !dtor and !radeg in as well, otherwise people might be wondering why !pi was put into !const but not the other two.

But don't remove the three existing system variables of course :)

Jeff

Subject: Re: Physical constants in IDL with !CONST
Posted by Craig Markwardt on Thu, 20 Dec 2012 04:43:16 GMT
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On Wednesday, December 19, 2012 10:36:24 PM UTC-5, Jeff N. wrote:
> Chris,
>
>
>
> If you're going to put pi in there, which we already have in !pi, you might also consider putting !dtor and !radeg in as well, otherwise people might be wondering why !pi was put into !const but not the other two.

But if you do, then put the double precision values! !DTOR is worse than useless for me because it's only single precision.

Craig

Subject: Re: Physical constants in IDL with !CONST
Posted by chris_torrence@NOSPAM on Thu, 20 Dec 2012 05:37:12 GMT
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On Wednesday, December 19, 2012 9:43:16 PM UTC-7, Craig Markwardt wrote:
> On Wednesday, December 19, 2012 10:36:24 PM UTC-5, Jeff N. wrote:
>
>> Chris,
>
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Hi all,

These are great suggestions.

Paul, I just added in all of your constants except "c1" and "c2". There seems to be a discrepancy with the definition of c1. NIST gives it as 2.pi.h.c^2, which is a factor of "pi" bigger than your constant. I don't want anyone to get confused and just use the constant blindly, perhaps including an unexpected extra factor of pi. Which one is in "standard" use?

Craig, I'll add in the AU, and the mass of the Sun & Earth. And of course "dtor" and "radeg" (double precision!). But don't worry, the older system variables won't go away.

Russell, great suggestion on including more info, like the "units". I'd love to do that, but I don't want to make the structure too complicated. What about having a second system variable, say something like !CONST_UNITS, which could contain additional information?

-Chris

Subject: Re: Physical constants in IDL with !CONST
Posted by wlandsman on Thu, 20 Dec 2012 14:24:31 GMT
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I wonder if the constants should be !DtoR and !RtoD (or RADEG and DEGRA) to correct the earlier inconsistency in the ancient history of IDL. I'm not sure about this, though. --Wayne

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Subject: Re: Physical constants in IDL with !CONST
Posted by ben.bighair on Thu, 20 Dec 2012 15:03:49 GMT
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On Thursday, December 20, 2012 12:37:12 AM UTC-5, Chris Torrence wrote:
> On Wednesday, December 19, 2012 9:43:16 PM UTC-7, Craig Markwardt wrote:
>
>> On Wednesday, December 19, 2012 10:36:24 PM UTC-5, Jeff N. wrote:
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> Russell, great suggestion on including more info, like the "units". I'd love to do that, but I don't want to make the structure too complicated. What about having a second system variable, say something like !CONST_UNITS, which could contain additional information?

Hi,

Great idea1 Would it be a pain to call it something like !K instead of !CONST for all of the keyboard-bumblers out there (like me)? It might be nice to include the reference for each definition if they come from different standards.

Have you considered the possibility of using an object in the system variable?

```
mass = 12*!K->get("u", /value)
print, "mass = ", mass, !K->Get("u", /unit)
```

It might be nice if it were the possibile to support two kinds of constants - built-in and user defined.

The built-in would be read only, but the user defined could be added/modified as the user sees fit at start-up or whenever. At least that would provide a unified interface.

Cheers,
Ben

Subject: Re: Physical constants in IDL with !CONST
Posted by chris_torrence@NOSPAM on Thu, 20 Dec 2012 17:02:32 GMT
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Hi Ben,

Yes, using some sort of object is a possibility.

But, not to throw out a bombshell, but... what if we were to change !C to be the constant? It's currently used for some very old (stupid) purpose like holding the min/max index from the last call to min/max.

Does anyone have any code that relies on this?!

-Chris

Subject: Re: Physical constants in IDL with !CONST
Posted by David Fanning on Thu, 20 Dec 2012 17:08:44 GMT
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Chris Torrence writes:

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>
> Does anyone have any code that relies on this?!

God help the boys at NASA who are still running IDL 1.0
on some of their machines! But, yes, I'm all in favor of
using !C as the constant system variable. :-)

Cheers,

David

--
David Fanning, Ph.D.
Fanning Software Consulting, Inc.
Coyote's Guide to IDL Programming: http://www.idlcoyote.com/
Sepore ma de ni thue. ("Perhaps thou speakest truth.")

Subject: Re: Physical constants in IDL with !CONST
Posted by Heinz Stege on Thu, 20 Dec 2012 17:36:21 GMT
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On Thu, 20 Dec 2012 06:24:31 -0800 (PST), wlandsman wrote:

> I wonder if the constants should be !DtoR and !RtoD (or RADEG and DEGRA) to correct the earlier inconsistency in the ancient history of IDL. I'm not sure about this, though. --Wayne
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A lot of discussions for a little thing, that everyone can do her or himself within a startup file.

However, I think Wayne is absolutly right.

A similar point is, that I wouldn't name the elementary charge "eV". I know, there is a name conflict with the Euler's number. However the Euler's number can simply be calculated by number=exp(1d). Therfore I suggest to simply remove it from the table.

Please realize, that most of the "constants" are from physics and chemistry and the Euler's number is a mathematical number which never will change. (You may argue, that pi also is a mathematical constant, however it is needed [even though by definition] for the calculation of the magnetic constant mu0=4d*!dpi*1d-7)

The name "ev" for the elementary charge is confusing, because the definition of the elementary charge constant has nothing to do with the energy unit "electron volt". The reason for 1 eV being 1.602... 10^-19 J only reflects, that changing the potential of a charge e about 1 V means an energy change of 1.602... 10^-19 J.

Thats what I wanted to say.

Cheers, Heinz

Subject: Re: Physical constants in IDL with !CONST
Posted by PMan on Thu, 20 Dec 2012 18:41:44 GMT
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On Tuesday, December 18, 2012 5:34:53 PM UTC-5, Chris Torrence wrote:
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>
>
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> -Chris
>
> ExelisVis
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> 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.

Excellent - being in a bunker myself, I understand how sensitive bunkered people are :)

Subject: Re: Physical constants in IDL with !CONST
Posted by chris_torrence@NOSPAM on Thu, 20 Dec 2012 19:10:32 GMT
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On Thursday, December 20, 2012 10:36:21 AM UTC-7, Heinz Stege wrote:
> On Thu, 20 Dec 2012 06:24:31 -0800 (PST), wlandsman wrote:
>
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Hi Heinz,

That's a really good point. I had the same dilemma about "eV" when I put it in. I like your idea of getting rid of "e".

Also, yes, I'll make the "DtoR" and "RtoD" consistent. Maybe "DegRad" and "RadDeg", so at least they are somewhat human-readable?

-Chris

Subject: Re: Physical constants in IDL with !CONST
Posted by Paul Van Delst[1] on Thu, 20 Dec 2012 20:31:14 GMT
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Hello,

On 12/20/12 14:10, Chris Torrence wrote:
> On Thursday, December 20, 2012 10:36:21 AM UTC-7, Heinz Stege wrote:
>
> Hi Heinz,
>
> That's a really good point. I had the same dilemma about "eV" when I
> put it in. I like your idea of getting rid of "e".

For what it's worth, I agree with Heinz. But for a (slightly) different reason.

The symbol for elementary charge on the NIST site is "e". Thus that should be what is used in !C.

Consistent adherence to a convention (in this case: all this stuff comes from the NIST/CODATA site) is A Good Thing (tm).

> Also, yes, I'll make the "DtoR" and "RtoD" consistent. Maybe "DegRad"
> and "RadDeg", so at least they are somewhat human-readable?

I prefer the former to the latter simply because of the preposition "to" indicating a direction of conversion.

<aside mode="tangential">
I've never been a big fan of making constant names short because people want to save some keystrokes. In fact, that violates most advice/conventions on naming in the usual texts ("Code Complete", "Clean Code", etc etc)

I'm a verbose sort so the following is what I use:

```
REAL(fp), PARAMETER :: PI = 3.14159265358979323846264338327 9_fp
REAL(fp), PARAMETER :: TWOPI = TWO * PI
REAL(fp), PARAMETER :: DEGREES_TO_RADIANS = PI / 180.0_fp
REAL(fp), PARAMETER :: RADIANS_TO_DEGREES = 180.0_fp / PI
```

(I have similar in IDL code so I'm sure of the precision)

So if it's human readability you want, why not DEGREES_TO_RADIANS and RADIANS_TO_DEGREES?

I realise just about everyone will disagree with me.

And that's o.k. :o)
</aside>

cheers,

paulv

Subject: Re: Physical constants in IDL with !CONST
Posted by David Fanning on Thu, 20 Dec 2012 20:59:46 GMT
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Paul van Delst writes:

> So if it's human readability you want, why not DEGREES_TO_RADIANS and
> RADIANS_TO_DEGREES?
>
> I realise just about everyone will disagree with me.

Not everyone! I'm a BIG fan of yours! ;-)

Cheers,

David

--
David Fanning, Ph.D.
Fanning Software Consulting, Inc.
Coyote's Guide to IDL Programming: http://www.idlcoyote.com/
Sepore ma de ni thue. ("Perhaps thou speakest truth.")

Subject: Re: Physical constants in IDL with !CONST
Posted by chris_torrence@NOSPAM on Sat, 22 Dec 2012 00:19:42 GMT
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Hi all,

Here's the current list of constants:

```
IDL> help,!const,/full
** Structure !CONST, 33 tags, length=264, data length=264:
   ALPHA           DOUBLE       0.0072973525697999997
   AU              DOUBLE          149597870700.00000
   C               DOUBLE          299792458.00000000
   DTOR            DOUBLE       0.017453292519943299
   E               DOUBLE      1.6021765650000000e-019
   EPS0            DOUBLE      8.8541878170000005e-012
   EULER           DOUBLE          2.7182818284590451
   F               DOUBLE          96485.336500000005
   G               DOUBLE      6.6742799999999995e-011
   GN              DOUBLE          9.8066499999999994
   H               DOUBLE      6.6260695699999996e-034
   HBAR            DOUBLE      1.0545717259999999e-034
   K               DOUBLE      1.3806488000000000e-023
   M_EARTH         DOUBLE      5.9721863899999997e+024
   M_SUN           DOUBLE      1.9884158605700001e+030
   ME              DOUBLE      9.1093829099999999e-031
   MN              DOUBLE      1.6749273509999999e-027
   MP              DOUBLE      1.6726217770000001e-027
   MU0             DOUBLE      1.2566370613999999e-006
   N0              DOUBLE      2.6867805000000001e+025
   NA              DOUBLE      6.0221412899999997e+023
   P0              DOUBLE          101325.00000000000
   PHI             DOUBLE          1.6180339887498949
   PI              DOUBLE          3.1415926535897931
   R               DOUBLE          8.3144621000000001
```

R_EARTH DOUBLE 6378136.5999999996
RTOD DOUBLE 57.295779513082323
RE DOUBLE 2.8179403267000001e-015
RYDBERG DOUBLE 10973731.568538999
SIGMA DOUBLE 5.6703730000000003e-008
T0 DOUBLE 273.14999999999998
U DOUBLE 1.6605389209999998e-027
VM DOUBLE 0.022413967999999999

Comments or suggestions?

-Chris
p.s. some of the "9's" on the ends of the numbers are just due to the finite precision of double-precision numbers. For example, in the C code, T0 really is defined as 273.15.
p.p.s. Happy Holidays!

Subject: Re: Physical constants in IDL with !CONST
Posted by Jeremy Bailin on Mon, 24 Dec 2012 04:21:04 GMT
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On 12/18/12 5:34 PM, Chris Torrence wrote:
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> 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
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> 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.
>

Just checking against astroconst (good lord, is it really over 10 years
since I updated the public version?????), all of the ones that aren't
there or haven't already been mentioned are probably too astronomy-specific.

I would much prefer !CONST over !C. I just grepped my code directories
and found one case of !C in there, from my first 2 months of using IDL.
Think of how many cases of () subscripts you see from time to time, and
take pity on people who have code still around from before they learned
to be half-decent IDL programmers!

-Jeremy.

Subject: Re: Physical constants in IDL with !CONST
Posted by on Mon, 24 Dec 2012 09:37:32 GMT
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Den tisdagen den 18:e december 2012 kl. 23:34:53 UTC+1 skrev Chris Torrence:
> 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
>
```

>
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> 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.
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> 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.

I suggest !const.xmase=1224 and !const.xmasd=1225.

Subject: Re: Physical constants in IDL with !CONST
Posted by vlk.astro on Wed, 26 Dec 2012 20:31:15 GMT
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Here are some more (excluding the ones already in your list, and excluding some -- like Bode's distances -- which are clearly only of specialized interest) that I have found to be useful from time to time (I have been collecting them in http://hea-www.harvard.edu/PINTofALE/pro/util/inicon.pro). Some of these are probably too esoteric still (e.g., not many people want to convert from Angstrom to keV), but who knows.

```
ESU        4.8030000e-10       electron charge [ESU]
KB         1.3806620e-16       Boltzmann's constant [erg/K]
A          7.5656559e-15       Radiation Pressure constant [erg/cm^3/deg^4]
WEIN         0.28978000        Wein Displacement Law constant [cm K]
ATM           1013250.0        1 Atmosphere [dynes/cm^2]
KEVANG         12.398521       keV*Ang (1e8*h*c/(e*1e10))
EVWAV      0.00012379700        1 eV in wave numbers [/cm]
DEGEV      8.6173468e-05        1 deg K in eV [eV] (K*degev/1e3->keV)
JOULEV     1.6021892e-19        1 eV in Joule = Coulomb*meter [J]
ERGEV      1.6021892e-12        1 eV in ergs [erg]
THOMPSON         6.65246e-25   Thompson cross-section for electron [cm^2]
COMPTON      0.024263026        Compton wavelength for electron, h/mc [Angstrom]
RADIAN         206264.81        1 radian [arcsec]
ARCSR      2.3504431e-11        1 arcsec^2 in steradians [sr]
PI      3.14159265358979323846  PI to 20 decimals
```

GAMMA 0.57721566 Euler's constant, gamma
RYD 13.577755 Rydberg Constant for H [eV]
RBOHR 5.2922910e-09 Bohr Radius [cm]
DAY 86636.6 mean solar day [sec]
YEAR 31643326. Equinoctial Year [sec]
YR 31644553. Sidereal Year [sec]
PC 3.0926963e+18 1 parsec [cm]
LY 9.4867984e+17 1 Light Year [cm]
AU 1.4959787e+13 Astronomical Unit [cm]
MSUN 1.9890000e+33 Mass of Sun [gm]
LSUN 3.8260000e+33 Luminosity of Sun [erg/s]
RSUN 6.96900e+10 Radius of Sun [cm]
TSUN 5770.00 Effective Temperature of Sun [K]
PSUN 25.3800 Rotational period of Sun [day]
MJUP 1.8986000e+30 Mass of Jupiter [gm]
RJUP 6.99110e+09 volumetric radius of Jupiter at 1 bar [cm]
MGEO 5.9720000e+27 Mass of Earth [gm]
MMOON 7.3429237e+25 Mass of Moon [gm]
RMOON 1737.90 Radius of Moon [km]
DMOON 384404. mean distance of Moon from Earth [km]

Cheers,
VLK

On Tuesday, December 18, 2012 5:34:53 PM UTC-5, Chris Torrence wrote:
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