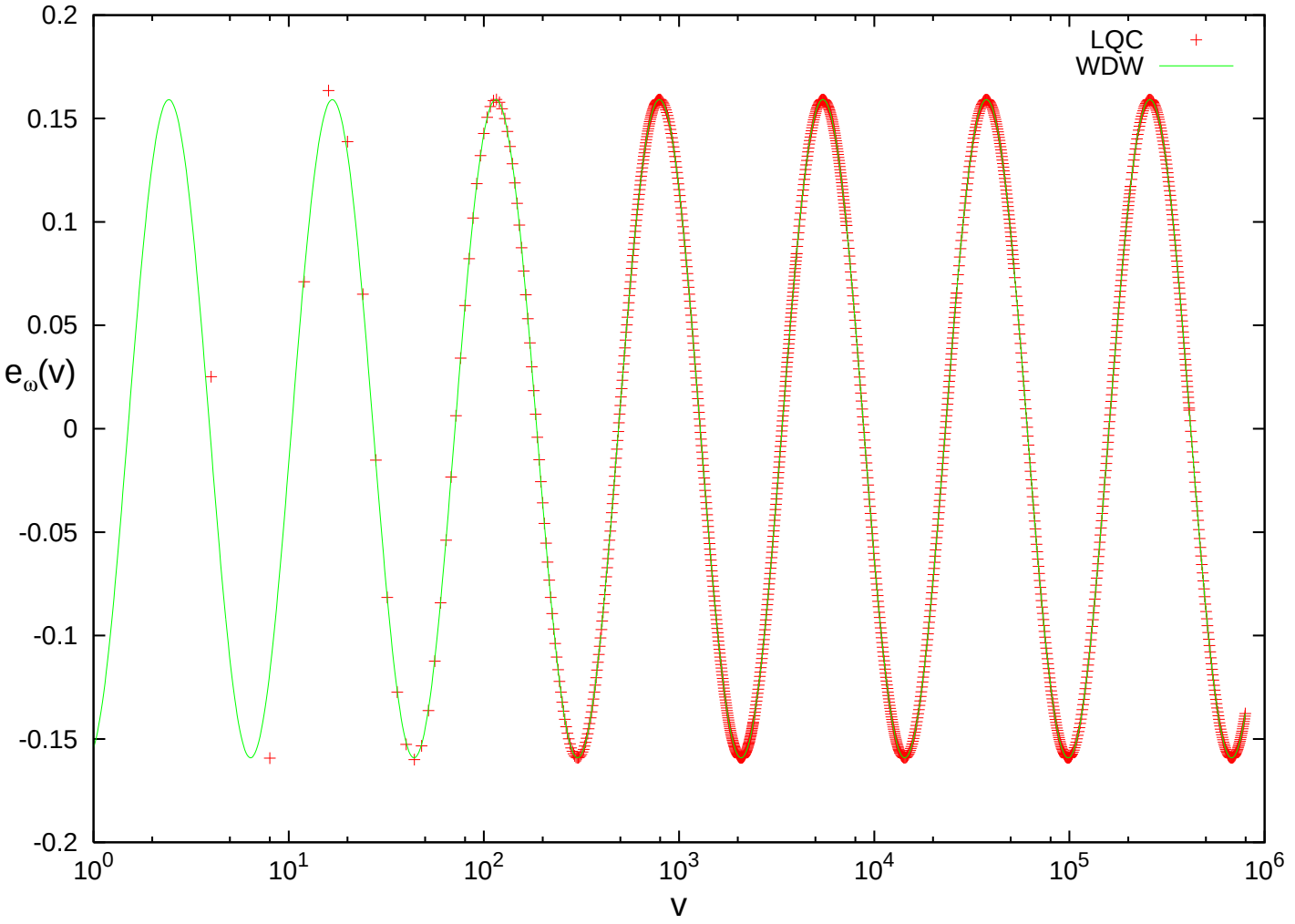
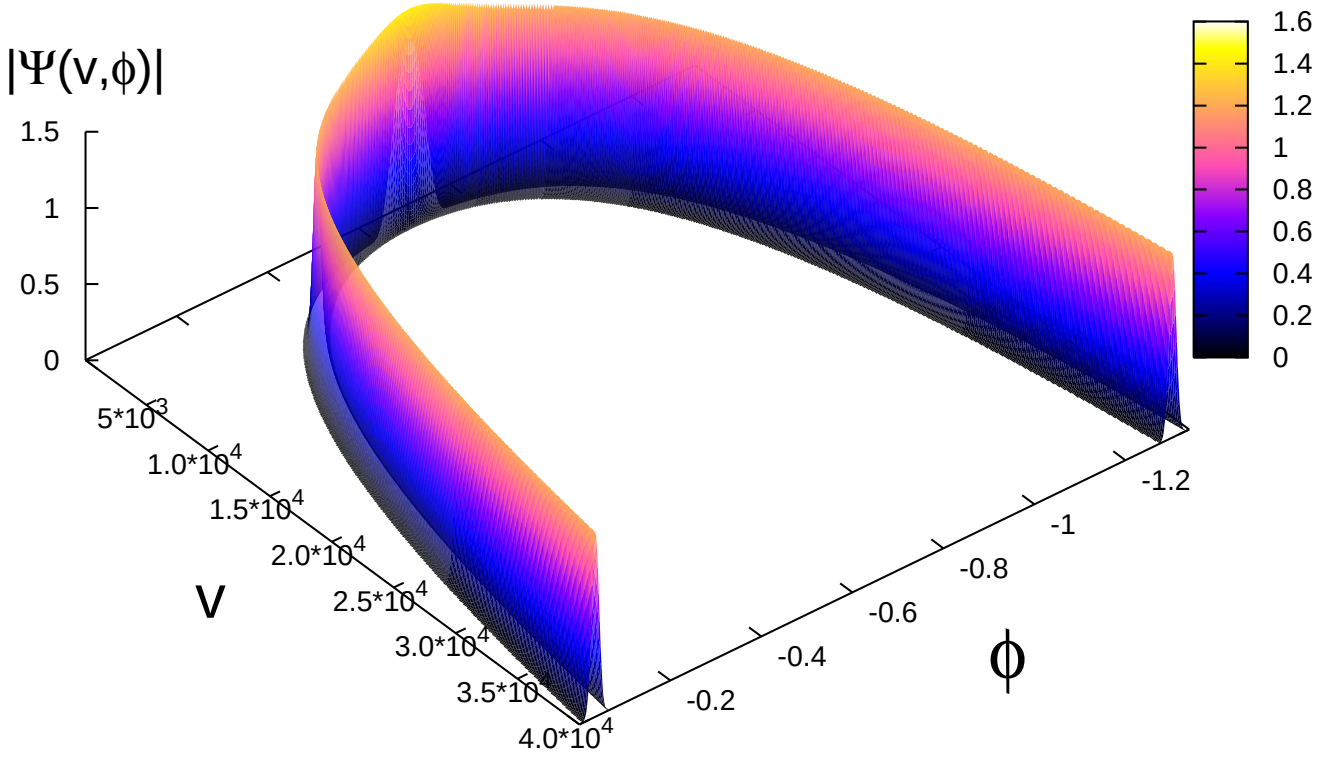
Plots for the LQC lecture in QGQG3

Eigenfunctions

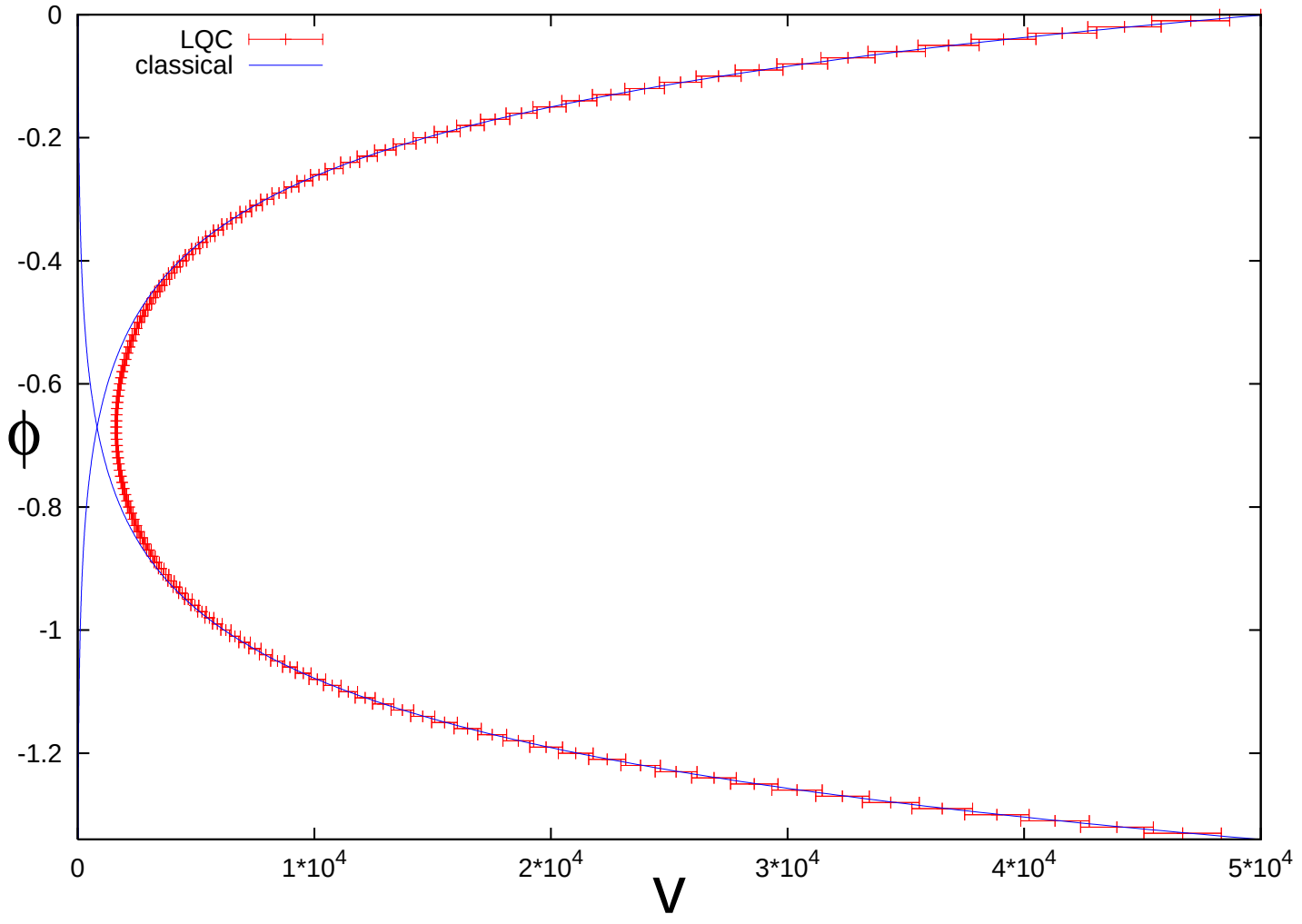


Plot of wavefunction

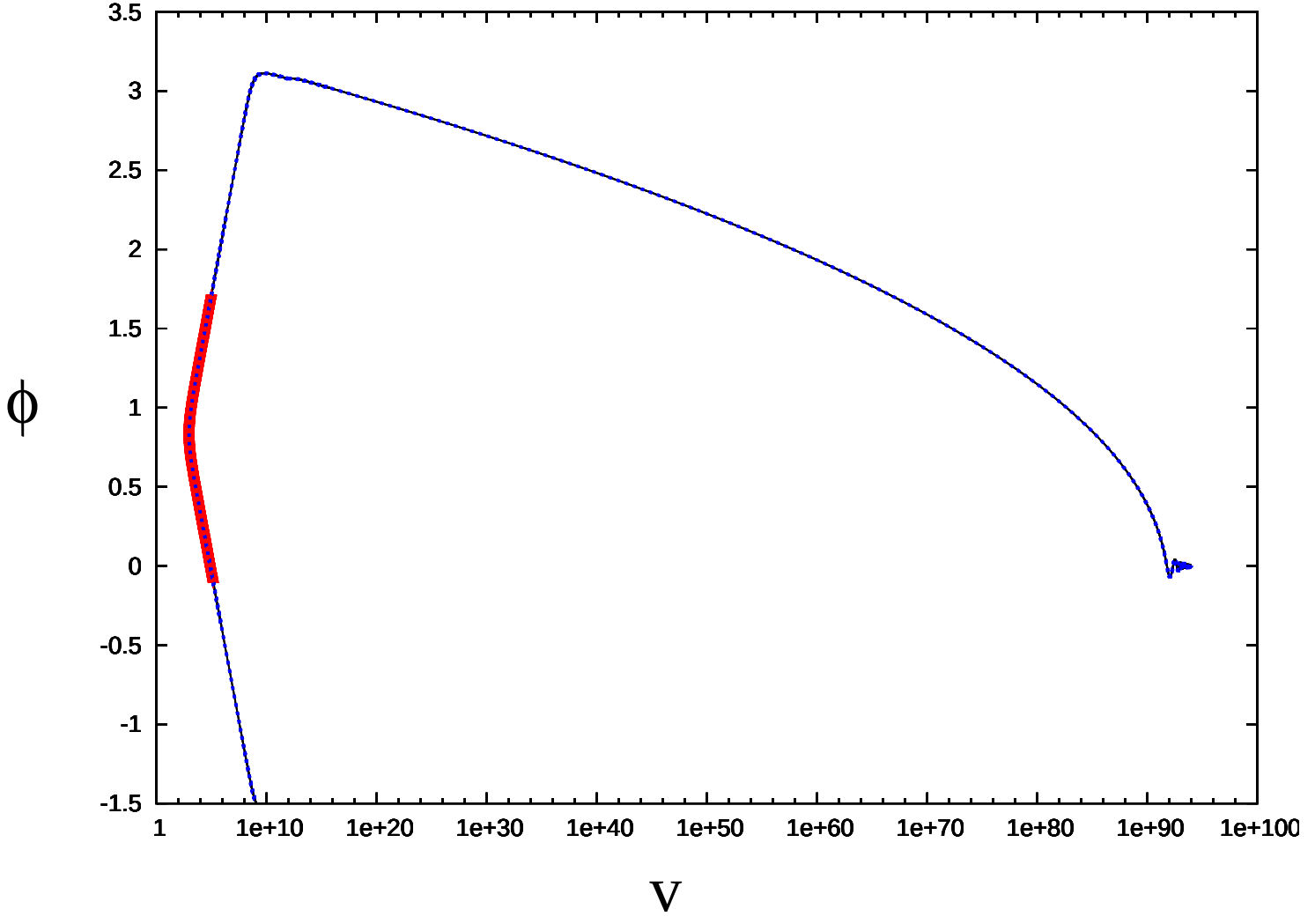
Initial data specified at $\phi = \phi_o$ for $\Psi(v, \phi_o)$ and $\partial_\phi \Psi|_{\phi_o}$ corresponding to a large value of $p_\phi = p_\phi^\star$ at late times.



Quantum Evolution

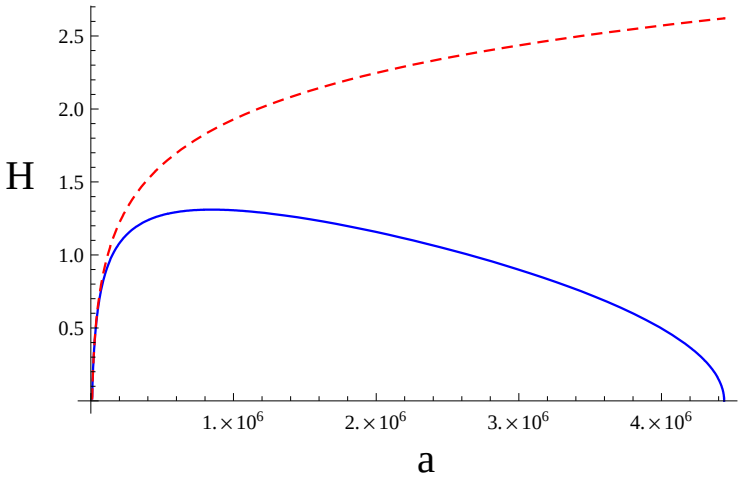


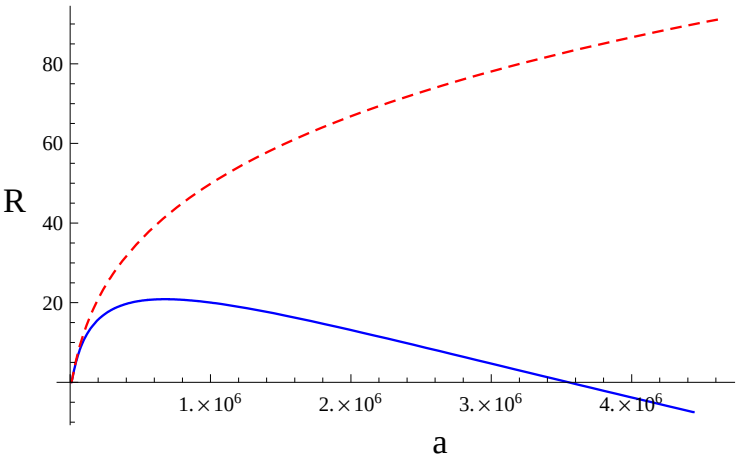
Inflationary potential



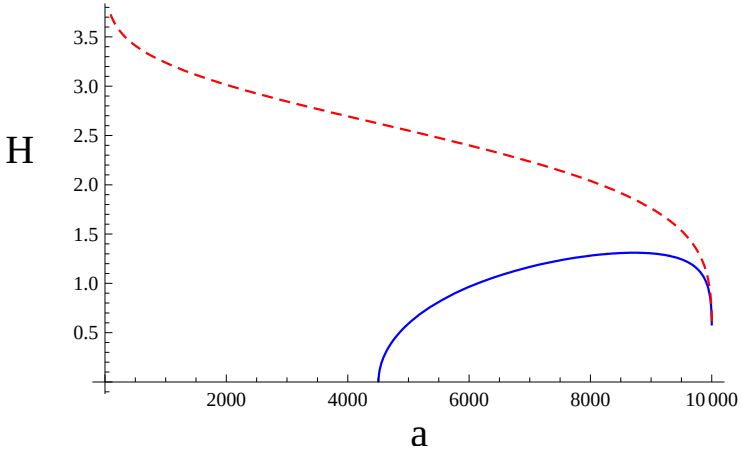
Singularities other than Big Bang/Big Crunch

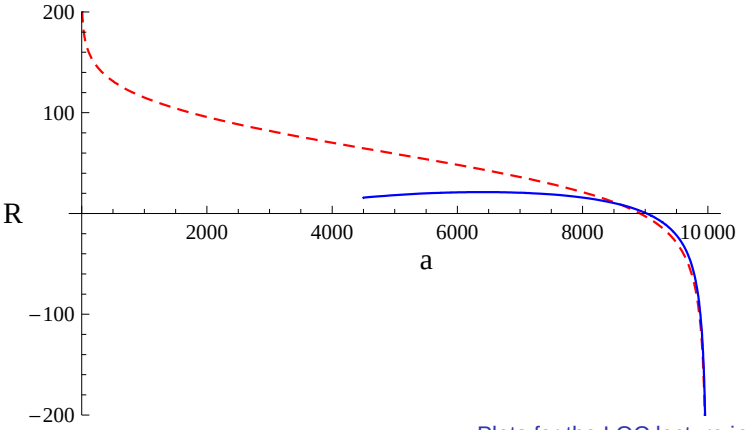
Big Rip is resolved in LQC





Sudden singularities are ignored since they are weak and geodesics can be extended in LQC





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Any physical singularities in LQC?

– It turns out that suddeen singularities, which are just ignored by quantum geometry, are not physical singularities!

– These are not strong curvature singularities. Tidal forces not sufficient to cause complete destruction.

Geodesics can be extended beyond such events in GR as well as effective LQC.

$$t'^{\,2} = \epsilon + \frac{\chi^2}{a^2(t)}, \quad t'' = -H\,(t'^{\,2} - \epsilon)$$

Can geodesics be extended in general? Yes! (for flat and isotropic LQC).
There exist no strong curvature singularities in flat and isotropic LQC (similar results for spatially closed and open models)

A simple way to understand this is by inspecting geometrical entities such as expansion parameter of geodesics. It is always bounded in LQC. (An exclusive feature of improved quantization)

Leads to insights on more general spacetimes. For Bianchi-I model only one known quantization has expansion parameter and shear bounded!