Exceptional Gene Duplication Dynamics in the Cyanobacterium *Acaryochloris*: A Possible Role for RecA Paralogs in Adaptation and Genome Instability. E. B. Sano[1], A. L. Gallagher[1] and S. R. Miller[1], [1]Division of Biological Sciences, University of Montana, Missoula, MT 59812; scott.miller@umontana.edu

Chlorophyll (Chl) *d*-producing cyanobacteria (*Acaryochloris* spp.) are a recently discovered and widely-distributed group of photosynthetic bacteria that uniquely possess this far-red light absorbing, structural relative of Chl *a* as the major pigment in photosynthesis. *Acaryochloris* genomes are both large (~8 Mbp) and contain an unusually high number of recent gene duplicates for bacteria. Although duplicates may experience a brief period of relaxed selection, most are rapidly lost.
Those that are retained are subject to strong purifying selection, and idiosyncratic duplicates in these genomes may adapt these organisms to environment-specific stress through dosage effects. The origin of most duplicates appears to involve homologous recombination between different genetic elements, and the difference in gene duplication rate between *Acaryochloris* genomes is positively associated with copy number of the recombinase A (*recA*) gene. *Acaryochloris* genomes contain up to seven copies of *recA*, which is highly unusual, as this is a single copy gene in nearly all bacterial genomes. RecA paralogs are monophyletic yet extremely diverse and are constitutively expressed. Statistical tests of molecular adaptation, structural considerations and preliminary experimental characterization suggest that some *Acaryochloris* RecAs have functionally diverged.

Future studies are aimed at addressing the mechanisms that promote *recA* paralog retention in *Acaryochloris* and the consequences of *recA* copy number for recombinase activity, genome evolution and organismal fitness. We propose that *recA* duplicates are retained despite dosage-enhanced, deleterious HR-mediated side-effects to provide full RecA functionality following functional divergence and subsequent degenerative evolution of unselected sub-functions among duplicates. With the recent development of genetic tools for these organisms that will enable us to manipulate *recA* copy number, the *Acaryochloris* system presents a unique opportunity to gain novel insights on the fitness consequences that emerge from the interplay between HR-mediated maintenance of genome stability, selectively favored gene duplications and non-adaptive genomic rearrangements.