

# Green Bank Telescope OH Observations of Smith's Cloud: Evidence Of A Lack Of Chemistry

Anthony Minter

Green Bank Observatory, National Radio Astronomy Observatory,  
Green Bank, WV, U.S.A. 24901  
email: [tminter@nrao.edu](mailto:tminter@nrao.edu)

**Abstract.** Smith's Cloud is a large  $few \times 10^6$  Solar Mass cloud which will impact the Milk Way disk in about 35 Million Years (Lockman *et al.*, 2008). Green Bank Telescope OH observations indicate that there are no molecules present in Smith's Cloud, and thus there is no active ongoing chemistry in Smith's Cloud.

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## 1. Introduction

The origin of Smith's Cloud (SC) is uncertain (Lockman *et al.*, 2008; Fox *et al.*, 2016). It could be a primordial cloud, a dwarf galaxy, a dark matter clump accreting gas from the outer disk, or outer disk gas which was launched towards the inner galaxy.

SC impacted the outer Milky Way plane roughly 70 Myr ago and will encounter the inner Milky Way plan in about 35 Myr (Lockman *et al.*, 2008).  $H_\alpha$ ,  $N_{II}$  and  $S$  have been detected in SC (Hill *et al.*, 2009; Fox *et al.*, 2016). This indicates that the metallicity of SC is approximately half solar. No stars have been detected in SC (Stark *et al.*, 2015).

Molecules can form whenever  $N_H > 3 \times 10^{20} \text{ cm}^{-2}$  (e.g., see Liszt & Lucas 2000; Gillmon *et al.*, 2006). SC could have formed molecules in 30-70 Myr (see Liszt & Lucas 2000). OH is the simplest and first molecule to form and is observed in dwarf galaxies but not in HVCs (Barriault *et al.*, 2010).

The Green Bank Telescope was used to limit OH emission to  $< 0.5 \text{ mK}$  at a resolution of  $1 \text{ km s}^{-1}$ . This gives a metallicity limit  $< 3\%$ . and implies that there is no active molecular formation, and thus chemistry, in SC.

The only young, no molecule, no star formation model for the origin of SC is if it is gas from the outer disk of Milky Way (maybe from dark matter passing through disk and accreting disk gas) on a trajectory to the inner disk.

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