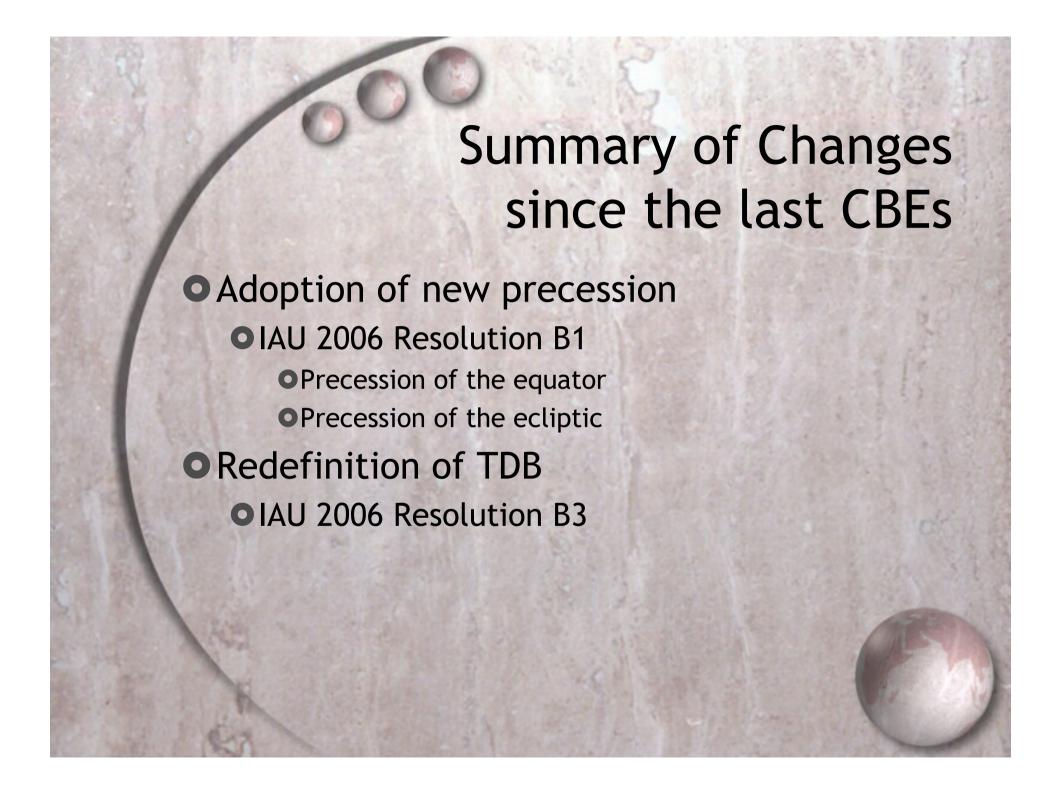


Brian Luzum, Nicole Capitaine, Agnes Fienga, William Folkner, Toshio Fukushima, James Hilton, Catherine Hohenkerk, George Krasinsky, Gérard Petit, Elena Pitjeva, Michael Soffel, Patrick Wallace

Brief History

- First Sub-group on Numerical Standards of the IAU
 WG on Astronomical Standards
 - Headed by M. Standish
 - Established many of the rules
 - Two-tiered approach to constants
 - Created the first list of Current Best Estimates (CBEs)
- IAU WG on Astronomical Standards
 - Chaired by T. Fukushima
 - Much of the work concentrated on constants in a general relativistic framework and the changes in the nutation models
 - Created a revised list of CBEs



WG Numerical Standards of Fundamental Astronomy

- Goals
 - OUpdate "IAU Current Best Estimates"
 - Conformal with IAU Resolutions/IERS
 Conventions/SI
- Members

N. Capitaine

A. Fienga

W. Folkner

T. Fukushima

J. Hilton

C. Hohenkerk

G. Krasinsky

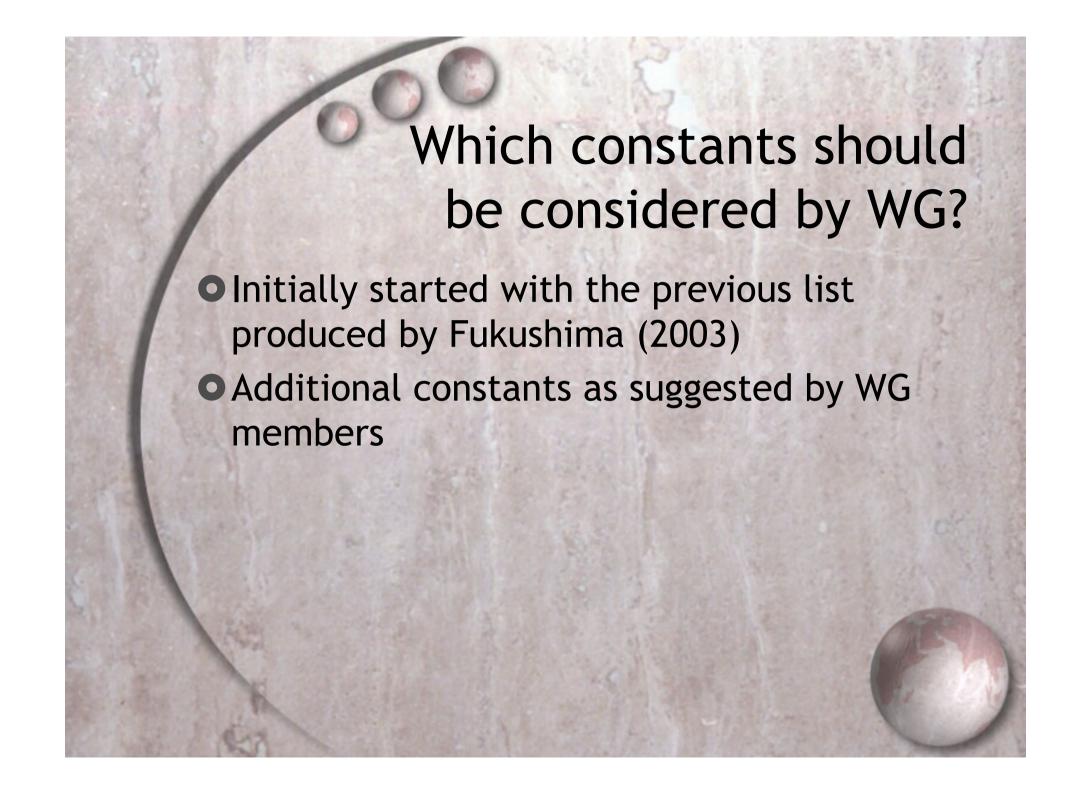
B. Luzum

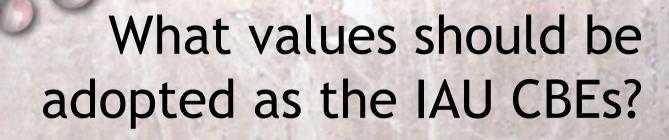
G. Petit

E. Pitjeva

M. Soffel

P. Wallace





- Initially started with the previous list produced by Fukushima (2003)
- Numerical values as suggested by WG members
- What level of accuracy is required?
 - Best possible accuracy



- Natural Defining Constants
 - OC

- Natural MeasurableConstants
 - OG

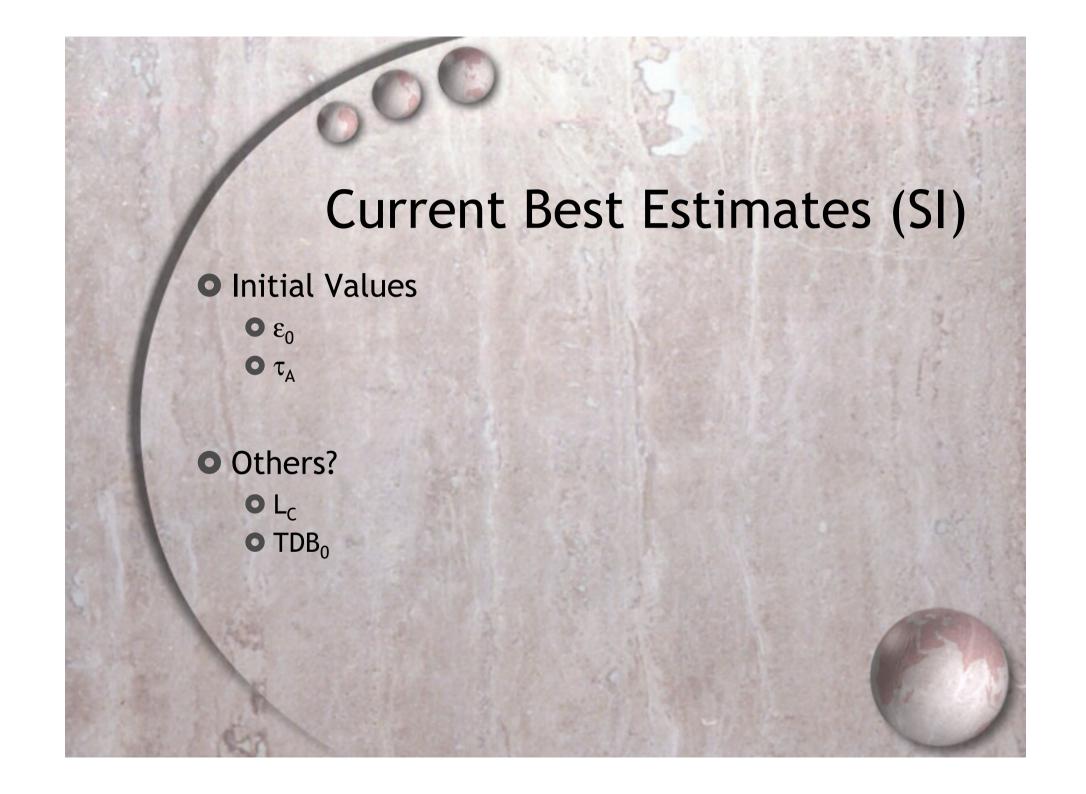
- Auxiliary Defining Constants
 - OK
 - OLG
 - OLB

Body Constants

- O M_M/M_F
- OM_S/M_{Me}
- O Ms/Mv
- O M_S/M_{ma}
- OM_S/M_J
- O M_S/M_{Sa}
- O M_S/M_U

- O M_S/M_N
- O M_S/M_P
- M_S/M_{Eris}
- M_{Ceres}/M_S
- M_{Pallas}/M_S
- M_{Vesta}/M_S

- o a_e
- 0 J₂
- O GME
- O Wo
- ο ω
- Ψ_{J2000}



What mechanism should be adopted to keep the CBEs current?

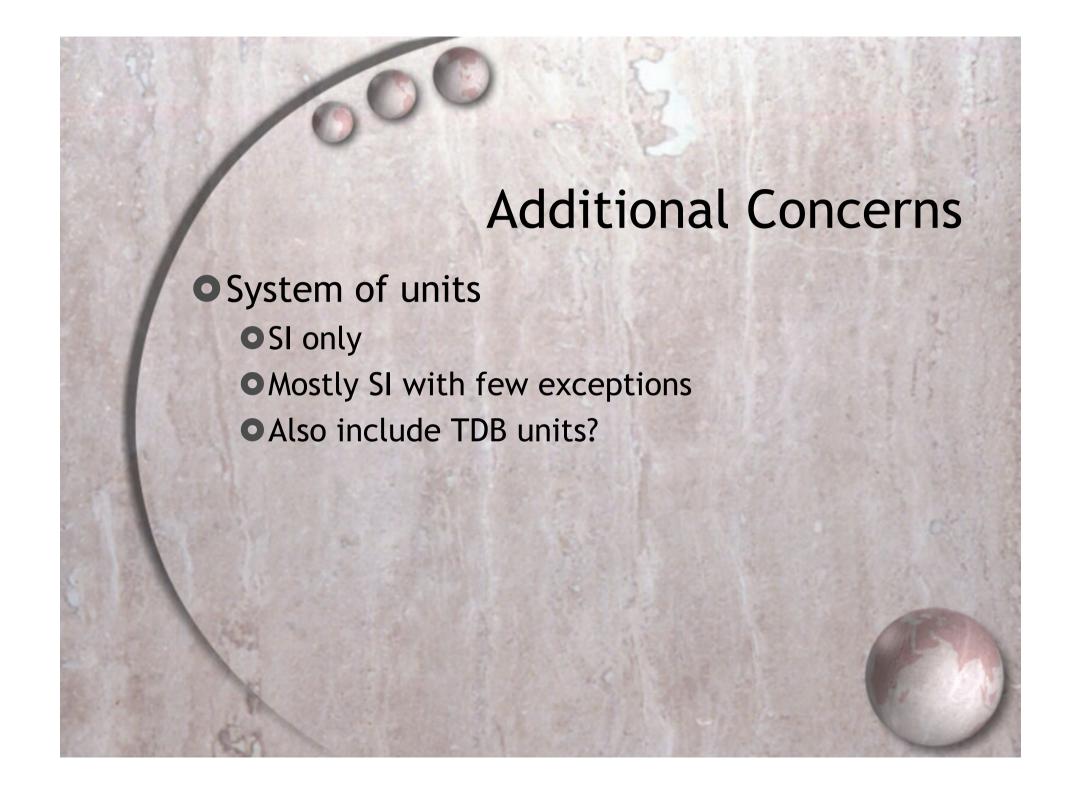
- Options
 - When appropriate, IAU forms WG to update the CBEs
 - Enlist the aid of the IERS Conventions
 - Mechanism already in place
 - •Serves slightly different users Is this a problem?
 - Provide lesser accuracy to ensure longer "shelf life"
 - Requires users with the highest accuracy requirements to have access and know where to look for high accuracy estimates

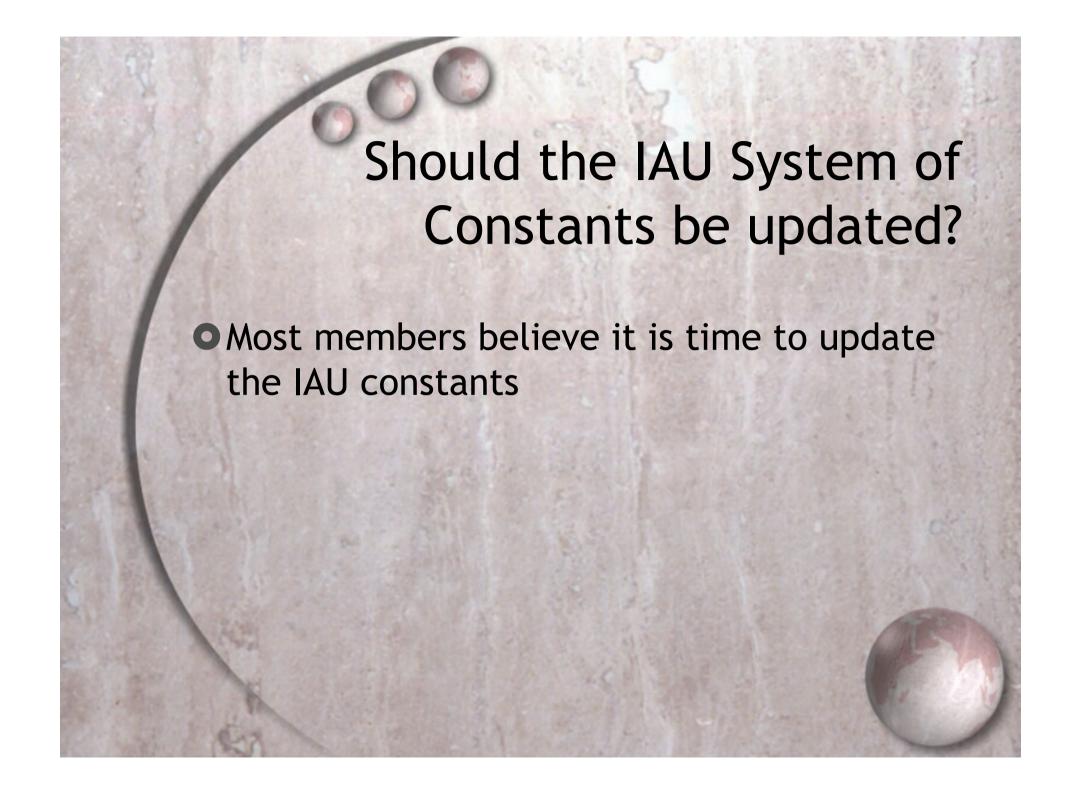
Link between Theory and Constants

- Meaning of constants is ambiguous (at best) without carefully defined theoretical context
- What are the implications for the WG?
 - Concerns about consistency
 - Concerns about documentation
- What are the solutions?
 - How to provide unambiguous documentation?

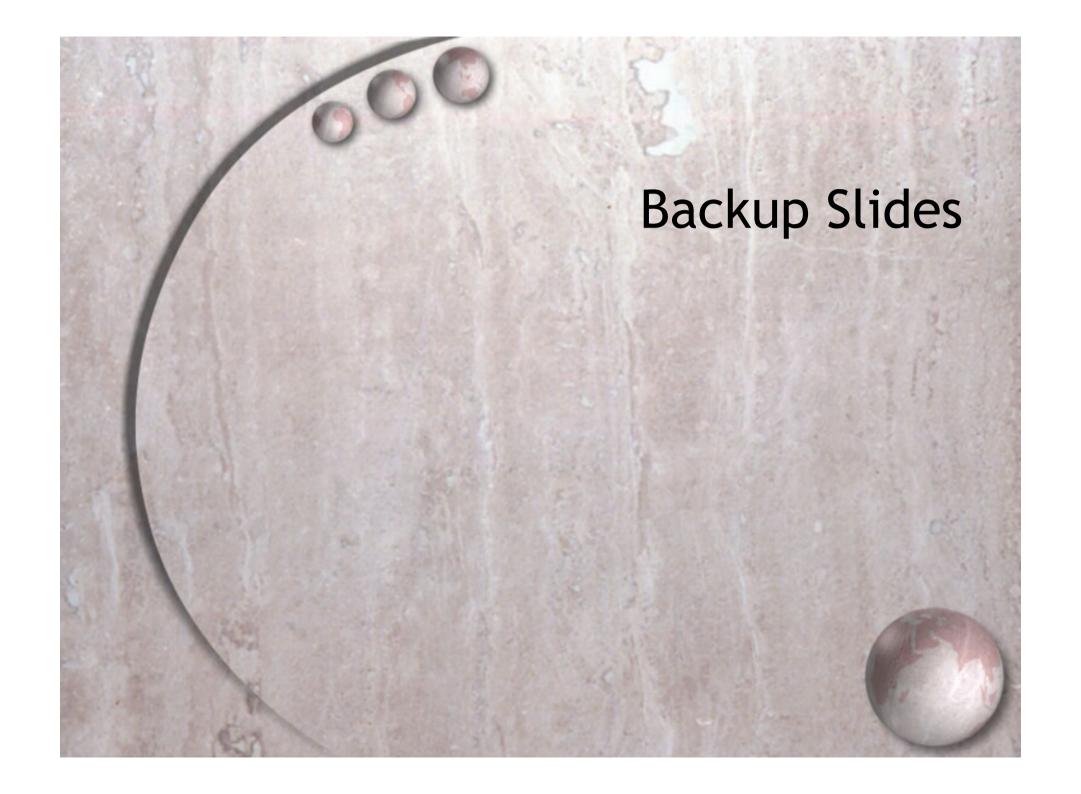
What is the role of electronic information in CBEs?

- Used as primary source of information
 - Provide web page of constants and documentation on models?
 - Provide links to pages of constants and documentation on models?
- Used as supplemental information
 - Provide links to additional pages









Constant	Value	Reference	Adopted
Natural Defining Constants			
С	2.997 924 58 x 10 ⁸ [ms ⁻¹]	CODATA 2006	IERS
Natural Measurable Constants			
G	6.674 28(67) x 10 ⁻¹¹ [m ³ kg ⁻¹ s ⁻²]	CODATA 2006	
Auxiliary Defining Constants			
k	1.720 209 895 x 10 ⁻²	IAU 1976	IAU
L _G	6.969 290 134 x 10 ⁻¹⁰	IAU Resolution /Petit 2000	IAU, IERS
L _B	1.550 519 768 x 10 ⁻⁸	IAU Resolution	IAU, IERS

Constant	Value	Reference	Adopted
Body Constants			
M _M /M _E	1.230 003 71(4) x 10 ⁻²	Standish 2007	
M _S /M _{Me}	6.023 6(3) x 10 ⁶	Anderson et al. (1987)	
M _S /M _V	4.085 237 19(8) x 10 ⁵	Konopliv et al. (1999)	
M _S /M _{Ma}	3.098 703 59(2) x 10 ⁶	Konopliv et al. (2006)	
M _S /M _J	1.047 348 625(17) x 10 ³	Jacobson (2003)	
M _S /M _{Sa}	3.497 901 8(1) x 10 ³	Jacobson et al. (2006)	

Constant	Value	Reference	Adopted
Body Constants			
M_M/M_U	2.290 298(3) x 10 ⁴	Jacobson et al. (1992)	IERS
M_S/M_N	1.941 224(4) x 10 ⁴	Jacobson et al. (1991)	IERS
M _S /M _P	1.365 78(39) x 10 ⁸	Tholen et al. (2007)	
M _S /M _{Eris}	1.191(14) x 10 ⁸	Brown and Schaller (2007)	
M _{Ceres} /M _S	4.72(3) x 10 ⁻¹⁰	Pitjeva and Standish (2007)	
M _{Pallas} /M _S	1.03(2) x 10 ⁻¹⁰	Pitjeva and Standish (2007)	
M _{Vesta} /M _S	1.35(2) x 10 ⁻¹⁰	Pitjeva and Standish (2007)	

Constant	Value	Reference	Adopted	
	Body Constants			
a _e	6.378 136 6(1) x 10 ⁶ [m]	Groten (2000)	IERS	
	1.082 635 9(1) x 10 ⁻³	Groten (2000)	IERS	
GM _E	3.986 004 418(8) x 10 ¹⁴ [m ³ s ⁻²]	Groten (2000)	IERS	
W ₀	6.263 685 60(5) x 10 ⁸ [m ² s ⁻²]	Groten (2000)	IERS	
ω	7.292 115(variable) x 10 ⁻¹¹ [rad s ⁻¹]	Groten (2000)	IERS	
Ψ _{J2000}	5.038 481 507 x 10 ³ ["/cy]	Hilton et al. (2006)	IAU	

	THE RESERVE OF THE PARTY OF THE	CE COLUMN TO THE PROPERTY OF THE PARTY OF TH	THE PERSON NAMED IN COLUMN	
Constant	Value	Reference	Adopted	
	Initial Values at J2000.0			
ϵ_0	8.438 140 6 x 10 ⁴ ["]	Hilton et al. (2006)	IAU	
τ_{A}	4.990 047 838 26 (10) x 10 ² [s]	Pitjeva and Standish (2007)		
Others				
L _C	1.480 826 867 4(14) x 10 ⁻⁸	Irwin and Fukushima (1999)	IAU, IERS	
TDB ₀	-6.55 x 10 ⁻⁵			