Paper-and-pencil cosmological calculator

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A cosmological calculator is usually a program which computes relations between redshift, distance, physical and angular sizes, luminosity and apparent magnitude for some cosmological model characterized by a convenient set of parameters such as the Hubble constant at present, H_0, the dimensionless matter and dark energy densities Ω_m and Ω_Λ. Several on-line calculators are available at NASA NED web site (http://ned.ipac.caltech.edu/help/cosmology_calc.html). Although these calculators are ready to use, there are situations when there is no the Internet or a PC at hand. Online calculators also may be not enough vivid to use them in education since they usually calculate the answer only for a single input redshift. One solution to these two problems is a calculator based on the nomogram method.

The proposed paper-and-pencil calculator is designed for the ΛCDM cosmological model with recent cosmological parameters from the Planck mission: $H_0 = 67.15$ km/s/Mpc, $\Omega_\Lambda = 0.683$ and $\Omega_m = 0.317$ [1]. The calculator contains the following quantities:

- z — redshift;
- H — current value of the Hubble constant, km/s/Mpc;
- r_comov — comoving distance, Mpc;
- dm — distance modulus;
- age — age of the Universe, Gyr;
- time — lookback time, Gyr;
- size 1" — physical size of an object which is seen as an 1" arc on the sky, kpc;
- angle 1kpc — angular size of a rod with physical size 1 kpc, arcsec.

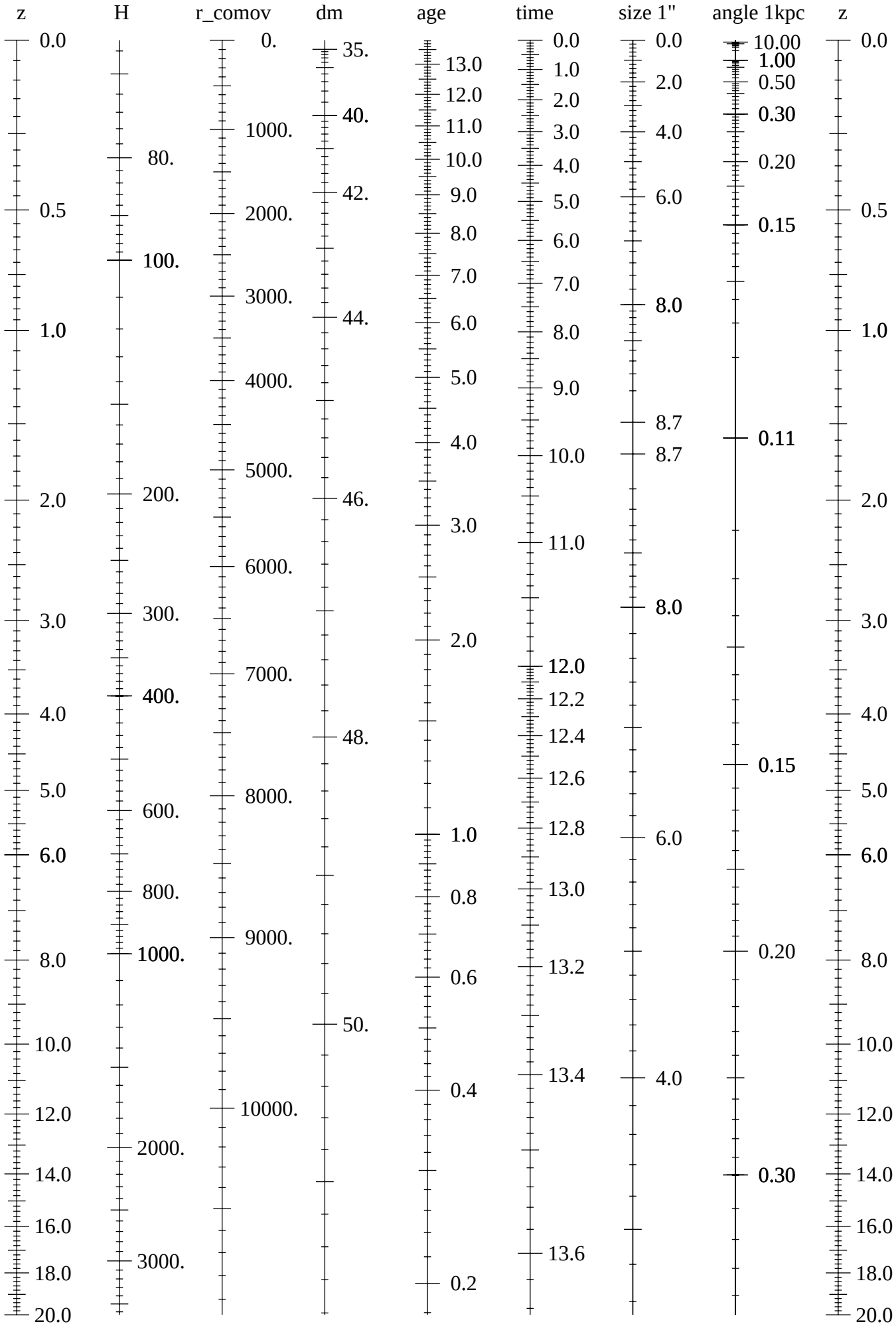
In order to use the calculator, one needs to find a known value on a respective vertical scale. All the other values are situated on the same horizontal level. For the comfort of using a ruler, the redshift scale is repeated twice. The calculators are available for three redshift intervals: $z < 20$, $z < 1$, $z < 0.1$. The space between major (labelled) tics on each vertical scale is always divided into ten equally-spaced intervals of the denoted value.

The code used to produce these calculators is public available and can be found at http://code.google.com/p/cosmonom/

References

[1] Planck collaboration XVI, 2013, submitted to A&A, arXiv:astro-ph/1303.5076

H0 = 67.15, OLambda = 0.683, Om = 0.317



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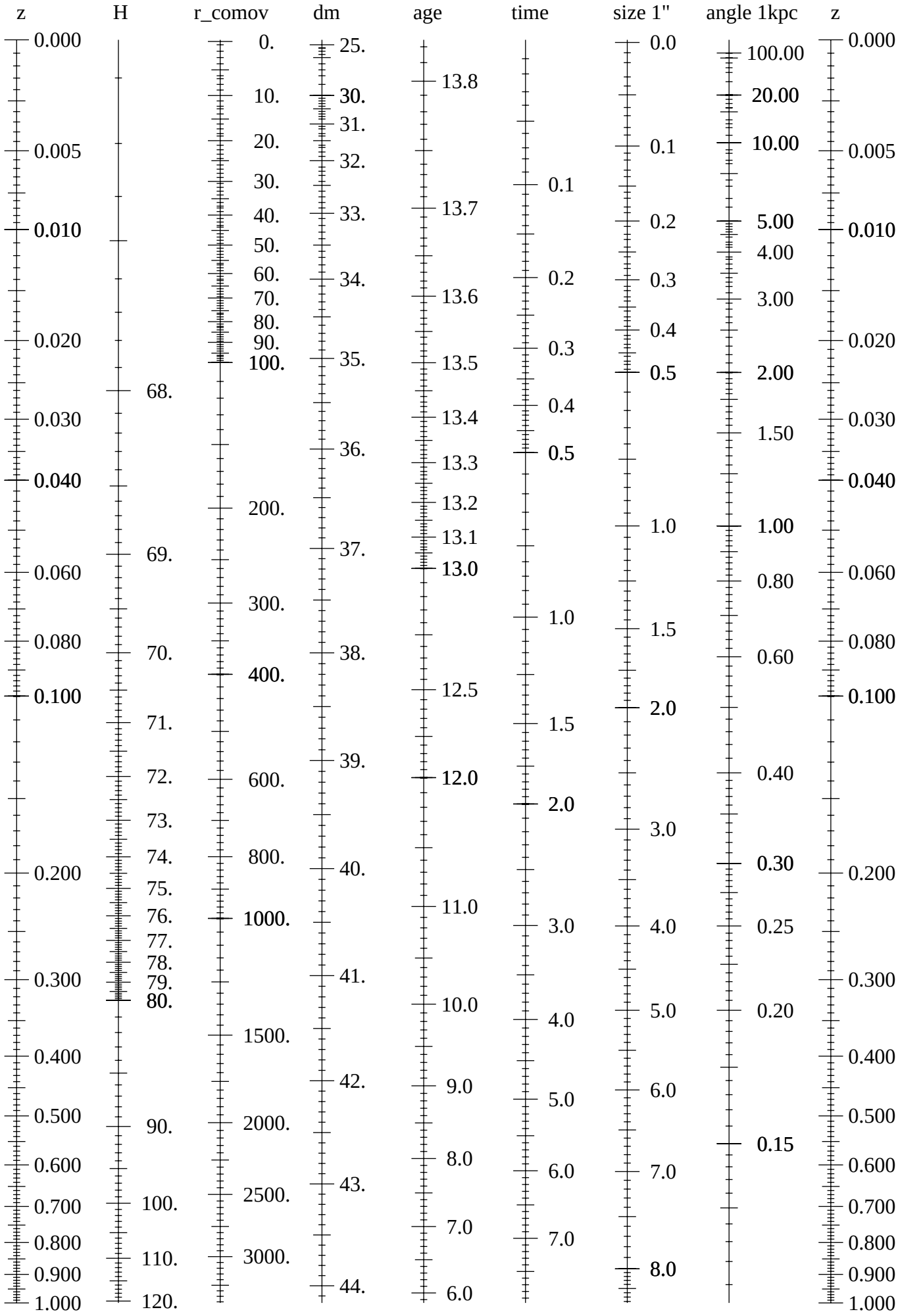
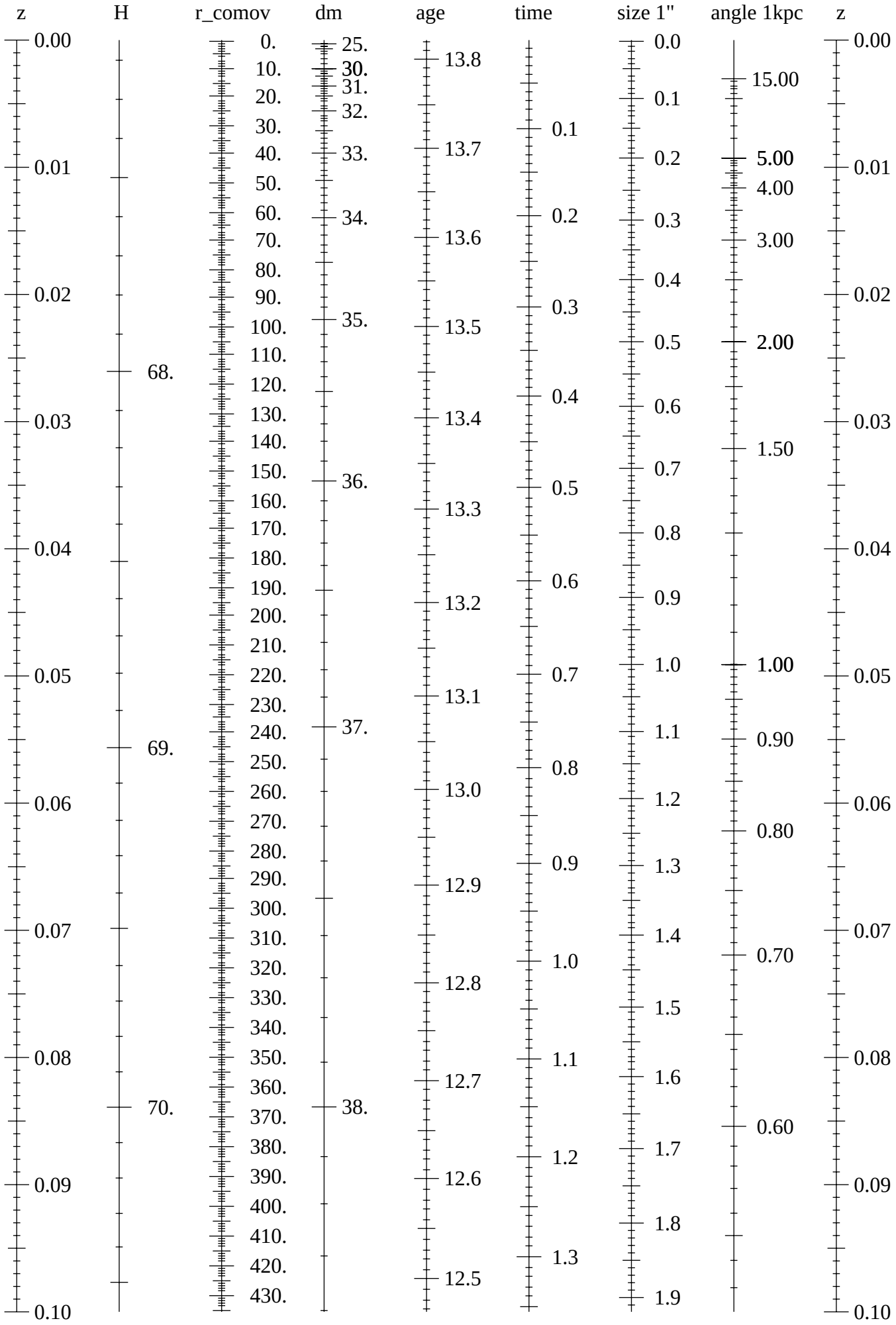
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