Purpose:

- Illustrate WA-BPM based on Padè approximation of the propagation equation, combined with Crank-Nicolson discretization. Two approaches are to be compared in this work-package. Method in 'direct' relies on direct sparse-matrix solver, and two version of iterative method are implemented in 'iterative.'
- Illustrate memory usage. Memory required for one two-dimensional slice of a field amplitude is less than 2MB in this example. Yet, running program utilizing direct solver consumes some 900MB of memory... Memory usage is less with iterative solvers, especially when explicit usage of the linear system matrix is eliminated.
- An alternative to multistep method is "Padeization" of the beam propagator directly. An example of such an approach is also included in the "iterative version" of this exercise package.

Besides EP19-WA-BPM, the following package EP20-WA-BPM contains program examples illustrating wide-angle BPM methods.

Task 1:

Inspect implementations in the direct and iterative folders. Implement your own version, test it, and compare the performance of iterated and direct solver approach. In this case, we deal with two-dimensional (transverse) domain. A strongly diffracting Gaussian beam can be utilized for testing the implementation.

Task 2:

Implement two-dimensional rotated Gaussian beam, and initialize a simulation with a beam propagating at a large angle. Compare the resulting numerical solution with the analytic one.

Take-home message:

- Modification related to wide-angle regime are easy to implement provided library (Matlab in this case) supplies routines for operations with sparse matrices.
- Memory usage is an issue.
- Iterated solvers require an additional layer of accuracy control.
