

time-symmetric.) Because in this scenario the overall entropy is unbounded, baby universes can always form as a means to increase the total entropy, and we just happen to live in one of them and experience its local arrow of time.

Although this may be a consistent scenario, the picture is still very much rooted in classical physics. In earlier chapters, the author has presented an excellent and detailed discussion of quantum theory and the Everett interpretation, so I wonder why he seems to have forgotten this in the last part of the book. If one looks for a quantum wave equation that gives Einstein's equations in the semiclassical limit, one immediately finds the Wheeler–DeWitt equation of quantum gravity, as briefly mentioned elsewhere in the book. This

equation has astonishing features. It is timeless in the sense of being devoid of any external time parameter. It instead contains an intrinsic time-like variable that can be constructed from the size of the (spatial) Universe. And it is highly asymmetric with respect to this intrinsic time. In typical semiclassical situations, an approximate time parameter can be recovered, which is correlated with the size of the Universe. The equation thus offers by its very mathematical structure the means to explain the arrow of time. For example, what would constitute a Big Bang and a Big Crunch in a classical model would correspond to the same range of arguments for the Wheeler–DeWitt equation, just describing a small Universe. A Big Bang and a Big Crunch would in terms of quantum gravitation be the same,

and there would be no need to make a distinction between boundary conditions for one and the other.

Despite this being a speculative scenario, I feel it is more conservative than the multiverse and baby universe scenarios, and it is consistently quantum. At least it would have deserved to be mentioned. This minor critique notwithstanding, *From Eternity to Here* is a fine book written in clear and entertaining language that is compulsory reading for anyone who is interested in the mysteries of the direction of time. □

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Science without walls

EXHIBITION

Since its inception in 2008, the World Science Festival set in and around New York City has attracted more than 300,000 visitors. Similarly, this year's programme, which runs from 2–6 June, will no doubt draw large crowds — not least owing to the recent media attention surrounding the Large

Hadron Collider, or the Hubble Space Telescope that turned 20 back in April.

Programmes will cover all areas of science and will make use of all available media formats, including technology being developed by the MIT Media Lab. Tod Machover — whose new technologies for music, such as Hyperinstruments, are appreciated by professional musicians and *Guitar Hero* players alike — and Marvin Minsky, the artificial-intelligence guru, are working on a new opera, *Death and the Powers*, opening in Monaco in September 2010. It features a chorus of robots. Intrigued? There will be a sneak preview in New York during the World Science Festival.

The opening gala includes the premiere of a film adaptation of festival co-founder Brian Greene's book for children, *Icarus at the Edge of Time*, about a boy who approaches a black hole. But it's more than a film. There's also a live narrator (John Lithgow) and a 62-piece orchestra playing an original score by Philip Glass.

Of the 40 scheduled events, several are free. One of the most visually impressive may be the full-scale model of the



Images courtesy of (clockwise from top left): Leo Caillard for World Science Festival; iStockphoto © Pavel Gaul; Robert Leslie for World Science Festival; and Julieta Cervantes.

James Webb Space Telescope, due to be launched in 2014 as the successor to Hubble. Set in Battery Park, the tennis-court-sized telescope will be accompanied by scientists, interactive exhibits and videos. Visitors are even encouraged to bring their own telescopes on Friday 4 June for a star party.

Such festivals bring science and scientists out of the laboratory and are hugely successful in showing the general public that science is not 'out there' but is in fact everywhere. □

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