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The Loewe Grant RITSAT

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Summary

On January 1, 2012 an «excellence initiative» within the «Loewe» program started with the aim of continuation of the research and development of rf-ion engines of the RIT type. The grant comprises 3.77 million EUR for three years, and it is given by the Minister of Science and Art of the Federal Country of Hessia, Wiesbaden. The R&D work will be mainly done by Giessen University with the assistance of 4 other German scientific institutions.

Keywords

Radio frequency ion thruster

Introduction

Rf-ion thrusters have been investigated, optimized, built, diagnosed and tested at the 1st Institute of Physics, Giessen University, since 1962, i.e. since the last 50 years. Beginning with a 10 cm diameter thruster «RIT-10», 8 different-sized engines from 2 cm up to 35 cm of ionizer diameter formed a thruster family which enables e.g. to establish scaling laws that are useful to scale up or down other rf-ion sources.

As spin-offs of the thruster development, neutral particles injector sources for fusion machines and rf-engines for material processing in industry have been investigated, developed, produced and delivered.

Since 1970, the 1st Institute of Physics cooperates successfully with EADS Astrium Space Transportation which industrialized the 10 cm thruster, built three motors flown onboard ESA's satellites EURECA and ARTEMIS, and developed a 22 cm engine.

The Giessen activities gained world wide appreciation. E.g. in 2011, the Moscow Aviation Institute started to work on rf-ion thrusters, supported by a 150 million rubles «Mega-Grant» from the Russian Minister of Education and Science.

Loewe Grant Initiation

The Hessian Ministry of Science and Art «HMWK» at Wiesbaden supports yearly renowned scientific and cultural Hessian institutions by a grant named «Loewe» or «excellent initiative». In autumn 2011, the grant in the field of nature science went to the University of Giessen assisted by four other German institutions (two of them coming from Hessia, too).

The grant amounts to 3.77 million Euro and has duration of 3 years. The official start was on January 1, 2012.

The project is called RITSAT indicating that it is focused on rf-ion thrusters. It is under the management of the 1st Institute of Physics, where the RIT-type has been invented and the R&D work started. Coordinators of RITSAT are Dr. D. Feili, the today's head of the EP group, and Prof. Dr. P. Klar from the same institute.

Figure 1 shows a graph indicating the cooperating institutions with their links. Besides of the Justus-Liebig University Giessen «JLU» with some physical and chemical institutes there are:

- the Center of Heavy Ions «GSI» at Darmstadt, responsible for ion sources and accelerators,
- the DLR – Institute at Göttingen, responsible for space technology,
- the Technical High School Middle-Hessia «THM» at Giessen and Friedberg, responsible for electro-technics, and
- Max-Planck Institute for Extraterrestrial Physics «MPE» at Garching, responsible for mission applications.

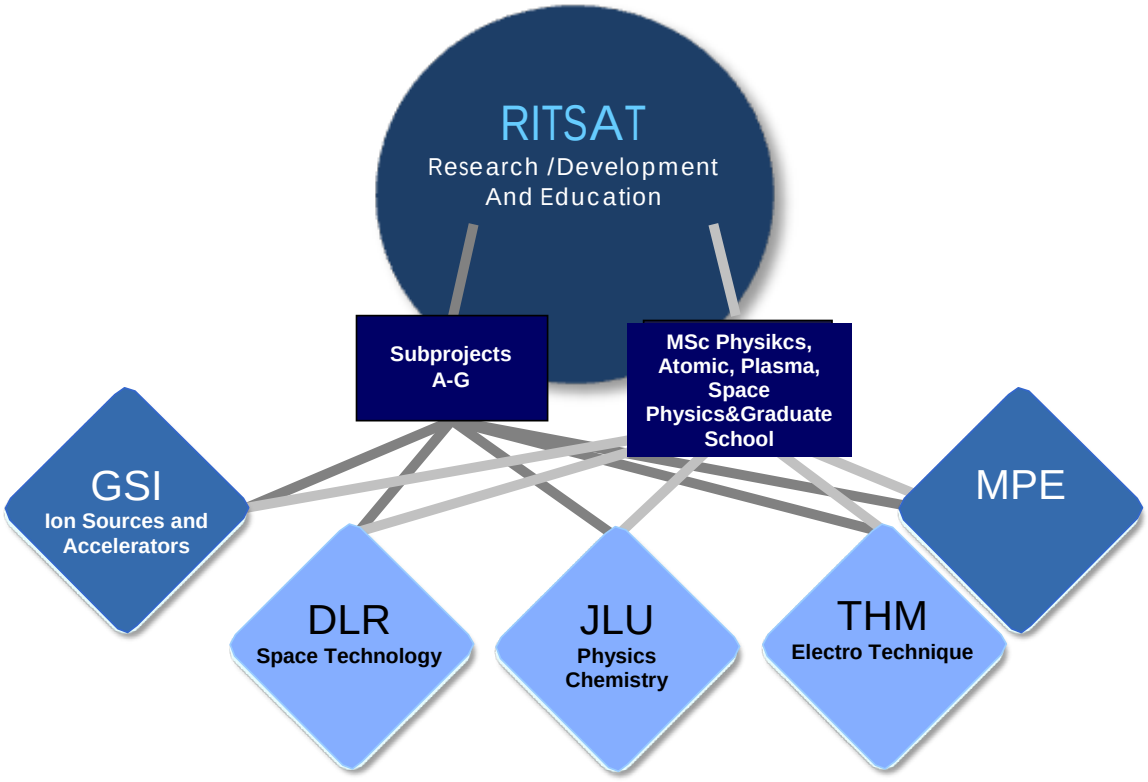

Figure 1 – Links of the RITSAT grant between institutions

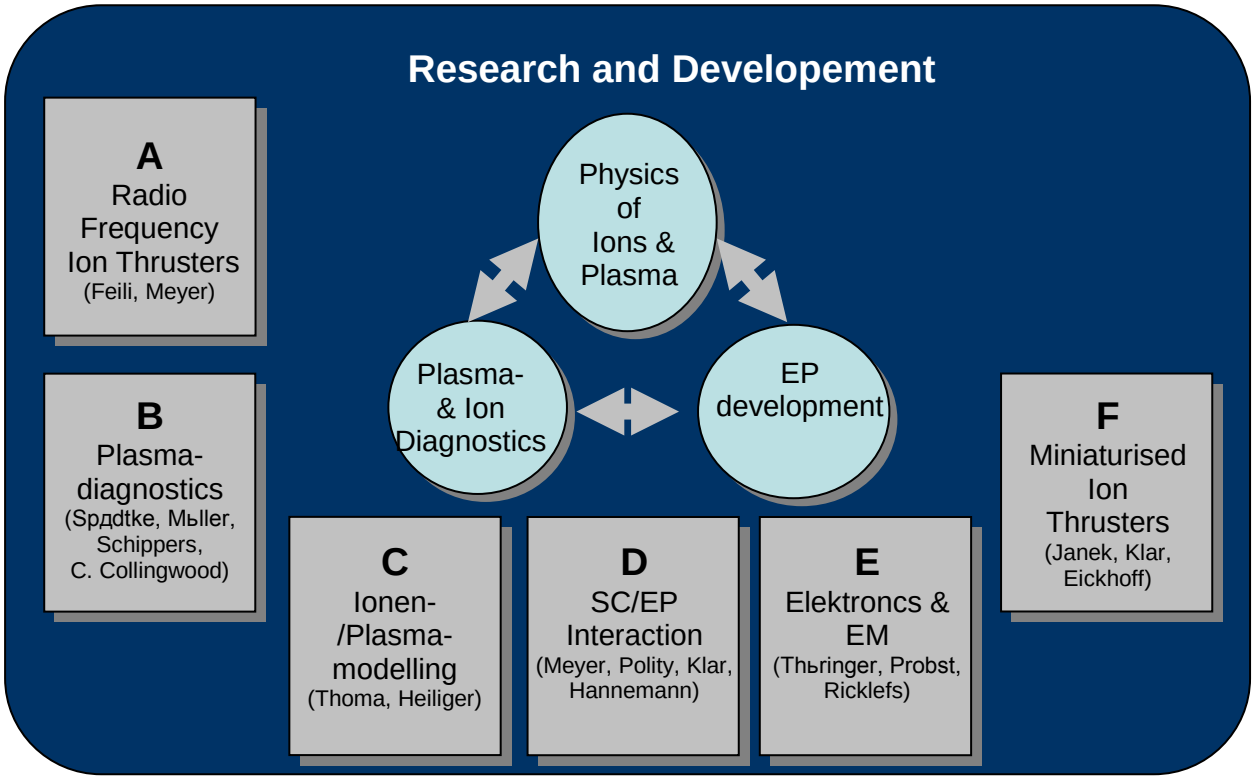

Figure 2 - Research fields and subprojects in the RITSAT program

Research Fields in RITSAT

The interaction between basic ion and plasma physics, the related diagnostics and the hardware development is shown in Fig. 2. The 6 subprojects are sketched, too.

- Subproject A deals with the development of ion thrusters operating with an rf-gas discharge. It continues the past EP-activities in the 1st Institute of Physics and may be considered as a core part of RITSAT. Three different tasks are considered in this subproject, namely:

  A.1 Small rf-thrusters μNRIT with thrusting levels between 20 and 2000 μN,

  A2 Scaled up primary propulsion motors with diameters of more than 40 cm,

  A3 Middle-sized sources to be optimized for operation with oxygen for RAM-EPs and material processing.

  Especially for the μNRITs (A1), a cooperation is planned with the subprojects B, C, D, and E (see below).

- Subproject B deals with the plasma diagnostics which is important for a further performance optimization and lifetime improvements of all rf-engines.

- Subprojects C concerns with a theoretical treatment of the discharge plasma and the ion extraction. Thus, it is of the same importance as subproject B. Moreover, the experimental results of the plasma diagnostics should be compared with the plasma modeling theory.

- Subproject D deals with the eventual thruster-spacecraft interaction that is important for real space applications.
- Subproject E concerns with thruster electronics and an eventual electromagnetic interference with the spacecraft which treats an outwards effect of the rf-thrusters like subproject D.
- Subproject F deals with widely minimized ion thrusters, i.e. it will extent the spectrum of the micro-Newton engines μNRIT (of subproject A1) towards the nano region. The background of this effort is the fact that it becomes not effective and thus no more senseful to scale down an rf-discharge below about 1 cm of diameter and 10 μN of thrust.

Education

The aim of the RITSAT grant is not only to develop the theory and hardware of rf-ion engines. As a lot of work should be done by master students and graduates, the education aspect is one important goal of the grant, too. We emphasize that a new study module of the physics department of Giessen University concerns with “atomic, plasma and space physics”. The three new professors are all involved in the above mentioned subprojects.

Conclusion

The R&D work of the RITSAT–Grant is going on. Some preliminary results will be reported elsewhere. The Hessian “Loewe-Grant” may be compared with the above mentioned Russian “Mega-Grant”, not only concerning the financial volume. The fact that both grants are focused on the RIT-type may be encouraging for both teams, and cooperation would be beneficial.

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