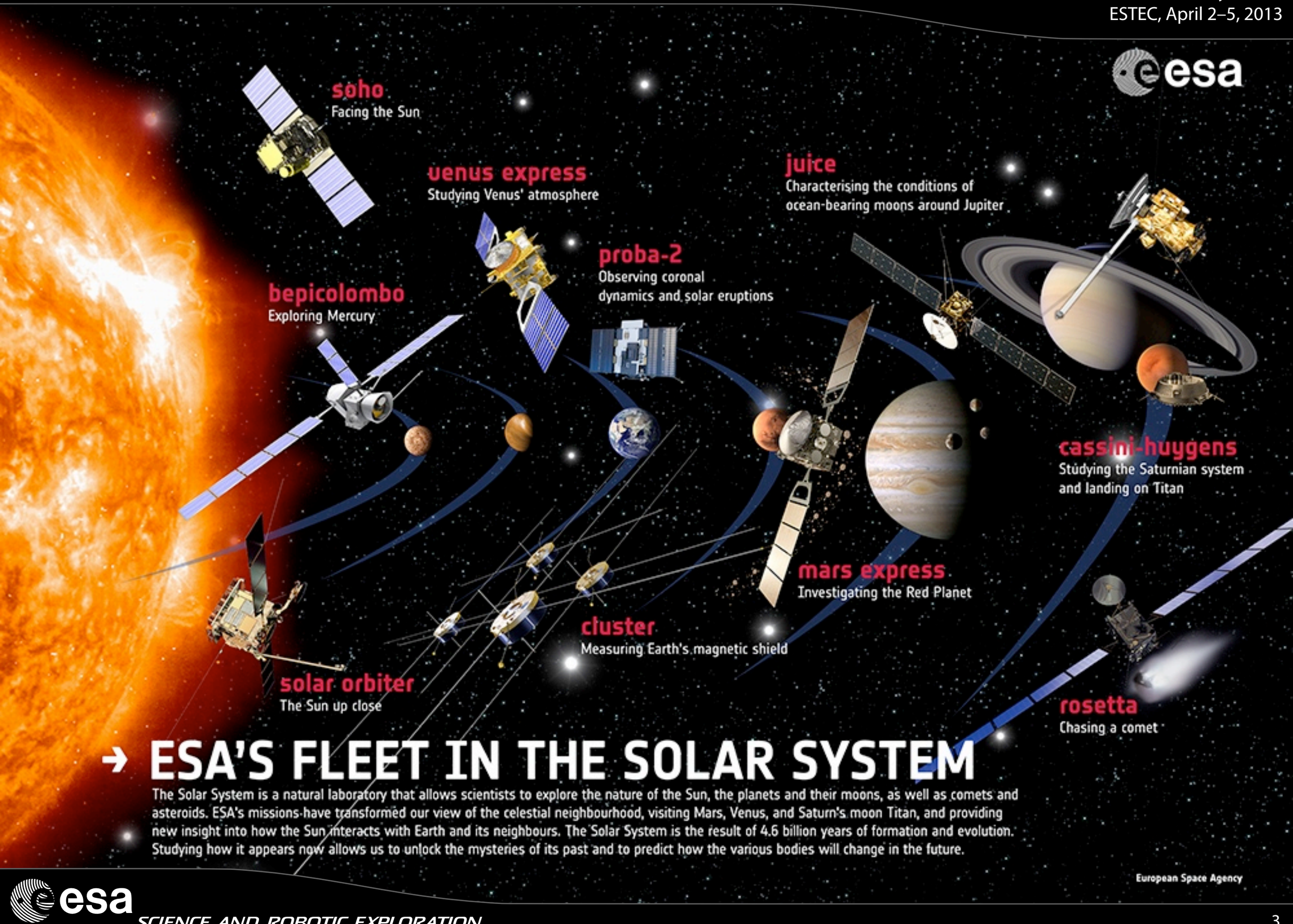
47th ESLAB Symposium

The Universe as seen by Planck

Mark McCaughrean
Research & Scientific Support Department
European Space Agency, ESTEC

ESLAB in Noordwijkerhout 1966

ESA


esa
soho
Facing the Sun
venus express
Studying Venus' atmosphere
proba-2
Observing coronal
dynamics and solar eruptions
bepicolombo
Exploring Mercury
juice
Characterising the conditions of
ocean-bearing moons around Jupiter
cassini-huygens
Studying the Saturnian system
and landing on Titan
mars express
Investigating the Red Planet
cluster
Measuring Earth's magnetic shield
solar orbiter
The Sun up close
rosetta
Chasing a comet
→ ESA'S FLEET IN THE SOLAR SYSTEM
The Solar System is a natural laboratory that allows scientists to explore the nature of the Sun, the planets and their moons, as well as comets and asteroids. ESA's missions have transformed our view of the celestial neighbourhood, visiting Mars, Venus, and Saturn's moon Titan, and providing new insight into how the Sun interacts with Earth and its neighbours. The Solar System is the result of 4.6 billion years of formation and evolution. Studying how it appears now allows us to unlock the mysteries of its past and to predict how the various bodies will change in the future.
European Space Agency

→ ESA'S FLEET ACROSS THE SPECTRUM

esa

Thanks to cutting edge technology, astronomy is unveiling a new world around us. With ESA's fleet of spacecraft, we can explore the full spectrum of light and probe the fundamental physics that underlies our entire Universe. From cool and dusty star formation revealed only at infrared wavelengths, to hot and violent high-energy phenomena, ESA missions are charting our cosmos and even looking back to the dawn of time to discover more about our place in space.

gaia
Surveying a billion stars

herschel
Unveiling the cool and dusty Universe

jwst
Observing the first light

planck
Looking back at the dawn of time

euclid
Probing dark matter, dark energy and the expanding Universe

hst
Expanding the frontiers of the visible Universe

xmm-newton
Seeing deeply into the hot and violent Universe

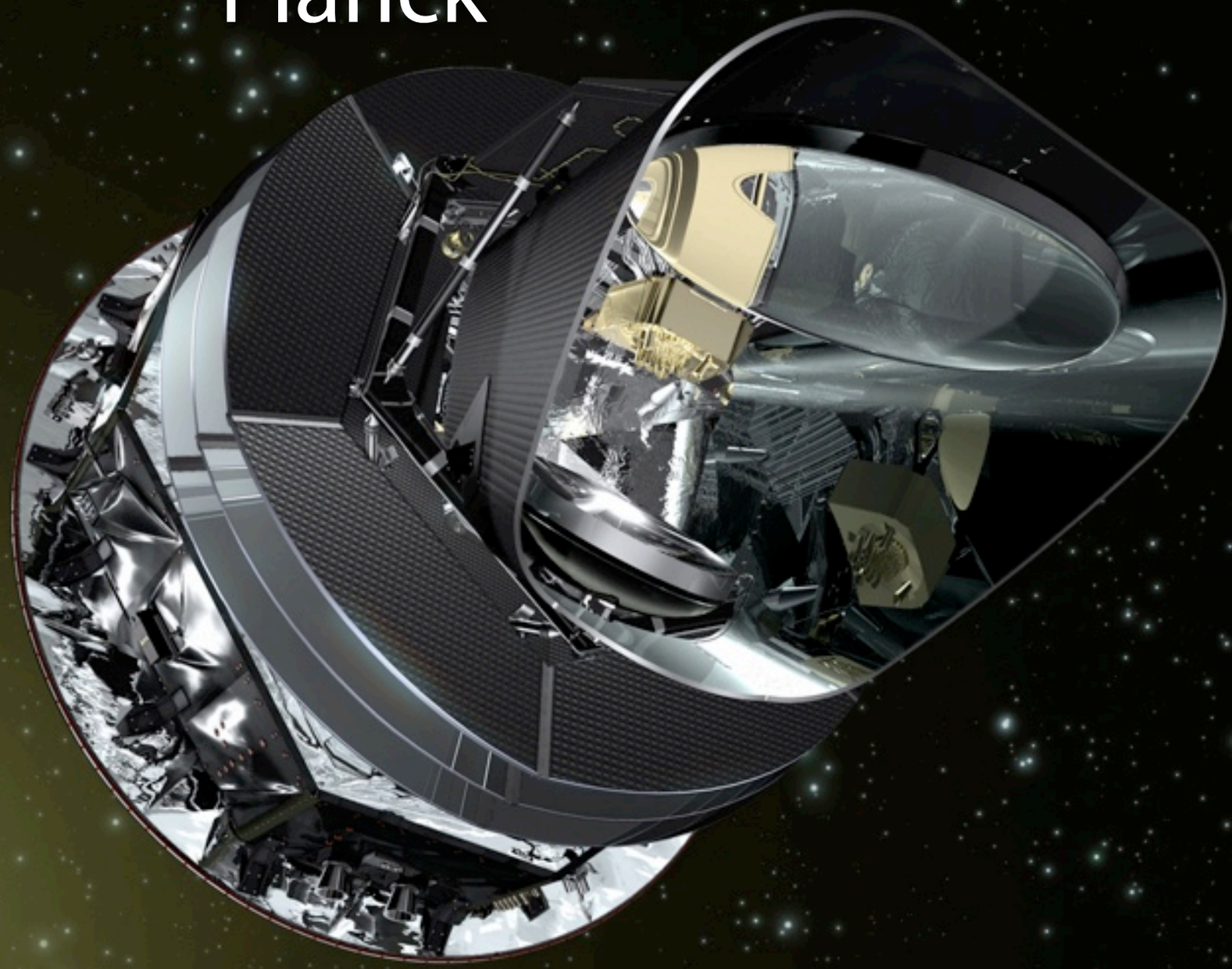
lisa pathfinder
Testing the technology for gravitational wave detection

integral
Seeking out the extremes of the Universe

microwaves
sub-millimetre
infrared
optical
ultraviolet
x-rays
gamma rays

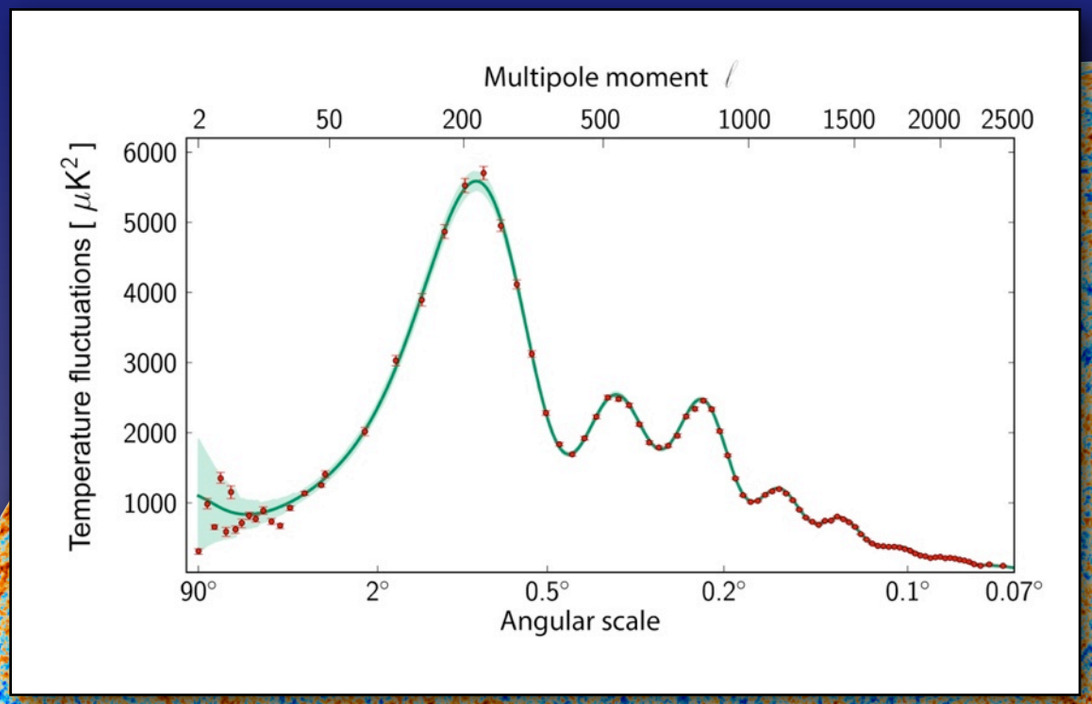
European Space Agency

Planck



ESA cosmic microwave background experiment, launched 2009

Planck's Cosmic Microwave Background



ESA and the Planck Collaboration

Through the Looking Glass: Chapter V

"I'm seven and a half exactly."

"You needn't say 'exactually,'" the Queen remarked: "I can believe it without that. Now I'll give *you* something to believe. I'm just one hundred and one, five months and a day."

"I can't believe *that!*" said Alice.

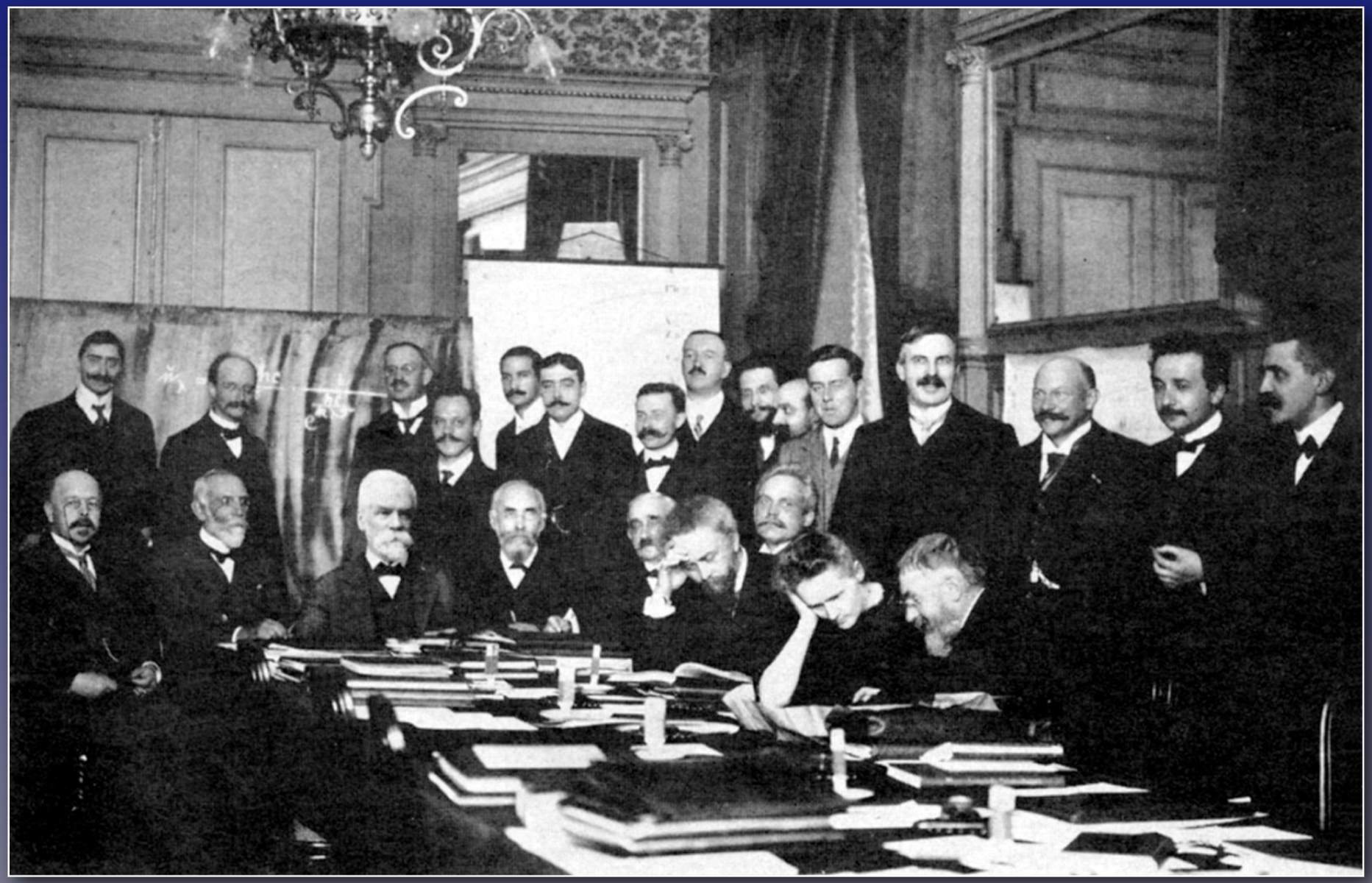
"Can't you?" the Queen said in a pitying tone. "Try again: draw a long breath, and shut your eyes."

Alice laughed. "There's no use trying," she said: "one *can't* believe impossible things."

"I daresay you haven't had much practice," said the Queen. "When I was your age, I always did it for half-an-hour a day. Why, sometimes I've believed as many as six impossible things before breakfast."

Lewis Carroll: "Through the Looking Glass and What Alice Found There" (1871) / Illustration: Sir John Tenniel

First Solvay Conference in 1911

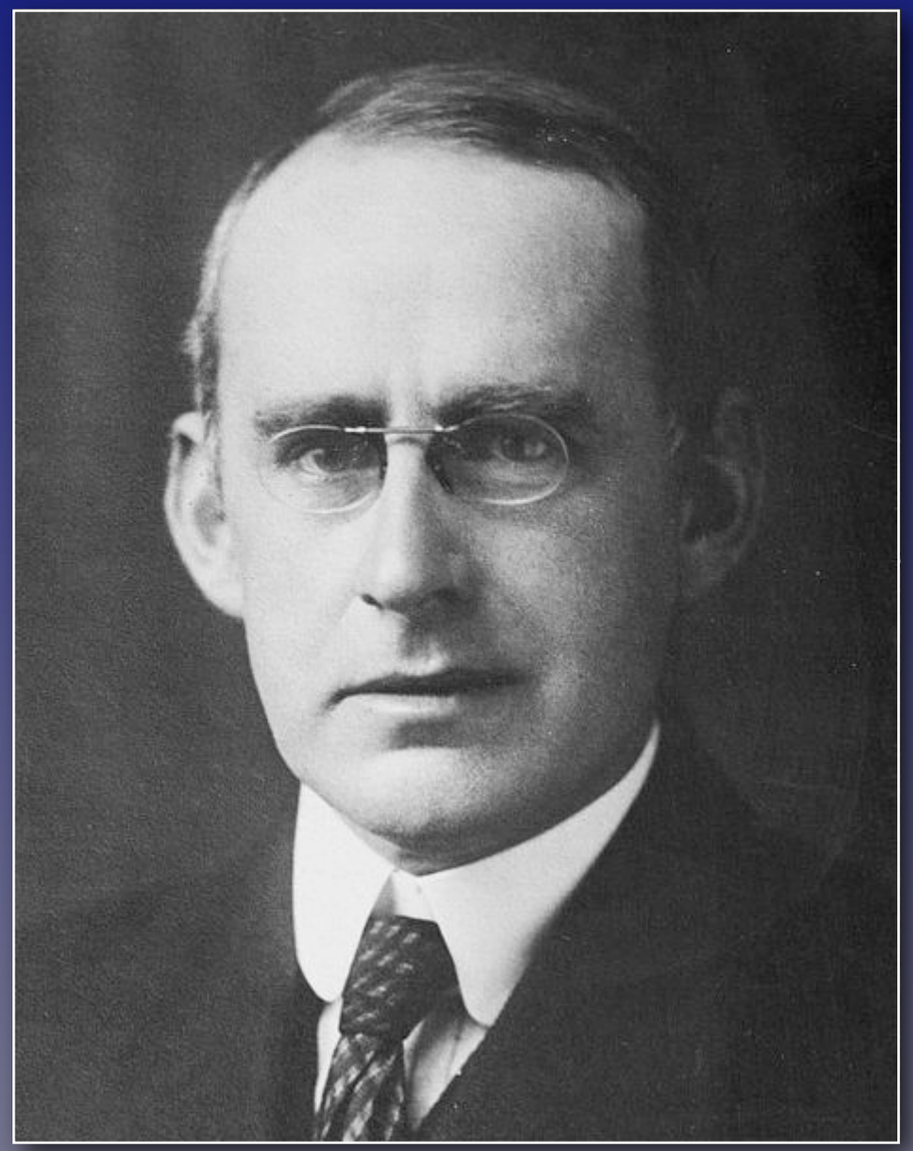


One hundred and one years, five months, and one day ago today

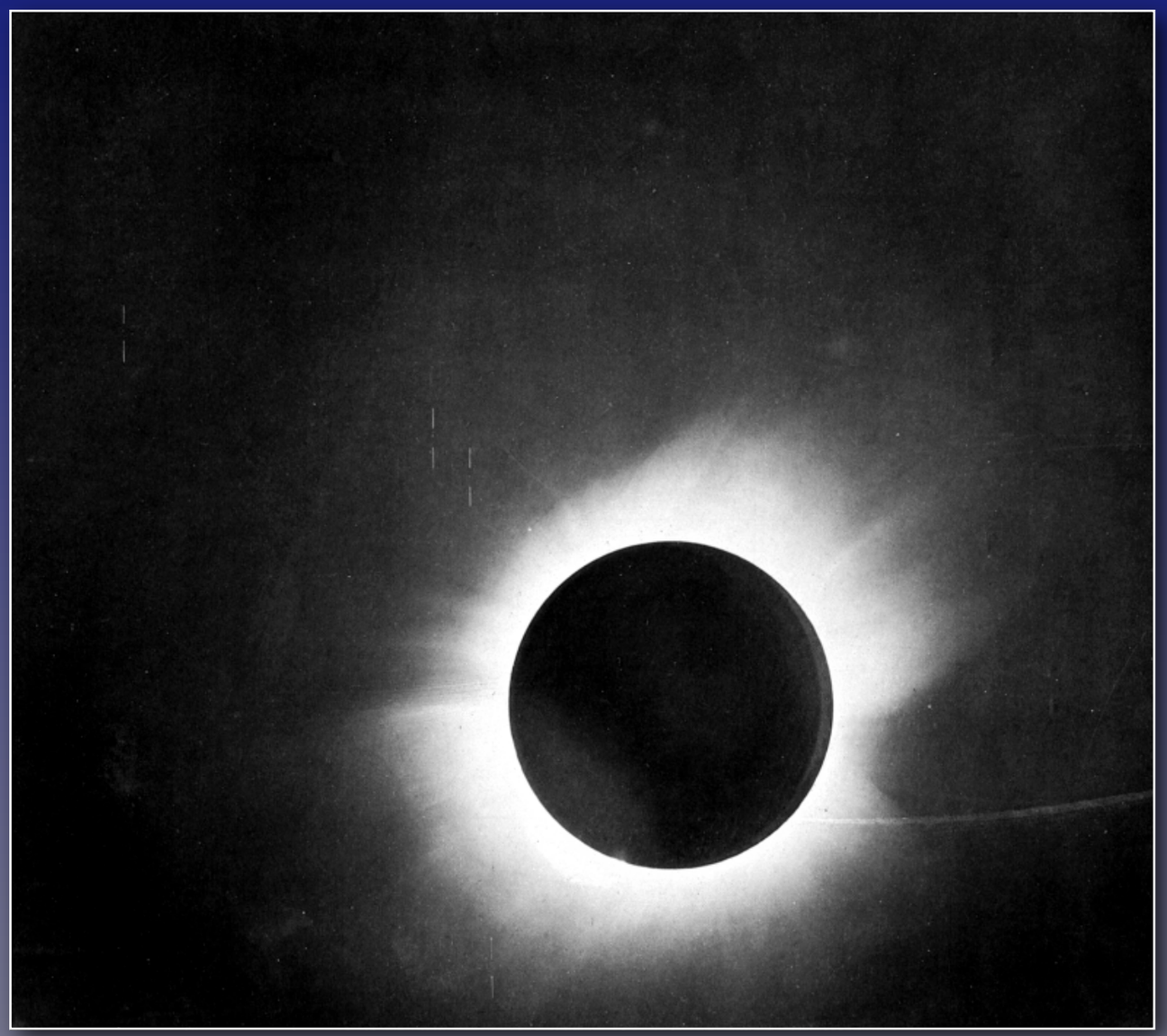
Standing L–R: Goldschmidt, Planck, Rubens, Sommerfeld, Lindemann, de Broglie, Knudsen, Hasenöhrl, Hostelet, Herzen, Jeans, Rutherford, Onnes, Einstein, Langevin Seated L–R: Nernst, Brillouin, Solvay, Lorentz, Warburg, Perrin, Wien, Curie, Poincaré

Photograph: Benjamin Couprie, via Wikipedia

Proving General Relativity

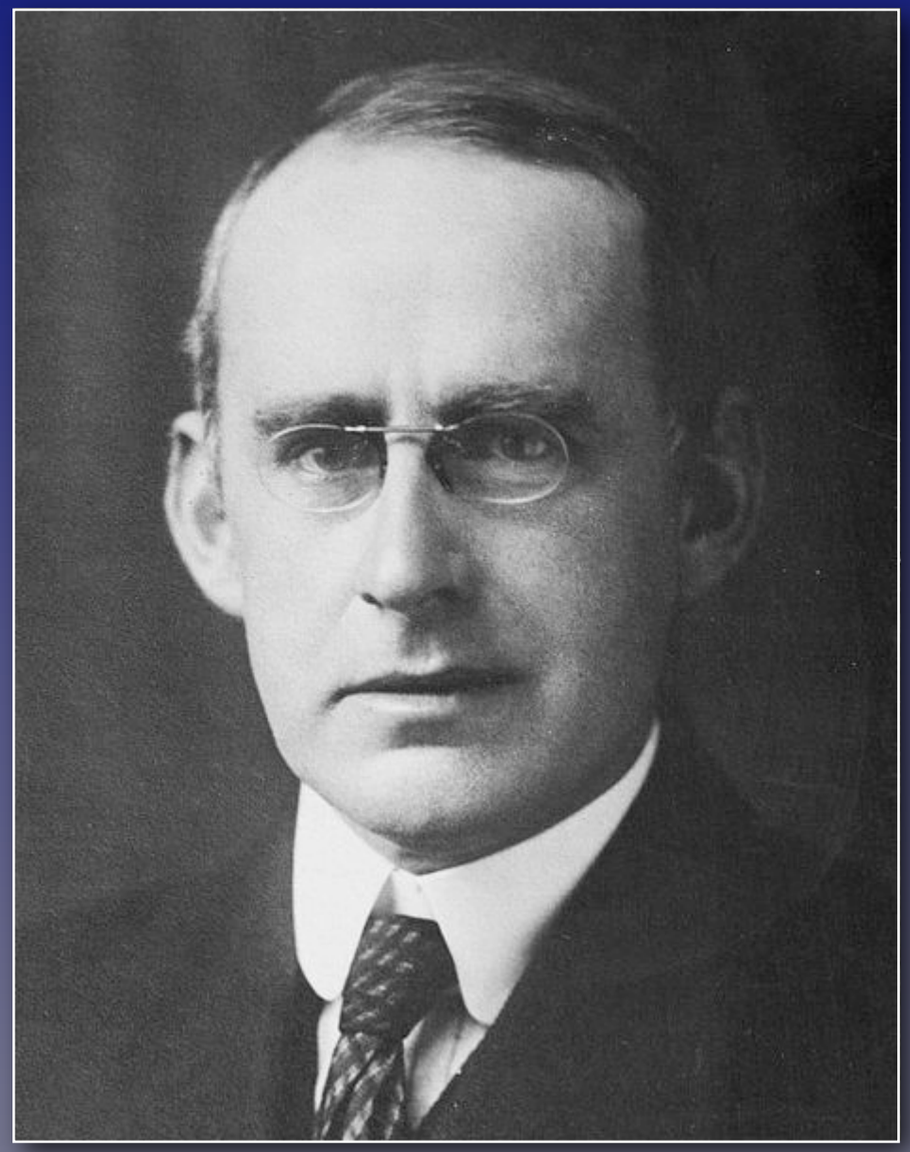


Sir Arthur Eddington

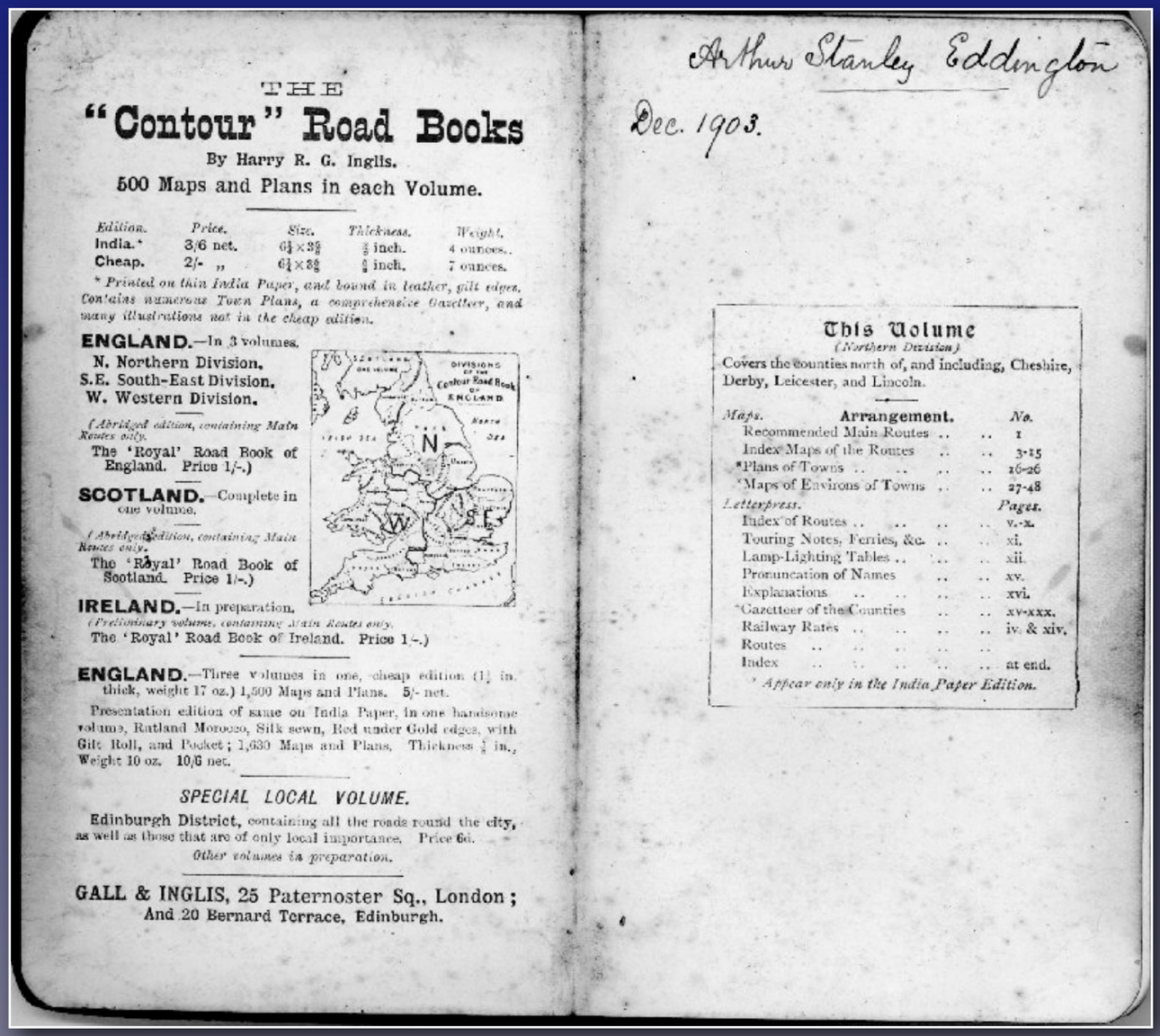


The total solar eclipse of 1919

Eddington and the E-number



Sir Arthur Eddington



THE
"Contour" Road Books
By Harry R. G. Inglis.
500 Maps and Plans in each Volume.

Edition.	Price.	Size.	Thickness.	Weight.
India.*	3/6 net.	6¼×3⅝	⅝ inch.	4 ounces.
Cheap.	2/- „	6¼×3⅝	⅝ inch.	7 ounces.

* Printed on thin India Paper, and bound in leather, gilt edges. Contains numerous Town Plans, a comprehensive Gazetteer, and many illustrations not in the cheap edition.

ENGLAND.—In 3 volumes.
N. Northern Division.
S.E. South-East Division.
W. Western Division.
(Abridged edition, containing Main Routes only.
The 'Royal' Road Book of England. Price 1/-.)

SCOTLAND.—Complete in one volume.
(Abridged edition, containing Main Routes only.
The 'Royal' Road Book of Scotland. Price 1/-.)

IRELAND.—In preparation.
(Preliminary volume, containing Main Routes only.
The 'Royal' Road Book of Ireland. Price 1/-.)

ENGLAND.—Three volumes in one, cheap edition (1¼ in. thick, weight 17 oz.) 1,500 Maps and Plans. 5/- net.

Presentation edition of same on India Paper, in one handsome volume, Ratland Morocco, Silk sewn, Red under Gold edges, with Gilt Roll, and Pocket; 1,630 Maps and Plans. Thickness ¾ in., Weight 10 oz. 10/6 net.

SPECIAL LOCAL VOLUME.

Edinburgh District, containing all the roads round the city, as well as those that are of only local importance. Price 6d.

Other volumes in preparation.

GALL & INGLIS, 25 Paternoster Sq., London;
And 20 Bernard Terrace, Edinburgh.

Arthur Stanley Eddington

Dec. 1903.

This Volume
(Northern Division)
Covers the counties north of, and including, Cheshire, Derby, Leicester, and Lincoln.

Maps. Arrangement.	No.
Recommended Main Routes	1
Index Maps of the Routes	3-15
*Plans of Towns	16-26
*Maps of Environs of Towns	27-48
Letterpress.	*Pages.*
Index of Routes	v.-x.
Touring Notes, Ferries, &c.	xi.
Lamp-Lighting Tables	xii.
Pronunciation of Names	xv.
Explanations	xvi.
*Gazetteer of the Counties	xv-xxx.
Railway Rates	iv. & xiv.
Routes	
Index	at end.

* *Appear only in the India Paper Edition.*

One of Eddington's original cycling guides

E is the number of days a cyclist has cycled more than E miles

Eddington's final E was 84; mine since May 2011 is only 25: must try harder!

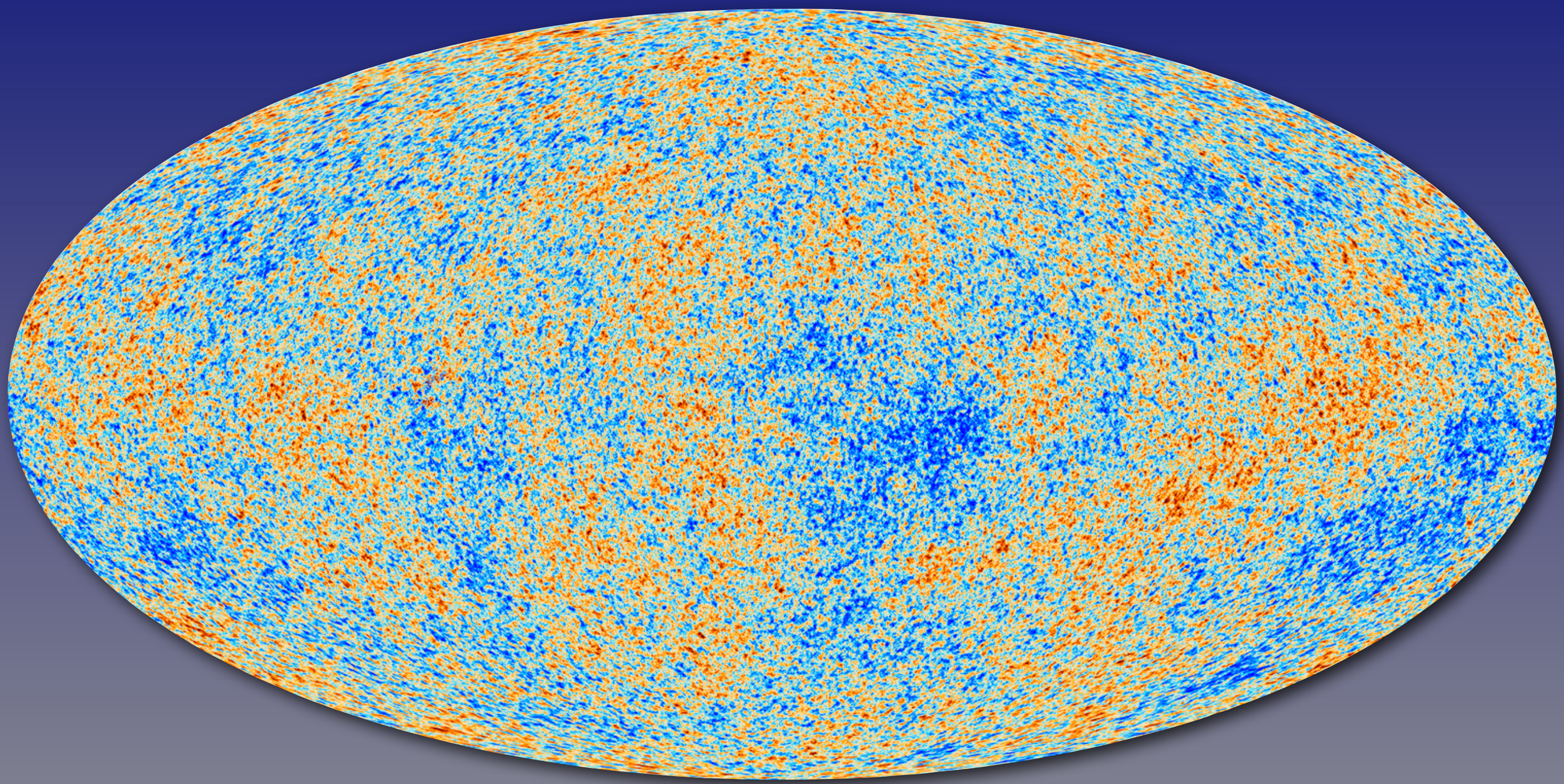
Courtesy John Butler, whose parents moved into Eddington's house in Cambridge

What was Einstein's E-number?

(His h-index is 97, according to Google Scholar)

Albert Einstein in front Ben Meyer's house in Santa Barbara, 1933 / Leo Baeck Institute archives

Planck's first all-sky CMB image

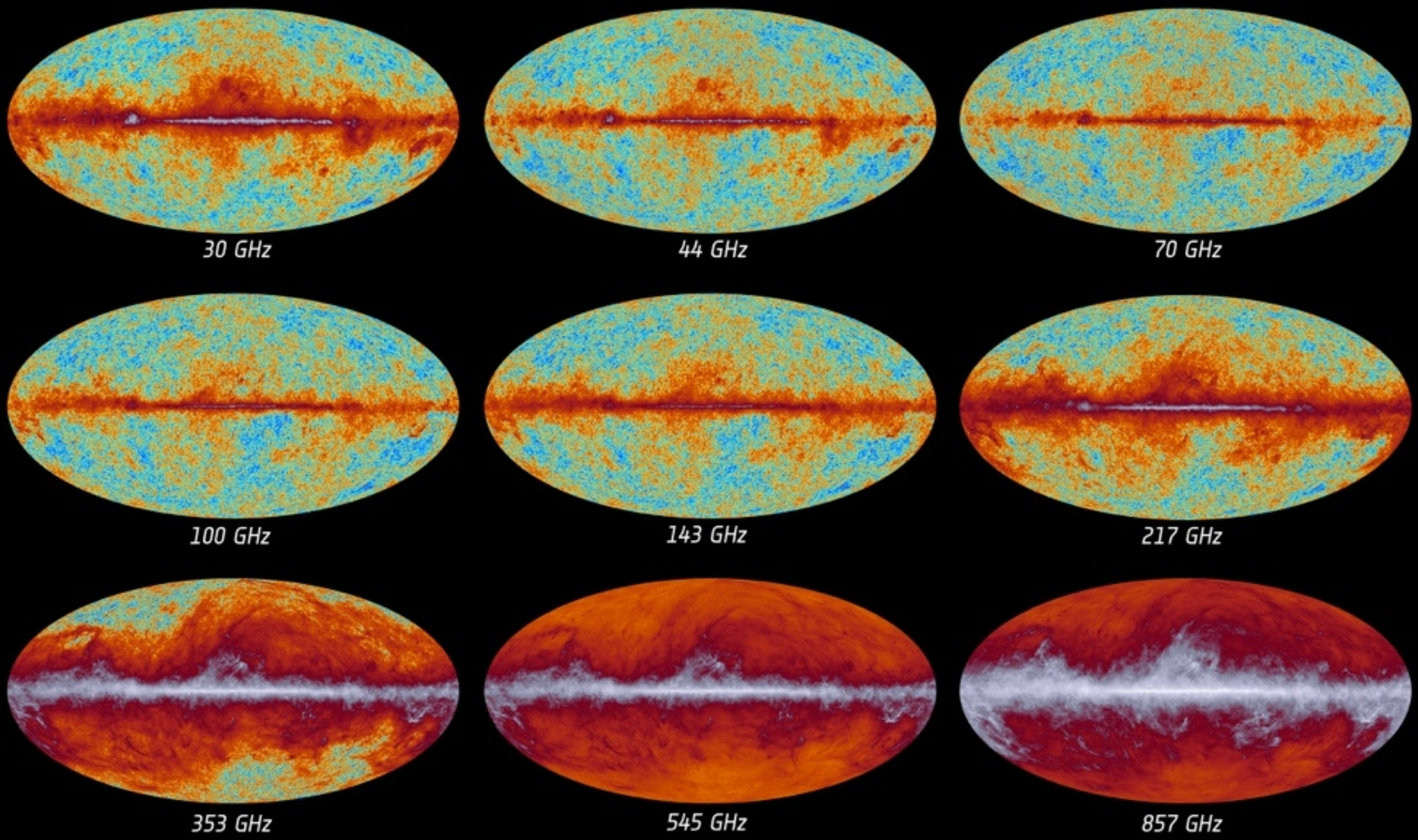


ESA and the Planck Collaboration

planck

The sky as seen by Planck

esa



Welcome ...