with $f(\pm \hat{A} dt) = e^{\pm i \hat{A} dt}$. **Input:** input vector $\vec{v} \in \mathbb{C}^N$; operator $\hat{A} \in \mathbb{C}^{N \times N}$; time step dt; **Output:** Approximation of propagated vector $\vec{w} = e^{-i\hat{A}dt}\vec{v} \in \mathbb{C}^N$

Algorithm 2 Chebychev-Propagator Evaluate $\vec{w} = f(\pm \hat{A} dt) \vec{v}$,

1: **procedure** Cheby (\vec{v}, \hat{A}, dt) $\Delta = \text{spectral radius of } \hat{A}$ 2:

$$\Delta = \text{spectral radius of } A$$

$$E_{\min} = \min \text{minimum eigenvalue of } \hat{A}$$

 $[a_0 \dots a_n] = \text{ExpChebyCoeffs}(\Delta, E_{\min}, dt)$ 4: $d = \frac{1}{2}\Delta; \beta = d + E_{\min}$ 5:

$$d = \frac{1}{2}\Delta; \ \beta = d$$

$$\vec{v_0} = \vec{v}$$

6:
$$\vec{v}_0 = \vec{v}$$

7: $\vec{w}^{(0)} = a_0 \vec{v}_0$
8: $\vec{v}_1 = \pm \frac{1}{2} (\hat{A} \vec{v}_0)$

$$\vec{v}_1 = \pm \frac{1}{d} \left(\hat{A} \vec{v}_0 - \beta \vec{v}_0 \right)$$

$$\vec{w}^{(1)} = \vec{w}^{(0)} + a_1 \vec{v}_1$$

9:
$$\vec{w}^{(1)} =$$

9:
$$\vec{w}^{(}$$
10: **fo**

14:

3:

10: **for**
$$i = \vec{v_i}$$

10: **for**
$$i = 11$$
: $\vec{v}_i = 11$

10: **for**
$$i = 2 : n$$
 do
11: $\vec{v}_i = \pm \frac{2i}{d} \left(\hat{A}i \right)$

10: **for**
$$i = 2$$
: 11: $\vec{v}_i = \pm$

10: **10:**
$$\vec{v}_i = \pm \frac{2}{a}$$
11: $\vec{v}_i = \pm \frac{2}{a}$

10: **for**
$$i = 2 : n$$
 do
11: $\vec{v}_i = \pm \frac{2i}{d} \left(\hat{A} \vec{v}_{i-1} - \beta \vec{v}_{i-1} \right) + \vec{v}_{i-2}$

$$ec{v}_i = \pm rac{2}{c}$$
 $ec{v}_i^{(i)} = v$

l:
$$ec{v}_i = \pm rac{2}{\sigma}$$

2: $ec{v}^{(i)} = ec{v}$

$$\vec{v}_i = \pm \frac{2}{a}$$
$$\vec{w}^{(i)} = \vec{u}$$

1:
$$\vec{v}_i = \pm \frac{2}{a}$$
2: $\vec{w}^{(i)} = \vec{u}$

11:
$$v_i = \pm \frac{1}{d} (Av_{i-1} - v_i)$$

12: $\vec{w}^{(i)} = \vec{w}^{(i-1)} + a_i \vec{v}_i$

12:
$$\vec{w}^{(i)} = \vec{u}$$
13: **end for**

$$ec{w}^{(i)} = ec{w}^{(i)}$$
 end for

- 15: end procedure

return $e^{\pm i\beta dt} \vec{w}^{(n)}$