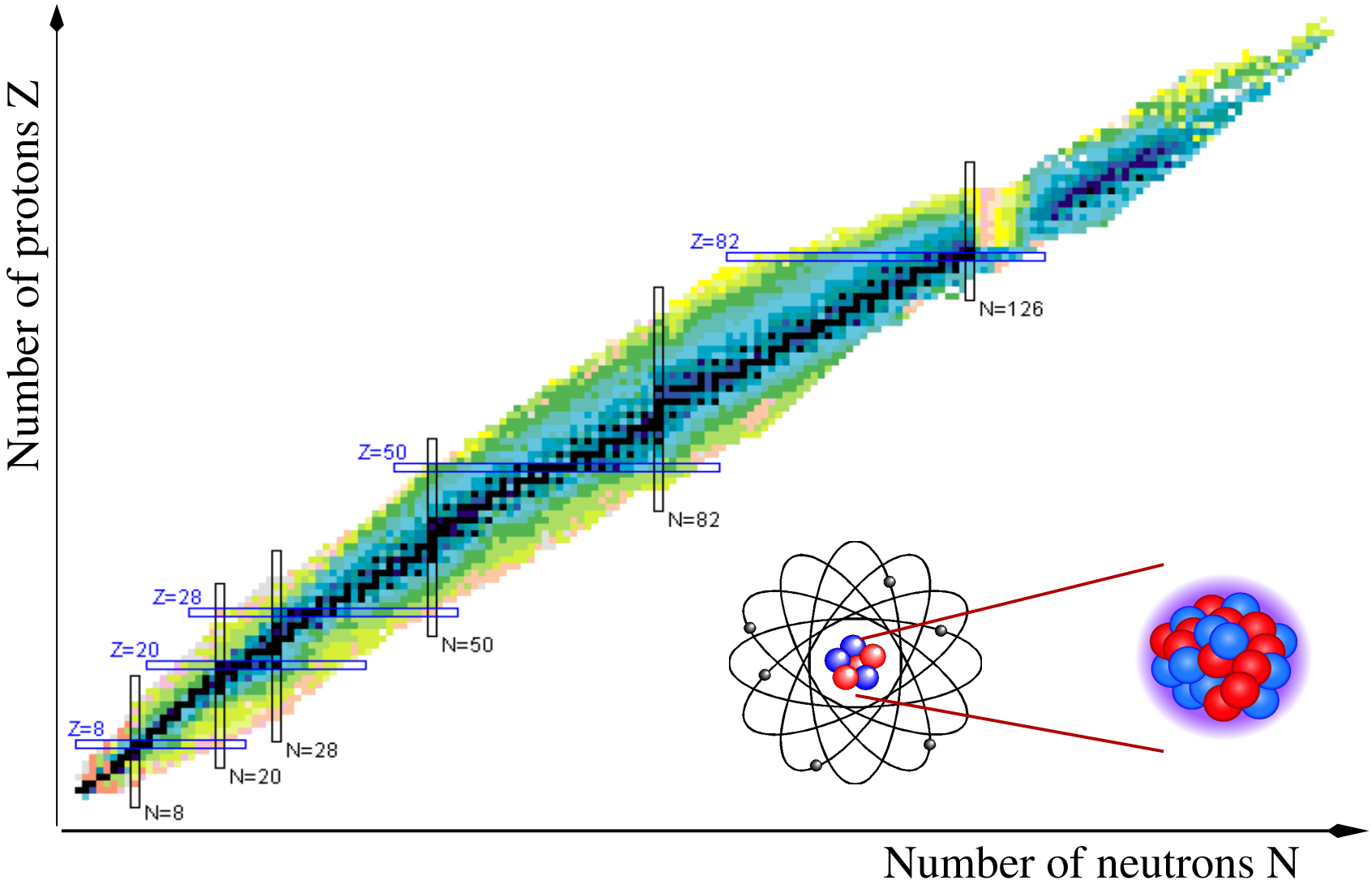
Monitoring radiation levels in the Pacific Northwest

The Fukushima Nuclear Crisis:Separating Fact from Fiction

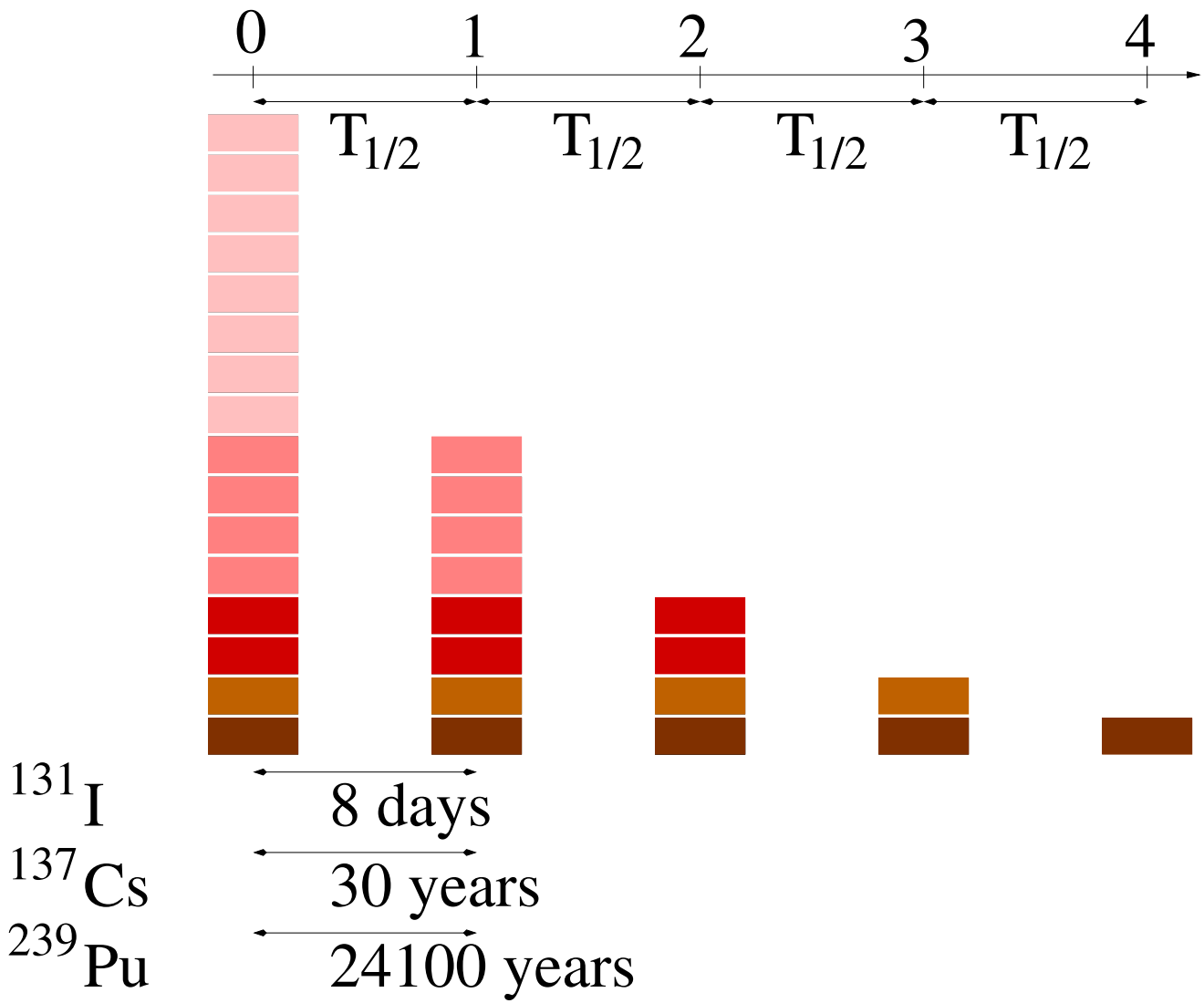
Simon Fraser University

April 11, 2011

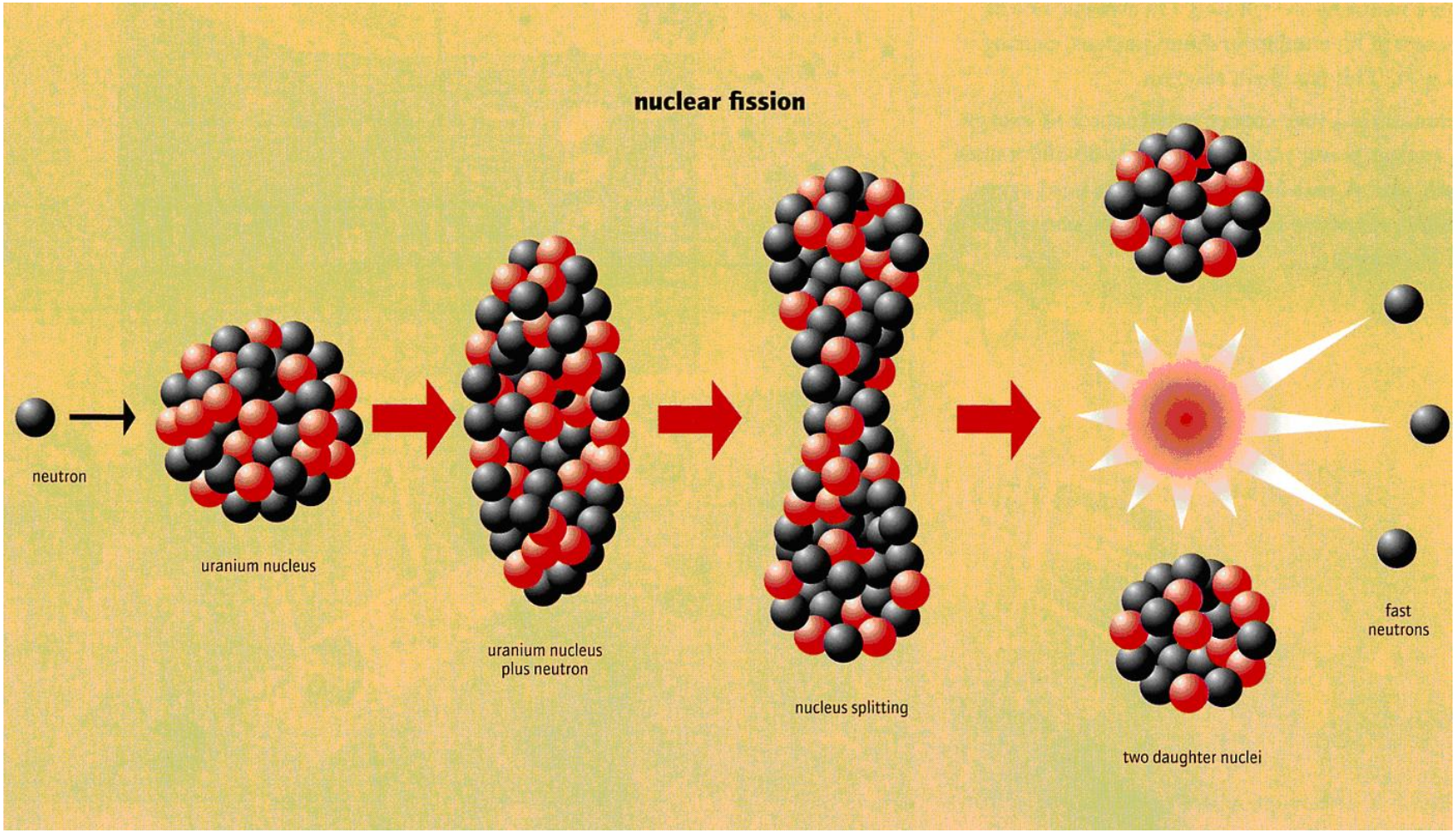
The nuclear chart



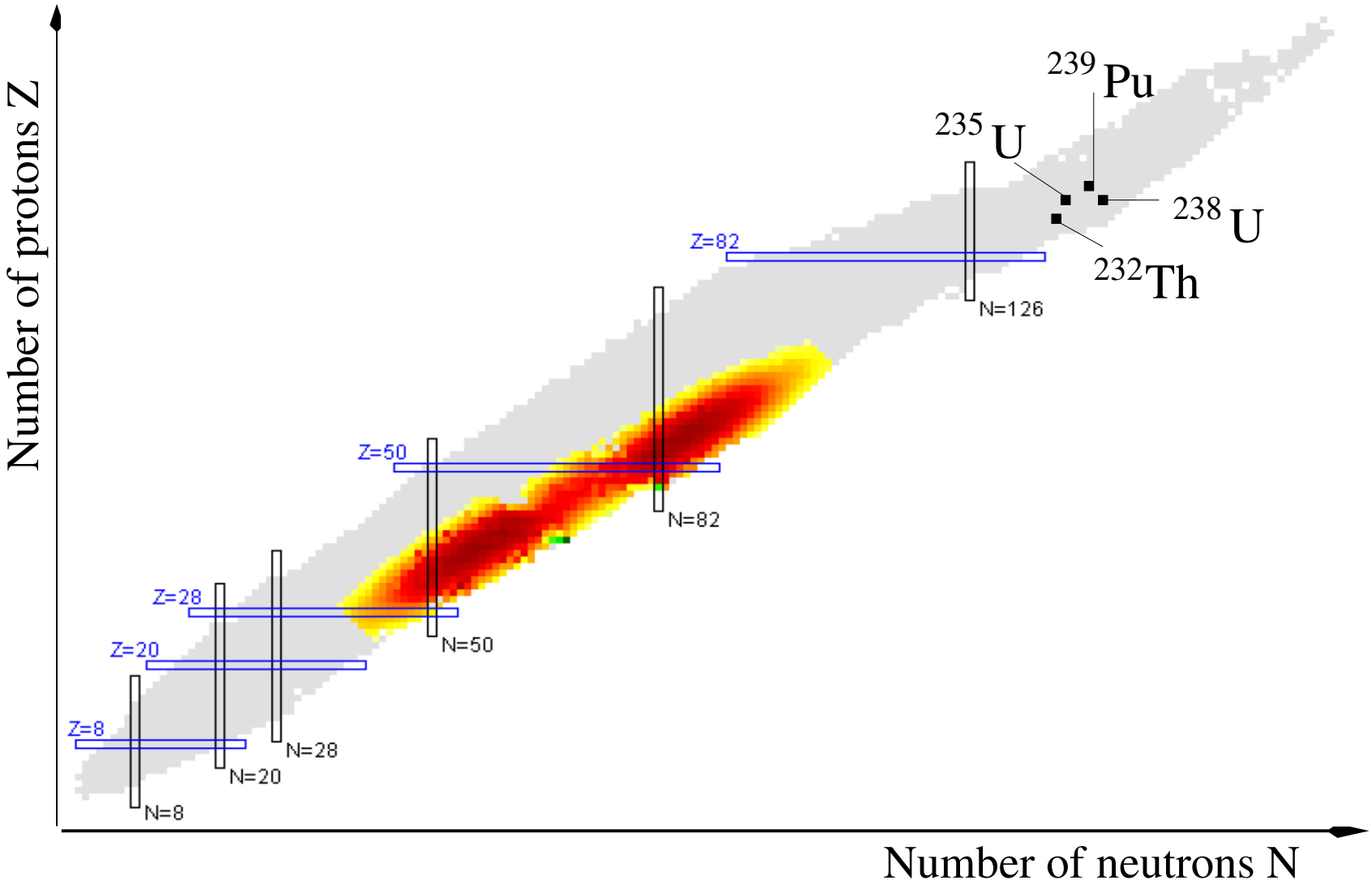
Nuclear decay half-life



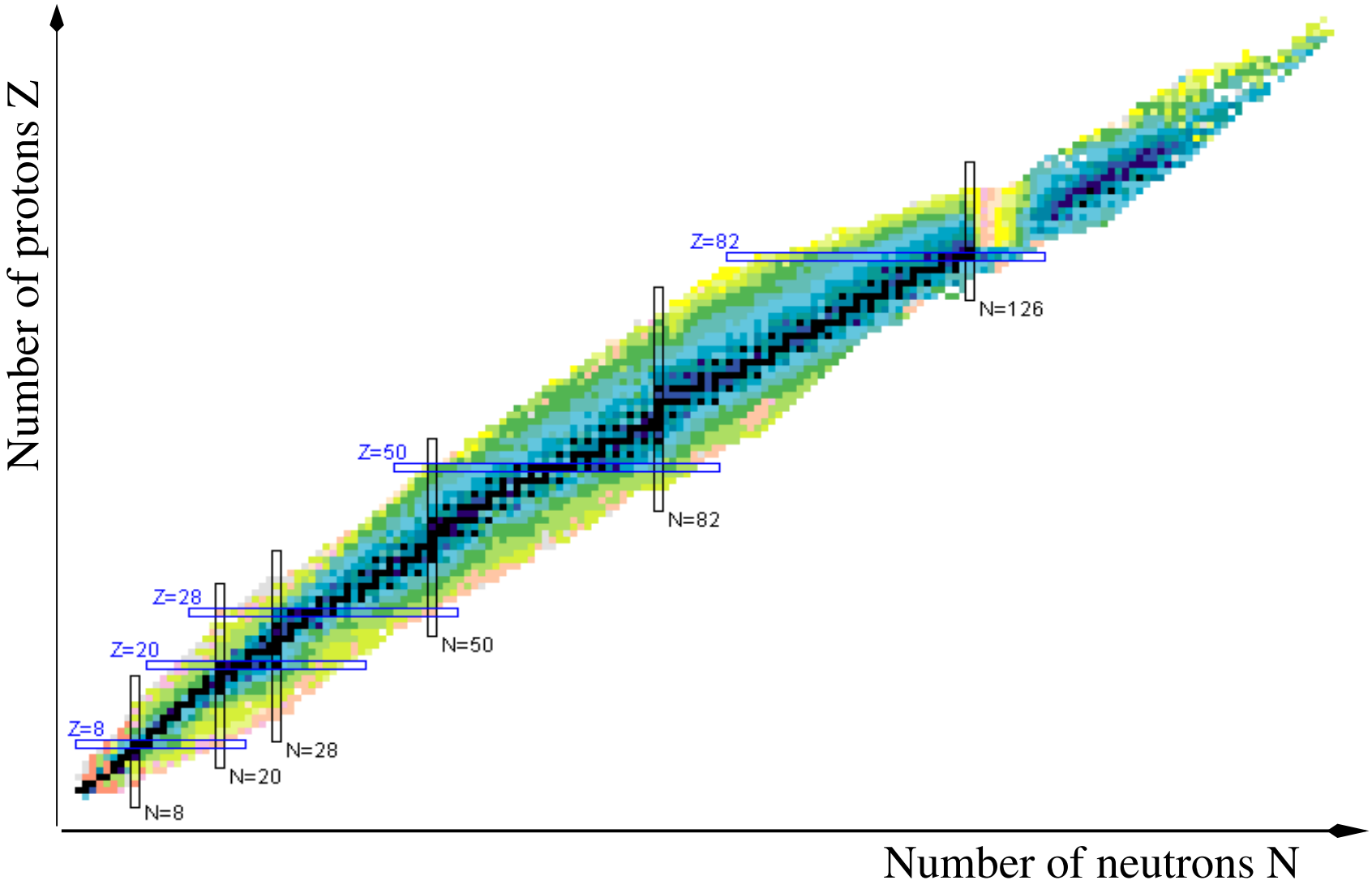
Nuclear fission



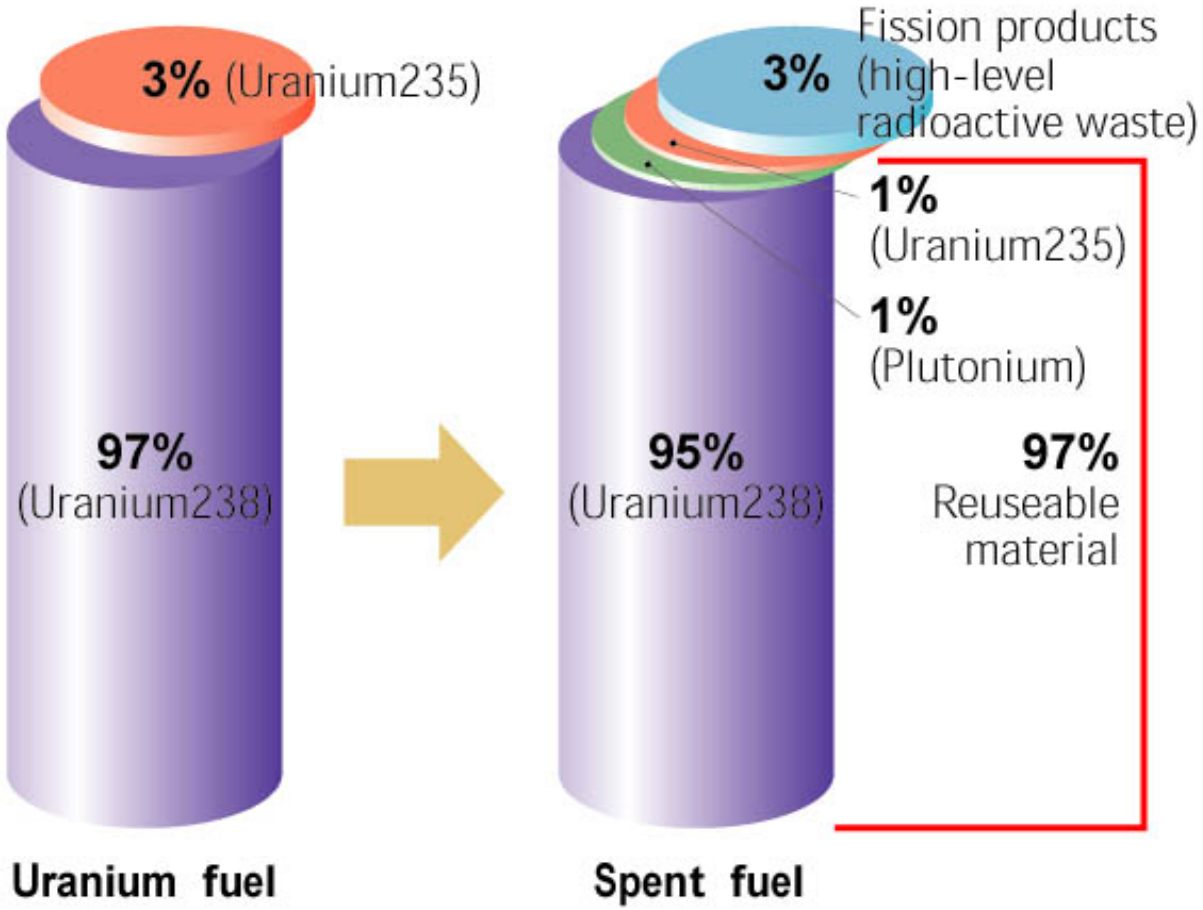
Fission fragments



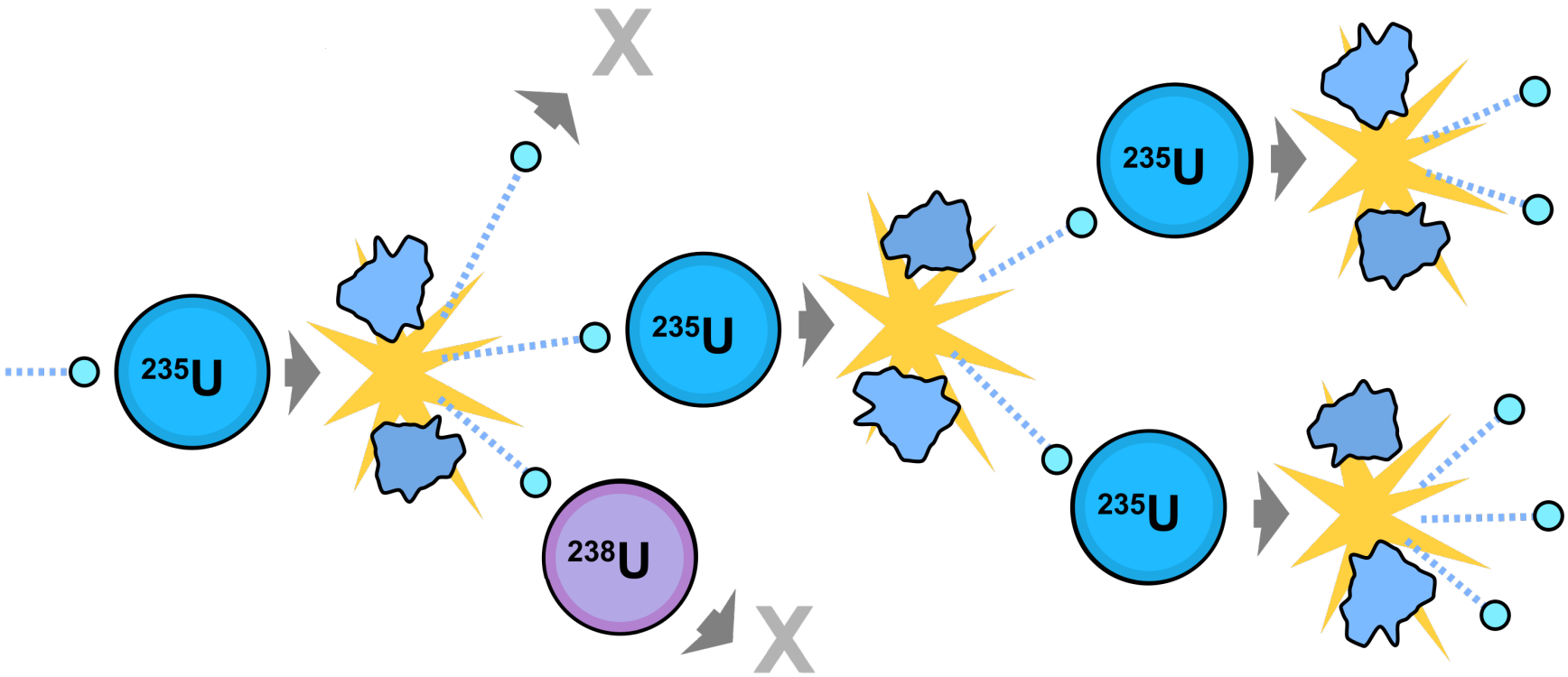
The nuclear chart



Fresh and spent nuclear fuel



Nuclear chain reaction



Plutonium

- Plutonium (Pu) is a man made, radioactive, heavy element containing 94 protons.
- ^{239}Pu is produced in fuel containing ^{238}U.
- ^{239}Pu is the material of choice for nuclear weapons.
- Mixed Oxide nuclear fuel used in one of the Fukushima reactors contains Pu/U mixture.
- The element of Pu is highly toxic when inhaled, (less toxic when ingested).
- Animal studies found that an accumulated dose of a few milligram of plutonium per kilogram of tissue is lethal.
- Traces of Pu were reported to be found at the Fukushima site (but not talked about recently).

Radio-iodine ^{131}I

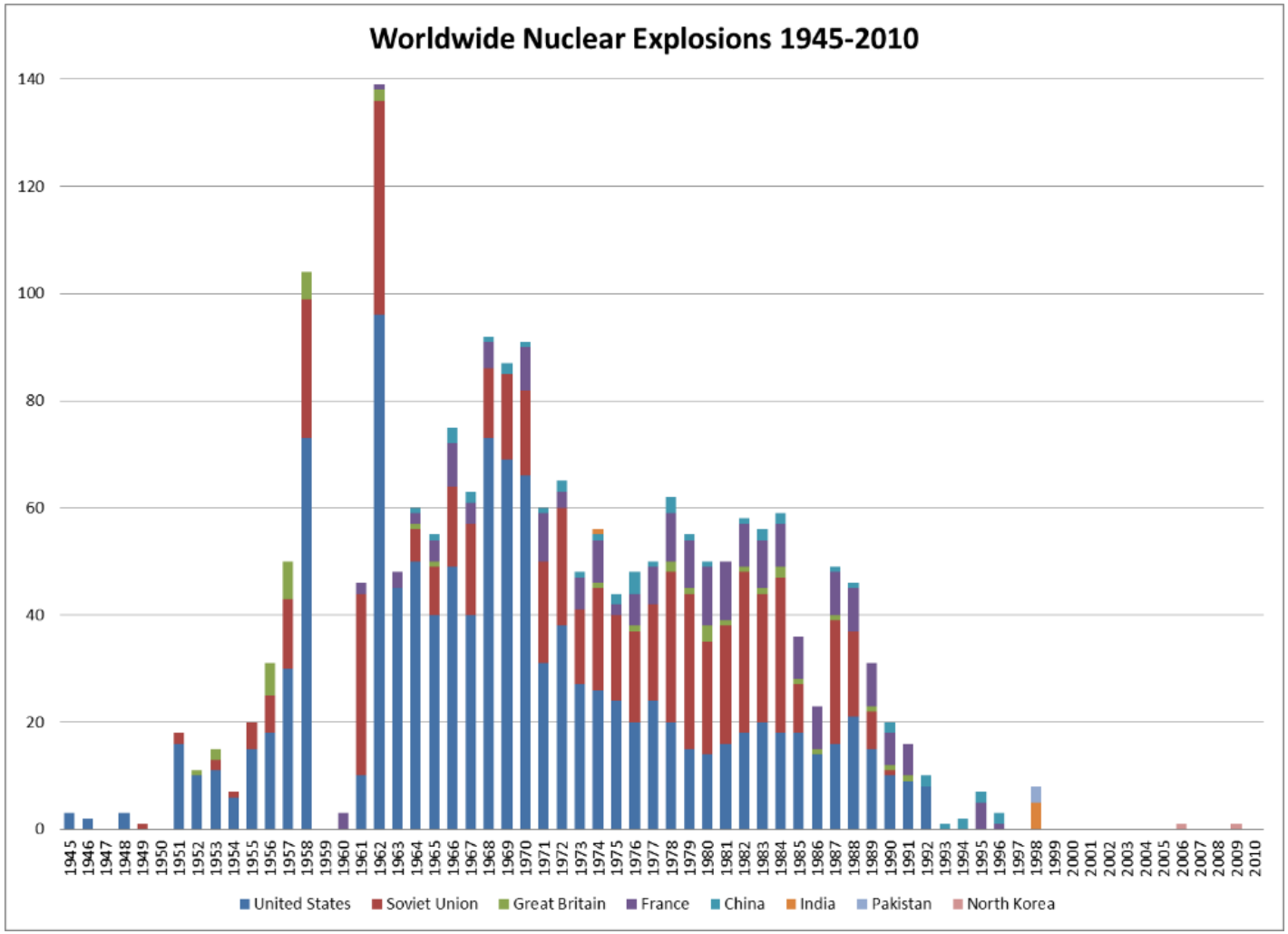
- ^{131}I is a man made radioactive isotope of Iodine.
- ^{131}I has a half life of 8 days.
- ^{131}I is an abundant fission fragment.
- ^{131}I is used in radiotherapy of cancer.
- ^{131}I is not found in the atmosphere in normal conditions .
- ^{131}I is a good indicator of radioactivity release in reactor accidents, the signal is not obstructed by background.
- Iodine accumulates in the thyroid, thus large scale exposure to ^{131}I is a potential health hazard.

Radioactive ^{137}Cs

- ^{137}Cs is a man made radioactive isotope of Cesium.
- ^{137}Cs has a half life of 30 years.
- ^{137}Cs is an abundant fission fragment.
- ^{137}Cs is used in radiotherapy of cancer and in food irradiation.
- ^{137}Cs was not present in the environment before 1940's when fission started to be used for nuclear power releases.
- ^{137}Cs background from nuclear weapon tests and previous nuclear accidents obscures the signal from Fukushima.
- Contamination with ^{137}Cs is long lasting.

Nuclear weapon tests

~2000 reported tests ~550 atmospheric explosions

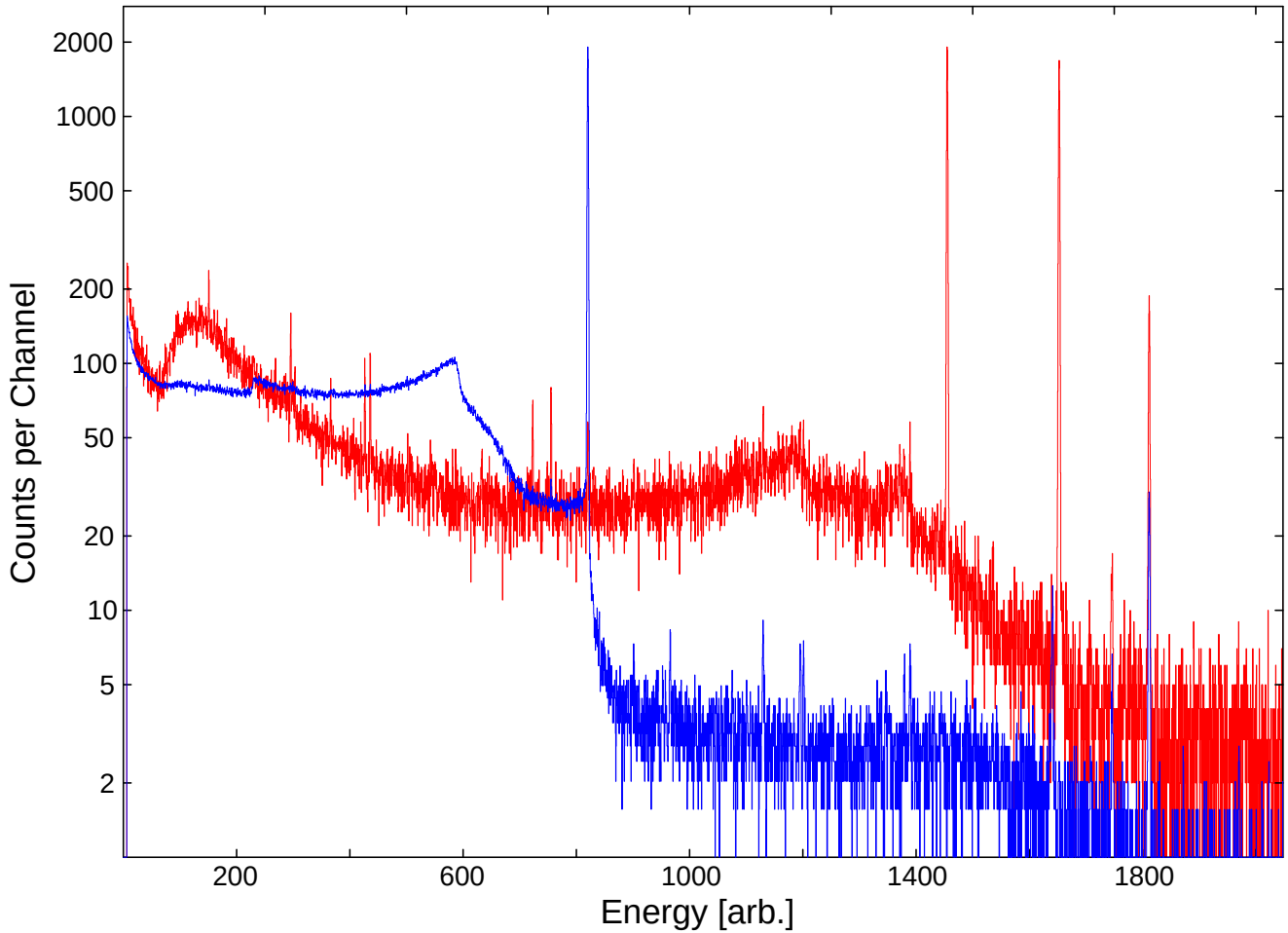


Fission fragments release

- Release depends critically on the accident scenario.
- Fission fragments which exists as gases, vapours, or aerosols are released first.
- The Three Mile Island accident released gases only, including ^{131}I.
- The explosions and fires following the Chernobyl accident resulted in a release of 6 tons of fragmented fuel along with radioactive gases.
- The release of ^{131}I from the Chernobyl was 2.4 million times larger than from the Three Mile Island accident.
- The crisis management at Fukushima successfully prevented large-scale radioactivity release in the past month, however, the cooling operates under emergency conditions.

Characteristic decay spectra

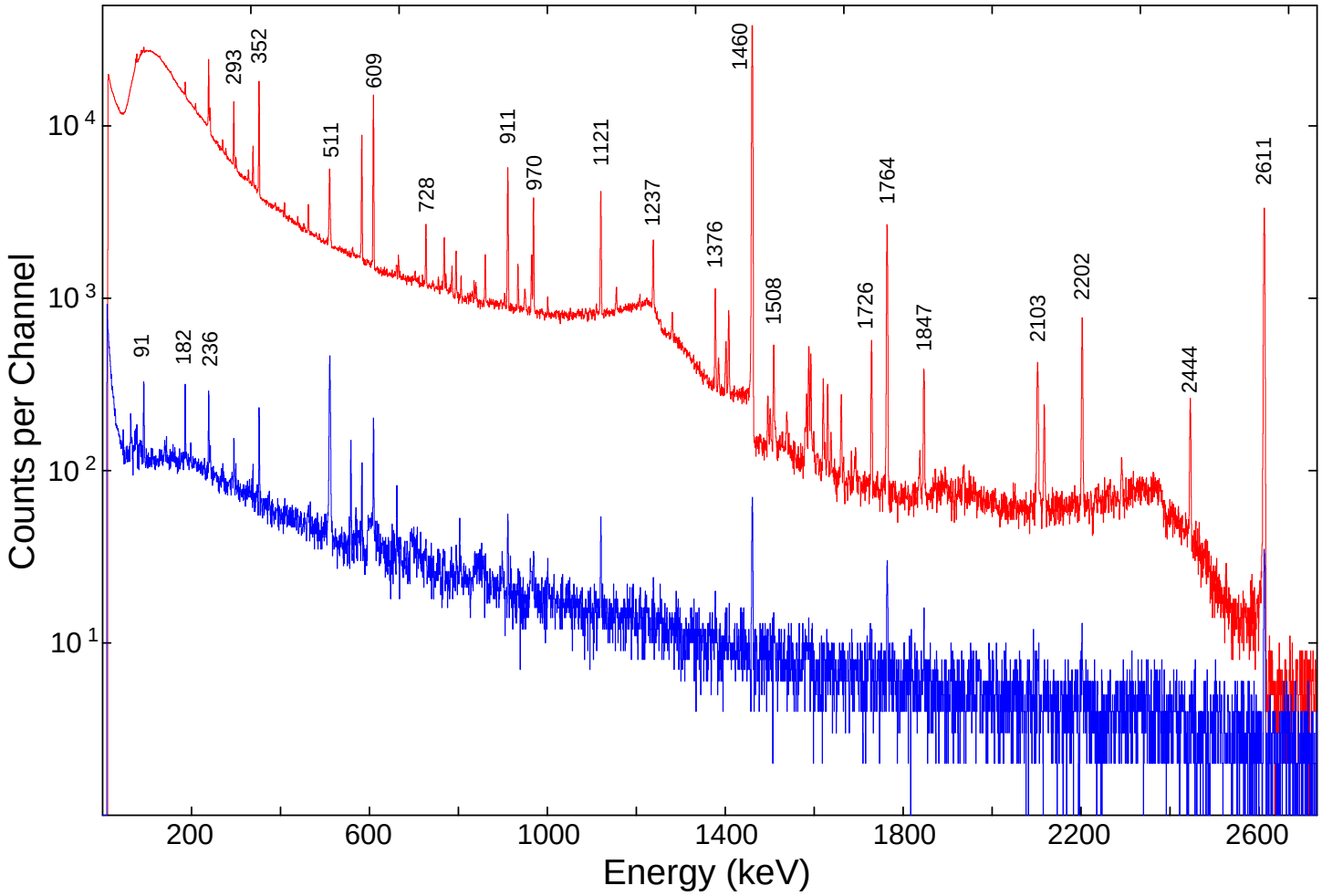
Blue: ^{137}Cs Red:^{60}Co



GEARS: Germanium detector for Elemental Analysis and Radioactivity Studies

Background suppression

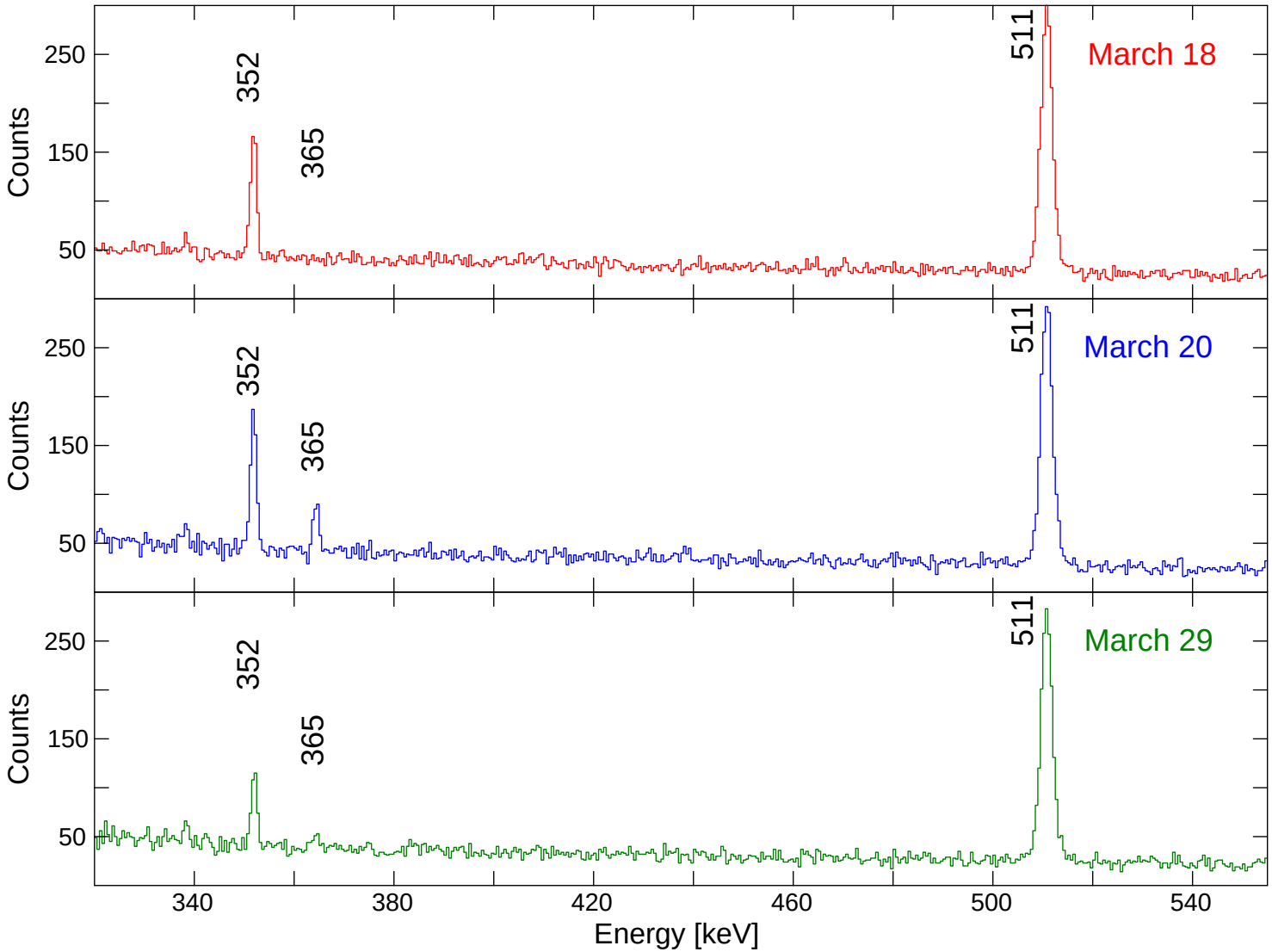
Blue: shielded Red: unshielded



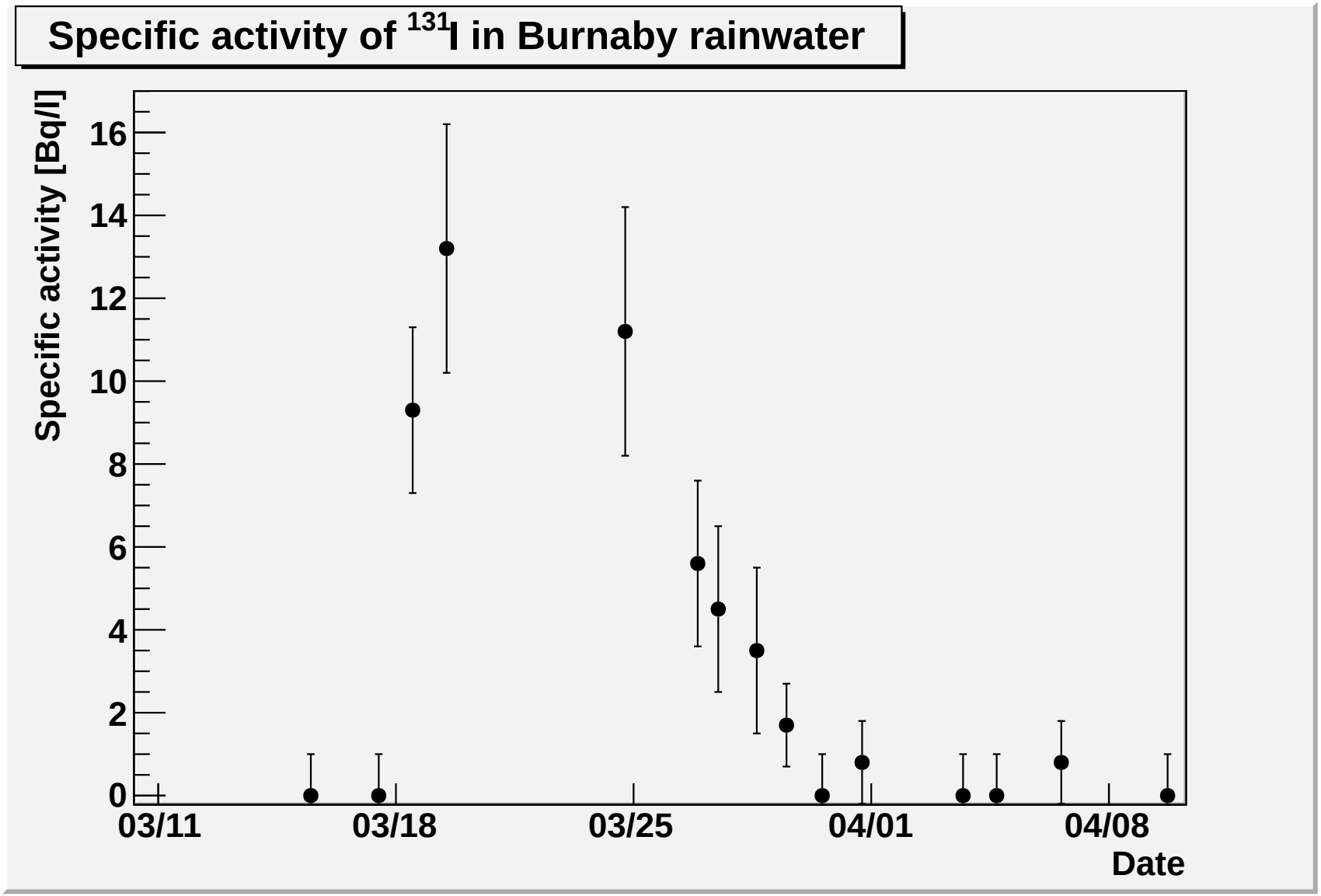
Credits for sample collection and handling

- SFU Burnaby rainwater : SFU Nuclear Science graduate students
  - Aaron Chester
  - Rachel Ashley
- North Vancouver seaweed : SFU Physics
  - Ken Myrtle
- Bamfield seaweed : Bamfield Marine Sciences Centre
  - David Riddell
  - Hana Kucera

^{131}I signature in the SFU rainwater

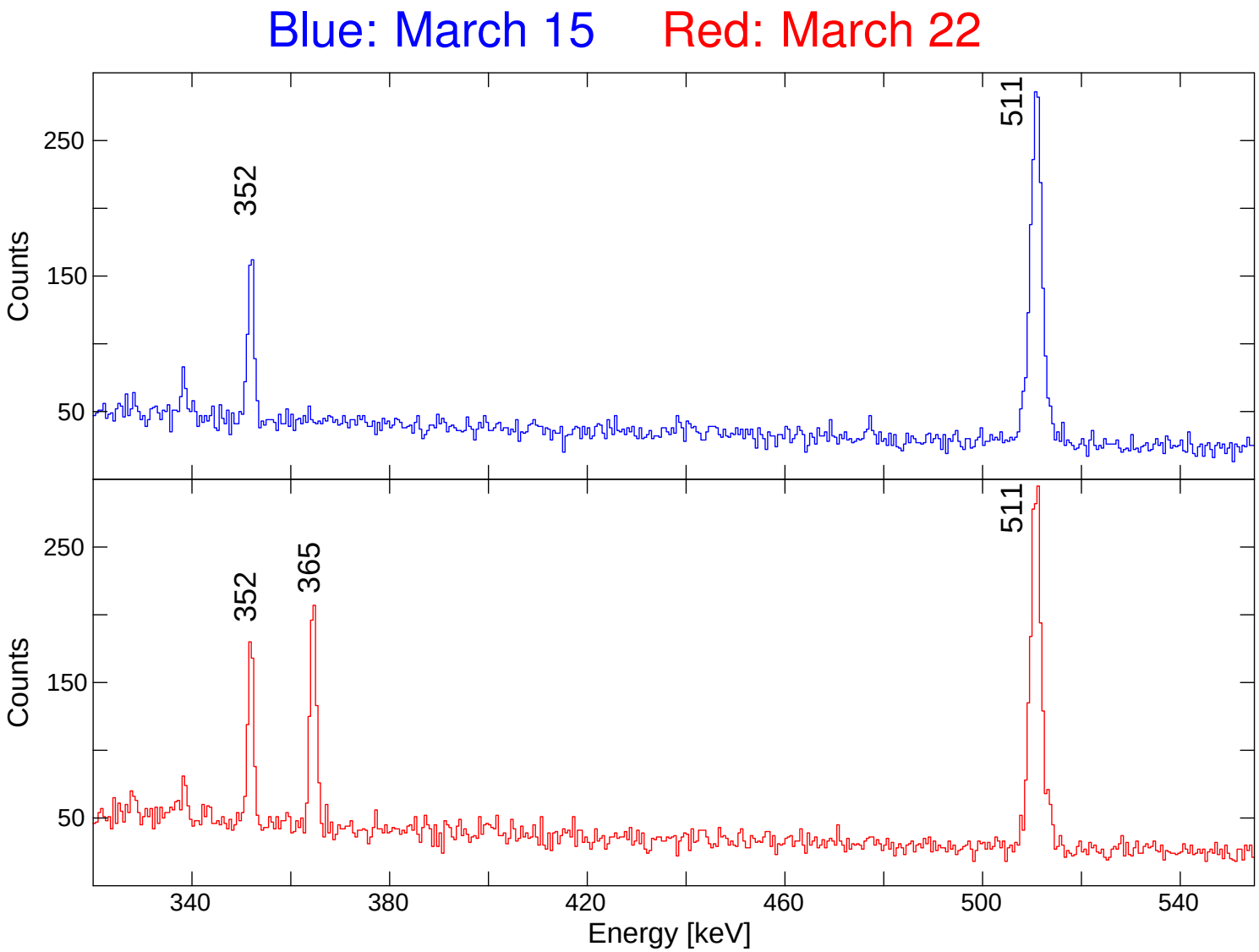


Time profile of the ^{131}I signature in Burnaby rainwater

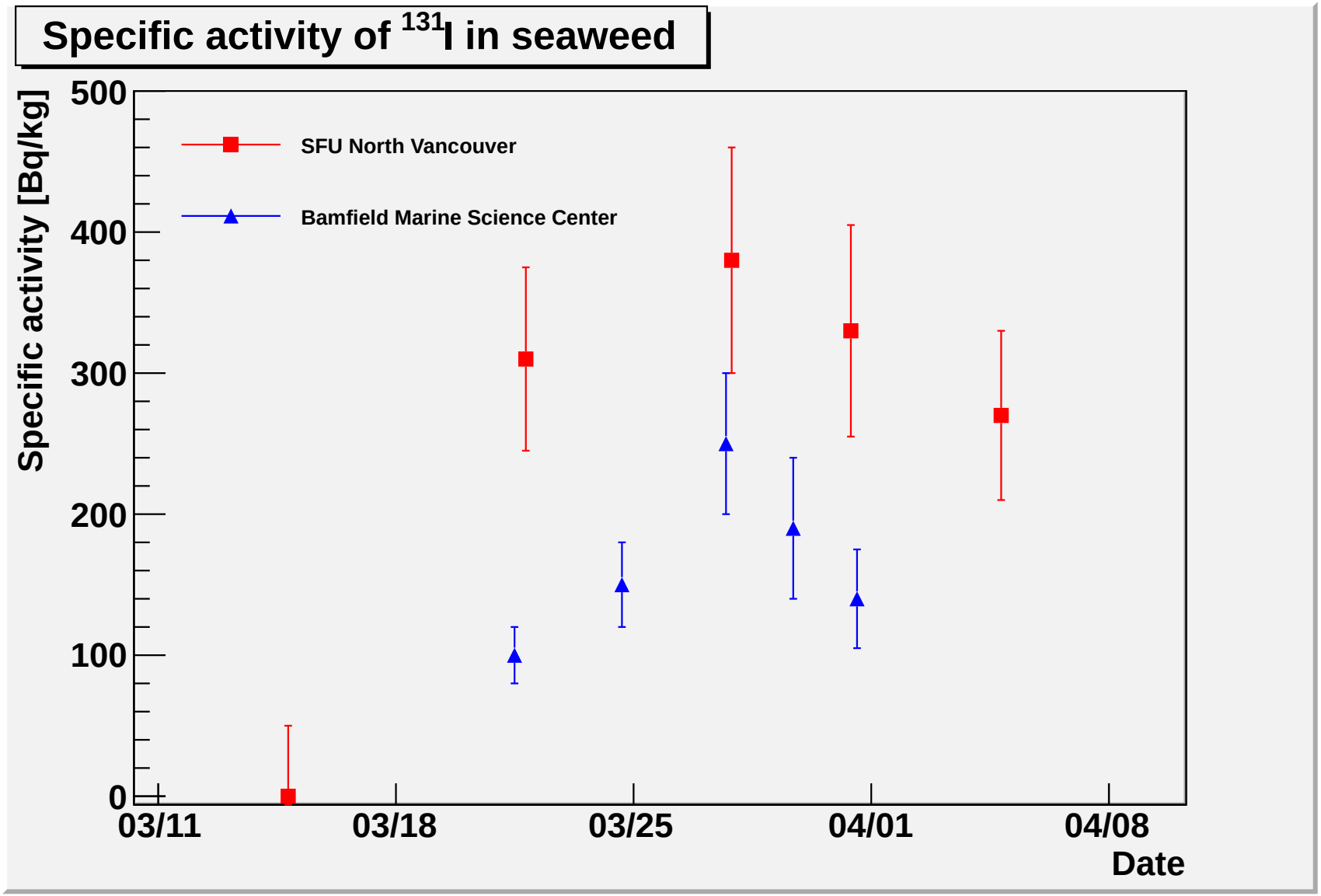


^{131}I sampling in seaweed

^{131}I signature in the North Vancouver seaweed



Time profile of the ^{131}I signature in seaweed



Time profile of the ^{131}I signature