

Sciencewatch

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Isotopes reveal dinosaur temperatures

In the debate over whether dinosaurs were cold- or warm-blooded (more correctly, took their temperature from the environment or not) it would be nice if there were some way of finding out what their body temperatures were. Amazingly, it turns out that there is. Robert A Eagle of Caltech and colleagues were able to make use of the fact that ^{13}C and ^{18}O isotopes preferentially bind to each other by an amount that depends on temperature. In particular, the precise amount of such binding in the carbonate in bones depends on the temperature at which they were

formed: the higher the temperature, the less this isotopic combination is present.

The researchers find that body temperatures of large Jurassic sauropods must have been $36\text{--}38^\circ\text{C}$ – similar to that of modern mammals and some $4\text{--}7^\circ\text{C}$ lower than predicted by models based on the scaling of temperature with mass for “cold”-blooded creatures. (They are in fact expected to be rather warm because of their large size and the associated difficulty in getting rid of heat.)

● Further reading

Robert A Eagle *et al.* 2011 *Science* **333** 443.



Jurassic sauropods such as *Diplodocus* could have had temperatures similar to modern mammals. (Image credit: Mr1805/Dreamstime.)

Towards a fountain of youth?

Everyone is gradually getting older, and yet the cells that go into reproduction somehow have to be set to a youthful state to make offspring – no matter how old the parents are. Now, Angelika Amon of Massachusetts Institute of Technology and colleagues have made a remarkable discovery in spores from young and old yeast cells: they both turn out to be free of the protein clumps and DNA fragments that characterize older cells.

A gene, *NDT80*, is activated during sporulation and, remarkably, if it is turned on in ageing cells then their lifespan doubles. It is early days but the discovery gives food for thought that, one day, researchers may not just slow down ageing but even manage to turn back the clock.

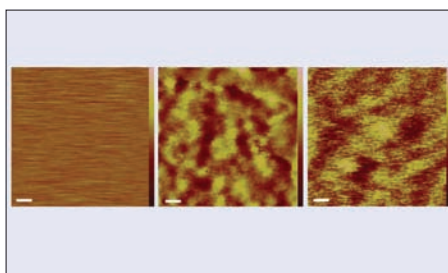
● Further reading

E Ünal *et al.* 2011 *Science* vol **332** 1554.

How things charge up

Put two different dielectrics in contact and then pull them apart, and they become oppositely charged, as in the classic example when an ebonite rod is rubbed with cat fur. Despite this being something done in the most elementary of electromagnetism lectures, there is actually very little known about what exactly goes on. Now, HT Baytekin and colleagues of Northwestern University in Illinois have shown that it is much more complicated than one might have thought.

Far from there being nearly uniform charge distributions, each piece of material comes away with a random mosaic of positively and negatively charged nanoscale



These potential maps show the mosaic result of contact electrification. The map at the left corresponds to a $4.5\text{ }\mu\text{m}$ square of dielectric material before contact electrification. The others show surfaces after contact-charging in two different ways; both feature a mosaic of + (light) and – (dark) regions.

areas. Although there is a net charge difference, there is far more net charge per unit area than anyone had ever imagined. Exactly what is going on is, at present, far from clear, so there is still much to be learnt – even in this seemingly simple phenomenon.

● Further reading

HT Baytekin *et al.* 2011 *Science* **333** 308.

Making a new genetic code

The use of genetically engineered organisms to produce proteins has so far been limited by the need to work within the standard genetic code (based on triples of letters C, T, A and G) found in nature. However, Farren Isaacs of Yale University and colleagues have found a way to rewrite it as they please.

Each three-letter combination of TAG or TAA represents “stop”, with the others coding for amino acids. By replacing all

Metamaterials for wireless power

Metamaterials have found many kinds of low-power applications for exotic devices, such as superlenses and invisibility cloaks, but it seems that they might be of help at the scale of many watts in removing the last cable from the ubiquitous laptop. Bingnan Wang of Mitsubishi Electric Research Laboratories in Cambridge, Massachusetts, and colleagues have shown that a panel constructed of metamaterial can vastly improve the coupling between resonators for wireless power transfer.

Powering a 40 W bulb from half a metre away, while putting a metamaterial grid of copper spirals between the source and receiver, boosted the efficiency of power transfer from 17% to 47%. This could represent a big step in finally having truly wireless (even for the power) consumer electronics.

● Further reading

Bingnan Wang *et al.* 2011 *Appl. Phys. Lett.* **98** 254101.

of the TAG stop codons in *E. coli* bacteria with TAA, they effectively freed up the TAG combination to be able to code for another amino acid. This opens up the possibility of engineering organisms that make proteins never before seen. These new organisms would act like alien life forms – immune to existing viruses and unable to mix their DNA with other organisms.

● Further reading

Farren J Isaacs *et al.* 2011 *Science* **333** 348.

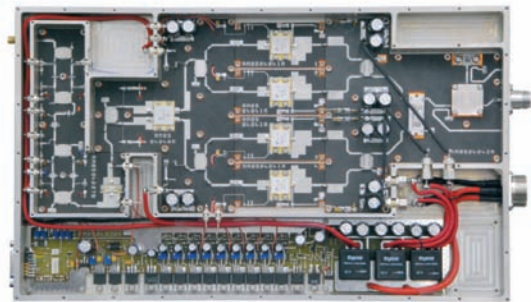
RF Power Amplifiers

Booth #1
IPAC 2011

Amplifiers for HEP applications – Klystron & IOT drivers, Buncher & Cooling PA's

Solid-state LDMOS, GaN & GaAs FET power amplifiers:

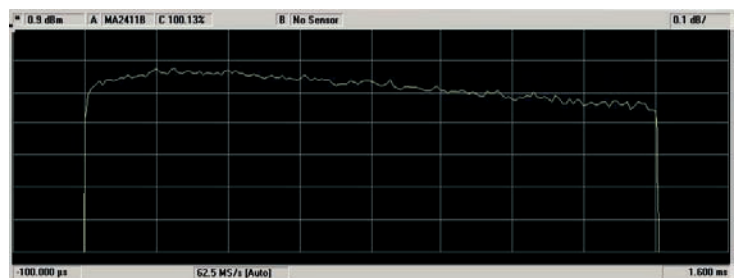
- High efficiency LDMOS, GaN & GaAs FET designs
- Pulsed power & CW models
- Output power to 4kW
- Low distortion
- High amplitude & phase stability
- Fast response times



Solid state designs offer advantages principally in terms of amplitude and phase stability as they are unaffected by the high voltage power supply variations affecting Klystrons and IOTs. Particularly so when an SSPA is used to drive electrically short IOTs, since system phase pushing and amplitude sensitivity is much reduced in comparison with higher gain Klystrons. The overall flexibility the SSPA offers in terms of frequency, amplitude and phase control, coupled with reliability factors including graceful degradation and a hot switching ability, make the use of SSPAs increasingly attractive in HEP RF system design.



AM86 1kW 1.3GHz PA



Typical 1.6ms 1kW pulse @ 1.3GHz

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