

(12) **United States Patent**
Gordon et al.

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- (54) **RYDBERG ATOM MIXER AND DETERMINING PHASE OF MODULATED CARRIER RADIATION**
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(58) **Field of Classification Search**
None
See application file for complete search history.

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(57) **ABSTRACT**

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A Rydberg atom mixer determines a phase of modulated carrier radiation and includes: a reference radiofrequency source for reference radiofrequency radiation; a modulated carrier source for modulated carrier radiation; a vapor cell to contain gas atoms and that receives reference radiofrequency radiation and modulated carrier radiation, such that the gas atoms produce modulated light modulated; and a transmission detector that receives the modulated light from the vapor cell and produces a transmission signal from the transmission detector for determination of a phase of the modulated carrier radiation, wherein the Rydberg atom mixer mixes the reference radiofrequency radiation and the modulated carrier radiation by the gas atoms in a Rydberg electronic state to produce the intermediate frequency IF that corresponds directly to the phase of the modulated carrier radiation.

(65) **Prior Publication Data**
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H04B 10/548 (2013.01)
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CPC **H04B 10/548** (2013.01); **H04B 10/503** (2013.01)

16 Claims, 31 Drawing Sheets

