NEUTRON DOSE AND SUB-KELVIN RESISTANCE OF THE TARDIGRADE: RAMAZZOTTIUS VARIEORANATUS. G. Kletetschka[1, 2,3], D. Horikawa[4], A. Parsons[1], J. Bodnarik[1], and J. Chervenak[5], [1] Astrochemistry, GSFC/NASA, Code 691, Greenbelt, MD, 20771; kletetschka@nasa.gov [2] Department of Physics, Catholic University of America, 200 Hannan Hall, DC 20064; [3] Institute of Geology, Academy of Sciences of the Czech Republic, Rozvojova 269, Prague 6, 16500, [4] NASA Astrobiology Institute, Ames Research Center, Moffett Field, CA 94035, [5] Cryogenic Detector Systems, GSFC/NASA, Code 553, Greenbelt, MD, 20771.

Introduction: Survival mechanisms of organisms capable to tolerate large degrees of stress remain largely unexplained, despite its relevance to astrobiology. An observation of these organisms (extremophiles) in wide range of environmental conditions clarifies the survival strategies. For example, an environment associated with lowering the temperature, is causing to slow down and even stop the cellular chemistry. Understanding the molecular mechanisms allowing withstanding extreme environment is one of the goals of astrobiology [1]. Extremophiles are mostly unicellular organisms and their adaptation to extreme environmental conditions was widely investigated [2]. In contrast to multiple studies of unicellular organisms, little attention has been paid to multicelullar organisms. Among them, the most tolerating organisms are tardigrades, because of their ability to exhibit high resistance to many environmental stresses [3]. These organisms are being considered as a model for astrobiological studies [4].

Tardigrades, or water bears, are invertebrates (0.1-1.0 mm length) found everywhere on Earth, from the bottom of the oceans to the high mountains [5]. They are also found in dry and cold conditions of arctic and Antarctic [4].

When tardigrades become dehydrated their water content drops to less than 3% of the hydrated animal and the body size significantly shrinks [6]. There are no signs of life in this desiccated form (anhydrobiosis). The process of desiccation causes accumulation of the non-reducing disaccharide trehalose to protect against the dehydration damage [7].

In their dehydrated state, tardigrades can survive near absolute zero temperature 0.008K [8]. They also tolerate high doses of radiation, for example: 1000s of Grays of X-rays [9], gamma rays [6, 10], and heavy ions [6].

The radiation damage is thought to be due to double strand brakes of their DNA [11]. We are following a working hypothesis that the tolerance against the radiation damage is due to trehalose being produced as part of the chromatin structure. Trehalose is keeping the DNA strands from migration after an occurrence of double strand brake and cell can fix the damage.

Tardigrades have never been shown if they tolerate neutron radiation. In this report we provide the data on radiation tolerance of tardigrades against neutrons.

Methods: Tardigrades are Ramazzottius varieornatus, and were grown by supplying the green alga Chlorella vulgaris as food. The life span is 35 +/-16.4 d, deposited eggs requires 5.7+/- 1.1 d to hatch, and animals began to deposit eggs 9 d after hatching. The reared individuals of this species had an anhydrobiotic capacity throughout their life cycle in egg, juvenile, and adult stages

We exposed groups of these tardigrades to different level of neutron radiation. We used 14 MeV neutron radiation (5e7 n/s) and various exposure intensity (varied by distance from the source; 7.5 cm, 12.5 cm, 93 cm).

We also obtained rates of cooling effect on survivability of tardigrades.

References: [1] Des Marais, D. J. et al. (2003) *Astrobiology.*, 3, 219-235. [2] Niehaus, F. et al. (1999) Appl. Microbiol. Biotechnol. 51:711–729. [3] Cavicchioli, R. (2002) *Astrobiology.*, 2, 281-292. [4] Jönsson, K.I. (2007) *Astrobiology.*, 7, 757-766. [5] Nelson, D. R. (2002) *Integr. Comp. Biol*. 42:652–659. [6] Horikawa et al., (2006) *Int. J. Radiat. Biol.* 82:843–848. [7] Hengerr et al., (2008) *FEBS J.* 2, 281-288. [8] Becquerel P. (1950) *C. r. hebd. Seanc. Acad. Sci.* 231, 261-263. [9] May R. M. et a., (1964), *Bull. Biol. Fr. Belg*. 98:349–367. [10] Jönsson, K.I. (2005), *Int. J. Radiat. Biol.* 81:649–656. [11] Mattimore and Battista (1996), *J. Bacteriol.*, 178, 633-637.