SIR — It has recently been noted[1] that a large variety of observations constrain cosmological models to a narrow range of 'concordant' parameters. Though a universe with a density parameter of $\Omega_0 = 1$ is excluded, the theoretically desirable quality of flatness can be retained with a finite cosmological constant λ. The effective contribution to the density made by a cosmological constant is $\Lambda_0 = \lambda/3H_0^2$, so models with $\Omega_0 + \Lambda_0 = 1$ have globally flat geometries.

As Einstein's 'greatest mistake', λ has historically been considered undesirable. It is currently invoked to salvage a flat geometry, and thereby non-contrived inflationary scenarios, by considerably extending the age of the universe. This addresses the most difficult constraint: the age problem. The oldest known stars appear to considerably exceed the age of the universe in which they reside. These stars are thought[2] to have ages $T_* = 16 \pm 2$ Gyr. In the absence of a cosmological constant, current estimates of the expansion rate of the universe[3,4] ($H_0 \approx 75$ km s^{-1}Mpc^{-1}) result in an age $T_U = 13$ Gyr for a completely empty $\Omega_0 = 0$ universe and $T_U = 9$ Gyr for a flat one with $\Omega_0 = 1$. Hence $T_U(\Omega_0 = 1) \approx \frac{1}{2}T_*$! Unless some gross systematic error is responsible (certainly a possibility), statistical analyses[5] give $\lesssim 6\%$ chance for this to occur.

The cosmological constant cures this ill by overwhelming the gravitational attraction of the universe's material contents to *accelerate* its expansion. This is quantified by the deacceleration parameter $q_0 = \frac{1}{2}\Omega_0 - \Lambda_0$. The parameters required by the concordant models are $\Omega_0 \approx 0.3$ and $\Lambda_0 \approx 0.7$, so $q_0 \lesssim -\frac{1}{2}$. Measurements of q_0 thereby provide an additional constraint. Though the many efforts to determine q_0 have not absolutely distinguished between $q_0 = 0$ and $+\frac{1}{2}$, I am not aware of any that have suggested such a very negative value. If $q_0 > 0$ in a flat universe, $\Omega_0 > 2\Lambda_0$ rather than $\Omega_0 < \frac{1}{2}\Lambda_0$.

In addition to increasing the age of the universe, the cosmological constant increases its observable volume. This is not indicated by the statistics of gravitational lensing[6] or by deep K-band galaxy counts[7]. Though these measurements probably do not yet firmly rule out a finite λ/negative q_0, reconciling them appears to require additional fiddling. One possible fiddle is to suppose that we reside in a region of abnormal density so enormous that it calls into question the assumption of homogeneity on which cosmological models are based. Indeed, nearly all such models are ruled out **IF** $q_0 > 0$ and **IF** we believe all the other constraints[1]. Though it may be tempting to ignore some subset of the data, Ostriker & Steinhardt point out that several measurements would need to change in a related way in order to achieve a flat universe with $\Lambda_0 = 0$. Thus we must abandon flatness and perhaps inflation, or tweak a lot of the data. An open model with $\Omega_0 = 2q_0 \approx 0.3$ is suggested by most direct measurements of these parameters, and requires 'only' a $\sim 2\sigma$ decrease in T_* or H_0. If some other constraint disallows[1] this, no standard model formally remains.

The essence of the problem is that one needs to increase the age of the universe without substantially increasing its volume. It would be interesting if an inhomogeneous solution of the Einstein equations or some other alternative could endow a viable cosmological model with this property.

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