



2nd French Russian Aerospace Forum

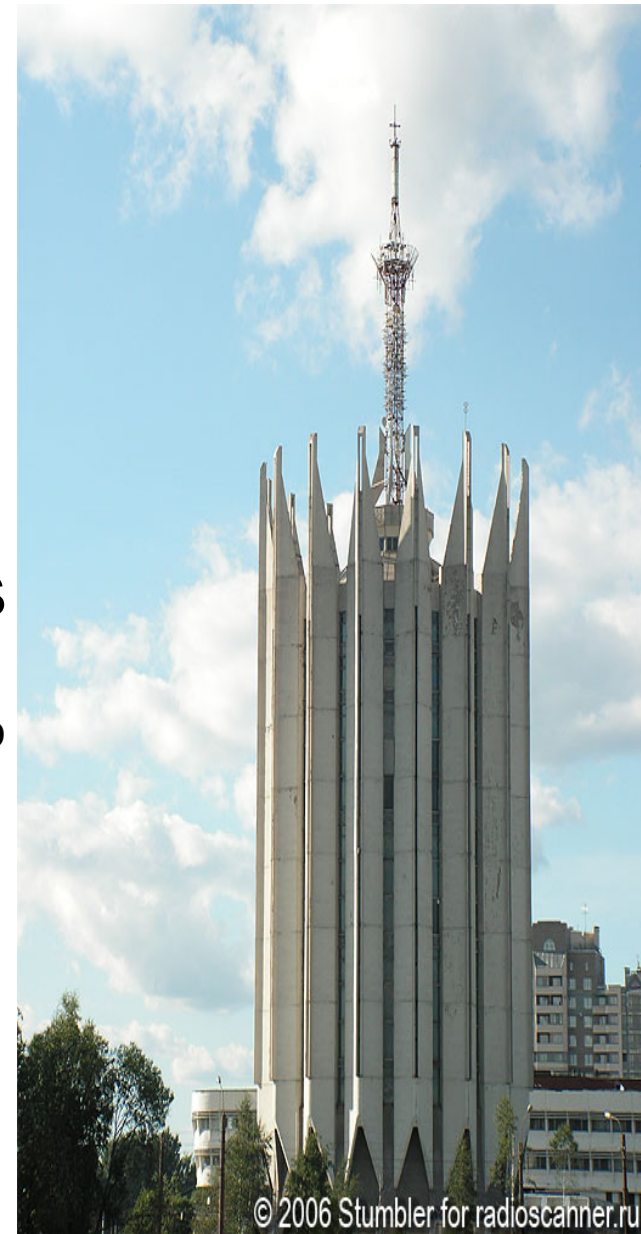
Novel Technologies of Electromagnetic Energy Transform into Motion Energy of Space Apparatus

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Institute of Physics, Nanotechnology and Telecommunications

Space Technologies and Astrophysics Department

- Astrophysics
- Gamma-ray astronomy
(collaborations with RAS, ESA, NASA)
- Space microwave systems
- Satellite systems
of automated vessel identification
- Small satellite technologies



Resources On-Board

Solar-electric thrusters

Ion

Electrostatic ion

Field-emission

Hall effect

Colloid

Electrothermal

DC arc jet

Microwave arc jet

Helicon Double Layer

Electromagnetic

Magneto plasma dynamics

Electrodeless plasma

Pulsed inductive

Pulsed plasma

Material Stock

Gaseous: Xe, Kr, Ar,...

Liquids, Colloids

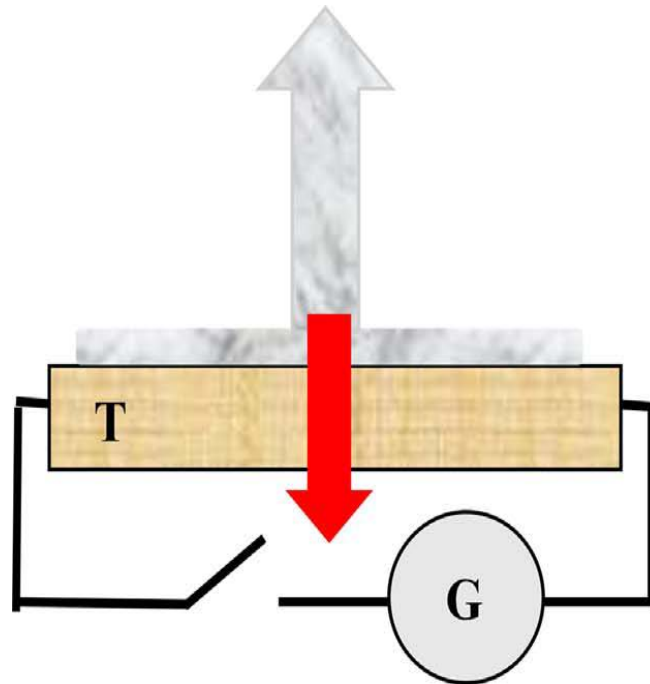
Solid State Materials:

Iodine, Bismuth, Zinc,
plastic (Teflon),...

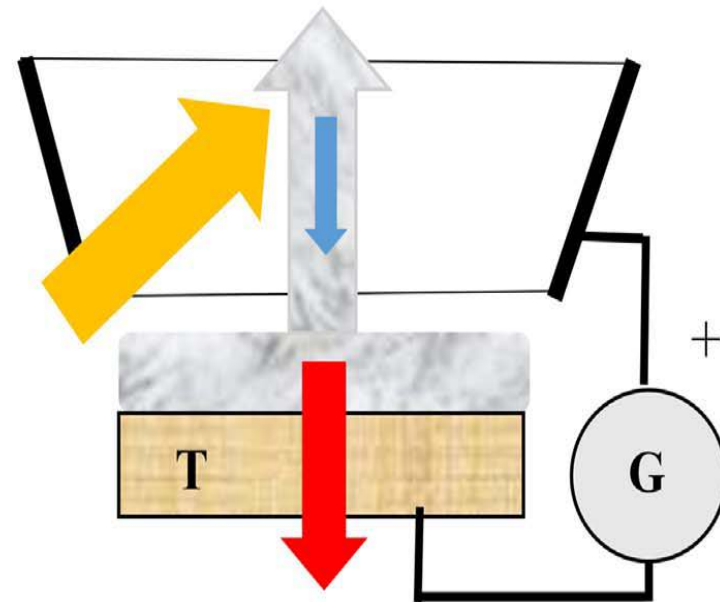


Novel stage of space technology?

Pulsed electrodynamic
desorption



Ion sputtering,
recycling scheme



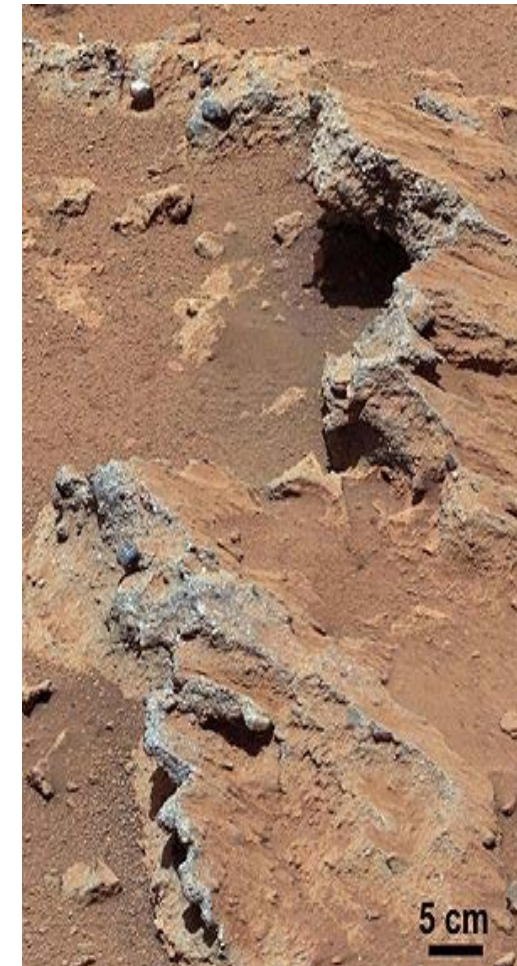
Left panel: ED. Right panel: ISSR. G – electrical power generator, T – target with substance sample surface layer (gray line), gray arrow – ejected particles flow, yellow arrow – ionizing beam, blue arrow – returning ionized part of ejected flow, red arrow – resulted thrust.

Novel Materials for Space Resources On-Board?

Metals: Cu, Sn, ..., Carbon, Metamaterials, Natural Materials of Planets, Asteroids: Minerals, Rocks, ...



| Moon | Mars |
|---|---|
| Si 20-25% | Si 20% |
| Al 7-12% | Al 3% |
| Fe 9-13% | Fe 12-14% |
| Ca 7-13% Regolith, Micro- structured | S > 3%, Ti 0.5% Fine-grained basalts with irregular holes, dust |



Conclusion

Electrodynamic Desorption and Recycled Ion Sputtering Ion Physics are under complex investigation with appropriate perspective materials to create:

- ❖ a promising universal transformation of electrical energy into propulsion,
- ❖ natural materials preparation, building blocks production, and chemical reactions activation,

in connection with emerging space science&technology.



POLYTECH

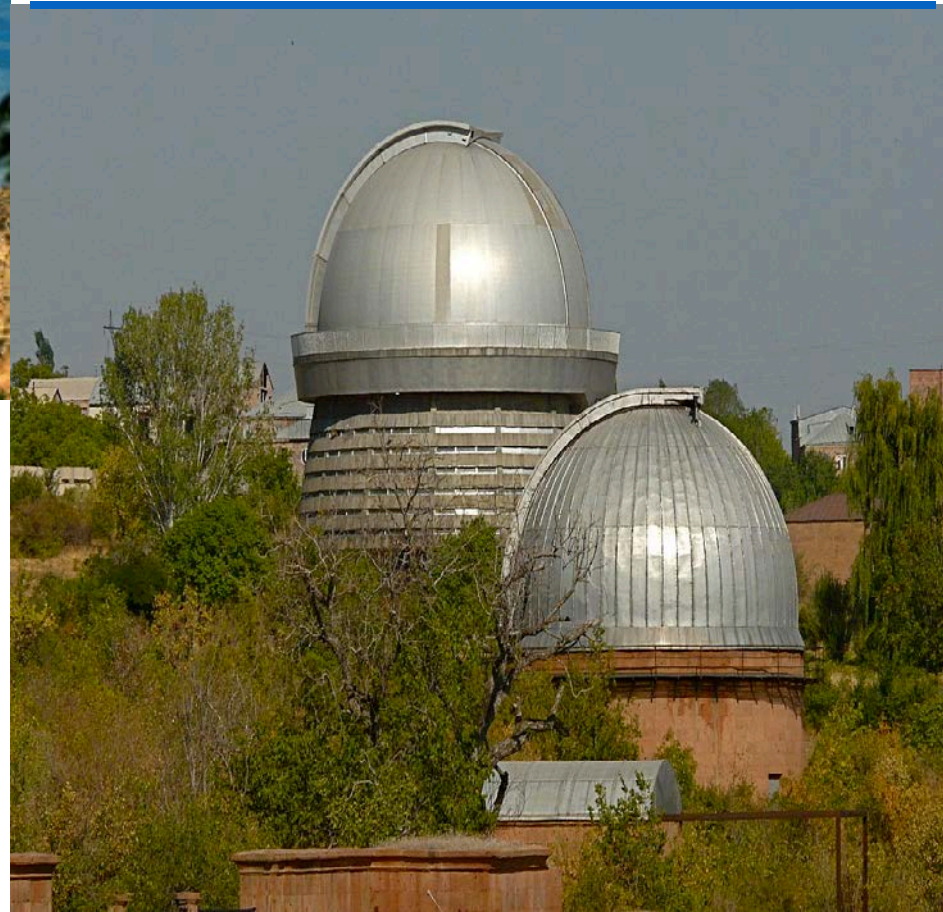
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www.International.rau.am

**2017 Young Researches
Astrophysics School
Armenia**

Byurakan observatory, 1490m



Химический состав (в процентах) образцов лунного грунта,
доставленных на Землю

| Элементы (окислы) | «Морские» районы | | «Материковые» районы | |
|--------------------------------|------------------------------|-------------------------------|---|-------------------------------|
| | «Луна-16» (Море Изобилля) | «Аполлон-15» (Море Дождей) | «Луна-20» (Горный район между Морем Изобилля и Морем Кризисов) | «Аполлон-17» (Тавр-Литров) |
| SiO ₂ | 42,95 | 45,0 | 44,2 | 48,5 |
| TiO ₂ | 5,5 | 2,54 | 0,32 | 0,95 |
| Al ₂ O ₃ | 13,88 | 8,9 | 19,1 | 17,2 |
| FeO | 20,17 | 22,21 | 6,91 | 14,4 |
| MgO | 6,05 | 9,08 | 13,37 | 8,94 |
| CaO | 10,8 | 10,27 | 13,3 | 11,6 |
| Na ₂ O | 0,23 | 0,28 | 0,48 | 0,40 |
| K ₂ O | 0,16 | 0,03 | 0,47 | 0,25 |
| Сумма | 99,74 | 98,31 | 98,15 | 99,24 |

Химический состав (в процентах) марсианского грунта

| Элемент | Район посадки спускаемых аппаратов | |
|----------|------------------------------------|------------|
| | «Викинг-1» | «Викинг-2» |
| Магний | 5,0 | — |
| Алюминий | 3,0 | — |
| Кремний | 20,9 | 20,0 |
| Сера | 3,1 | 2,6 |
| Хлор | 0,7 | 0,6 |
| Калий | 0,25 | 0,25 |
| Кальций | 4,0 | 3,6 |
| Титан | 0,5 | 0,6 |
| Железо | 12,7 | 14,2 |