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References:

- [1] Mukhanov V F and Brandenberger R H 1992 \textit{Phys. Rev. Lett.} 68 1969 · [Zbl 0969.83520](#) · [doi:10.1103/PhysRevLett.68.1969](#)
- [2] Guth A H 1981 \textit{Phys. Rev.} D 23 347 · [Zbl 1371.83202](#) · [doi:10.1103/PhysRevD.23.347](#)
- [3] Borde A and Vilenkin A 1994 \textit{Phys. Rev. Lett.} 72 3305 · [doi:10.1103/PhysRevLett.72.3305](#)
- [4] Novello M and Bergliaffa S E P 2008 \textit{Phys. Rep.} 463 127 · [doi:10.1016/j.physrep.2008.04.006](#)
- [5] Brandenberger R H 2012 (arXiv:1206.4196 [astro-ph.CO])
- [6] Cai Y F 2014 \textit{Sci. China Phys. Mech. Astron.} 57 1414 · [doi:10.1007/s11433-014-5512-3](#)
- [7] Battefeld D and Peter P 2015 \textit{Phys. Rep.} 571 1 · [Zbl 1370.83107](#) · [doi:10.1016/j.physrep.2014.12.004](#)
- [8] Brandenberger R and Peter P 2017 \textit{Found. Phys.} 47 797-850 · [Zbl 1372.83002](#) · [doi:10.1007/s10701-016-0057-0](#)
- [9] Cai Y F, Marciano A, Wang D G and Wilson-Ewing E 2016 \textit{Universe} 3 1 · [doi:10.3390/universe3010001](#)
- [10] Nojiri S I and Odintsov S D 2006 \textit{eConf} C 0602061 06
- [11] Nojiri S I and Odintsov S D 2007 \textit{Int. J. Geom. Methods Mod. Phys.} 4 115 · [Zbl 1112.83047](#) · [doi:10.1142/S0219887807001928](#)
- [12] Capozziello S and De Laurentis M 2011 \textit{Phys. Rep.} 509 167 · [doi:10.1016/j.physrep.2011.09.003](#)
- [13] Cai Y F, Capozziello S, De Laurentis M and Saridakis E N 2016 \textit{Rep. Prog. Phys.} 79 106901 · [doi:10.1088/0034-4885/79/10/106901](#)
- [14] Veneziano G 1991 \textit{Phys. Lett.} B 265 287 · [doi:10.1016/0370-2693\(91\)90055-U](#)
- [15] Khoury J, Ovrut B A, Steinhardt P J and Turok N 2001 \textit{Phys. Rev.} D 64 123522 · [doi:10.1103/PhysRevD.64.123522](#)
- [16] Khoury J, Ovrut B A, Seiberg N, Steinhardt P J and Turok N 2002 \textit{Phys. Rev.} D 65 086007 · [doi:10.1103/PhysRevD.65.086007](#)
- [17] Biswas T, Mazumdar A and Siegel W 2006 \textit{J. Cosmol. Astropart. Phys.} JCAP03(2006) 009 · [Zbl 1236.83020](#) · [doi:10.1088/1475-7516/2006/03/009](#)
- [18] Nojiri S and Saridakis E N 2013 \textit{Astrophys. Space Sci.} 347 221 · [Zbl 1284.83188](#) · [doi:10.1007/s10509-013-1509-z](#)
- [19] Bamba K, Makarenko A N, Myagky A N, Nojiri S and Odintsov S D 2014 \textit{J. Cosmol. Astropart. Phys.} JCAP01(2014) 008 · [doi:10.1088/1475-7516/2014/01/008](#)
- [20] Nojiri S and Odintsov S D 2014 \textit{Mod. Phys. Lett.} A 29 1450211 · [Zbl 1305.83061](#) · [doi:10.1142/S0217732314502113](#)
- [21] Pavlovic P and Sossich M 2017 \textit{Phys. Rev.} D 95 103519 · [doi:10.1103/PhysRevD.95.103519](#)
- [22] Cai Y F, Chen S-H, Dent J B, Dutta S and Saridakis E N 2011 \textit{Class. Quantum Grav.} 28 215011 · [Zbl 1230.83074](#) · [doi:10.1088/0264-9381/28/21/215011](#)
- [23] Cai Y F, Gao C and Saridakis E N 2012 \textit{J. Cosmol. Astropart. Phys.} JCAP10(2012) 048 · [doi:10.1088/1475-7516/2012/10/048](#)
- [24] Shtanov Y and Sahni V 2003 \textit{Phys. Lett.} B 557 1 · [Zbl 1009.83068](#) · [doi:10.1016/S0370-2693\(03\)00179-5](#)
- [25] Saridakis E N 2009 \textit{Nucl. Phys.} B 808 224 · [Zbl 1192.83061](#) · [doi:10.1016/j.nuclphysb.2008.09.022](#)
- [26] Cai Y F and Saridakis E N 2009 \textit{J. Cosmol. Astropart. Phys.} JCAP10(2009) 020 · [doi:10.1088/1475-7516/2009/10/020](#)
- [27] Saridakis E N 2010 \textit{Eur. Phys. J.} C 67 229 · [doi:10.1140/epjc/s10052-010-1294-6](#)
- [28] Bojowald M 2001 \textit{Phys. Rev. Lett.} 86 5227 · [doi:10.1103/PhysRevLett.86.5227](#)
- [29] Cai Y F and Wilson-Ewing E 2014 \textit{J. Cosmol. Astropart. Phys.} JCAP03(2014) 026 · [doi:10.1088/1475-7516/2014/03/026](#)

- [30] Odintsov S D, Oikonomou V K and Saridakis E N 2015 *Ann. Phys., NY* 363 141 · *Zbl* 1360.83093 · doi:10.1016/j.aop.2015.08.021
- [31] Cai Y F and Saridakis E N 2011 *Class. Quantum Grav.* 28 035010 · *Zbl* 1208.83112 · doi:10.1088/0264-9381/28/3/035010
- [32] Cai Y F, Qiu T, Piao Y S, Li M and Zhang X 2007 *J. High Energy Phys.* JHEP10(2007) 071 · doi:10.1088/1126-6708/2007/10/071
- [33] Cai Y F, Qiu T T, Brandenberger R and Zhang X M 2009 *Phys. Rev. D* 80 023511 (Perturbations) · doi:10.1103/PhysRevD.80.023511
- [34] Cai Y F, Saridakis E N, Setare M R and Xia J Q 2010 *Phys. Rep.* 493 1 · doi:10.1016/j.physrep.2010.04.001
- [35] Nojiri S, Odintsov S D, Oikonomou V K and Saridakis E N 2015 *J. Cosmol. Astropart. Phys.* JCAP09(2015) 044 · doi:10.1088/1475-7516/2015/9/044
- [36] Saridakis E N and Weller J M 2010 *Phys. Rev. D* 81 123523 · doi:10.1103/PhysRevD.81.123523
- [37] Saridakis E N and Ward J 2009 *Phys. Rev. D* 80 083003 · doi:10.1103/PhysRevD.80.083003
- [38] Wands D 1999 *Phys. Rev. D* 60 023507 · doi:10.1103/PhysRevD.60.023507
- [39] Finelli F and Brandenberger R 2002 *Phys. Rev. D* 65 103522 · doi:10.1103/PhysRevD.65.103522
- [40] Cai Y F, Xue W, Brandenberger R and Zhang X 2009 *J. Cosmol. Astropart. Phys.* JCAP05(2009) 011 · doi:10.1088/1475-7516/2009/05/011
- [41] Li Y B, Quintin J, Wang D G and Cai Y F 2017 *J. Cosmol. Astropart. Phys.* JCAP03(2017) 031 · doi:10.1088/1475-7516/2017/03/031
- [42] Nicolis A, Rattazzi R and Trincherini E 2009 *Phys. Rev. D* 79 064036 · doi:10.1103/PhysRevD.79.064036
- [43] Deffayet C, Esposito-Farese G and Vikman A 2009 *Phys. Rev. D* 79 084003 · doi:10.1103/PhysRevD.79.084003
- [44] Deffayet C, Deser S and Esposito-Farese G 2009 *Maintain Phys. Rev. D* 80 064015 · doi:10.1103/PhysRevD.80.064015
- [45] De Felice A and Tsujikawa S 2012 *J. Cosmol. Astropart. Phys.* JCAP02(2012) 007 · doi:10.1088/1475-7516/2012/02/007
- [46] Horndeski G W 1974 *Int. J. Theor. Phys.* 10 363 · doi:10.1007/BF01807638
- [47] Silva F P and Koyama K 2009 *Phys. Rev. D* 80 121301 · doi:10.1103/PhysRevD.80.121301
- [48] De Felice A and Tsujikawa S 2010 *Phys. Rev. Lett.* 105 111301 · doi:10.1103/PhysRevLett.105.111301
- [49] Gannouji R and Sami M 2010 *Phys. Rev. D* 82 024011 · doi:10.1103/PhysRevD.82.024011
- [50] Tretyakov P 2012 *Gravit. Cosmol.* 18 93 · *Zbl* 1252.83031 · doi:10.1134/S0202289312010185
- [51] Leon G and Saridakis E N 2013 *J. Cosmol. Astropart. Phys.* JCAP03(2013) 025 · doi:10.1088/1475-7516/2013/03/025
- [52] Creminelli P, Nicolis A and Trincherini E 2010 *J. Cosmol. Astropart. Phys.* JCAP11(2010) 021 · doi:10.1088/1475-7516/2010/11/021
- [53] Kobayashi T, Yamaguchi M and Yokoyama J 'I 2010 *Phys. Rev. Lett.* 105 231302 · doi:10.1103/PhysRevLett.105.231302
- [54] Ohashi J and Tsujikawa S 2012 *J. Cosmol. Astropart. Phys.* JCAP10(2012) 035 · doi:10.1088/1475-7516/2012/10/035
- [55] Mizuno S and Koyama K 2010 *Phys. Rev. D* 82 103518 · doi:10.1103/PhysRevD.82.103518
- [56] Gao X and Steer D A 2011 *J. Cosmol. Astropart. Phys.* JCAP12(2011) 019 · doi:10.1088/1475-7516/2011/12/019
- [57] Renaux-Petel S, Mizuno S and Koyama K 2011 *J. Cosmol. Astropart. Phys.* JCAP11(2011) 042 · doi:10.1088/1475-7516/2011/11/042
- [58] Kobayashi T, Tashiro H and Suzuki D 2010 *Phys. Rev. D* 81 063513 · doi:10.1103/PhysRevD.81.063513
- [59] De Felice A, Kase R and Tsujikawa S 2011 *Phys. Rev. D* 83 043515 · doi:10.1103/PhysRevD.83.043515
- [60] Barreira A, Li B, Baugh C and Pascoli S 2012 *Phys. Rev. D* 86 124016 · doi:10.1103/PhysRevD.86.124016
- [61] Ali A, Gannouji R and Sami M 2010 *Phys. Rev. D* 82 103015 · doi:10.1103/PhysRevD.82.103015
- [62] Appleby S A and Linder E V 2012 *J. Cosmol. Astropart. Phys.* JCAP08(2012) 026 · doi:10.1088/1475-7516/2012/08/026
- [63] Iorio L 2012 *J. Cosmol. Astropart. Phys.* JCAP07(2012) 001 · doi:10.1088/1475-7516/2012/07/001
- [64] Qiu T, Evslin J, Cai Y F, Li M and Zhang X 2011 *J. Cosmol. Astropart. Phys.* JCAP10(2011) 036 · doi:10.1088/1475-7516/2011/10/036
- [65] Easson D A, Sawicki I and Vikman A 2011 *J. Cosmol. Astropart. Phys.* JCAP11(2011) 021 · doi:10.1088/1475-7516/2011/11/021
- [66] Cai Y F, Easson D A and Brandenberger R 2012 *J. Cosmol. Astropart. Phys.* JCAP08(2012) 020 · doi:10.1088/1475-7516/2012/08/020
- [67] Osipov M and Rubakov V 2013 *J. Cosmol. Astropart. Phys.* JCAP11(2013) 031 · doi:10.1088/1475-7516/2013/11/031
- [68] Qiu T, Gao X and Saridakis E N 2013 *Phys. Rev. D* 88 043525 · doi:10.1103/PhysRevD.88.043525
- [69] Battarra L, Koehn M, Lehnert J L and Ovrut B A 2014 *J. Cosmol. Astropart. Phys.* JCAP07(2014) 007 · doi:10.1088/1475-7516/2014/07/007
- [70] Qiu T and Wang Y T 2015 *J. High Energy Phys.* JHEP04(2015) 130 · *Zbl* 1388.83942 · doi:10.1007/JHEP04(2015)130
- [71] Banerjee S and Saridakis E N 2017 *Phys. Rev. D* 95 063523 · doi:10.1103/PhysRevD.95.063523
- [72] Ijjas A and Steinhardt P J 2016 *Phys. Rev. Lett.* 117 121304 · doi:10.1103/PhysRevLett.117.121304
- [73] Ijjas A and Steinhardt P J 2017 *Phys. Lett. B* 764 289 · *Zbl* 1369.85008 · doi:10.1016/j.physletb.2016.11.047

- [74] Ijjas A 2018 \textit{J. Cosmol. Astropart. Phys.}JCAP02(2018) 007· doi:10.1088/1475-7516/2018/02/007
- [75] Saridakis E N, Banerjee S and Myrzakulov R 2018 \textit{Phys. Rev.} D 98 063513· doi:10.1103/PhysRevD.98.063513
- [76] Kobayashi T 2016 \textit{Phys. Rev.} D 94 043511· doi:10.1103/PhysRevD.94.043511
- [77] Akama S and Kobayashi T 2017 \textit{Phys. Rev.} D 95 064011· doi:10.1103/PhysRevD.95.064011
- [78] Kolevatov R and Mironov S 2016 \textit{Phys. Rev.} D 94 123516· doi:10.1103/PhysRevD.94.123516
- [79] Kolevatov R, Mironov S, Sukhov N and Volkova V 2017 \textit{J. Cosmol. Astropart. Phys.}JCAP08(2017) 038· doi:10.1088/1475-7516/2017/08/038
- [80] Gleyzes J, Langlois D, Piazza F and Vernizzi F 2013 \textit{J. Cosmol. Astropart. Phys.}JCAP08(2013) 025· doi:10.1088/1475-7516/2013/08/025
- [81] Cai Y, Wan Y, Li H G, Qiu T and Piao Y S 2017 \textit{J. High Energy Phys.}JHEP01(2017) 090 · Zbl 1373.83124 · doi:10.1007/JHEP01(2017)090
- [82] Cai Y, Li H G, Qiu T and Piao Y S 2017 \textit{Eur. Phys. J.} C 77 369· doi:10.1140/epjc/s10052-017-4938-y
- [83] Cai Y and Piao Y S 2017 \textit{J. High Energy Phys.}JHEP09(2017) 027 · Zbl 1382.83005 · doi:10.1007/JHEP09(2017)027
- [84] Quintin J, Sherkatghanad Z, Cai Y F and Brandenberger R H 2015 \textit{Phys. Rev.} D 92 063532· doi:10.1103/PhysRevD.92.063532
- [85] Fertig A, Lehnert J L, Mallwitz E and Wilson-Ewing E 2016 \textit{JCAP}1610 005· doi:10.1088/1475-7516/2016/10/005
- [86] Kobayashi T, Yamaguchi M and Yokoyama J 2011 \textit{Prog. Theor. Phys.}126 511 · Zbl 1243.83080 · doi:10.1143/PTP.126.511
- [87] Akama S and Kobayashi T 2019 \textit{Phys. Rev.}99 043522· doi:10.1103/PhysRevD.99.043522
- [88] Mironov S, Rubakov V and Volkova V 2018 \textit{J. Cosmol. Astropart. Phys.}JCAP10(2018) 050· doi:10.1088/1475-7516/2018/10/050
- [89] Libanov M, Mironov S and Rubakov V 2016 \textit{J. Cosmol. Astropart. Phys.}JCAP08(2016) 037· doi:10.1088/1475-7516/2016/08/037
- [90] Evseev O A and Melichev O I 2018 \textit{Phys. Rev.} D 97 124040· doi:10.1103/PhysRevD.97.124040
- [91] Dobre D A, Frolov A V, Ghersi J T G, Ramazanov S and Vikman A 2018 \textit{J. Cosmol. Astropart. Phys.}JCAP03(2018) 020· doi:10.1088/1475-7516/2018/03/020
- [92] Lehnert J L 2008 \textit{Phys. Rep.}465 223· doi:10.1016/j.physrep.2008.06.001
- [93] Cai Y F and Saridakis E N 2011 \textit{J. Cosmol.}17 7238
- [94] Baum L and Frampton P H 2008 \textit{Mod. Phys. Lett.} A 23 33· doi:10.1142/S0217732308026170

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