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Global existence and blow-up for a space and time nonlocal reaction-diffusion equation.

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Summary: A time-space fractional reaction-diffusion equation in a bounded domain is considered. Under some conditions on the initial data, we show that solutions may experience blow-up in a finite time. However, for realistic initial conditions, solutions are global in time. Moreover, the asymptotic behavior of bounded solutions is analysed.

MSC:

- [35R11](#) Fractional partial differential equations
- [35B44](#) Blow-up in context of PDEs
- [35B50](#) Maximum principles in context of PDEs
- [26A33](#) Fractional derivatives and integrals
- [35K20](#) Initial-boundary value problems for second-order parabolic equations
- [35K57](#) Reaction-diffusion equations

Keywords:

Caputo derivative; fractional Laplacian; reaction-diffusion equation; global existence; blow-up

Full Text: [DOI](#) [arXiv](#)

References:

- [1] Abadias, L.; Alvarez, E., Uniform stability for fractional Cauchy problems and applications, *Topological Methods in Nonlinear Analysis*, 52, 2, 707-728 (2018) · [Zbl 1414.34003](#) · [doi:10.12775/TMNA.2018.038](#)
- [2] Acosta, G.; Borthagaray, J. P., A Fractional Laplace Equation: Regularity of Solutions and Finite Element Approximations, *SIAM Journal of Numerical Analysis*, 55, 2, 472-495 (2017) · [Zbl 1359.65246](#) · [doi:10.1137/15M1033952](#)
- [3] Ahmad, B.; Alhothuali, M. S.; Alsulami, H. H.; Kirane, M.; Timoshin, S., On a time fractional reaction diffusion equation, *Applied Mathematics and Computation*, 257, 199-204 (2015) · [Zbl 1338.35456](#) · [doi:10.1016/j.amc.2014.06.099](#)
- [4] Alsaedi, A.; Ahmad, B.; Kirane, M., A survey of useful inequalities in fractional calculus, *Fractional Calculus and Applied Analysis*, 20, 3, 574-594 (2017) · [Zbl 1367.26016](#) · [doi:10.1515/fca-2017-0031](#)
- [5] Alvarez, E.; Gal, C. G.; Keyantuo, V.; Warma, M., Well-posedness results for a class of semi-linear super-diffusive equations, *Nonlinear Analysis*, 181, 24-61 (2019) · [Zbl 1411.35268](#) · [doi:10.1016/j.na.2018.10.016](#)
- [6] Brasco, L.; Parini, E., The second eigenvalue of the fractional p-Laplacian, *Advances in Calculus of Variations*, 9, 4, 323-355 (2016) · [Zbl 1349.35263](#) · [doi:10.1515/acv-2015-0007](#)
- [7] Cao, J.; Song, G.; Wang, J.; Shi, Q.; Sun, S., Blow-up and global solutions for a class of time fractional nonlinear reaction-diffusion equation with weakly spatial source, *Applied Mathematics Letters*, 91, 201-206 (2019) · [Zbl 1407.35034](#) · [doi:10.1016/j.aml.2018.12.020](#)
- [8] De Andrade, B.; Carvalho, A. N.; Carvalho-Neto, P. M.; Marín-Rubio, P., Semilinear fractional differential equations: global solutions, critical nonlinearities and comparison results, *Topological Methods in Nonlinear Analysis*, 45, 439-469 (2015) · [Zbl 1368.34018](#) · [doi:10.12775/TMNA.2015.022](#)
- [9] Gal, C.G. and Warma, M., Fractional-in-time semilinear parabolic equations and applications, HAL Id: hal-01578788, 2017. <https://hal.archives-ouvertes.fr/hal-01578788>
- [10] Hnaïen, D.; Kellil, F.; Lassoued, R., Blowing-up solutions and global solutions to a fractional differential equation, *Fractional Differential Calculus*, 4, 1, 45-53 (2014) · [Zbl 1412.34021](#)
- [11] Jia, J.; Li, K., Maximum principles for a time-space fractional diffusion equation, *Applied Mathematics Letters*, 62, 23-28 (2016) · [Zbl 1350.35044](#) · [doi:10.1016/j.aml.2016.06.010](#)
- [12] Kemppainen, J.; Siljander, J.; Zacher, R., Representation of solutions and large-time behavior for fully nonlocal diffusion equations, *Journal of Differential Equations*, 263, 149-201 (2017) · [Zbl 1366.35218](#) · [doi:10.1016/j.jde.2017.02.030](#)
- [13] Keyantuo, V.; Lizama, C.; Warma, M., Existence, regularity and representation of solutions of time fractional diffusion equations, *Advanced Differential Equations*, 21, 9-10, 837-886 (2016) · [Zbl 1375.47034](#)
- [14] Kilbas, A. A.; Srivastava, H. M.; Trujillo, J. J., *Theory and Applications of Fractional Differential Equations*, 204 (2006), Elsevier: Elsevier, Amsterdam · [Zbl 1092.45003](#)
- [15] Simon, T., Comparing Frechet and positive stable laws, *Electronic Journal of Probability*, 19, 1-25 (2014) · [Zbl 1288.60018](#)

[doi:10.1214/EJP.v19-3058](https://doi.org/10.1214/EJP.v19-3058)

- [16] Vergara, V.; Zacher, R., Optimal decay estimates for time fractional and other non-local subdiffusion equations via energy methods, *SIAM Journal of Mathematical Analysis*, 47, 1, 210-239 (2015) · [Zbl 1317.45006](#) · [doi:10.1137/130941900](#)
- [17] Vergara, V.; Zacher, R., Stability, instability, and blow-up for time fractional and other nonlocal in time semilinear subdiffusion equations, *Journal of Evolution Equations*, 17, 1, 599-626 (2017) · [Zbl 1365.35218](#) · [doi:10.1007/s00028-016-0370-2](#)

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