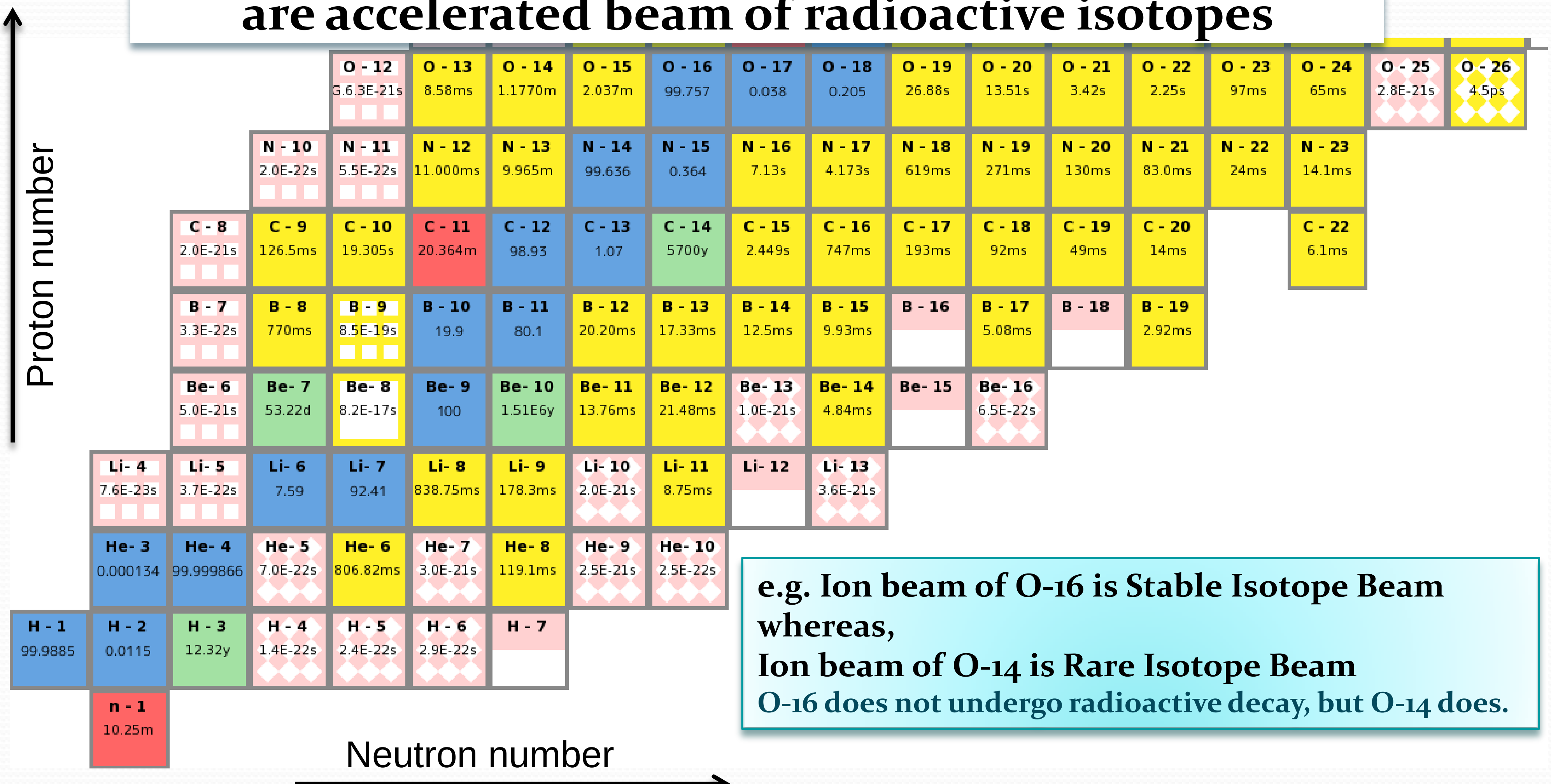
What is RIB?

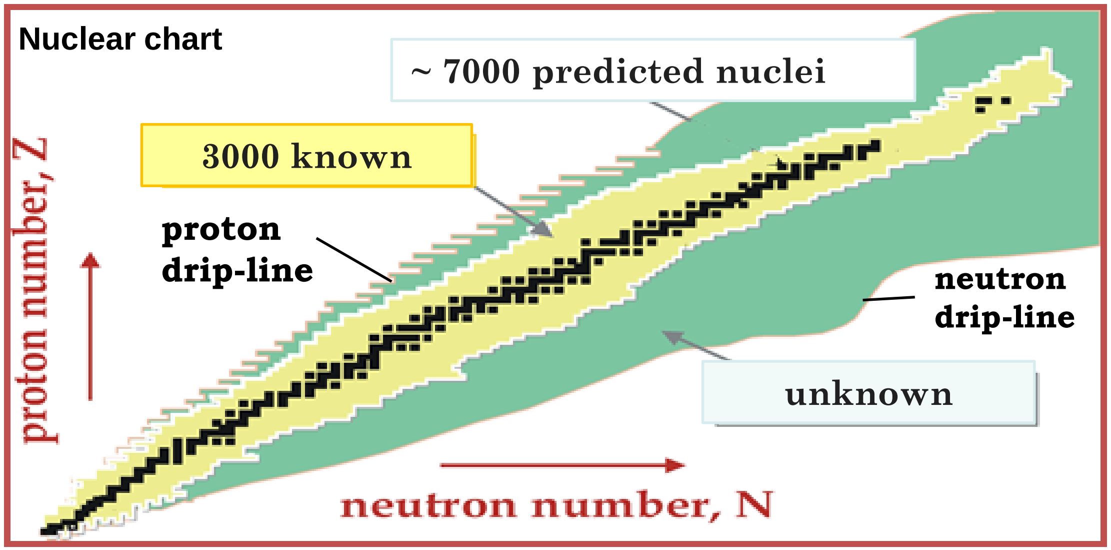
RIB : Rare Isotope Beam or Radioactive Ion Beam
are accelerated beam of radioactive isotopes



e.g. Ion beam of O-16 is Stable Isotope Beam whereas,
Ion beam of O-14 is Rare Isotope Beam
O-16 does not undergo radioactive decay, but O-14 does.

The prime motivation for radioactive ion beams is study of **exotic nuclei** i.e. nuclei away from beta stability

Exotic nuclei : have different neutron to proton ratio than stable nuclei, show unusual properties like nuclear halo, new magic numbers not predicted earlier



There is a need for systematic study of a large number of nuclei for the refinement & better predictability of nuclear models

Exotic nuclei production difficulties

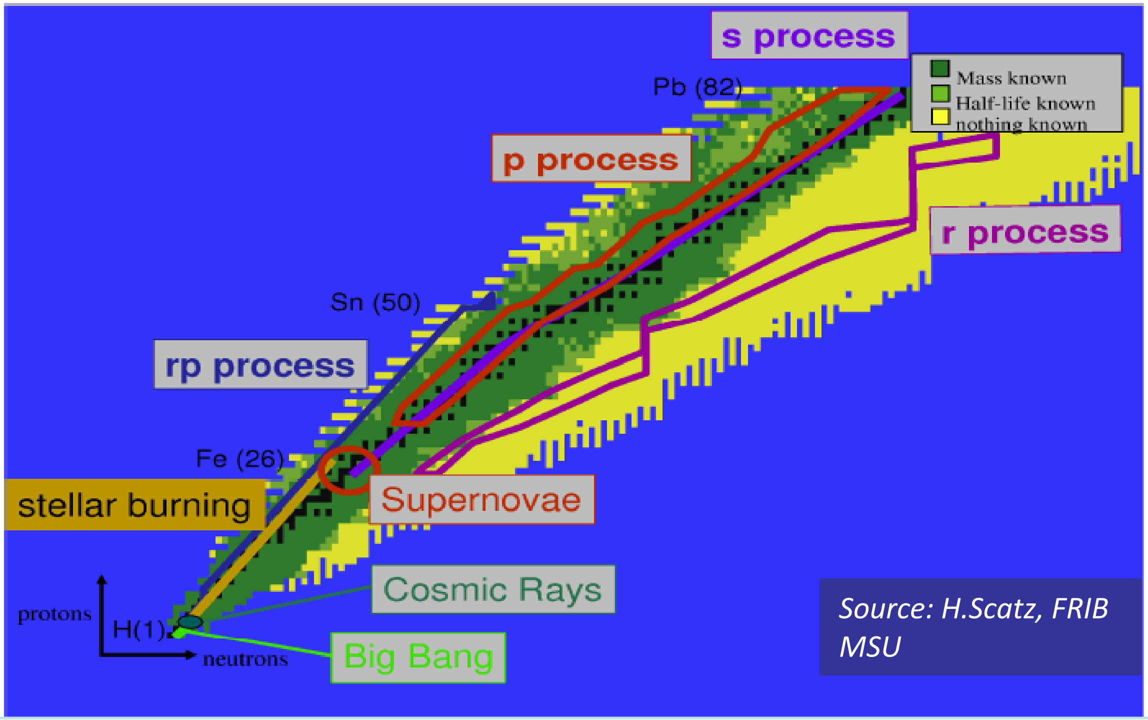
- Low production cross-sections
- Short half lives
- Unwanted species predominant

Advantage with RIB

- Large number & kind of beams
- Since RIB is n-rich or p-rich, exotic nuclei are expected to be produced with better S/N ratio

Exotic nuclei play a crucial role in explosive nucleo-synthesis of heavy-elements beyond iron

Half of nuclear species beyond iron produced in rapid neutron-capture r-process
Fusion stops at iron ; slow capture process up to ^{209}Bi - beyond Bi, r-process



Data on short-lived exotic nuclei needed for nuclear astrophysics models :

Mass; limits of existence, Half-lives, Matter distribution, Shell closures, Excited States,

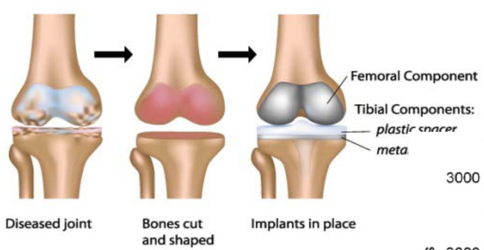
Decay modes, (n, γ) ; (p, γ) cross-sections

RIB is a tool for research in applied sciences

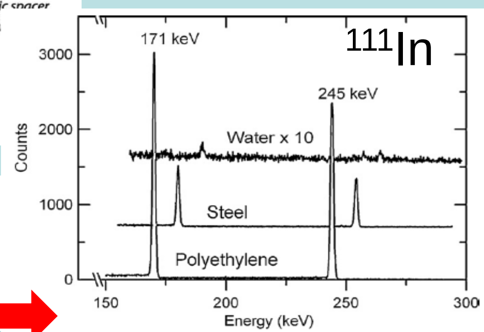
- Wide variety of radioactive probes become available
- One can tune implantation energy & intensity ; implant in chemically incompatible lattice
- One can precisely study local environment of the substrate at atomic scale using hyperfine interaction between the implanted radio-isotope and substrate atoms
- Chemical changes due to decay of the implanted radio-isotope can be studied in-situ
- Non-destructive implantation in polymers , ceramics, biological samples becomes possible with wide applications

Wear studies on bio-medical implants

Artificial joints

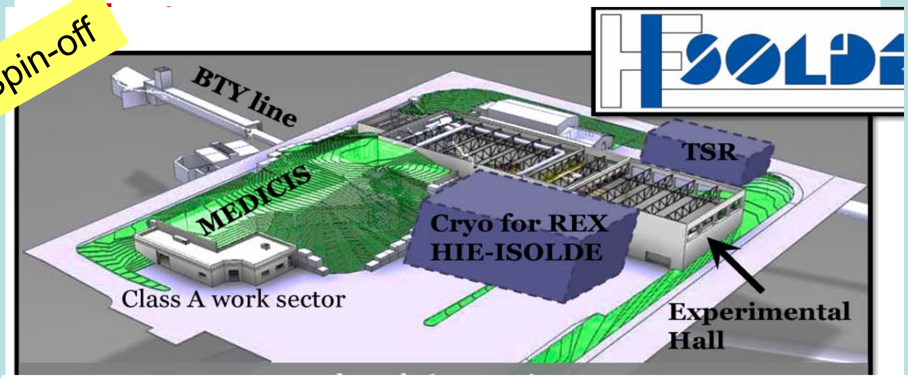


Study of wear in UHWPE polymer using ^{111}In implantation



Isotope harvesting : CERN MEDICIS

Spin-off



85% proton beam passes the target without interaction
Bio-medical isotopes on industrial scale