In Situ Visualization - Coprocessing

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Klein Gordon Equation

$$\mathbf{u}_{tt} - \Delta\mathbf{u} + \mathbf{u} = |\mathbf{u}|^2\mathbf{u}$$

is relativistic wave equation, related to the Schrödinger equation.
assume periodic boundary conditions and exponentially decaying initial condition.

Picture

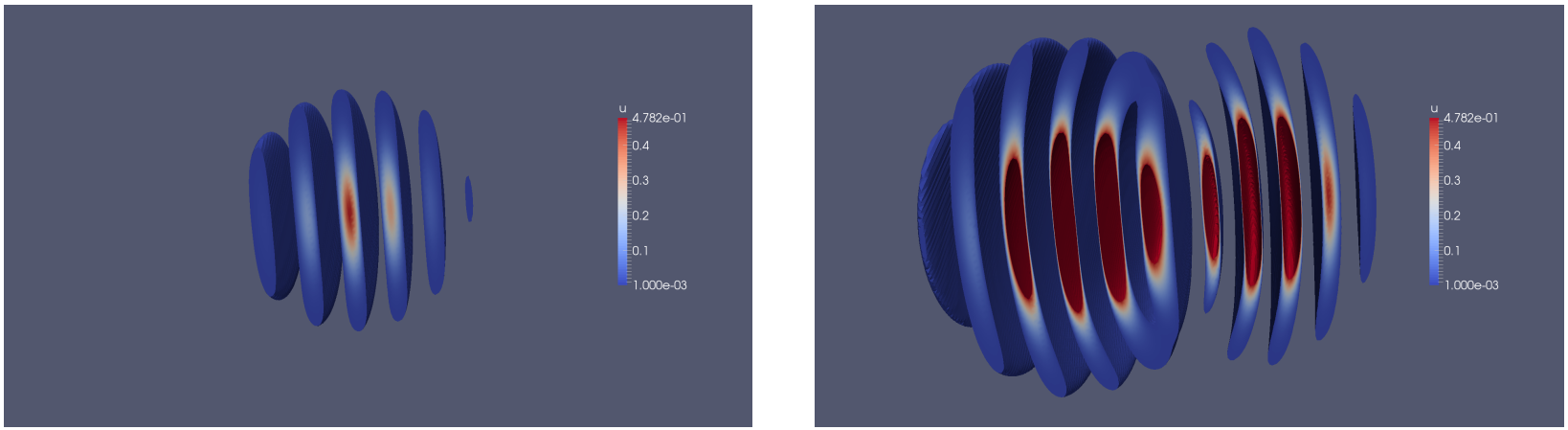
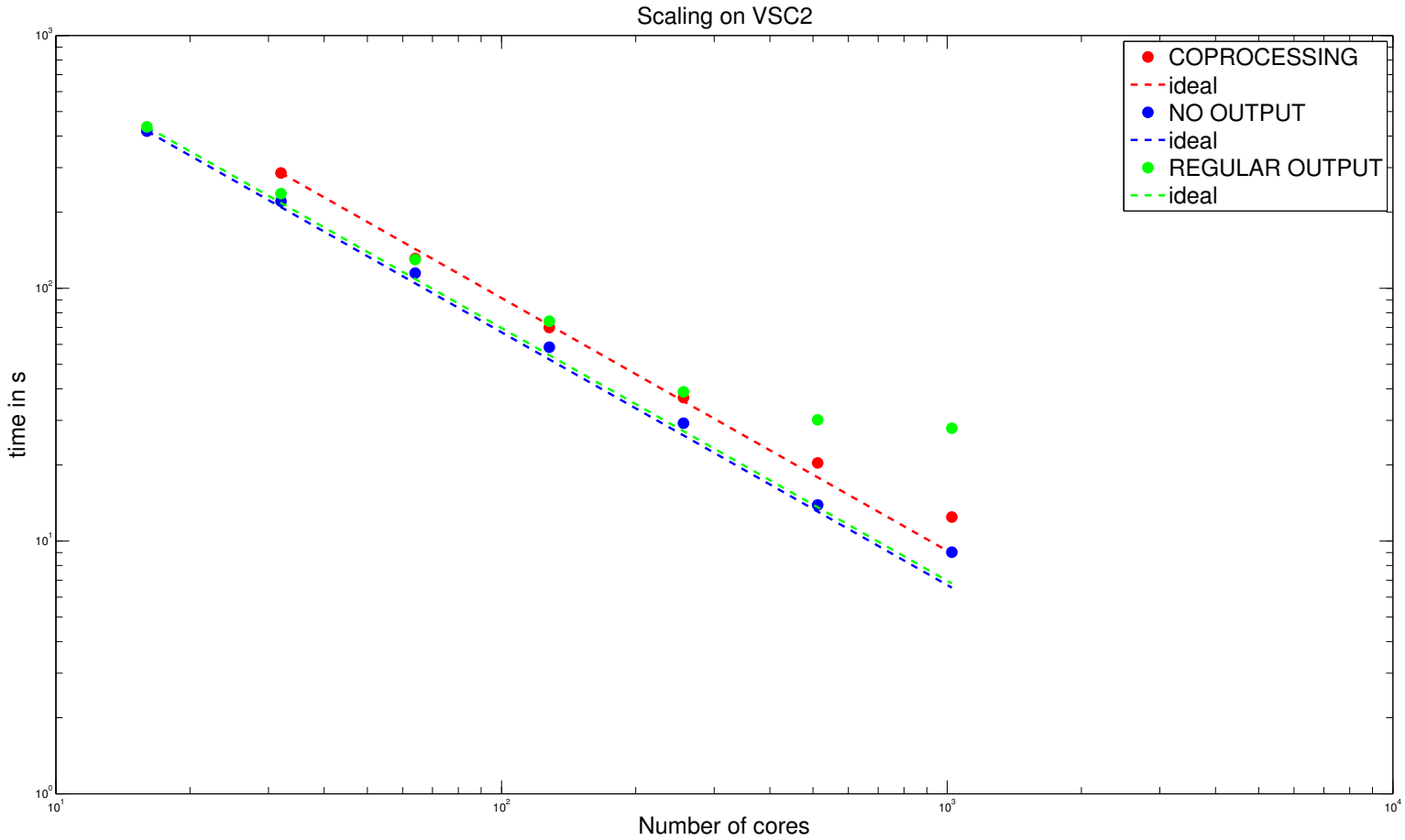


Figure: The images show propaganding of the initialcondidtion on a $[-3\pi, 3\pi]^3$ domain. Plots are at times = 0, 1. The timestep was 10^{-3} and resolution was 512^3.

Numerical Scheme

- $$\frac{u^{n+1} - 2u^n + u^{n-1}}{\delta t^2} - \Delta \frac{u^{n+1} + 2u^n + u^{n-1}}{4} + \frac{u^{n+1} + 2u^n + u^{n-1}}{4} = \left|u^n\right|^2 u^n$$
- $u^n \approx u(n\delta t, x, y, z)$
- Time stepping takes place in Fourier space
- Solution of linear system of equations is easy in Fourier space, though can also be done by iterative methods in real space
- Two FFTs per time step implemented using `2decomp&fft`

Why does scaling stop?



Analysis

- writing to disc can stop scaling
- high storage requirements
- scientists not interested in plain data
- Solution: Coprocessing!

Questions?