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REFERENCES

1. **Agarwal, M., Arthur, M., Arbeit, R., and Goldstein, R.** 1990. Regulation of icosahedral virion capsid size by the *in vivo* activity of a cloned gene product. Proc. Natl. Acad. Sci. USA **87**:2428-2432.
2. **Alano, P., Dehò, G., Sironi, G., and Zangrossi, S.** 1986. Regulation of the plasmid state of the genetic element P4. Mol. Gen. Genet. **203**:445-450.
3. **Argos, P., Landy, A., Abremski, K., Egan, J.B., Haggård-Ljungquist, E., Hoess, R.H., Kahn, M.L., Kalionis, B., Narayana, S.V., Pierson, L.S., III, Sternberg, N., and Leong, J.M.** 1986. The integrase family of site-specific recombinases: regional similarities and global diversity. EMBO J. **5**:433-440.
4. **Arnold, H.P., She, Q., Phan, H., Stedman, K., Prangishvili, D., Holz, I., Kristjansson, J.K., Garrett, R., and Zillig, W.** 1999. The genetic element pSSVx of the extremely thermophilic crenarchaeon *Sulfolobus* is a hybrid between a plasmid and a virus. Mol. Microbiol. **34**:217-226.
5. **Bach, S., Buchrieser, C., Prentice, M., Guiyoule, A., Msadek, T., and Carniel, E.** 1999. The high-pathogenicity island of *Yersinia enterocolitica* Ye8081 undergoes low-frequency deletion but not precise excision, suggesting recent stabilization in the genome. Infect. Immun. **67**:5091-5099.
6. **Barrett, K.J., Gibbs, W., and Calendar, R.** 1972. A transcribing activity induced by satellite phage P4. Proc. Natl. Acad. Sci. USA **69**:2986-2990.
7. **Bertani, L.E.** 1968. Abortive induction of bacteriophage P2. Virology **36**:87-103.

8. **Bertani, G. and Dehò, G.** 2001. Bacteriophage P2: recombination in the superinfection preprophage state and under replication control by phage P4. *Mol. Gen. Genet.* **266**:406-416.
9. **Blattner, F.R., Plunkett, G., Bloch, C.A., Perna, N.T., Burland, V., Riley, M., Collado-Vides, J., Glasner, J.D., Rode, C.K., Mayhew, G.F., Gregor, J., Davis, N.W., Kirkpatrick, H.A., Goeden, M.A., Rose, D.J., Mau, B., and Shao, Y.** 1997. The complete genome sequence of *Escherichia coli* K-12. *Science* **277**:1453-1474.
10. **Bowden, D.W., Twersky, R.S., and Calendar, R.** 1975. *Escherichia coli* deoxyribonucleic acid synthesis mutants: their effect upon bacteriophage P2 and satellite bacteriophage P4 deoxyribonucleic acid synthesis. *J. Bacteriol.* **124**:167-175.
11. **Bramhill, D. and Kornberg, A.** 1988. A model for initiation at origins of DNA replication. *Cell* **54**:915-918.
12. **Brendler, T., Abeles, A., and Austin, S.** 1991. Critical sequences in the core of the P1 plasmid replication origin. *J. Bacteriol.* **173**:3935-3942.
13. **Briani, F., Zangrossi, S., Ghisotti, D., and Dehò, G.** 1996. A Rho-dependent transcription termination site regulated by bacteriophage P4 RNA immunity factor. *Virology* **223**:57-67.
14. **Briani, F., Ghisotti, D., and Dehò, G.** 2000. Antisense RNA-dependent transcription termination sites that modulate lysogenic development of satellite phage P4. *Mol. Microbiol.* **36**:1124-1134.
15. **Briani, F., Del Vecchio, E., Migliorini, M., Hajnsdorf, E., Régnier, P., Ghisotti, D., and Dehò, G.** 2002. RNase E and polyadenyl polymerase I are involved in maturation of CI RNA, the P4 phage immunity factor. *J. Mol. Biol.* **318**:321-331.
16. **Buchrieser, C., Brosch, R., Bach, S., Guiyoule, A., and Carniel, E.** 1998. The high-pathogenicity island of *Yersinia pseudotuberculosis* can be inserted into any of the three chromosomal asn tRNA genes. *Mol. Microbiol.* **30**:965-978.

17. **Calendar, R., Ljungquist, E., Dehò, G., Usher, D.C., Goldstein, R., Youderian, P., Sironi, G., and Six, E.W.** 1981. Lysogenization by satellite phage P4. *Virology* **113**:20-38.
18. **Cheetham, B.F. and Katz, M.E.** 1995. A role for bacteriophages in the evolution and transfer of bacterial virulence determinants. *Mol. Microbiol.* **18**:201-208.
19. **Cheetham, B.F., Tattersall, D.B., Bloomfield, G.A., Rood, J.I., and Katz, M.E.** 1995. Identification of a gene encoding a bacteriophage-related integrase in a *vap* region of the *Dichelobacter nodosus* genome. *Gene* **162**:53-58.
20. **Christian, R.B.** 1990. Studies on P4 bacteriophage replication. University of California, Berkeley, Thesis dissertation.
21. **Christie, G.E. and Calendar, R.** 1983. Bacteriophage P2 late promoters. Transcription initiation sites for two late mRNAs. *J. Mol. Biol.* **167**:773-790.
22. **Christie, G.E. and Calendar, R.** 1985. Bacteriophage P2 late promoters. II. Comparison of the four late promoter sequences. *J. Mol. Biol.* **181**:373-382.
23. **Citron, M. and Schuster, H.** 1990. The c4 repressors of bacteriophages P1 and P7 are antisense RNAs. *Cell* **62**:591-598.
24. **Clark, A.J., Beltrame, J., and Manning, P.A.** 1991. The *oac* gene encoding a lipopolysaccharide O-antigen acetylase maps adjacent to the integrase-encoding gene on the genome of *Shigella flexneri* bacteriophage Sf6. *Gene* **107**:43-52.
25. **Crosa, J.H.** 1980. Three origins of replication are active *in vivo* in the R plasmid RSF1040. *J. Biol. Chem.* **255**:11075-11077.
26. **Dale, E.C., Christie, G.E., and Calendar, R.** 1986. Organization and expression of the satellite bacteriophage P4 late gene cluster and the sequence of the polarity suppression gene. *J. Mol. Biol.* **192**:793-803.
27. **Dehò, G.** 1983. Circular genetic map of satellite bacteriophage P4. *Virology* **126**:267-278.

28. **Dehò, G., Ghisotti, D., Alano, P., Zangrossi, S., Borrello, M.G., and Sironi, G.** 1984. Plasmid mode of propagation of the genetic element P4. *J. Mol. Biol.* **178**:191-207.
29. **Dehò, G., Ghisotti, D., Zangrossi, S., Alano, P., Neri, T., Fattore, S., and Sironi, G.** 1988. Regulation of alternative intracellular states in the phage- plasmid P4. In: *Gene expression and regulation: the legacy of Luigi Gorini*. Bissel, M., Dehò, G., Sironi, G., and Torriani, A. (Eds.) Amsterdam: Excerpta Medica, pp. 65-72.
30. **Dehò, G., Zangrossi, S., Ghisotti, D., and Sironi, G.** 1988. Alternative promoters in the development of bacteriophage plasmid P4. *J. Virol.* **62**:1697-1704.
31. **Dehò, G., Zangrossi, S., Sabbattini, P., Sironi, G., and Ghisotti, D.** 1992. Bacteriophage P4 immunity controlled by small RNAs via transcription termination. *Mol. Microbiol.* **6**:3415-3425.
32. **Diana, C., Dehò, G., Geisselsoder, J., Tinelli, L., and Goldstein, R.** 1978. Viral interference at the level of capsid size determination by satellite phage P4. *J. Mol. Biol.* **126**:433-445.
33. **Diaz-Orejas, R., Ziegerlin, G., Lurz, R., and Lanka, E.** 1994. Phage P4 DNA replication *in vitro*. *Nucleic Acids Res.* **22**:2065-2070.
34. **Dokland, T.** 1999. Scaffolding proteins and their role in viral assembly. *Cell. Mol. Life Sci.* **56**:580-603.
35. **Dokland, T., Wang, S., and Lindqvist, B.H.** 2002. The structure of P4 procapsids produced by co-expression of capsid and external scaffolding proteins. *Virology* **298**:224-231.
36. **Flensburg, J. and Calendar, R.** 1987. Bacteriophage P4 DNA replication. Nucleotide sequence of the P4 replication gene and the *cis* replication region. *J. Mol. Biol.* **195**:439-445.

37. **Forti, F., Sabbattini, P., Sironi, G., Zangrossi, S., Dehò, G., and Ghisotti, D.** 1995. Immunity determinant of phage-plasmid P4 is a short processed RNA. *J. Mol. Biol.* **249**:869-878.
38. **Forti, F., Polo, S., Lane, K.B., Six, E.W., Sironi, G., Dehò, G., and Ghisotti, D.** 1999. Translation of two nested genes in bacteriophage P4 controls immunity-specific transcription termination. *J. Bacteriol.* **181**:5225-5233.
39. **Forti, F., Dragoni, I., Briani, F., Dehò, G., and Ghisotti, D.** 2002. Characterization of the small antisense CI RNA that regulates bacteriophage P4 immunity. *J. Mol. Biol.* **315**:541-549.
40. **Geisselsoder, J., Youderian, P., Dehò, G., Chidambaram, M., Goldstein, R., and Ljungquist, E.** 1981. Mutants of satellite virus P4 that cannot derepress their bacteriophage P2 helper. *J. Mol. Biol.* **148**:1-19.
41. **Ghisotti, D., Finkel, S., Halling, C., Dehò, G., Sironi, G., and Calendar, R.** 1990. Nonessential region of bacteriophage P4: DNA sequence, transcription, gene products, and functions. *J. Virol.* **64**:24-36.
42. Ghisotti, D., Chiaramonte, R., Forti, F., Zangrossi, S., Sironi, G., and Dehò, G. 1992. Genetic analysis of the immunity region of phage-plasmid P4. *Mol. Microbiol.* **6**:3405-3413.
43. **Goldstein, R., Lengyel, J., Pruss, G., Barrett, K., Calendar, R., and Six, E.** 1974. Head size determination and the morphogenesis of satellite phage P4. *Curr. Top. Microbiol. Immunol.* **68**:59-75.
44. **Goldstein, R., Sedivy, J., and Ljungquist, E.** 1982. Propagation of satellite phage P4 as a plasmid. *Proc. Natl. Acad. Sci. USA* **79**:515-519.
45. **Grambow, N.J., Birkeland, N.K., Anders, D.L., and Christie, G.E.** 1990. Deletion analysis of a bacteriophage P2 late promoter. *Gene* **95**:9-15.

46. **Halling, C. and Calendar, R.** 1990. Bacteriophage P2 *ogr* and P4 *delta* genes act independently and are essential for P4 multiplication. *J. Bacteriol.* **172**:3549-3558.
47. **Halling, C., Calendar, R., Christie, G.E., Dale, E.C., Dehò, G., Finkel, S., Flensburg, J., Ghisotti, D., Kahn, M.L., and Lane, K.B.** 1990. DNA sequence of satellite bacteriophage P4. *Nucleic Acids Res.* **18**:1649
48. **Halling, C., Sunshine, M.G., Lane, K.B., Six, E.W., and Calendar, R.** 1990. A mutation of the transactivation gene of satellite bacteriophage P4 that suppresses the *rpoA109* mutation of *Escherichia coli*. *J. Bacteriol.* **172**:3541-3548.
49. **Hare, J.M., Wagner, A.K., and McDonough, K.A.** 1999. Independent acquisition and insertion into different chromosomal locations of the same pathogenicity island in *Yersinia pestis* and *Yersinia pseudotuberculosis*. *Mol. Microbiol.* **31**:291-303.
50. **Harris, J.D. and Calendar, R.** 1978. Transcription map of satellite coliphage P4. *Virology* **85**:343-358.
51. **Inman, R.B., Schnös, M., Simon, L.D., Six, E.W., and Walker, D.H.J.** 1971. Some morphological properties of P4 bacteriophage and P4 DNA. *Virology* **44**:67-72.
52. **Inouye, S., Sunshine, M., Six, E., and Inouye, M.** 1991. Retronphage ØR73: an *E. coli* phage that contains a retroelement and integrates into a tRNA gene. *Science* **252**:969-971.
53. **Inuzuka, N., Inuzuka, M., and Helinski, D.R.** 1980. Activity *in vitro* of three replication origins of the antibiotic resistance plasmid RSF1040. *J. Biol. Chem.* **255**:11071-11074.
54. **Isaksen, M.L., Rishovd, S.T., Calendar, R., and Lindqvist, B.H.** 1992. The polarity suppression factor of bacteriophage P4 is also a decoration protein of the P4 capsid. *Virology* **188**:831-839.

55. **Isaksen, M.L., Dokland, T., and Lindqvist, B.H.** 1993. Characterization of the capsid associating activity of bacteriophage P4's Psu protein. *Virology* **194**:674-681.
56. **Julien, B. and Calendar, R.** 1996. Bacteriophage PSP3 and ΦR73 activator proteins: analysis of promoter specificities. *J. Bacteriol.* **178**:5668-5675.
57. **Julien, B., Lefevre, P., and Calendar, R.** 1997. The two P2 Ogr-like domains of the δ protein from bacteriophage P4 are required for activity. *Virology* **230**:292-299.
58. **Kahn, M., Ow, D., Sauer, B., Rabinowitz, A., and Calendar, R.** 1980. Genetic analysis of bacteriophage P4 using P4-plasmid ColE1 hybrids. *Mol. Gen. Genet.* **177**:399-412.
59. **Kim, K.J., Sunshine, M.G., Lindqvist, B.H., and Six, E.W.** 2001. Capsid size determination in the P2-P4 bacteriophage system: suppression of *sir* mutations in P2's capsid gene N by supersid mutations in P4's external scaffold gene *sid*. *Virology* **283**:49-58.
60. **Kirby, J.E., Trempy, J.E., and Gottesman, S.** 1994. Excision of a P4-like cryptic prophage leads to Alp protease expression in *Escherichia coli*. *J. Bacteriol.* **176**:2068-2081.
61. **Kita, K., Tsuda, J., Kato, T., Okamoto, K., Yanase, H., and Tanaka, M.** 1999. Evidence of horizontal transfer of the EcoO109I restriction-modification gene to *Escherichia coli* chromosomal DNA. *J. Bacteriol.* **181**:6822-6827.
62. **Krevolin, M.D. and Calendar, R.** 1985. The replication of bacteriophage P4 DNA *in vitro*. Partial purification of the P4 α gene product. *J. Mol. Biol.* **182**:509-517.
63. **Krevolin, M.D., Inman, R.B., Roof, D., Kahn, M., and Calendar, R.** 1985. Bacteriophage P4 DNA replication. Location of the P4 origin. *J. Mol. Biol.* **182**:519-527.
64. **Lagos, R., Jiang, R.Z., Kim, S., and Goldstein, R.** 1986. Rho-dependent transcription termination of a bacterial operon is antagonized by an extrachromosomal gene product. *Proc. Natl. Acad. Sci. USA* **83**:9561-9565.

65. **Lengyel, J.A., Goldstein, R.N., Marsh, M., Sunshine, M.G., and Calendar, R.** 1973. Bacteriophage P2 head morphogenesis: cleavage of the major capsid protein. *Virology* **53**:1-23.
66. **Lin, C.S.** 1984. Nucleotide sequence of the essential region of bacteriophage P4. *Nucleic Acids Res.* **12**:8667-8684.
67. **Linderoth, N.A. and Calendar, R.** 1991. The Psu protein of bacteriophage P4 is an antitermination factor for rho-dependent transcription termination. *J. Bacteriol.* **173**:6722-6731.
68. **Lindqvist, B.H. and Six, E.W.** 1971. Replication of bacteriophage P4 DNA in a nonlysogenic host. *Virology* **43**:1-7.
69. **Lindqvist, B.H., Dehò, G., and Calendar, R.** 1993. Mechanisms of genome propagation and helper exploitation by satellite phage P4. *Microbiol. Rev.* **57**:683-702.
70. **Liu, T., Renberg, S.K., and Haggård-Ljungquist, E.** 1997. Derepression of prophage P2 by satellite phage P4: cloning of the P4 ϵ gene and identification of its product. *J. Virol.* **71**:4502-4508.
71. **Liu, T., Renberg, S.K., and Haggard-Ljungquist, E.** 1998. The E protein of satellite phage P4 acts as an anti-repressor by binding to the C protein of helper phage P2. *Mol. Microbiol.* **30**:1041-1050.
72. **Marvik, O.J., Jacobsen, E., Dokland, T., and Lindqvist, B.H.** 1994. Bacteriophage P2 and P4 morphogenesis: assembly precedes proteolytic processing of the capsid proteins. *Virology* **205**:51-65.
73. **Marvik, O.J., Sharma, P., Dokland, T., and Lindqvist, B.H.** 1994. Bacteriophage P2 and P4 assembly: alternative scaffolding proteins regulate capsid size. *Virology* **200**:702-714.

74. **Marvik, O.J., Dokland, T., Nokling, R.H., Jacobsen, E., Larsen, T., and Lindqvist, B.H.** 1995. The capsid size-determining protein Sid forms an external scaffold on phage P4 procapsids. *J. Mol. Biol.* **251**:59-75.
75. **Ow, D.W. and Ausubel, F.M.** 1980. Recombinant P4 bacteriophages propagate as viable lytic phages or as autonomous plasmids in *Klebsiella pneumoniae*. *Mol. Gen. Genet.* **180**:165-175.
76. **Piazza, F., Zappone, M., Sana, M., Briani, F., and Dehò, G.** 1996. Polynucleotide phosphorylase of *Escherichia coli* is required for the establishment of bacteriophage P4 immunity. *J. Bacteriol.* **178**:5513-5521.
77. **Pierson, L.S., III and Kahn, M.L.** 1984. Cloning of the integration and attachment regions of bacteriophage P4. *Mol. Gen. Genet.* **195**:44-51.
78. **Pierson, L.S., III and Kahn, M.L.** 1987. Integration of satellite bacteriophage P4 in *Escherichia coli*. DNA sequences of the phage and host regions involved in site-specific recombination. *J. Mol. Biol.* **196**:487-496.
79. **Polo, S., Sturniolo, T., Dehò, G., and Ghisotti, D.** 1996. Identification of a phage-coded DNA-binding protein that regulates transcription from late promoters in bacteriophage P4. *J. Mol. Biol.* **257**:745-755.
80. **Pruss, G.J., Wang, J.C., and Calendar, R.** 1975. *In vitro* packaging of covalently-closed circular monomers of bacteriophage DNA. *J. Mol. Biol.* **98**:465-465.
81. **Ravatn, R., Studer, S., Zehnder, A.J., and van der Meer, J.** 1998. Int-B13, an unusual site-specific recombinase of the bacteriophage P4 integrase family, is responsible for chromosomal insertion of the 105-kilobase *clc* element of *Pseudomonas* sp. Strain B13. *J. Bacteriol.* **180**:5505-5514.

82. **Ravin, N.V., Svarchevsky, A.N., and Dehò, G.** 1999. The anti-immunity system of phage-plasmid N15: identification of the antirepressor gene and its control by a small processed RNA. *Mol. Microbiol.* **34**:980-994.
83. **Reiter, K., Lam, H., Young, E., Julien, B., and Calendar, R.** 1998. A complex control system for transcriptional activation from the *sid* promoter of bacteriophage P4. *J. Bacteriol.* **180**:5151-5158.
84. **Renberg Eriksson, S.K., Liu, T., and Haggård-Ljungquist, E.** 2000. Interacting interfaces of the P4 antirepressor E and the P2 immunity repressor C. *Mol. Microbiol.* **36**:1148-1155.
85. **Sabbattini, P., Forti, F., Ghisotti, D., and Dehò, G.** 1995. Control of transcription termination by an RNA factor in bacteriophage P4 immunity: identification of the target sites. *J. Bacteriol.* **177**:1425-1434.
86. **Sabbattini, P., Six, E., Zangrossi, S., Briani, F., Ghisotti, D., and Dehò, G.** 1996. Immunity specificity determinants in the P4-like retrorhage ΦR73. *Virology* **216**:389-396.
87. **Saha, S., Haggård-Ljungquist, E., and Nördstrom, K.** 1989. Activation of prophage P4 by the P2 Cox protein and the sites of action of the Cox protein on the two phage genomes. *Proc. Natl. Acad. Sci. USA* **86**:3973-3977.
88. **Sauer, B., Ow, D., Ling, L., and Calendar, R.** 1981. Mutants of satellite bacteriophage P4 that are defective in the suppression of transcriptional polarity. *J. Mol. Biol.* **145**:29-46.
89. **Shore, D., Dehò, G., Tsipis, J., and Goldstein, R.** 1978. Determination of capsid size by satellite bacteriophage P4. *Proc. Natl. Acad. Sci. USA* **75**:400-404.
90. **Six, E.W.** 1963. A defective phage depending on phage P2. *Bacteriol. Proc.*, p. 138.
91. **Six, E.W. and Klug, C.A.** 1973. Bacteriophage P4: a satellite virus depending on a helper such as prophage P2. *Virology* **51**:327-344.

92. **Six, E.W.** 1975. The helper dependence of satellite bacteriophage P4: which gene functions of bacteriophage P2 are needed by P4? *Virology* **67**:249-263.
93. **Six, E.W. and Lindqvist, B.H.** 1978. Mutual derepression in the P2-P4 bacteriophage system. *Virology* **87**:217-230.
94. **Six, E.W., Sunshine, M.G., Williams, J., Haggård-Ljungquist, E., and Lindqvist, B.H.** 1991. Morphopoietic switch mutations of bacteriophage P2. *Virology* **182**:34-46.
95. **Souza, L., Calendar, R., Six, E.W., and Lindqvist, B.H.** 1977. A transactivation mutant of satellite phage P4. *Virology* **81**:81-90.
96. **Strack, B., Lessl, M., Calendar, R., and Lanka, E.** 1992. A common sequence motif, -E-G-Y-A-T-A-, identified within the primase domains of plasmid-encoded I- and P-type DNA primases and the α protein of the *Escherichia coli* satellite phage P4. *J. Biol. Chem.* **267**:13062-13072.
97. **Sullivan, J.T. and Ronson, C.W.** 1998. Evolution of rhizobia by acquisition of a 500-kb symbiosis island that integrates into a phe-tRNA gene. *Proc. Natl. Acad. Sci. USA* **95**:5145-5149.
98. **Sun, J., Inouye, M., and Inouye, S.** 1991. Association of a retroelement with a P4-like cryptic prophage (retronphage Φ R73) integrated into the selenocystyl tRNA gene of *Escherichia coli*. *J. Bacteriol.* **173**:4171-4181.
99. **Swenson, D.L., Bukanov, N.O., Berg, D.E., and Welch, R.A.** 1996. Two pathogenicity islands in uropathogenic *Escherichia coli* J96: cosmid cloning and sample sequencing. *Infect. Immun.* **64**:3736-3743.

100. **Tamanoi, F., Saito, H., and Richardson, C.C.** 1980. Physical mapping of primary and secondary origins of bacteriophage T7 DNA replication. Proc. Natl. Acad. Sci. USA **77**:2656-2660.
101. **Terzano, S., Christian, R., Espinoza, F.H., Calendar, R., Dehò, G., and Ghisotti, D.** 1994. A new gene of bacteriophage P4 that controls DNA replication. J. Bacteriol. **176**:6059-6065.
102. **Tocchetti, A., Serina, S., Terzano, S., Dehò, G., and Ghisotti, D.** 1998. Identification of two replicons in phage-plasmid P4. Virology **245**:344-352.
103. **Tocchetti, A., Galimberti, G., Dehò, G., and Ghisotti, D.** 1999. Characterization of the *oriI* and *oriII* origins of replication in phage-plasmid P4. J. Virol. **73**:7308-7316.
104. **Tocchetti, A., Serina, S., Oliva, I., Dehò, G., and Ghisotti, D.** 2001. Cnr interferes with dimerization of the replication protein α in phage-plasmid P4. Nucleic Acids Res. **29**:536-544.
105. **Wang, S., Palasingam, P., Nokling, R.H., Lindqvist, B.H., and Dokland, T.** 2000. *In vitro* assembly of bacteriophage P4 procapsids from purified capsid and scaffolding proteins. Virology **275**:133-144.
106. **Woelker, B., and Messer, W.** 1993. The structure of the initiation complex at the replication origin, *oriC*, of *Escherichia coli*. Nucleic Acids Res. **21**:5025-5033.
107. **Yeo, H.-J., Ziegelin, G., Korolev, S., Calendar, R., Lanka, E., and Waksman, G.** 2002. Phage P4 origin-binding domain structure reveals a mechanism for regulation of DNA-binding activity by homo- and heterodimerization of winged helix proteins. Mol. Microbiol. **43**:857-866.

108. **Ziegerlin, G., Scherzinger, E., Lurz, R., and Lanka, E.** 1993. Phage P4 α protein is multifunctional with origin recognition, helicase and primase activities. *EMBO J.* **12**:3703-3708.
109. **Ziegerlin, G., Linderoth, N.A., Calendar, R., and Lanka, E.** 1995. Domain structure of phage P4 α protein deduced by mutational analysis. *J. Bacteriol.* **177**:4333-4341.
110. **Ziegerlin, G., Calendar, R., Ghisotti, D., Terzano, S., and Lanka, E.** 1997. Cnr protein, the negative regulator of bacteriophage P4 replication, stimulates specific DNA binding of its initiator protein α . *J. Bacteriol.* **179**:2817-2822.
111. **Ziegerlin, G., Calendar, R., Lurz, R., and Lanka, E.** 1997. The helicase domain of phage P4 α protein overlaps the specific DNA binding domain. *J. Bacteriol.* **179**:4087-4095.
112. **Ziermann, R. and Calendar, R.** 1990. Characterization of the *cos* sites of bacteriophages P2 and P4. *Gene* **96**:9-15.