# Nuclear Fusion In A Spherical Reactor

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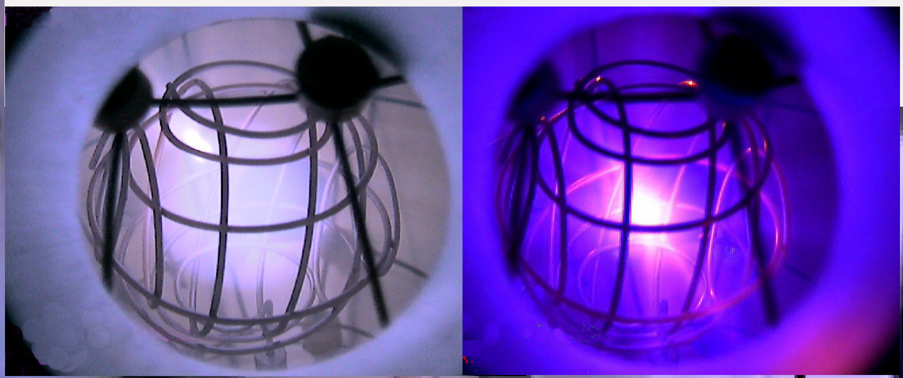
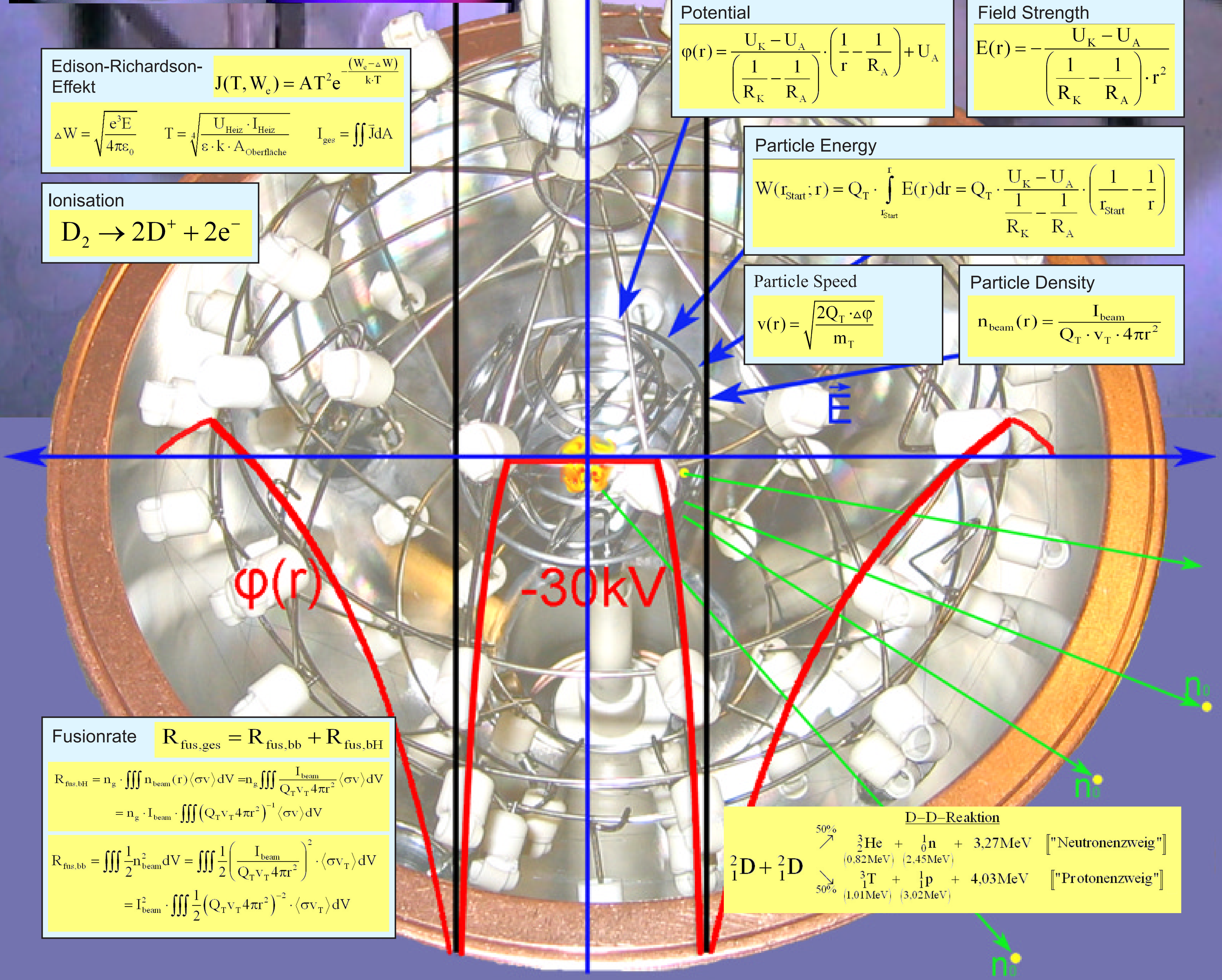
Ever since the development of the *Stellerator*- and *Tokamak-Principle* in 1951/52, modern nuclear fusion research has almost solely focused on the Magnetic confinement fusion. Only a few research facilities occupy themselves with the largely unknown IEC-fusion method. This fusion technology originally devised by Philo Farnsworth in the fifties offers the possibility of a relatively simple and controlled Deuterium-Deuterium-Fusion. Even though the efficiency according to the existing current state of research is not sufficient for an operational reactor to generate energy, the IEC-Nuclear fusion still holds many unknown theoretical and practical opportunities.

The aim of this project is the construction of a portable Nuclear-fusion-reactor, the observation of the physical coherence's and improvement of the efficiency.
The detection of neutrons does not only serve the purpose of fusion verification but should shed light on the activity of various fusion conditions.
By means of a novel concept which allows the ionization of deuterium molecules with a spherical filament-wire-alignment we expect an increased efficiency during fusion operation. With this new technique and the home-made fusion reactor, interesting possibilities are opened regarding the examination of the fusion plasmas in focus and the deuteron acceleration in the electrostatic field of 10-35kV.



## Inertial Electrostatic Confinement Fusion

Classical test arrangements of the IEC-operation are made up of a globular-reactor-chamber, which is evacuated to a pressure of <10-3 mbar and are run with constant influx of deuterium.
Positioned inside the reactor chamber there is a grid-sphere which is electrically shielded from the chamber environment. Within this grid-anode another small grid-cathode is located. If now a negative high voltage Uk is attached to this grid-sphere it operates as a cathode, the outer with voltage Ua as an anode. This setup is easier to understand as a *spherical capacitor.*
Now through the high field strength the deuterium molecules are ionized. If both the grid-electrodes are built symmetrically and placed into one another, it is possible to achieve fusion reactions within the grid-cathode. As of now the deuteron's are accelerated evenly from all sides towards the cathode, penetrate the grid and generate at the centre point a spherically shaped plasma. Its appearance is similar to that of a star.




### Potential

$$\varphi(r)=\frac{U_K-U_A}{\left(\frac{1}{R_K}-\frac{1}{R_A}\right)}\cdot\left(\frac{1}{r}-\frac{1}{R_A}\right)+U_A$$

### Field Strength

$$E(r)=-\frac{U_K-U_A}{\left(\frac{1}{R_K}-\frac{1}{R_A}\right)\cdot r^2}$$

### Edison-Richardson-Effekt

$$J(T,W_e)=A T^2 e^{-\frac{(W_e-\Delta W)}{k\cdot T}}$$

$$\Delta W=\sqrt{\frac{e^3E}{4\pi\varepsilon_0}} \qquad T=\sqrt[4]{\frac{U_{Heiz}\cdot I_{Heiz}}{\varepsilon\cdot k\cdot A_{Oberfläche}}} \qquad I_{ges}=\iint \vec{J}dA$$

### Ionisation

$$D_2 \rightarrow 2D^+ + 2e^-$$

### Particle Energy

$$W(r_{Start};r)=Q_T\cdot\int_{r_{Start}}^{r}E(r)dr=Q_T\cdot\frac{U_K-U_A}{\frac{1}{R_K}-\frac{1}{R_A}}\cdot\left(\frac{1}{r_{Start}}-\frac{1}{r}\right)$$

### Particle Speed

$$v(r)=\sqrt{\frac{2Q_T\cdot\Delta\varphi}{m_T}}$$

### Particle Density

$$n_{beam}(r)=\frac{I_{beam}}{Q_T\cdot v_T\cdot 4\pi r^2}$$

### Fusionrate

$$R_{fus,ges}=R_{fus,bb}+R_{fus,bH}$$

$$R_{fus,bH}=n_g\cdot\iiint n_{beam}(r)\langle\sigma v\rangle dV=n_g\iiint\frac{I_{beam}}{Q_T v_T 4\pi r^2}\langle\sigma v\rangle dV$$
$$=n_g\cdot I_{beam}\cdot\iiint\left(Q_T v_T 4\pi r^2\right)^{-1}\langle\sigma v\rangle dV$$

$$R_{fus,bb}=\iiint\frac{1}{2}n_{beam}^2 dV=\iiint\frac{1}{2}\left(\frac{I_{beam}}{Q_T v_T 4\pi r^2}\right)^2\cdot\langle\sigma v_T\rangle dV$$
$$=I_{beam}^2\cdot\iiint\frac{1}{2}\left(Q_T v_T 4\pi r^2\right)^{-2}\cdot\langle\sigma v_T\rangle dV$$

### D–D–Reaktion

$${}^2_1D+{}^2_1D \xrightarrow{50\%} {}^3_2He\,(0{,}82MeV) + {}^1_0n\,(2{,}45MeV) + 3{,}27MeV \quad [\![\text{"Neutronenzweig"}]\!]$$

$${}^2_1D+{}^2_1D \xrightarrow{50\%} {}^3_1T\,(1{,}01MeV) + {}^1_1p\,(3{,}02MeV) + 4{,}03MeV \quad [\![\text{"Protonenzweig"}]\!]$$