

H a b i l i t a t i o n

Freie Universität Berlin

Fachbereich Physik

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Im Zuge seines Habilitationsverfahrens wird

Herr Dr. Torsten Siebert

FUB

am **Mittwoch, den 15. Januar 2014** um **14.15 Uhr**
seinen öffentlichen wissenschaftlichen Vortrag über das
Thema:

**„Naturally occurring population inversion
and amplified emission:**

**On the conditions for maser and laser activity
in planetary and interstellar environments“**

halten.

Anschließend findet vor Mitgliedern des Fachbereichsrats und den Mitgliedern der Habilitationskommission eine Aussprache statt.

Vorsitzender der Habilitationskommission

Microwave and light amplification by stimulated emission of radiation is generally realized in media far from thermodynamic equilibrium, where a very specific set of prerequisites must be met for its occurrence [1-4]. Despite the stringent requirements, naturally occurring population inversion and amplification has been identified in numerous astrophysical settings, ranging from pulsed microwave emission within hydroxyl clouds in proximity to pulsars and the mid-infrared emission of carbon dioxide from the atmosphere of Mars to the numerous emission bands from the Weigelt blobs of η -Carinae, given here as selected examples [4-6]. The awareness and understanding derived from the first laboratory realization of the maser and laser over half a century ago have played a central role in the first postulation and identification of interstellar microwave amplification from the ground state of the hydroxy radical approximately a decade later [1,2,7,8]. Despite the many parallels that can be derived between population inversion and gain in interstellar plasmas or planetary atmospheres with discharge lasers in laboratories, there are fundamental differences. Central are the mechanisms in the radiative and collisional pumping and relaxation dynamics of the medium. The gain and dimensions of the active medium in the presence or absence of feedback together with preferential directionality in the emission constitute further points that deviate from laboratory masers and lasers [4]. These critical aspects will be described within specific examples. Furthermore, the criteria for differentiating maser and laser action from spontaneous emission in the line shapes and the relation of relative intensities in the emission bands will be discussed along with the necessary technology for observing extraterrestrial radiation in the microwave and optical regime [4-6]. With the understanding of underlying mechanism, the observation of amplified emission from different astrophysical settings provides insight to the nature and physical state of the respective media. In an outlook, the question towards population inversion and amplification in terrestrial phenomena such as lightning discharge in air or the non-equilibrium state of gaseous media such as carbon dioxide in the outer atmosphere of earth will be presented [9].

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[5] J. M. Weisberg, S. Johnston, B. Koribalski, and S. Stanimirovic, *Science* 106-110, **309** (2005).

[6] M. J. Mumma, D. Buhl, G. Chin, D. Deming, F. Espenak, T. Kostiuik, and D. Zipoy, *Science* 45-49, **212** (1981).

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[9] W.P. Silfvast *Opt. Photonics News* 32-37, **21** (2010).