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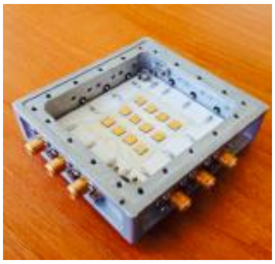
TECHNOLOGY TRANSFER PROGRAMME

Diamond detector

A 12--pixels diamond based neutron spectrometer matrix has been built in a collaboration between the two CNR institutes IFP (Institute of Plasma Physics, Milan) and ISM (Institute of the Structure of Matter, Rome). The spectrometer is equipped with fast electronics and digital acquisition, which for the first time allows combined fast neutron spectroscopy (>1 MeV) with good energy resolution (<3% at 14 MeV) and high count--rate capability in excess of 1 MHz.

Description of the technology

A 12--pixel diamond--based neutron spectrometer matrix has been developed and built in a collaboration between two Italian research institutes within the VNS enhancement project. This new spectrometer allows for spectroscopic analysis of fast neutrons to be undertaken where both a good energy resolution and high count--rate can be achieved. Each pixel is made of a single crystal diamond of area 4x4x0.5 mm3 and is grown using the Chemical Vapor Deposition (CVD) technique.



The diamond matrix will be used to take high energy resolution measurementsof t he 14MeV neutron spectra created in Deuterium--Tritium plasmas within the JET tokamak. Moreover, the diamond matrix is also capable of measuring 2.5 MV neut ron spectra from D plasma with limited energy resolution. Each pixel is completely independent of the others.

The new detector features the advantages of being compact, insensitive to magnetic field and radiation resistant, which makes it ideal for use on neutron cameras of future burning plasma experiments such as ITER or DEMO.

No patent has been made on this instrument.

Innovation and advantages of the offer

- Fast neutron spectroscopy with combined good energy resolution (<3% at 14MeV) and high count–rate (in excess of 1MHz).
- Compact
- Insensitive to magnetic fields
- Radiation resistant

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Non-fusion Applications

Currently being developed for use on JET to measure neutron spectra from DT plasmas.

Applications also exist at spallation neutron sources for the measurement of fast neutron beam characteristics (spatial and energy distribution). Due to the typical short–pulsed nature of the beam (width in the range 1–-70ns) these measurements require a spectrometer capable of handling a very high instantaneous count rate (>1 MHz) and spectroscopy in a wide energy range (from 10 MeV up to hundreds of MeV).

The diamond matrix can also be developed and used for spectroscopic analysis of charged particles, such as protons or alpha particles.

The matrix can be exploited for radiation therapy dosimetry. The single pixel can operate also as a diamond dosimeter, with advantages connected to radiation damage resistance, response linearity with radiation dose and dose–rate, and tissue–equivalent behavior (atomic number very close to the mean of human tissue). The matrix, mounted inside a water phantom normally used in radiation therapy, can be motorized by x–y–-z translational stages to cover large areas and field depth, thus allowing a real–time, fast, and precise periodic calibration of the large radiation fields used in radiation therapy (i.e. dose–rate distribution map), which is today performed with rougher and significantly less precise methods.

Finally, application could be foreseen in the field of security wherever a compact and portable detector is needed for detection of fast neutrons.

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