Particle discovery: the 4th wave

Paolo Palazzi - *pp@particlez.org*
http://particlez.org

FFP9, Udine, 9 January 2008

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Rumsfeld Hadrons

F.E.Close
Rudolf Peierls Centre for Theoretical Physics; University of Oxford; Oxford OX1 3NP; England

Donald Rumsfeld, in attempting to excuse the inexcusable, once (in)famously said that "there are things that we know we know; there are things that we know we don't know; and then there are things that we don't know that we don't know". Recent discoveries about hadrons with heavy flavours fall into those categories. It is of course the third category that is the most tantalising, but lessons from the first two may help resolve the third.

I. THINGS THAT WE KNOW WE KNOW

We have heard reported observation of the B_c with mass $m(B_c) = 6276.5 \pm 4.0 \pm 2.7$MeV and comparison of its mass with predictions from various models and lattice QCD[1]. Not everything is mysterious. Compare this lightest $b\bar{c}$ with $(m(\psi) + m(\Upsilon))/2 = 6278.6$. They agree to better than a part per mille. This illustrates how apparent agreements with the mass are driven by the large intrinsic mass scales of the b and c and that yet again the mass scales of hadrons are phenomenologically rather straightforward. The interesting dynamics will come when excitations of the $b\bar{c}$ are found.

A more profound testing of QCD effects has come from the discovery of Σ_b and Σ_b^* at CDF[2]. The chromomagnetic splittings between baryons were predicted thirty years ago[3]. The $\Delta - N$ splitting of

$$M(D_{sJ}(2860)) = 2856.6 \pm 1.5 \pm 5.0 \text{ Mev} \quad (1)$$

and the width is

Γ(

There is r
decay mo
more, stru
that yields

M

and

$$\Gamma(D_{sJ}(2690)) = 112 \pm 7 \pm 36 \text{ MeV}. \quad (4)$$

The state $D_s(2690)$ has the characteristics of a vector and is consistent with being the $2S(^3S_1)$ or pos-

Rumsfeld hadrons:

1. known knowns
2. known unknowns
3. unknown unknowns

Fermilab *Today*

Wednesday, December 19, 2007

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Calendar

Wednesday, Dec. 19
THERE WILL BE NO FERMILAB ILC R&D MEETING THIS WEEK
3:30 p.m.
DIRECTOR'S COFFEE BREAK - 2nd Flr X-Over
4 p.m.
Fermilab Colloquium - One West
Speaker: R. Barry, University of Colorado, Boulder
Title: The Role of Snow and Ice in the Climate System

Thursday, Dec. 20
11 a.m.
All Hands meeting -

In the News

Federal budget impact on Fermilab and HEP

Editor's note: The FY08 federal budget, which is expected to pass later this week, eliminates $90 million in funding for High Energy Physics. As outlined in Tuesday's Director's Corner, the diminished funds will have a powerful impact on Fermilab

Included in the budget cuts are funding for R&D on the International Linear Collider and the R&D on Super Conducting Radio Frequency as well as funding for NOvA. More information on the cuts and their impact will be discussed at the All Hands meeting Thursday morning at 11 a.m. in Ramsey Auditorium

From the Business Services Section

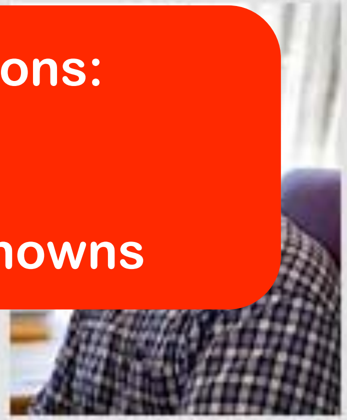
To prevent accidents: ask why

Today's column is written by Randy Ortgiesen, head of the Facilities Engineering Services Section.

Rumsfeld leptons:

...
4. unknown knowns

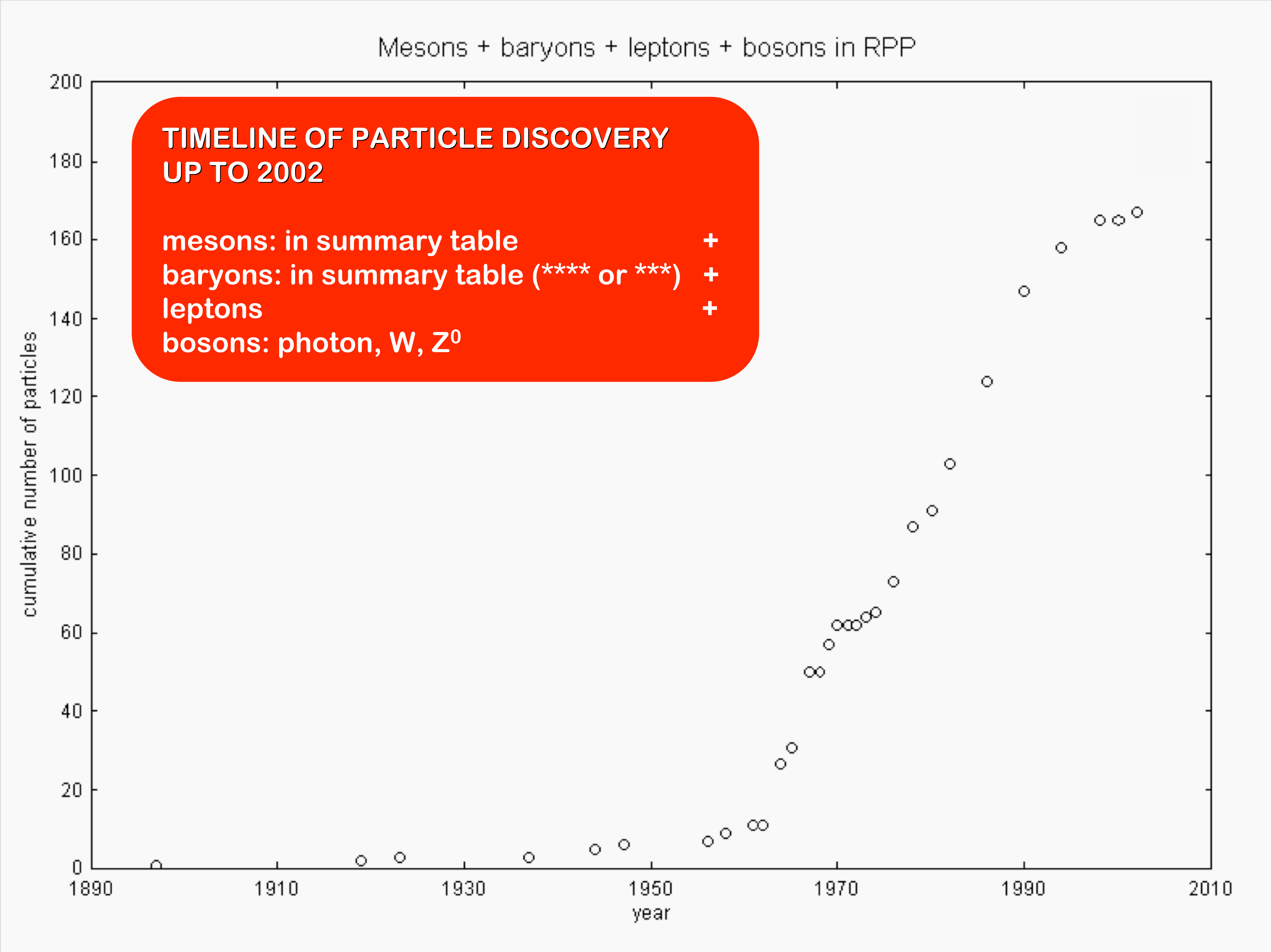
be critical to preventing them from happening at all.



Randy Ortgiesen

One way that FESS and Fermilab are working toward reducing safety

" and each year we discover
a few more of those..."


Mesons + baryons + leptons + bosons in RPP
TIMELINE OF PARTICLE DISCOVERY
UP TO 2002
mesons: in summary table +
baryons: in summary table (**** or ***) +
leptons +
bosons: photon, W, Z0
cumulative number of particles
year
0
20
40
60
80
100
120
140
160
180
200
1890
1910
1930
1950
1970
1990
2010

April 28, 2003 – SLAC experiment identifies new subatomic particle – Press Release

http://home.slac.stanford.edu/pressreleases/2003/20030428.htm

Address Book ▾ 6.dcssb ▾ TOTEM ▾ FFP8 ▾ Particle Physics PhysicsTL dfs sort out ▾ read ▾ CERN DCS ▾ PM ▾ IP ▾ webmail ▾ food ▾

SLAC

STANFORD LINEAR ACCELERATOR CENTER
Operated by Stanford University for the U.S. Dept. of Energy

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Office of Science/ U.S. D.O.E.

Press Release: SLAC experiment identifies new subatomic particle

-- return to Press Releases --

breaking news !

Date Issued: April 28, 2003

Contact:

- Neil Calder, Stanford Linear Accelerator Center: 1 (650) 926-8707, neil.calder@slac.stan

Comment:

- Marcello Giorgi, Stanford Linear Accelerator Center: 1 (650) 926-2385, giorgi@slac.stanfo

Relevant Web URLs:

- http://www.slac.stanford.edu/slac/media-info/20030428/photos.html
- http://www-public.slac.stanford.edu/babar/

Physicist Antimo Palano representing the BABAR experiment presented the evidence for the identification of a new subatomic particle named Ds (2317) to a packed auditorium on Monday 28th April at the Department of Energy's Stanford Linear Accelerator Center (SLAC). Initial studies indicate that the particle is an unusual configuration of a 'charm' quark and a 'strange' anti-quark. A scientific paper was sent for publication in Physical Review Letters on April 11th 2003.

"Congratulations to BaBar!" said SLAC Director, Jonathan Dorfan. "The discovery of this new particle underlines the vigor of our high energy physics research program, and is a concrete justification for the Department of Energy's support of fundamental physics research. The existence of the particle is not a surprise, but its mass is lower than expected. This result will send theorists back to their drawing boards."

"The BaBar experiment continues to produce important new knowledge adding to our fundamental understanding of the structure of matter," said Dr. Raymond L. Orbach, Director of the Energy Department's Office of Science. "This impressive accomplishment reflects the success of a strong team of professionals at SLAC---accelerator physicists, computer specialists, engineers, administrators and many others---whose efforts were essential for the result. I would like to congratulate them all on their combined achievement."

Six types of quarks are present in nature. The up and down quarks are the lightest, and are found within the nuclei of atoms of ordinary matter. Heavier quarks were present in the early universe and are created today in particle accelerators and in collisions of cosmic rays with atoms in the earth's atmosphere. SLAC has a long tradition of discovery in the physics of charm quarks, beginning with the Nobel-prize-winning discovery of the first such particle, a charm-anticharm system, in 1974. The new particle called the Ds (2317), which combines a charm quark with another heavy quark - an anti strange, has unexpected properties that will provide insight into the force that binds the quarks together. This force, unlike most others in nature, becomes stronger as the distance between the two quarks increases.

hadron spectroscopy 2003 ->

new states in PDG RPP
[count in January, published in June]:

- 2004: + 10 (in summary table)
- 2006: + 9 "
- 2008: + ?

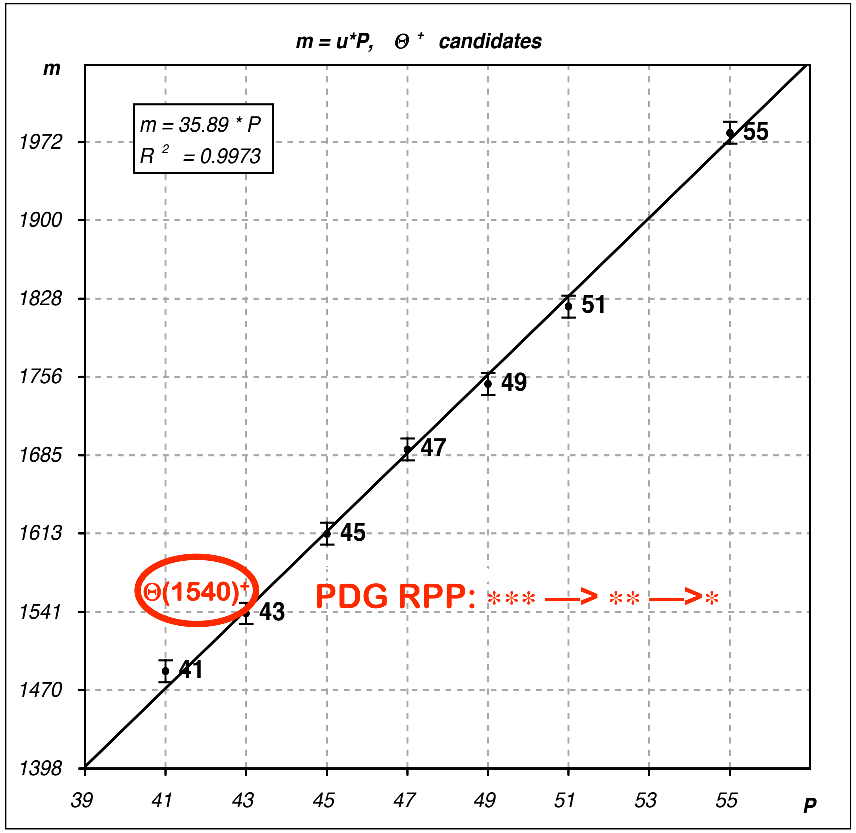
from arXiv I counted 14 new states
in 2006

hadron spectroscopy in 2006

B 23-OCT: Σ_b, 4 states, CDF [new]
M 23-OCT: $B_s(1)(5829)$, CDF
M 23-OCT: confirm $B_s^*(2)(5840)$, CDF [confirmation}
M 10-OCT: $e^+e^- \rightarrow \pi^+\pi^-\Psi(2S)$ broad structure (4320) BaBar
M 07-OCT: $1^{--}(2175)$ meson, BaBar
B 24-AUG: Ω_c^*, BaBar
B 16-AUG: J^P of $\Lambda_c(2880)=5/2^+$, Belle
M 10 AUG: $D_s(J)(2700)$, Belle
B 04-AUG: precise masses of $\Xi_c(2654)$ and $\Xi_c(2815)$, Belle
B 23-JUL: m, W, J of $\Xi^0(1690)$, BaBar
B 22-JUL: confirm $\Xi_c(2980)$ and $\Xi_c(3077)$, BaBar
M 27-JUL: precise mass of $D_s(1)(2536)$, BaBar
M 27-JUL: $D_s(2856)$ and also (2688), BaBar
B 22-JUN: $\Xi_c(2980)$ and $\Xi_c(3077)$, Belle
B 16-JUN: Ω^-, J=3/2, BaBar
M 29-APR: $\kappa(730)$, JINR bubble chamber
B 25-MAR: $?_c$ (2940), BaBar
M 20-FEB: confirm Y(4260) found by BaBar, CLEO

14 new states in 2006, several more at HADRON07 (OCT)

Preprint: p3a-2005-005
11-AUG-2005



No.	Mexp ± ΔMexp, MeV/c2	Γexp ± ΔΓexp MeV/c2	Γ ± ΔΓ MeV/c2	significance S.D.
1	1487 ± 10			2.9
2	1540 ± 8	18.2 ± 2.1	9.2 ± 1.8	5.5
3	1613 ± 10	23.6 ± 6.0	16.1 ± 4.1	4.8
4	1690 ± 10			3.6
5	1750 ± 10			2.3
6	1821 ± 11	35.9 ± 12.0	28.90 ± 9.4	5.0
7	1980 ± 10			3.0

!

1, 3-7 not in PDG RPP

Seven at one blow: the mass system of the Θ+ baryons

Paolo Palazzi

Abstract

Several Θ+ exotic baryon candidates have recently been identified using data from the JINR propane bubble chamber. The pK^0_s invariant mass spectrum shows seven resonant structures ranging from 1487 to 1980 MeV/c², including the already established Θ(1540)+. In the present work the masses of the seven resonances are found to be equally spaced by about 70 MeV/c². This regularity is statistically relevant, and is compatible with an overall particle mass quantization scheme.

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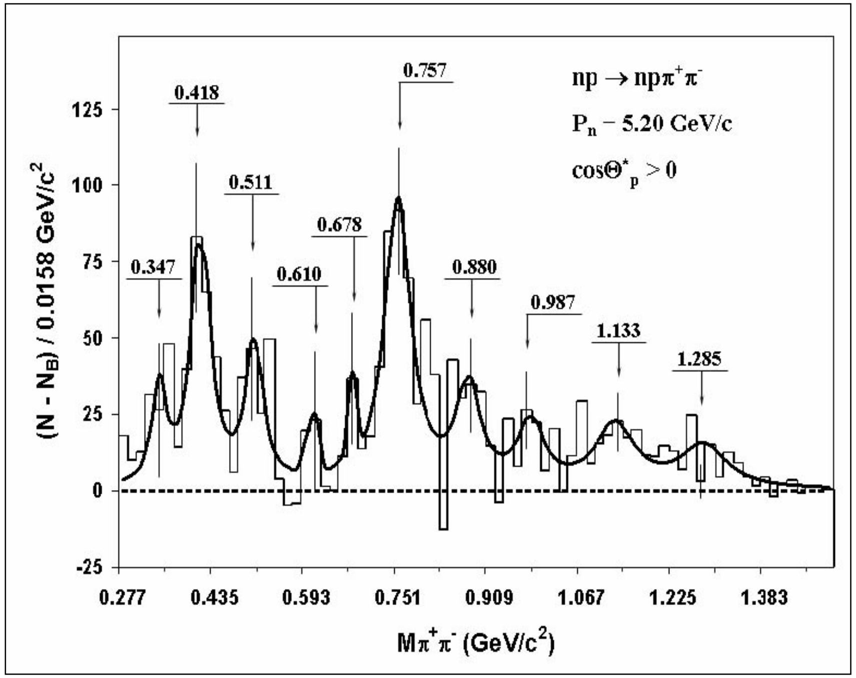


2a

No.	$M_{exp} \pm \Delta M_{exp}$, MeV/c^2	$\Gamma exp \pm \Delta\Gamma exp$, MeV/c^2	σ, μb	S.D.	J	I
1	347 ± 12	36 ± 35	10 ± 5	2.9		0
2	418 ± 06	39 ± 13	26 ± 7	5.2	0	0
3	511 ± 12	40 ± 23	15 ± 6	3.5	0	0
4	610 ± 5	24 ± 13	5 ± 5	1.4		0
5	678 ± 17	16 ± 14	6 ± 4	2.0		0
6	757 ± 5	51 ± 15	38 ± 7	8.5	0	0
7	880 ± 12	45 ± 24	14 ± 5	4.8		0
8	987 ± 12	49 ± 36	11 ± 4	3.8		0
9	1133 ± 15	80 ± 30	10 ± 3	5.1		0
10	1285 ± 22	94 ± 30	10 ± 2	6.0		0

2b

!

several not in PDG RPP

distribution of π+π- combinations V/c, selected under the condition of cosθ*(p) > 0, in the form of 10 Breit-Wigner resonance curves, minus a background in the form of a superposition of Legendre polynomials up to the 9-th degree inclusive; 2b, table with the properties of the 10 states (graph and table adapted from [4], courtesy of the authors).

2. The 10 low-mass Dubna mesons

In 2002 physicists from a Dubna group reported evidence of 10 resonances seen in the $\pi^+\pi^-$ mass spectrum , in the reaction np --> np $\pi^+\pi^-$ at a neutron incident momentum of 5.2 GeV/c in the 1-m HBC of LHE JINR [4]. Such effects were not found in $\pi^-\pi^0$ combinations from the reaction np --> pp $\pi^-\pi^0$, and from that the authors deduce that the 10 resonances are all I=0. The spin could be estimated only for 3 states, m = 418, 511 and 757, and was found to be = 0.

On the basis of these results, the authors deduce that at least the 3 resonances listed above have quantum numbers $I^G(J^{PC}) = 0^+(0^{++})$ and may be identified as σ_0 (sigma(0)) mesons. They then offer evidence that the width of these three states is not in contradiction with a possible glueball interpretation, and compare their results with other sigma(0) searches.

The entry of the PDG RPP [5] meson listings devoted the f(0)(600) a.k.a. sigma(0), with its note on the scalar mesons, is for sure one of the most intriguing of the whole book. Scalar resonances are experimentally difficult to resolve and also to interpret, with the I=0, $J^{PC}=0^{++}$ being the most complex sector, and the sigma(0) masses based on partial wave analysis spanning a large interval from 400 to 1200 MeV/c^2. At the La Thuile 2005 meeting BES reported a sigma(0) meson at 541 ± 39 MeV/c^2, together with a k meson (another problematic state) at 760 ± 20 ± 40.

The Dubna measurements discussed here promise to shed some light in this obscure corner of the meson spectrum, based as they are on the observed direct signals from resonances in the effective mass spectra of the corresponding particle combinations, rather than through PWA. The Dubna widths are however much smaller in comparison with those extracted from PWA.

For convenience in what follows we will refer to the 10 Dubna mesons with the short notation X1, X2, .. X10 ordered according to increasing mass values.

3. Analysis procedure

In what follows, relevant steps of the procedure already applied successfully in [3] to each meson family to produce the results of figure 1b will be used:

compute mass numbers P_i: $m_i=P_i$*u with a u-scan, varying u in the range (33,38) to find the value of u corresponding to the best alignment on the basis of the R^2 correlation parameter, fit to compute u and its error;

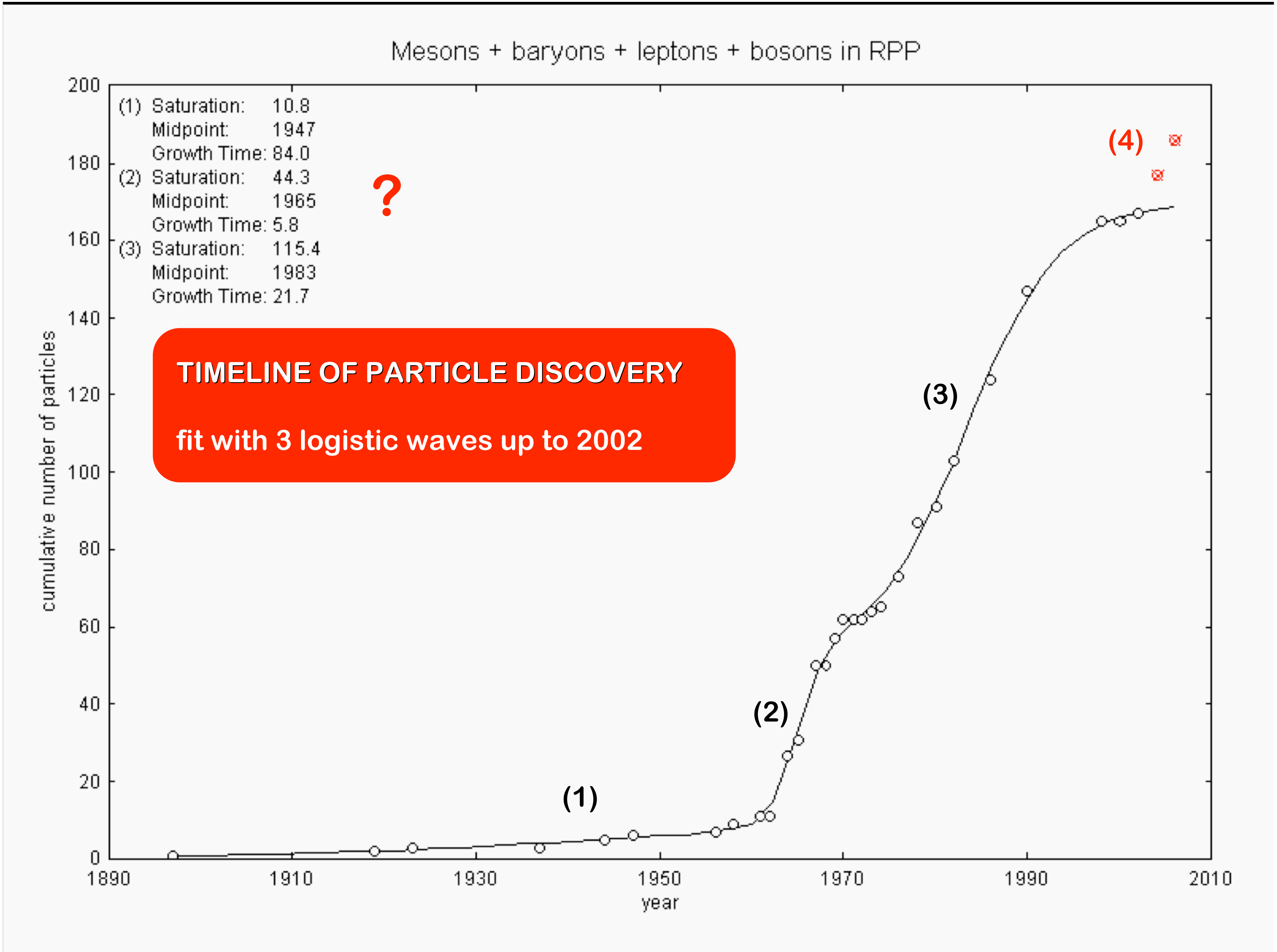
perform a weighted fit with the measurement errors, check the chi-squared;

evaluate the goodness-of-fit (p-value) by comparing the R^2 of the fit with the R^2 distribution of random samples of the same count in the same mass range.

Please refer to [3] for more details about the original analysis procedure, and the definition of relevant statistical variables.

… and several other states not listed in the PDG RPP:

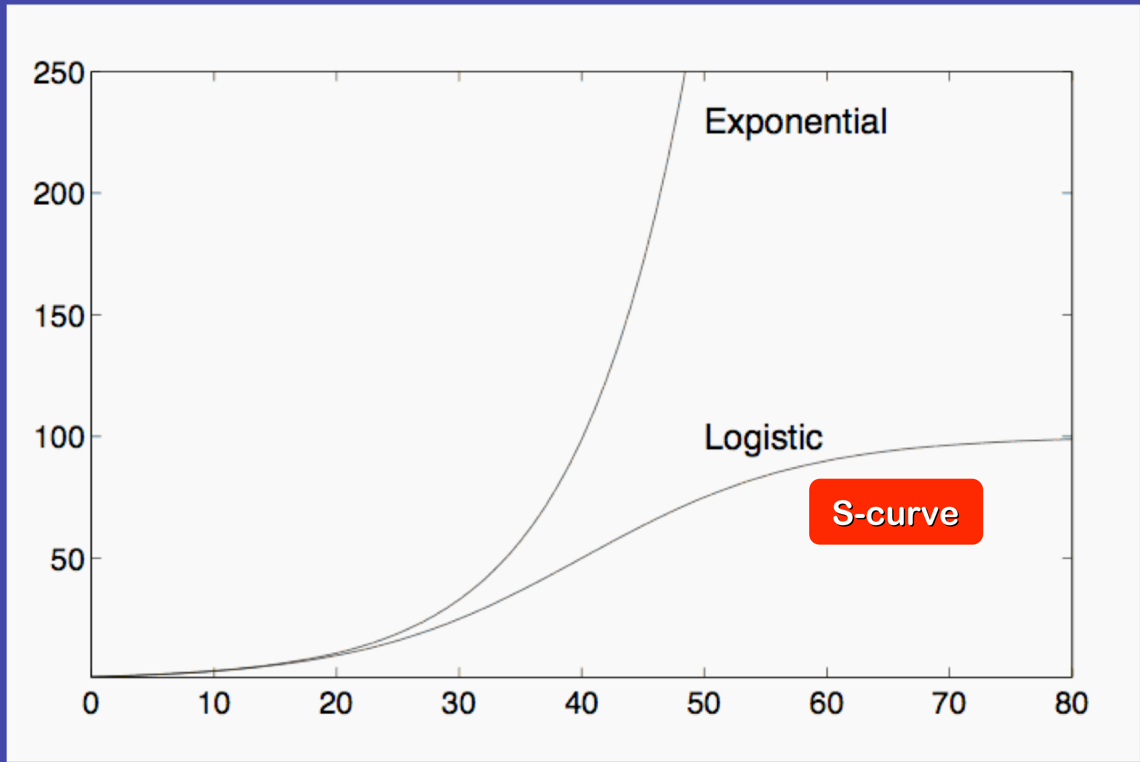
- the HyperCP boson at 214.13 MeV/c^2
- 10 S=1 baryonic resonances seen at JINR
- 17 narrow baryons seen at SPES3 and SPES4 (SATURNE)
- and more



Mesons + baryons + leptons + bosons in RPP
(1) Saturation: 10.8
Midpoint: 1947
Growth Time: 84.0
(2) Saturation: 44.3
Midpoint: 1965
Growth Time: 5.8
(3) Saturation: 115.4
Midpoint: 1983
Growth Time: 21.7
?
TIMELINE OF PARTICLE DISCOVERY
fit with 3 logistic waves up to 2002
(1)
(2)
(3)
(4)
cumulative number of particles
year
0
20
40
60
80
100
120
140
160
180
200
1890
1910
1930
1950
1970
1990
2010

intermezzo:
the logistic curve

logistic curve: describes growth



exponential:

$dP(t) / dt = \alpha.P(t)$

$\mathbf{P(t) = \beta.exp(\alpha\ t)}$

logistic: (Verhulst 1838)

$dP(t) / dt = \alpha.P(t).(1 - P(t)/\kappa)$

$\mathbf{P(t) = \kappa / (1+ exp(-\alpha.(t-\beta))}$

logistic curve: parametrization

$P(t) = \kappa / (1+ \exp(-\alpha.(t-\beta))$: **α, β, κ**

Saturation: κ
Midpoint: $t_m = \beta$ (growth=50%)
Growth Time: $\Delta t = \ln(81)/ \alpha$
[10% -> 90%]

$N(t) = \kappa / (1+ \exp(-(\ln(81)/\Delta t).(t-tm))$

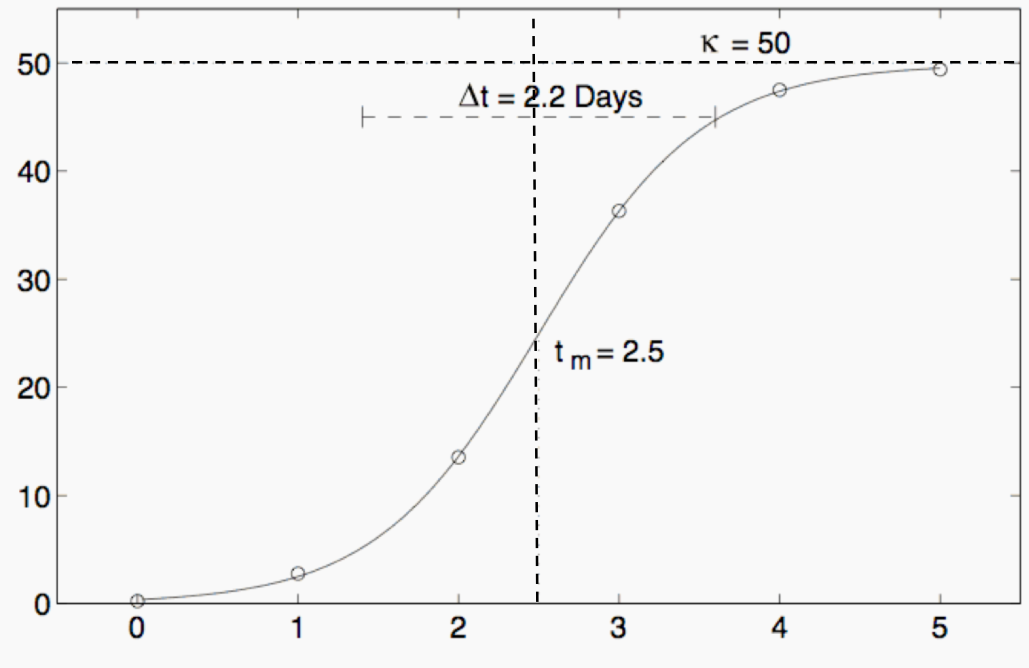
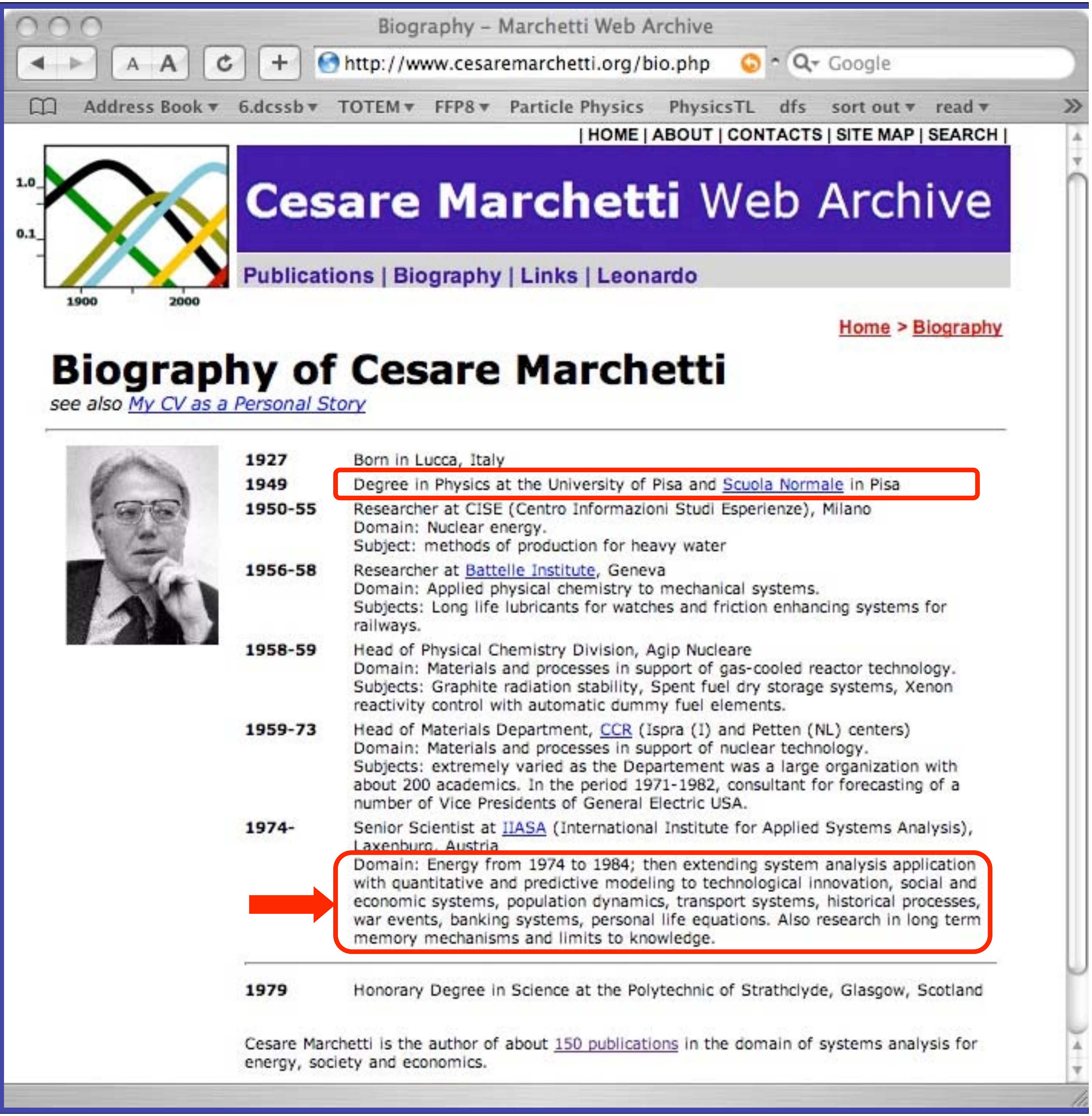


FIGURE 2. Growth of a bacteria colony fitted to a logistic curve.

logistic curve:

the guru



Biography – Marchetti Web Archive

http://www.cesaremarchetti.org/bio.php

Address Book ▾ 6.dcssb ▾ TOTEM ▾ FFP8 ▾ Particle Physics PhysicsTL dfs sort out ▾ read ▾

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Cesare Marchetti Web Archive

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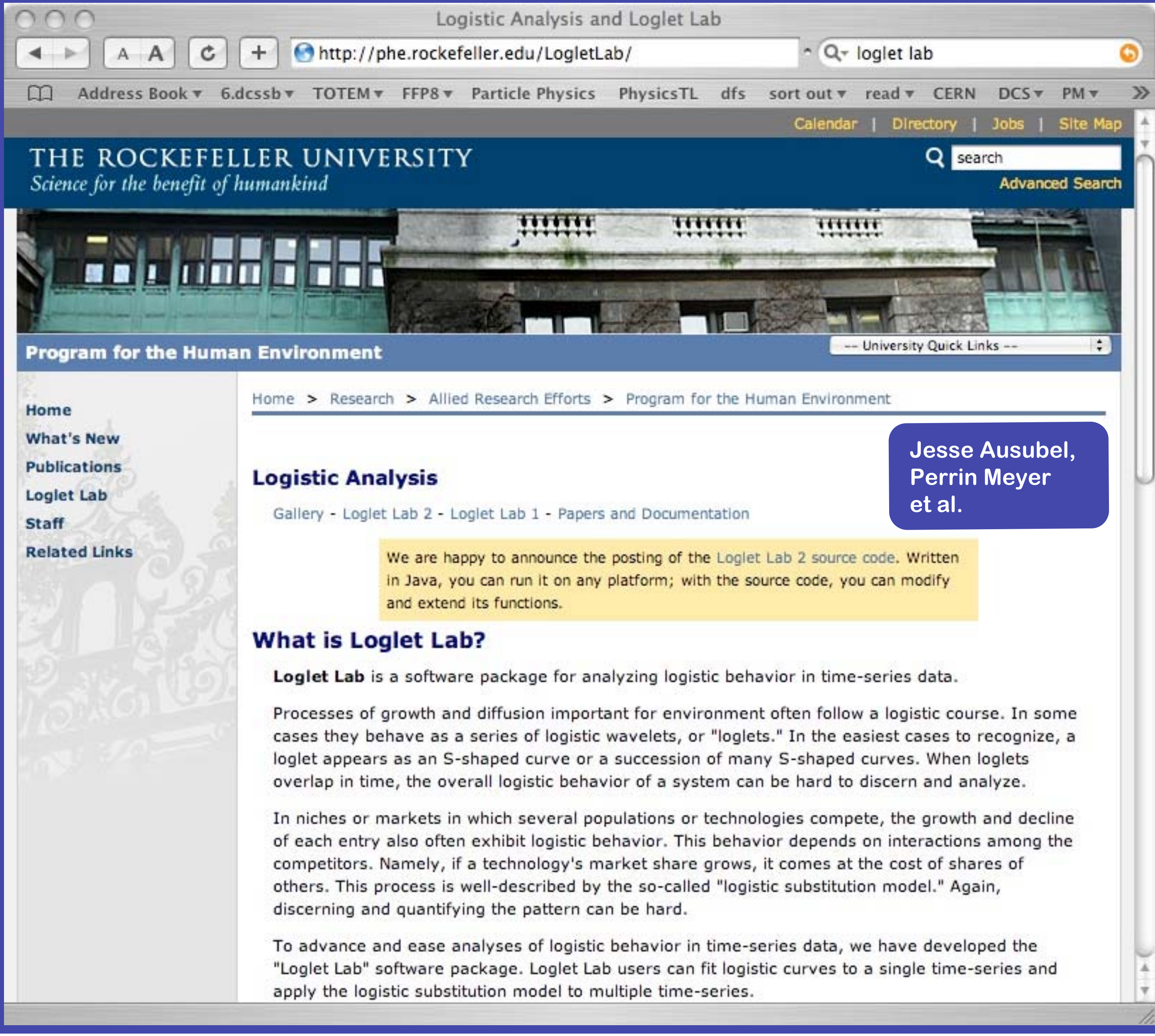
Biography of Cesare Marchetti

see also My CV as a Personal Story

1927	Born in Lucca, Italy
1949	Degree in Physics at the University of Pisa and Scuola Normale in Pisa
1950-55	Researcher at CISE (Centro Informazioni Studi Esperienze), Milano Domain: Nuclear energy. Subject: methods of production for heavy water
1956-58	Researcher at Battelle Institute, Geneva Domain: Applied physical chemistry to mechanical systems. Subjects: Long life lubricants for watches and friction enhancing systems for railways.
1958-59	Head of Physical Chemistry Division, Agip Nucleare Domain: Materials and processes in support of gas-cooled reactor technology. Subjects: Graphite radiation stability, Spent fuel dry storage systems, Xenon reactivity control with automatic dummy fuel elements.
1959-73	Head of Materials Department, CCR (Ispra (I) and Petten (NL) centers) Domain: Materials and processes in support of nuclear technology. Subjects: extremely varied as the Departement was a large organization with about 200 academics. In the period 1971-1982, consultant for forecasting of a number of Vice Presidents of General Electric USA.
1974-	Senior Scientist at IIASA (International Institute for Applied Systems Analysis), Laxenburg, Austria Domain: Energy from 1974 to 1984; then extending system analysis application with quantitative and predictive modeling to technological innovation, social and economic systems, population dynamics, transport systems, historical processes, war events, banking systems, personal life equations. Also research in long term memory mechanisms and limits to knowledge.
1979	Honorary Degree in Science at the Polytechnic of Strathclyde, Glasgow, Scotland

Cesare Marchetti is the author of about 150 publications in the domain of systems analysis for energy, society and economics.

logistic curve software: Loglet Lab



Jesse Ausubel, Perrin Meyer et al.

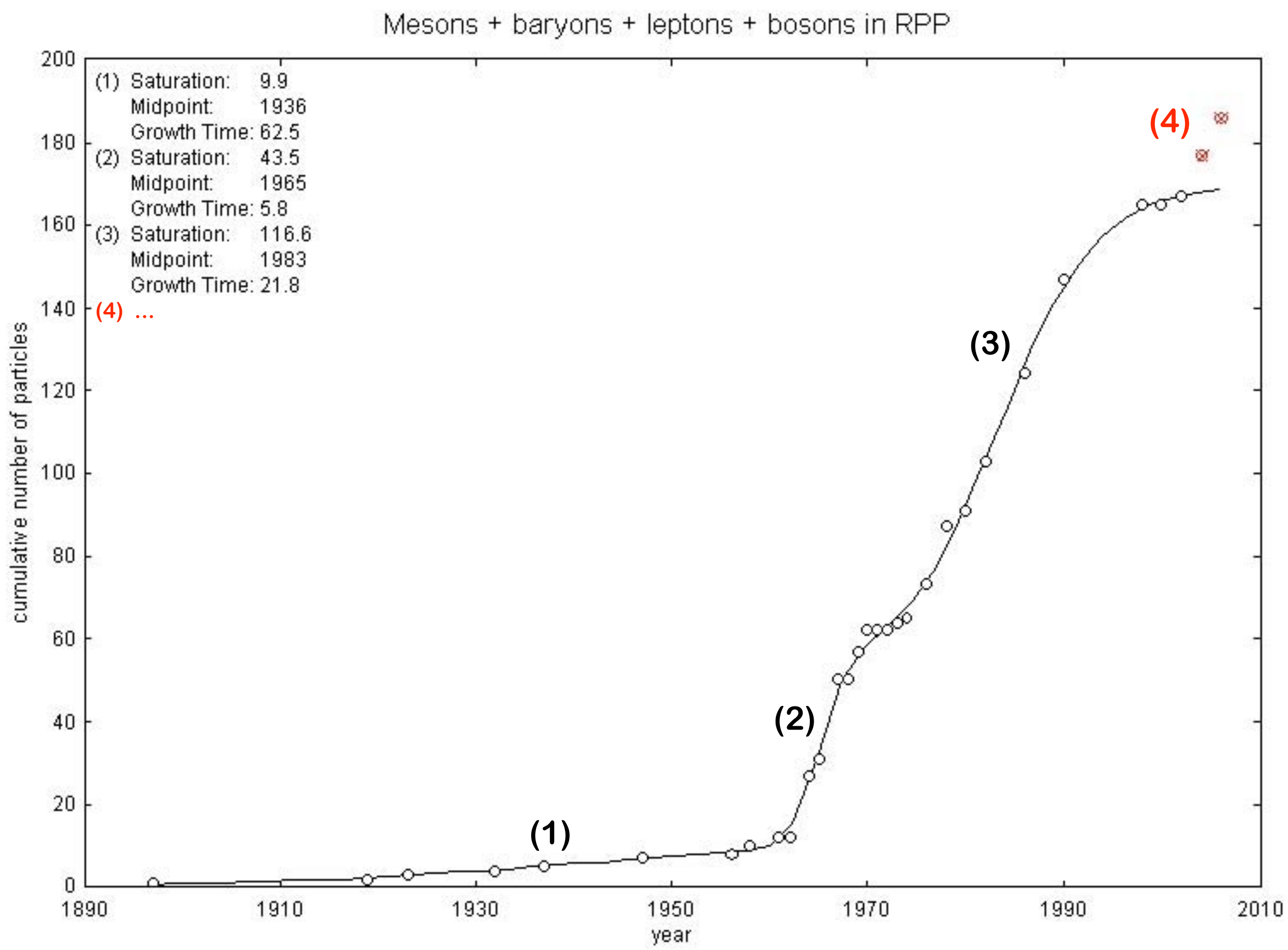
WinXP

Loglet Lab - [MBlb]

File Edit View Data Graph Window Help

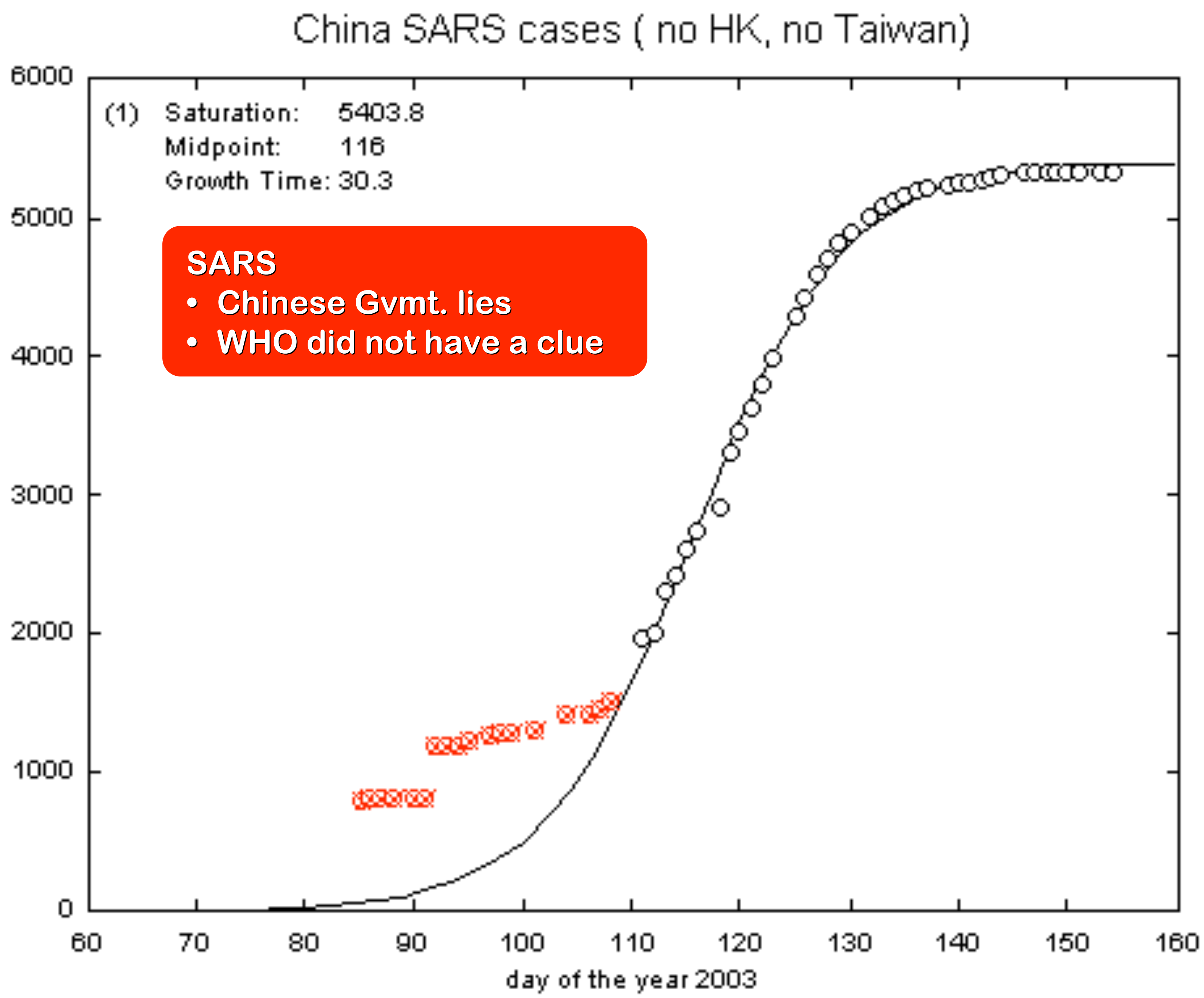
	Item	#1	M
1	1897	1	
2	1919	2	
3	1923	3	
4	1932	4	
5	1937	5	
6	1947	7	
7	1956	8	
8	1958	10	
9	1961	12	
10	1962	12	
11	1964	27	
12	1965	31	
13	1967	50	
14	1968	50	
15	1969	57	
16	1970	62	
17	1971	62	
18	1972	62	
19	1973	64	
20	1974	65	
21	1976	73	
22	1978	87	
23	1980	91	
24	1982	103	
25	1986	124	
26	1990	147	
27	1998	165	
28	2000	165	
29	2002	167	
30	2004	177	
31	2006	186	
32			
33			
34			
35			
36			
37			

tricky series

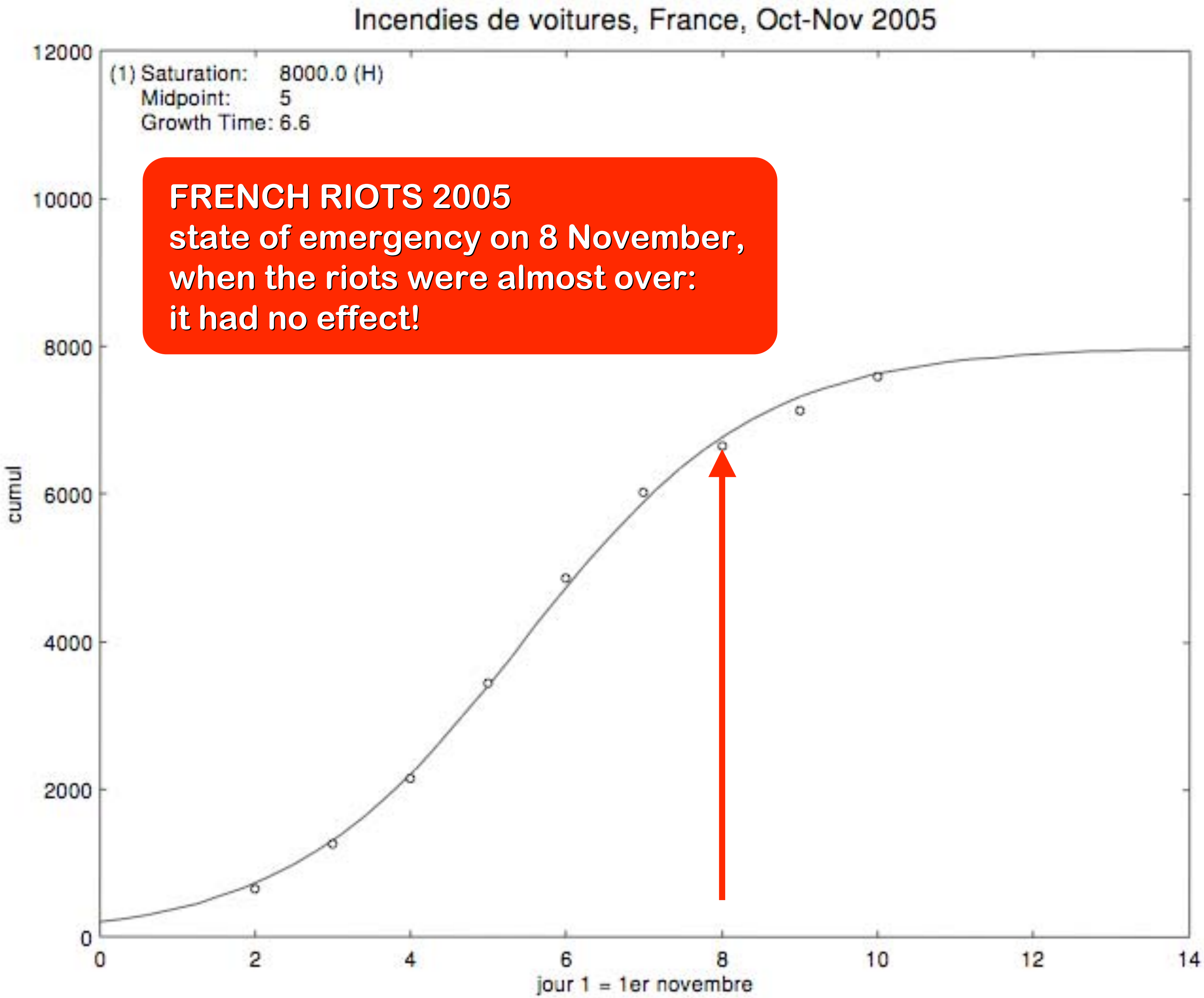


For Help, press F1

start Desktop Mix Loglet Lab - [MBlb] 2:05 PM



China SARS cases (no HK, no Taiwan)
(1) Saturation: 5403.8
Midpoint: 116
Growth Time: 30.3
SARS
• Chinese Gvmt. lies
• WHO did not have a clue
6000
5000
4000
3000
2000
1000
0
60
70
80
90
100
110
120
130
140
150
160
day of the year 2003

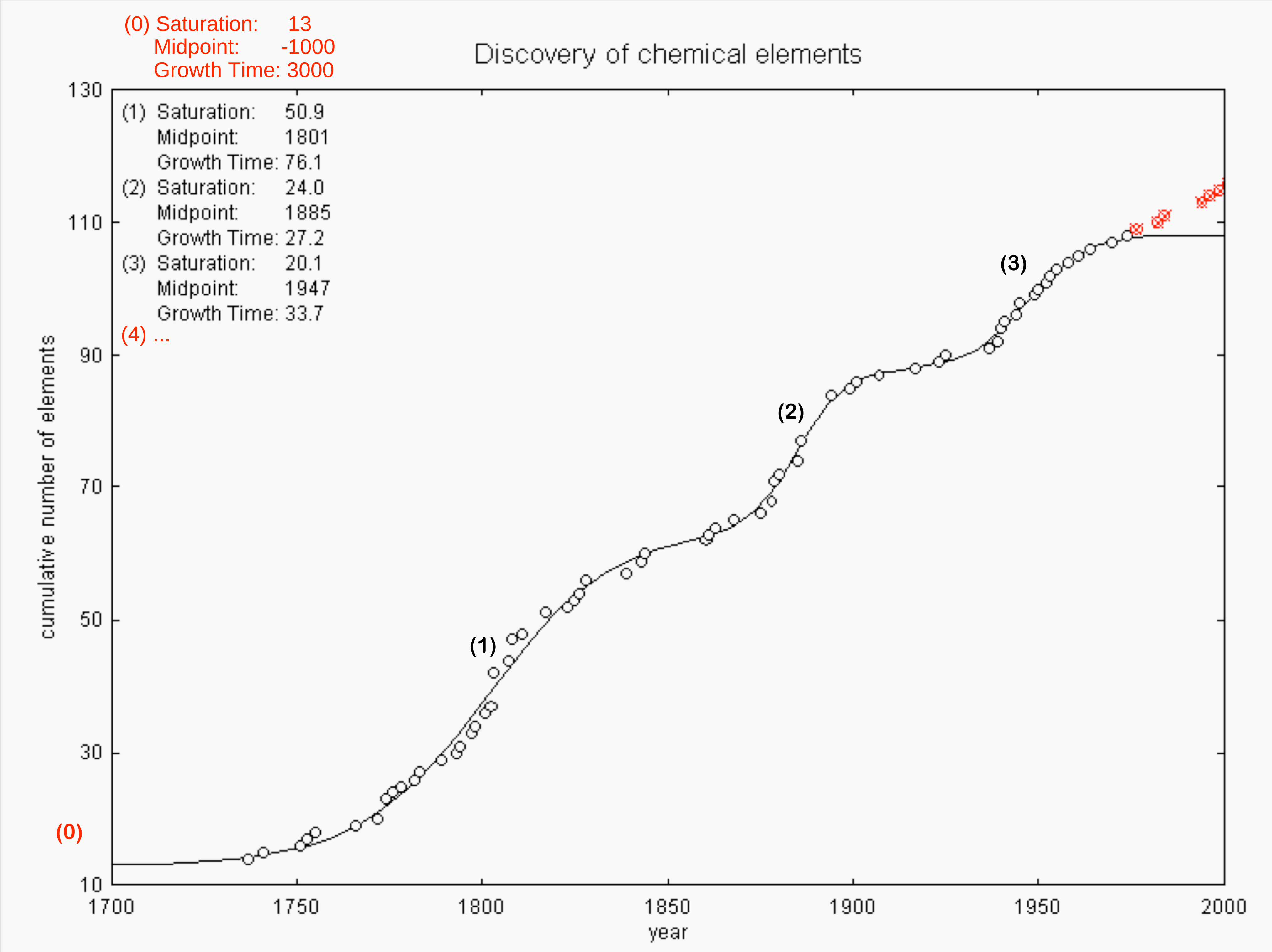


Incendies de voitures, France, Oct-Nov 2005
(1) Saturation: 8000.0 (H)
Midpoint: 5
Growth Time: 6.6
FRENCH RIOTS 2005
state of emergency on 8 November,
when the riots were almost over:
it had no effect!
12000
10000
8000
6000
4000
2000
0
cumul
0
2
4
6
8
10
12
14
jour 1 = 1er novembre

example:

discovery of chemical elements

C. Marchetti (1985), T. Modis (1992)



(0) Saturation: 13
Midpoint: -1000
Growth Time: 3000
Discovery of chemical elements
(1) Saturation: 50.9
Midpoint: 1801
Growth Time: 76.1
(2) Saturation: 24.0
Midpoint: 1885
Growth Time: 27.2
(3) Saturation: 20.1
Midpoint: 1947
Growth Time: 33.7
(4) ...
(1)
(2)
(3)
(0)
cumulative number of elements
year
130
110
90
70
50
30
10
1700
1750
1800
1850
1900
1950
2000

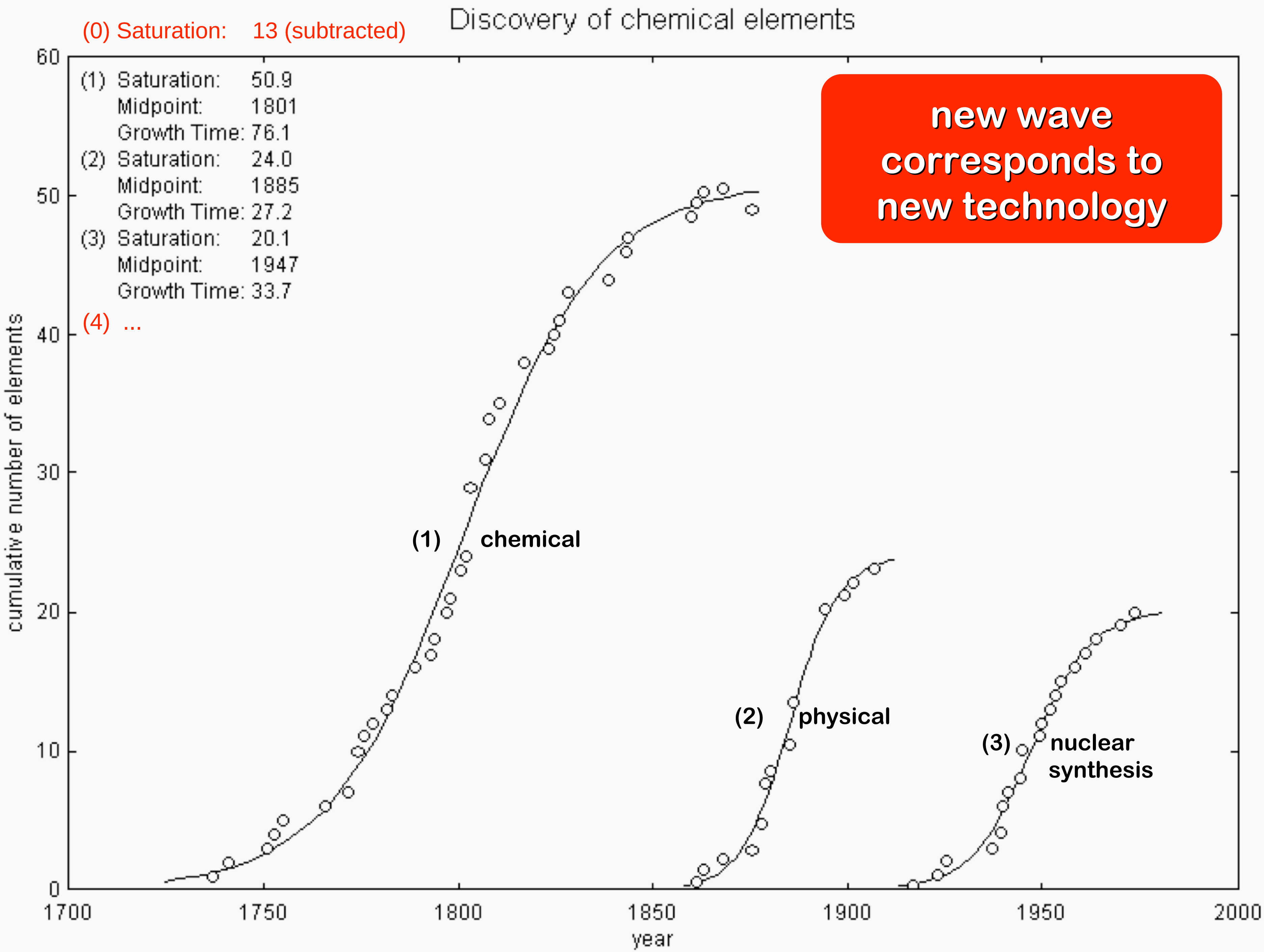


Cu

Au

Pb

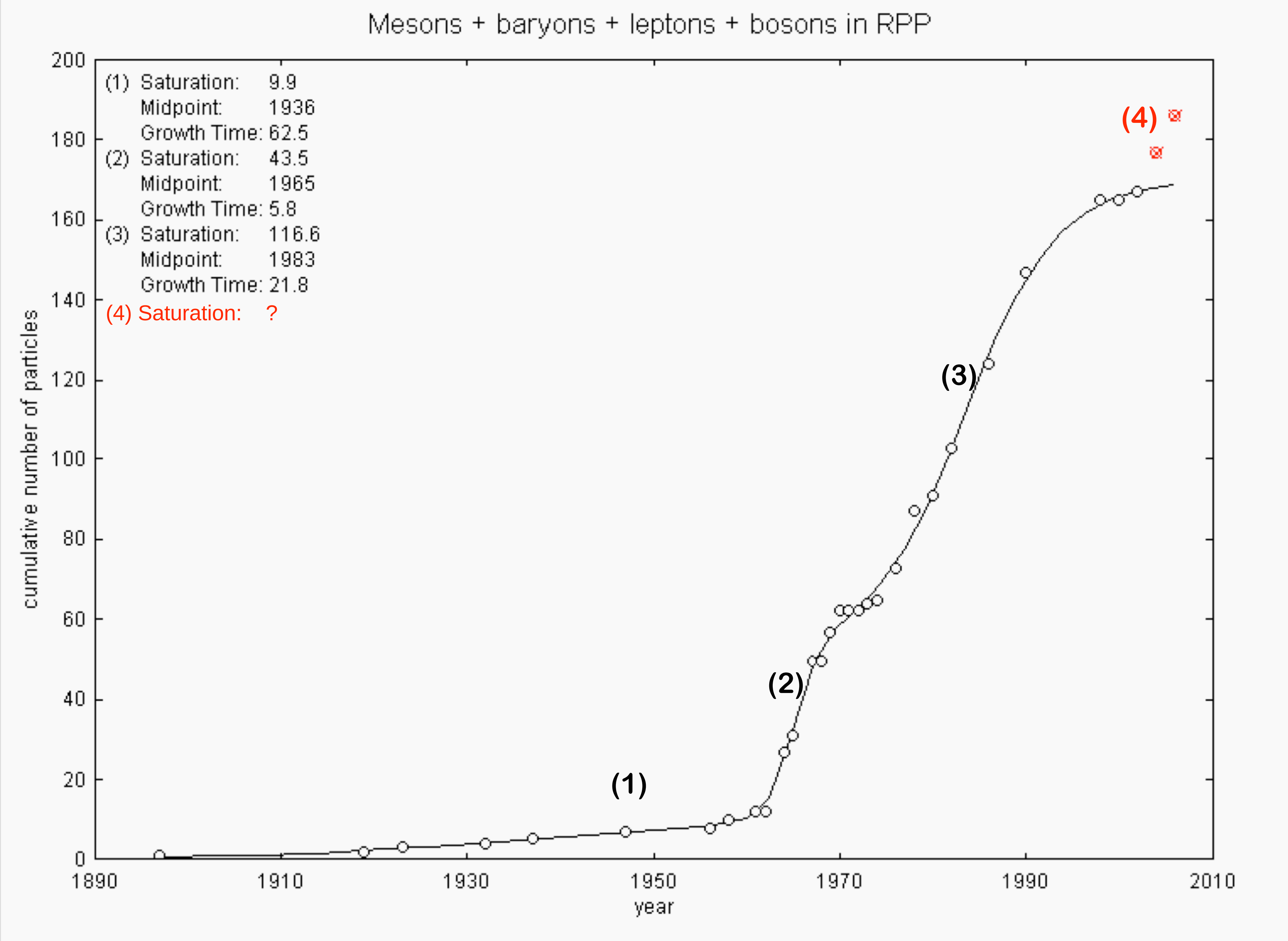
wave (0)



(0) Saturation: 13 (subtracted)
Discovery of chemical elements
(1) Saturation: 50.9
Midpoint: 1801
Growth Time: 76.1
(2) Saturation: 24.0
Midpoint: 1885
Growth Time: 27.2
(3) Saturation: 20.1
Midpoint: 1947
Growth Time: 33.7
(4) ...
new wave corresponds to new technology
(1) chemical
(2) physical
(3) nuclear synthesis
cumulative number of elements
year
0
10
20
30
40
50
60
1700
1750
1800
1850
1900
1950
2000

back

to particles



Mesons + baryons + leptons + bosons in RPP
(1) Saturation: 9.9
Midpoint: 1936
Growth Time: 62.5
(2) Saturation: 43.5
Midpoint: 1965
Growth Time: 5.8
(3) Saturation: 116.6
Midpoint: 1983
Growth Time: 21.8
(4) Saturation: ?
(1)
(2)
(3)
(4)
cumulative number of particles
year
0
20
40
60
80
100
120
140
160
180
200
1890
1910
1930
1950
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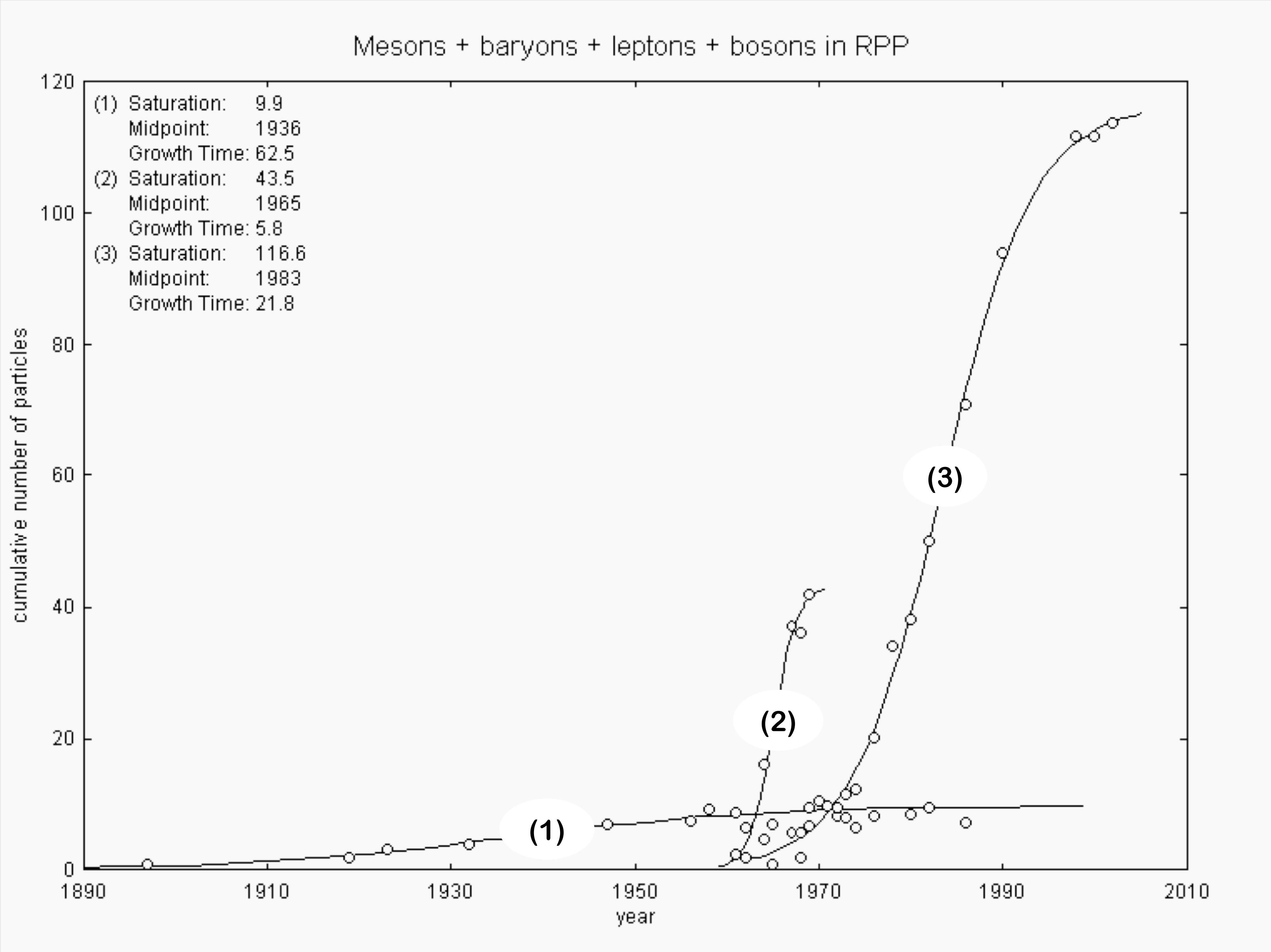
1990
2010


Mesons + baryons + leptons + bosons in RPP
(1) Saturation: 9.9
Midpoint: 1936
Growth Time: 62.5
(2) Saturation: 43.5
Midpoint: 1965
Growth Time: 5.8
(3) Saturation: 116.6
Midpoint: 1983
Growth Time: 21.8
(1)
(2)
(3)
cumulative number of particles
year
0
20
40
60
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1890
1910
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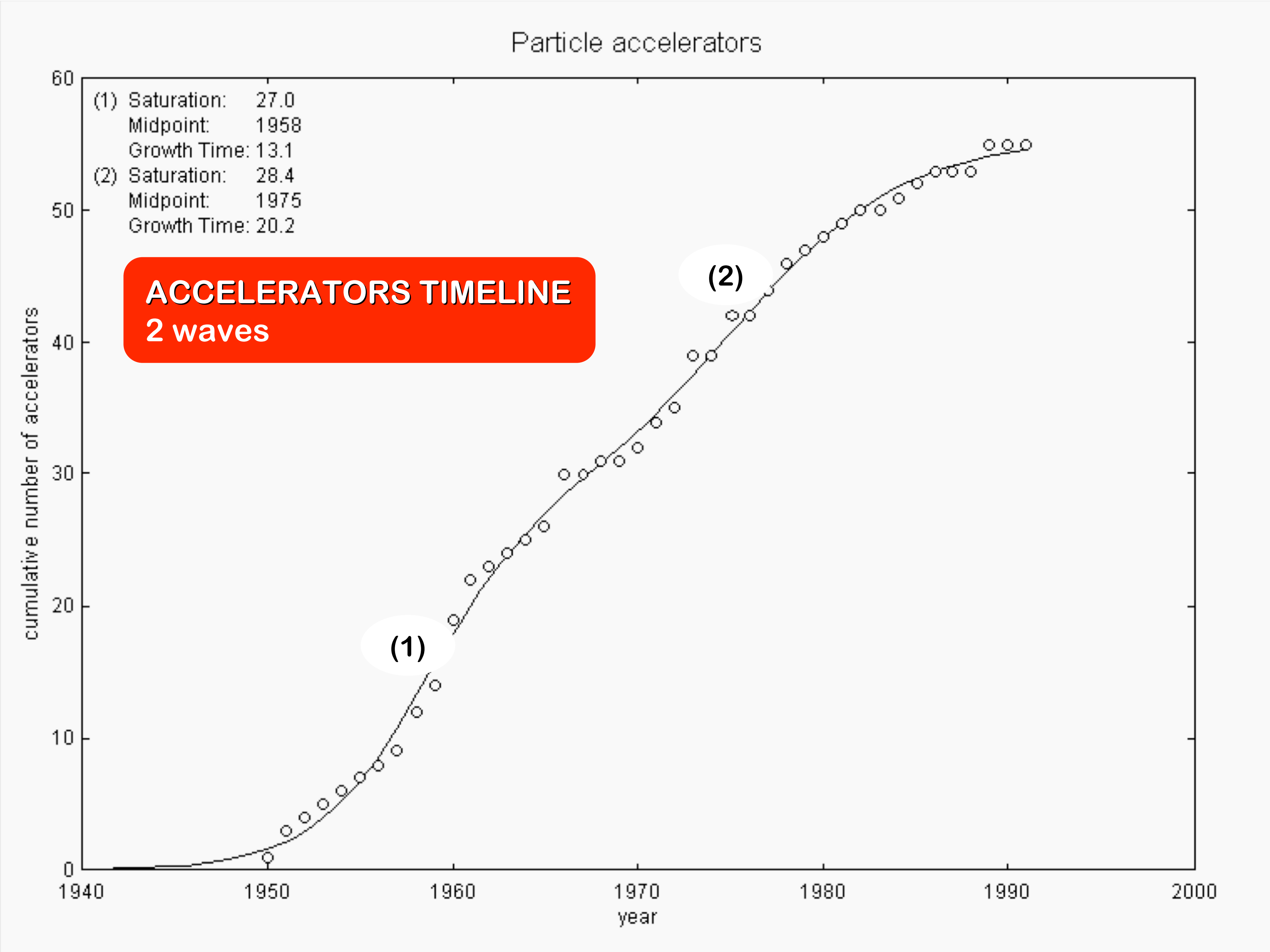
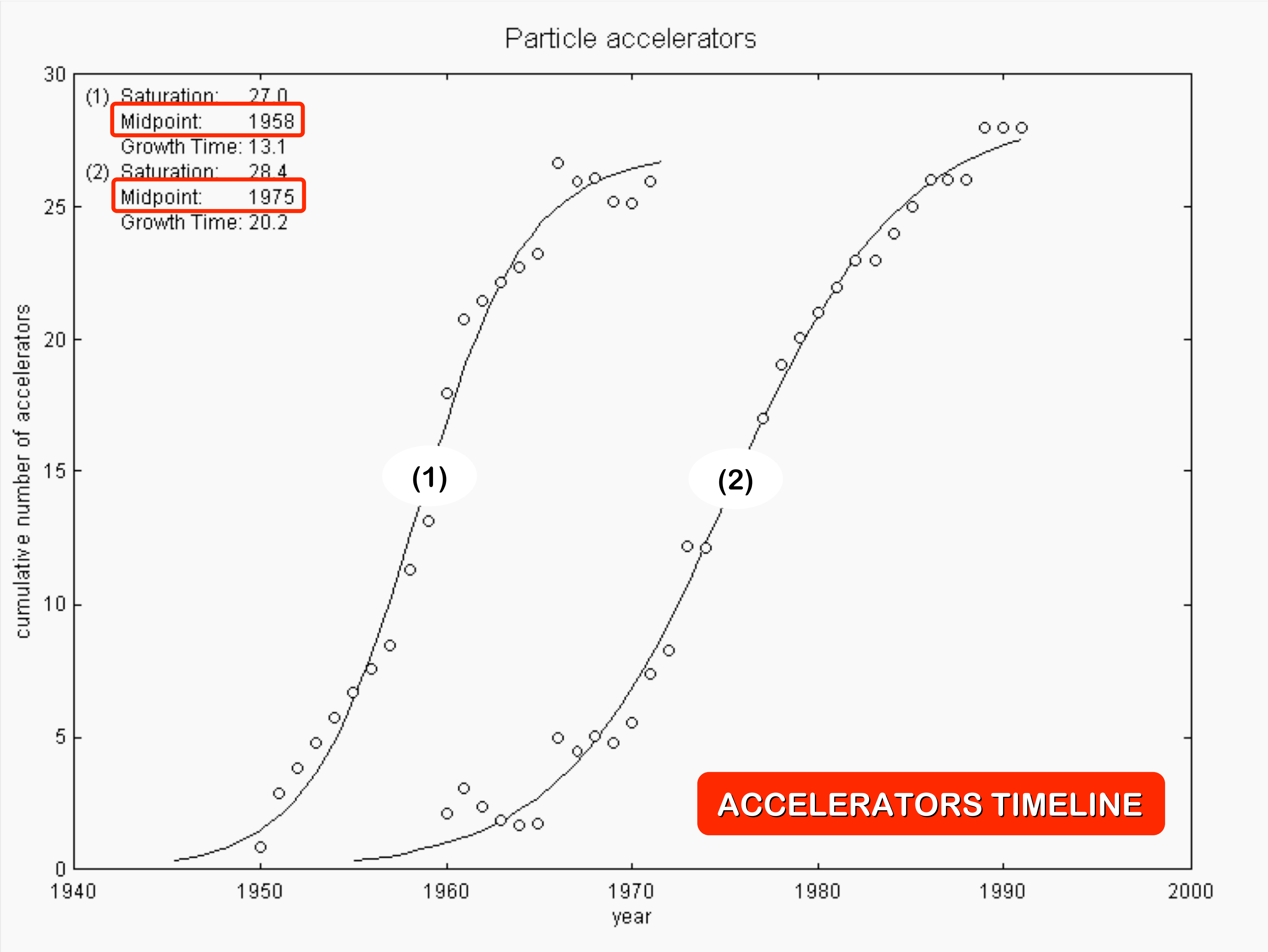
1990
2010

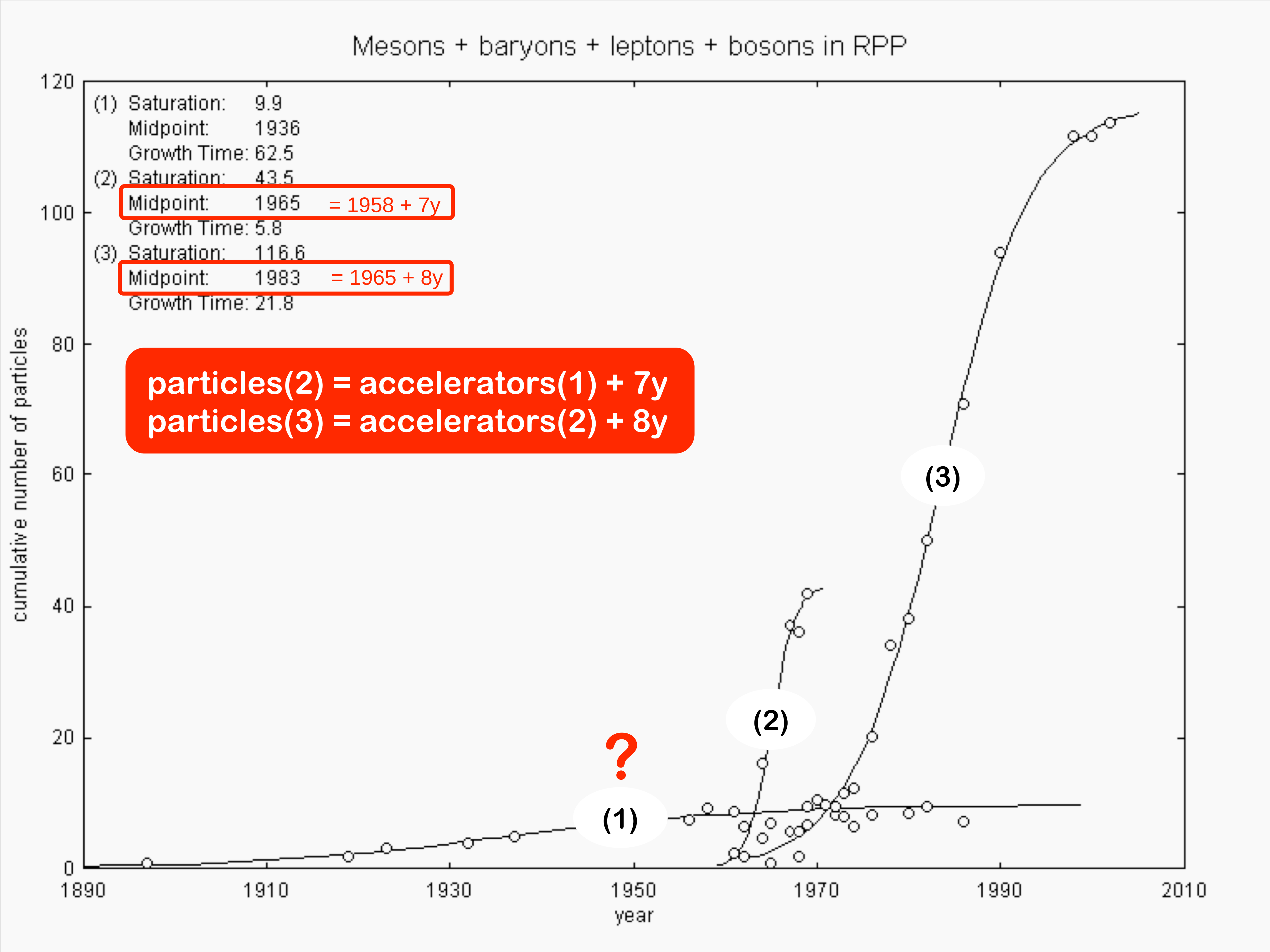
accelerators

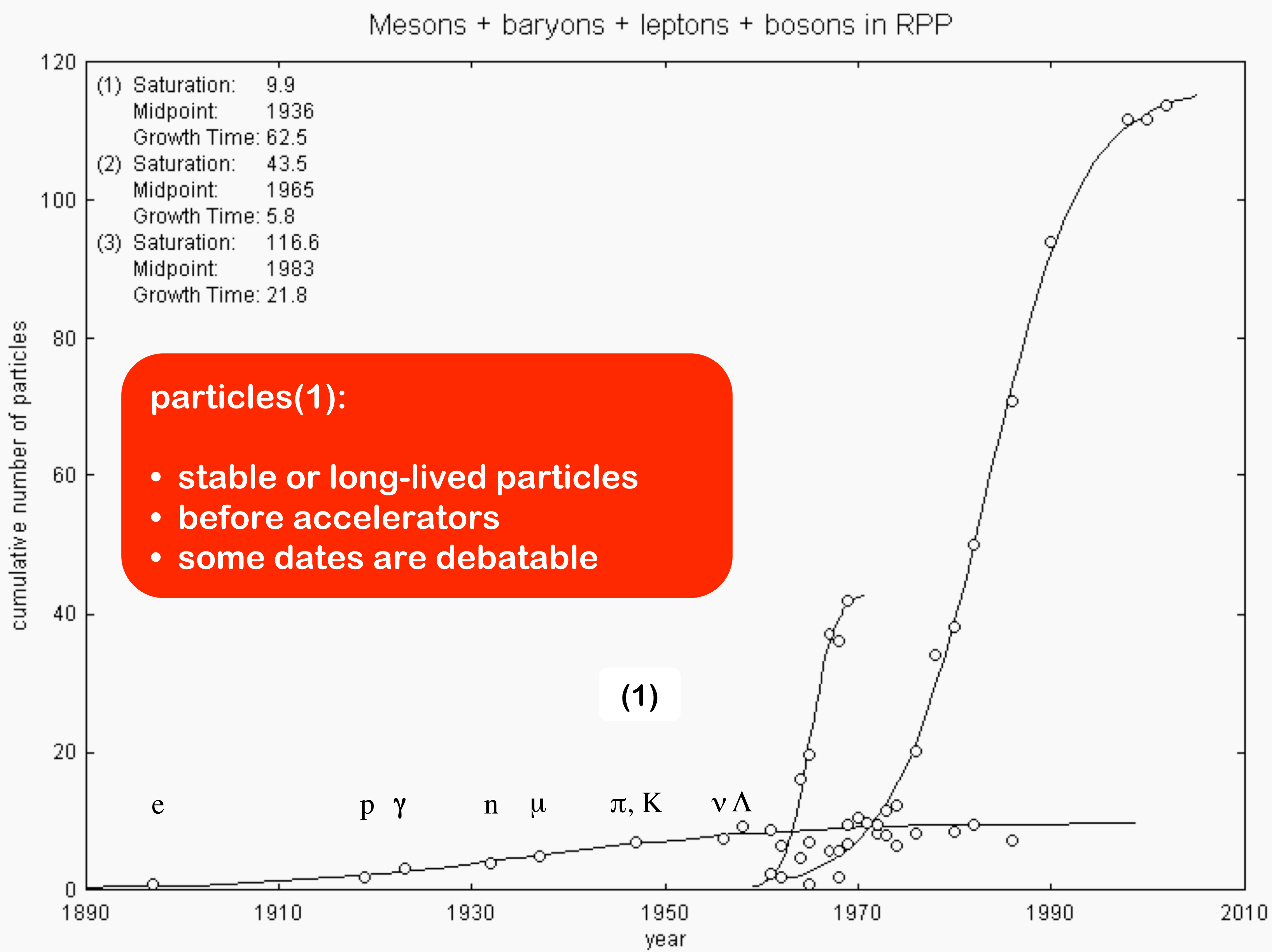


Particle accelerators
(1) Saturation: 27.0
Midpoint: 1958
Growth Time: 13.1
(2) Saturation: 28.4
Midpoint: 1975
Growth Time: 20.2
ACCELERATORS TIMELINE
2 waves
(2)
(1)
0
10
20
30
40
50
60
1940
1950
1960
1970
1980
1990
2000
year
cumulative number of accelerators



Particle accelerators
(1) Saturation: 27.0
Midpoint: 1958
Growth Time: 13.1
(2) Saturation: 28.4
Midpoint: 1975
Growth Time: 20.2
cumulative number of accelerators
year
(1)
(2)
ACCELERATORS TIMELINE


Mesons + baryons + leptons + bosons in RPP
(1) Saturation: 9.9
Midpoint: 1936
Growth Time: 62.5
(2) Saturation: 43.5
Midpoint: 1965 = 1958 + 7y
Growth Time: 5.8
(3) Saturation: 116.6
Midpoint: 1983 = 1965 + 8y
Growth Time: 21.8
particles(2) = accelerators(1) + 7y
particles(3) = accelerators(2) + 8y
?
(1)
(2)
(3)
cumulative number of particles
year
0
20
40
60
80
100
120
1890
1910
1930
1950
1970
1990
2010

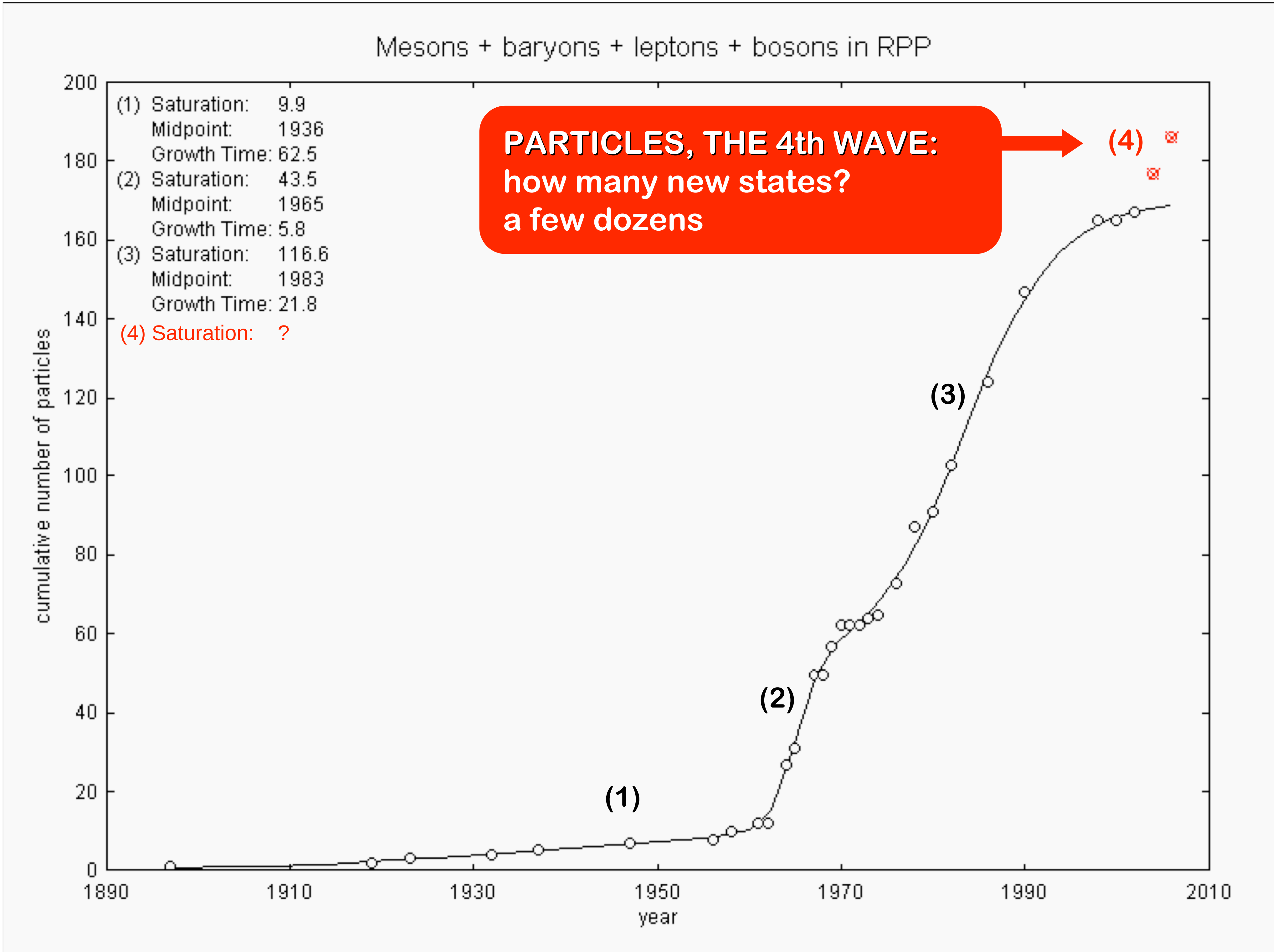


particles(1):

- **stable or long-lived particles**
- **before accelerators**
- **some dates are debatable**

back

to the 4th wave



Mesons + baryons + leptons + bosons in RPP
(1) Saturation: 9.9
Midpoint: 1936
Growth Time: 62.5
(2) Saturation: 43.5
Midpoint: 1965
Growth Time: 5.8
(3) Saturation: 116.6
Midpoint: 1983
Growth Time: 21.8
(4) Saturation: ?
PARTICLES, THE 4th WAVE:
how many new states?
a few dozens
(4)
(3)
(2)
(1)
cumulative number of particles
year
200
180
160
140
120
100
80
60
40
20
0
1890
1910
1930
1950
1970
1990
2010

what
are the new hadrons ?

- expected (known unknowns)
  - mass values much more precise than predictions
- unexpected (unknown unknowns)
  - very many: hybrids, molecules,..? >> taxonomy is incomplete

where
will the new states
be discovered
?

hadron spectroscopy in 2006

B 23-OCT: Σ_b, 4 states, CDF

M 23-OCT: $B_s(1)(5829)$, CDF

M 23-OCT: confirm $B_s^*(2)(5840)$, CDF

M 10-OCT: $e^+e^- \to \pi^+\pi^-\Psi(2S)$ broad structure (4320) BaBar

M 07-OCT: $1^{--}(2175)$ meson, BaBar

B 24-AUG: Ω_c^*, BaBar

B 16-AUG: J^P of $\Lambda_c(2880)=5/2^+$, Belle

M 10 AUG: $D_s(J)(2700)$, Belle

B 04-AUG: precise masses of $\Xi_c(2654)$ and $\Xi_c(2815)$, Belle

B 23-JUL: m, W, J of $\Xi^0(1690)$, BaBar

B 22-JUL: confirm $\Xi_c(2980)$ and $\Xi_c(3077)$, BaBar

M 27-JUL: precise mass of $D_s(1)(2536)$, BaBar

M 27-JUL: $D_s(2856)$ and also (2688), BaBar

B 22-JUN: $\Xi_c(2980)$ and $\Xi_c(3077)$, Belle

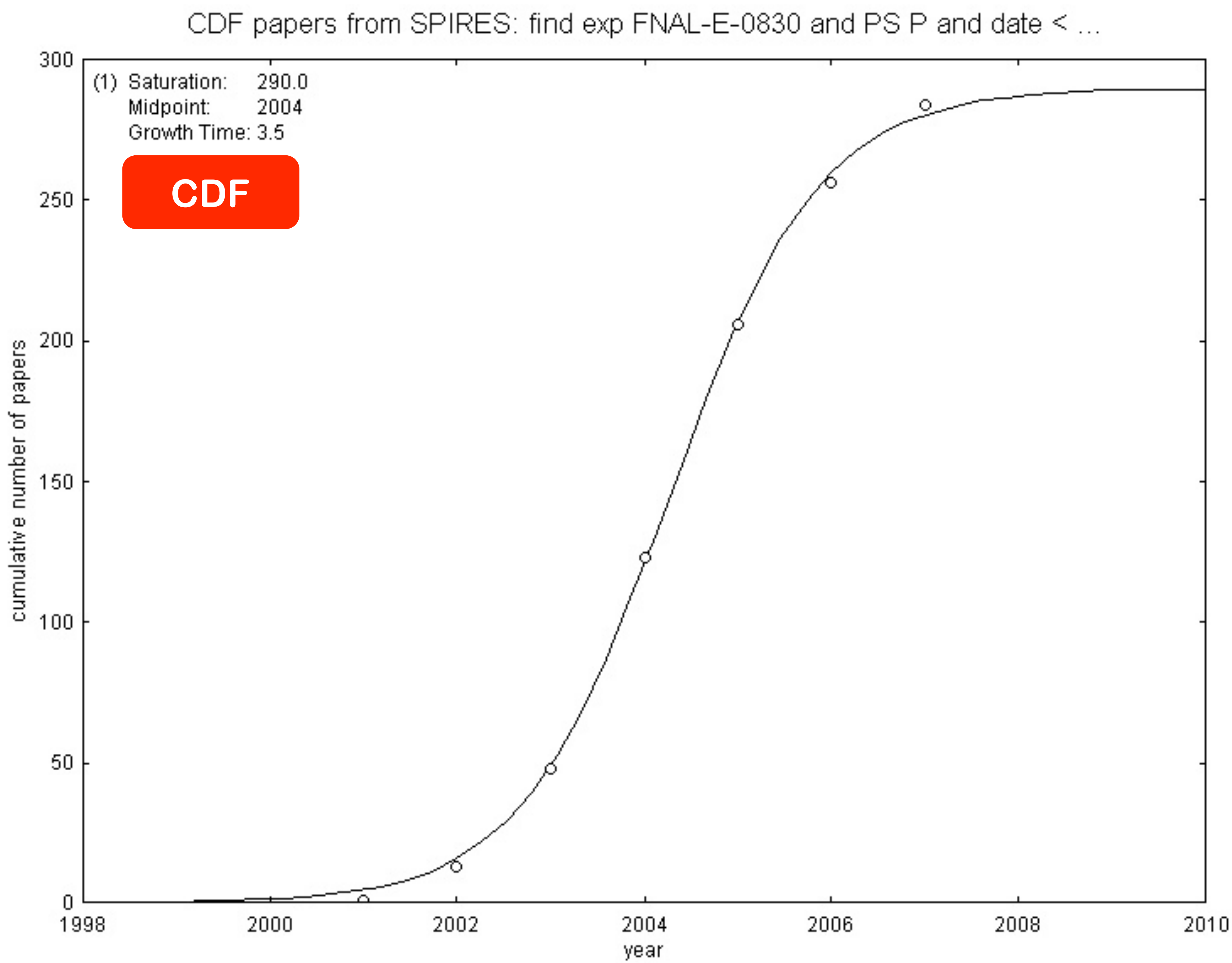
B 16-JUN: Ω^-, J=3/2, BaBar

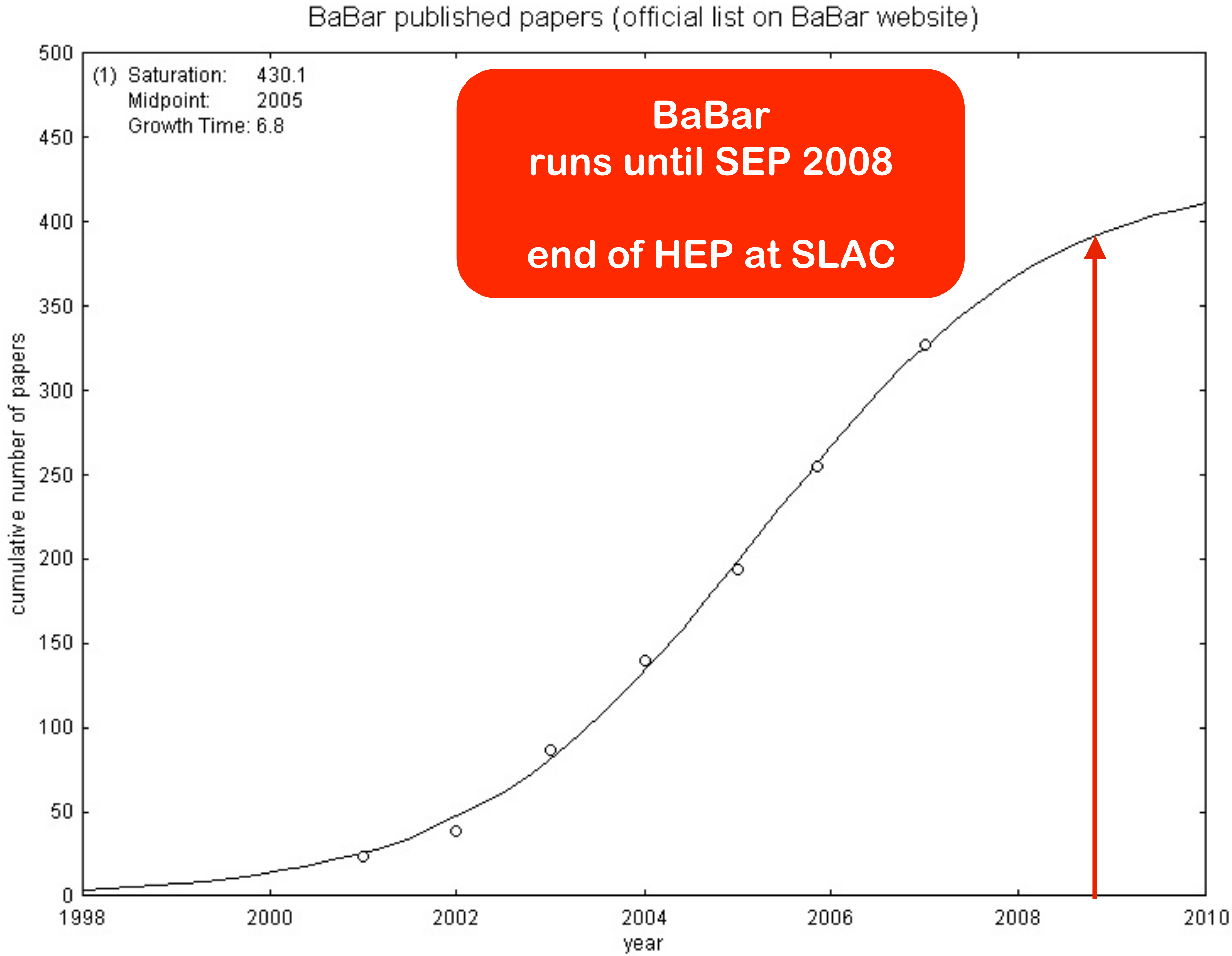
M 29-APR: $\kappa(730)$, JINR bubble chamber

B 25-MAR: $?_c$ (2940), BaBar

M 20-FEB: confirm Y(4260) found by BaBar, CLEO

USA, Japan, Russian Federation; not much in W. Europe


CDF papers from SPIRES: find exp FNAL-E-0830 and PS P and date < ...
(1) Saturation: 290.0
Midpoint: 2004
Growth Time: 3.5
CDF
cumulative number of papers
year
300
250
200
150
100
50
0
1998
2000
2002
2004
2006
2008
2010


BaBar published papers (official list on BaBar website)
(1) Saturation: 430.1
Midpoint: 2005
Growth Time: 6.8
BaBar
runs until SEP 2008
end of HEP at SLAC
cumulative number of papers
year
0
50
100
150
200
250
300
350
400
450
500
1998
2000
2002
2004
2006
2008
2010

The European strategy for particle physics

Particle physics stands on the threshold of a new and exciting era of discovery. The next generation of experiments will explore new domains and probe the deep structure of space-time. They will measure the properties of the elementary constituents of matter and their interactions with unprecedented accuracy, and they will uncover new phenomena such as the Higgs boson or new forms of matter. Long-standing puzzles such as the origin of mass, the matter-antimatter asymmetry of the Universe and the mysterious dark matter and energy that permeate the cosmos will soon benefit from the insights that new measurements will bring. Together, the results will have a profound impact on the way we see our Universe; *European particle physics should thoroughly exploit its current exciting and diverse research programme. It should position itself to stand ready to address the challenges that will emerge from exploration of the new frontier, and it should participate fully in an increasingly global adventure.*

General issues

1. European particle physics is founded on strong national institutes, universities and laboratories and the CERN Organization; *Europe should maintain and strengthen its central position in particle physics.*

2. Increased globalization, concentration and scale of particle physics make a well coordinated strategy in Europe paramount; *this strategy will be defined and updated by CERN Council as outlined below.*

Scientific activities

3. The LHC will be the energy frontier machine for the foreseeable future, maintaining European leadership in the field; *the highest priority is to fully exploit the physics potential of the LHC, resources for completion of the initial programme have to be secured such that machine and experiments can operate optimally at their design performance.* A subsequent major luminosity upgrade (SLHC), motivated by physics results and operation experience, will be enabled by focussed R&D; *to this end, R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015.*

4. In order to be in the position to push the energy and luminosity frontier even further it is vital to strengthen the advanced accelerator R&D programme; *a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility.*

5. It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assessment by Council around 2010.*

6. Studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012; *Council will play an active role in promoting a coordinated European participation in a global neutrino programme.*

7. A range of very important non-accelerator experiments take place at the overlap between particle and astroparticle physics exploring otherwise inaccessible phenomena; *Council will seek to work with ApPEC to develop a coordinated strategy in these areas of mutual interest.*

8. Flavour physics and precision measurements at the high-luminosity frontier at lower energies complement our understanding of particle physics and allow for a more accurate interpretation of the results at the high-energy frontier; *these should be led by national or regional collaborations, and the participation of European laboratories and institutes should be promoted.*

9. A variety of important research lines are at the interface between particle and nuclear physics requiring dedicated experiments; *Council will seek to work with NuPECC in areas of mutual interest, and maintain the capability to perform fixed target experiments at CERN.*

10. European theoretical physics has played a crucial role in shaping and consolidating the Standard Model and in formulating possible scenarios for future discoveries. Strong theoretical research and close collaboration with experimentalists are essential to the advancement of particle physics and to take full advantage of experimental progress; *the forthcoming LHC results will open new opportunities for theoretical developments, and create new needs for theoretical calculations, which should be widely supported.*

European labs did not contribute much to the 4th wave, and do not consider hadron spectroscopy for the future, apart from...

use of resources while maintaining European capabilities.

13. Through its programmes, the European Union establishes in a broad sense the European Research Area with European particle physics having its own established structures and organizations; *there is a need to strengthen this relationship for communicating issues related to the strategy.*

Panda Homepage
http://www-panda.gsi.de/auto/_home.htm
panda gsi
Address Book 6.dcssb TOTEM FFP8 Particle Physics PhysicsTL dfs sort out read CERN DCS PM
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Antiproton Annihilation at Darmstadt at the High Energy Storage Ring at GSI -
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GSI Wiki
Computing Wiki
Hadron Forum
Panda Webmaster
The panda Experiment at GSI
An Experiment at FAIR
"Facility of Antiproton and Ion Research"
Technical Progress Report (Feb 2005, 395 pages, 46 MB, pdf)
Collaboration Meeting December 11-15, 2006 at GSI
Panda
2012
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J-PARC | Nuclear and Particle Physics Facility

http://j-parc.jp/NuclPart/index_e.html

Address Book ▾ sort out ▾ Rainwater RadarEU TS ▾ AccWatch Yock ▾ FP7 ▾ NZ ▾ RPvsLHC ▾ Conf07 ▾

J-PARC

Japan Proton Accelerator Research Complex

Nuclear and Particle Physics Facility

- HOME
- Japanese
- Nuclear and Particle Physics Facility
- Materials and Life Science Facility
- Accelerator-Driven Transmutation Experimental Facility
- Accelerator

What's News

μ

Program Advisory Committee (PAC) for Nuclear and Particle Physics Experiments at the J-PARC 50GeV Proton Synchrotron, 4th meeting, Mon 07 – Wed 09 January, 2008

New proposals should be submitted by November 30, 2007.

Overview

Overview: J-PARC Nuclear and Particle Physics Facility

- Nuclear Physics and Particle Physics are the scientific research to investigate the origin of matter in the extremely small scale.
- The 50GeV Proton Synchrotron is the accelerator that opens great opportunities for the research.

2008 ->

why

is hadron spectroscopy

relevant

?

is it because
particle physics is
schizophrenic*
?

[*] as suggested in a previous talk
by Mohammed El Naschie

atomic physics timeline

CHEMISTRY
1808 Dalton: chemistry is atomic

TAXONOMY
1869 Mendeleyev: periodic table

ENERGY LEVELS
1885 Balmer: spectral rules
1890 Rydberg: extended spectral rules

CONSTITUENTS
1987 Thomson: electron

MODEL
1907 Lenard: model with (+,-) charges
1904 Nagaoka: planetary model
1913 Bohr: model of the H atom

THEORY
1925 Heisenberg: matrix (QM)
1926 Schroedinger: equation (QM)
1926 Schroedinger: H atom
1927: Heitler and London, quantum theory explains chemical bonding
1928 Dirac: equation

particle physics timeline

CHEMISTRY
1963 quark-based CKM: accurate, but mixed-up

TAXONOMY
1961 SU(X) multiplets: plausible but incomplete

ENERGY LEVELS (MASSES)
lots of data, but no rules:
1962-64 GMO and 1962 Chew-Frauschi plot,
m^2 rules (?), no longer quoted by the PDG

CONSTITUENTS
1969 partons (.. = quarks, undeconfinable)

MODEL
1964 quark "model" evolved from taxonomy, clunky

THEORY
197x, blessed in 2004: perfect, but ...

? ?

current situation:

- big projects late or in trouble
- signs of saturation
- cognitive timeline is paradoxical

but

- many new unexpected hadrons

time for a change of paradigm?

suggestions:

- invest in hadron spectroscopy
- measure masses and lifetimes precisely

- study hadron systematics
- try out new models
- understand Cabibbo K M
- ..

the current situation in particle physics:

we know quite a lot,

but we understand very little!

Thank You
and
Good Luck
!