Effective Rate Coefficients for Charge Exchange Recombination Spectroscopy (CXRS) with fully Ionized Helium and Argon

23. Januar 2012

T. Schlummer[1], O. Marchuk[1], W. Biel[1], Yu. Ralchenko[2], D.R. Schultz[3], G. Bertschinger[1], D. Reiter[1]

1. Institut f. Energie- und Klimaforschung, Plasmaphysik, Forschungszentrum Jülich GmbH, Association EURATOM – FZJ, Partner im Trilateralen Euregio Cluster, Jülich, Deutschland
2. National Institute of Standards and Technology, Gaithersburg, MD 20899-8422, USA
3. Physics Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA

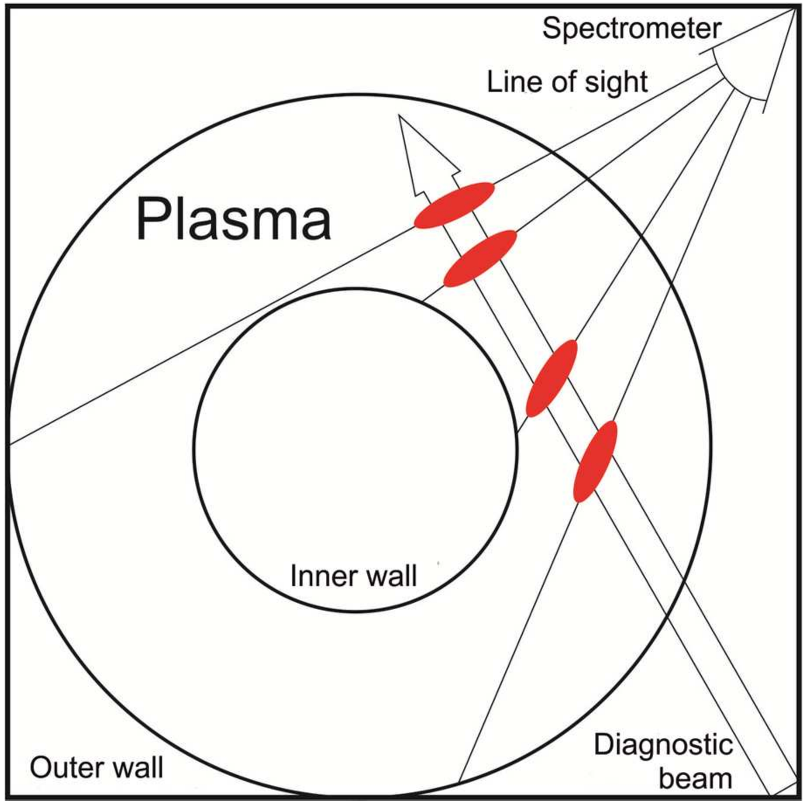
Part 1 – CXRS

Charge **E**xchange **R**ecombination **S**pectroscopy (CXRS)

- Active plasma diagnostic for:
  - ion temperature
  - Plasma velocity
  - Absolute impurity densities
    (e.g. helium, carbon, neon or argon)

- Based on neutral beam injection:
  - H-atoms @ 100keV (ITER)

- The produced line intensities are proportional to the absolute density of the impurity ions
  - $\mathbf{I \sim Q_{eff} \cdot N_{imp} \cdot N_{beam}}$



Part 1 – Effective rate coefficient Q_{eff}

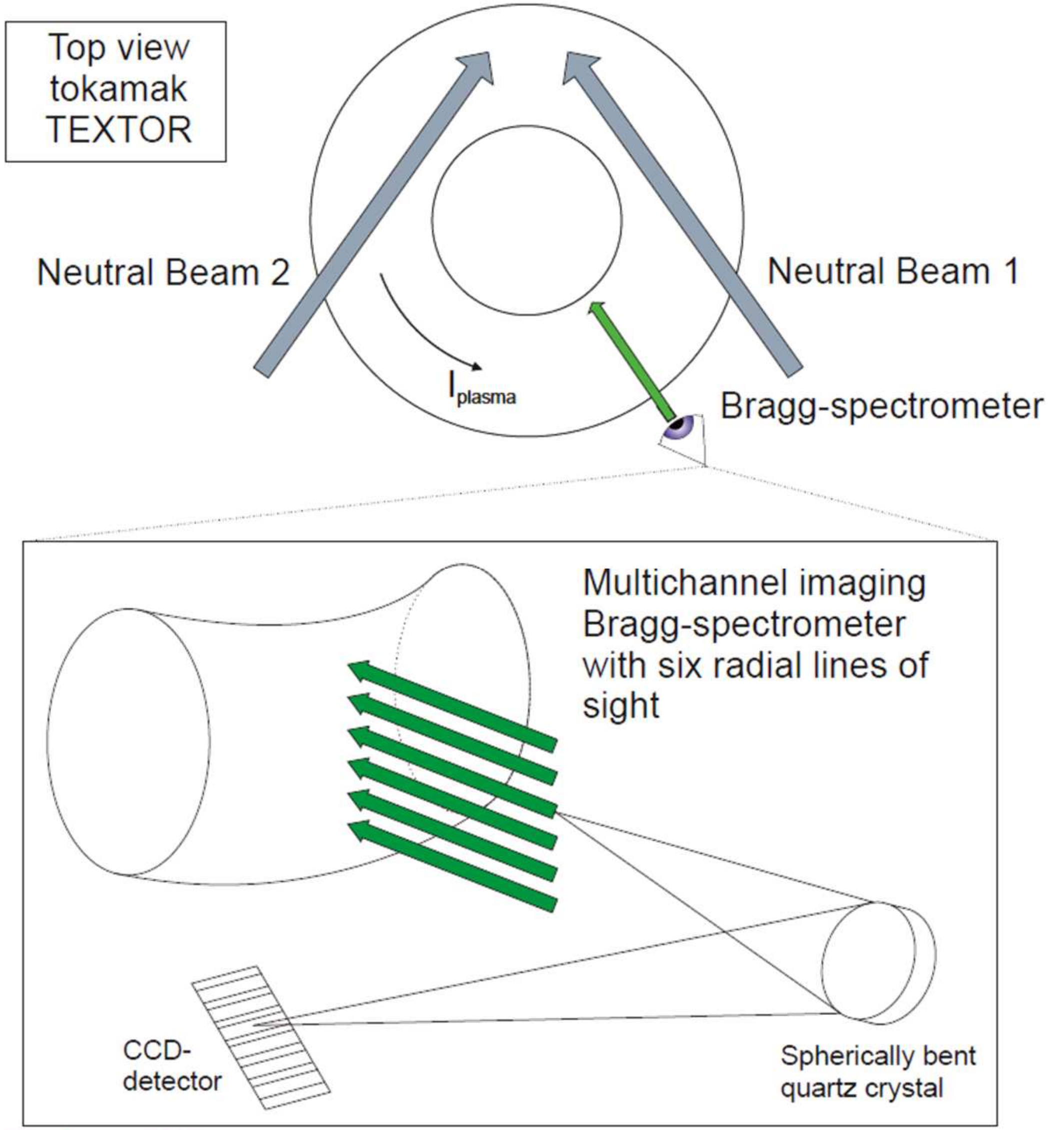
- The effective rate coefficient $\mathbf{Q_{eff}}$ contains all atomic data involved in light emission.

- Verification of existing Q_{eff} – data (**ADAS**, www.adas.ac.uk)

- Calculation of $\mathbf{Q_{eff}}$ based on the collisional radiative model **NOMAD** (Y. Ralchenko)

- **Results:**
  - Up to **80% higher** than the reference data
  - Partly qualitative differences in parameter dependecies (n_e, T, Z_{eff})

Part 2 – Argon ion ratios in TEXTOR

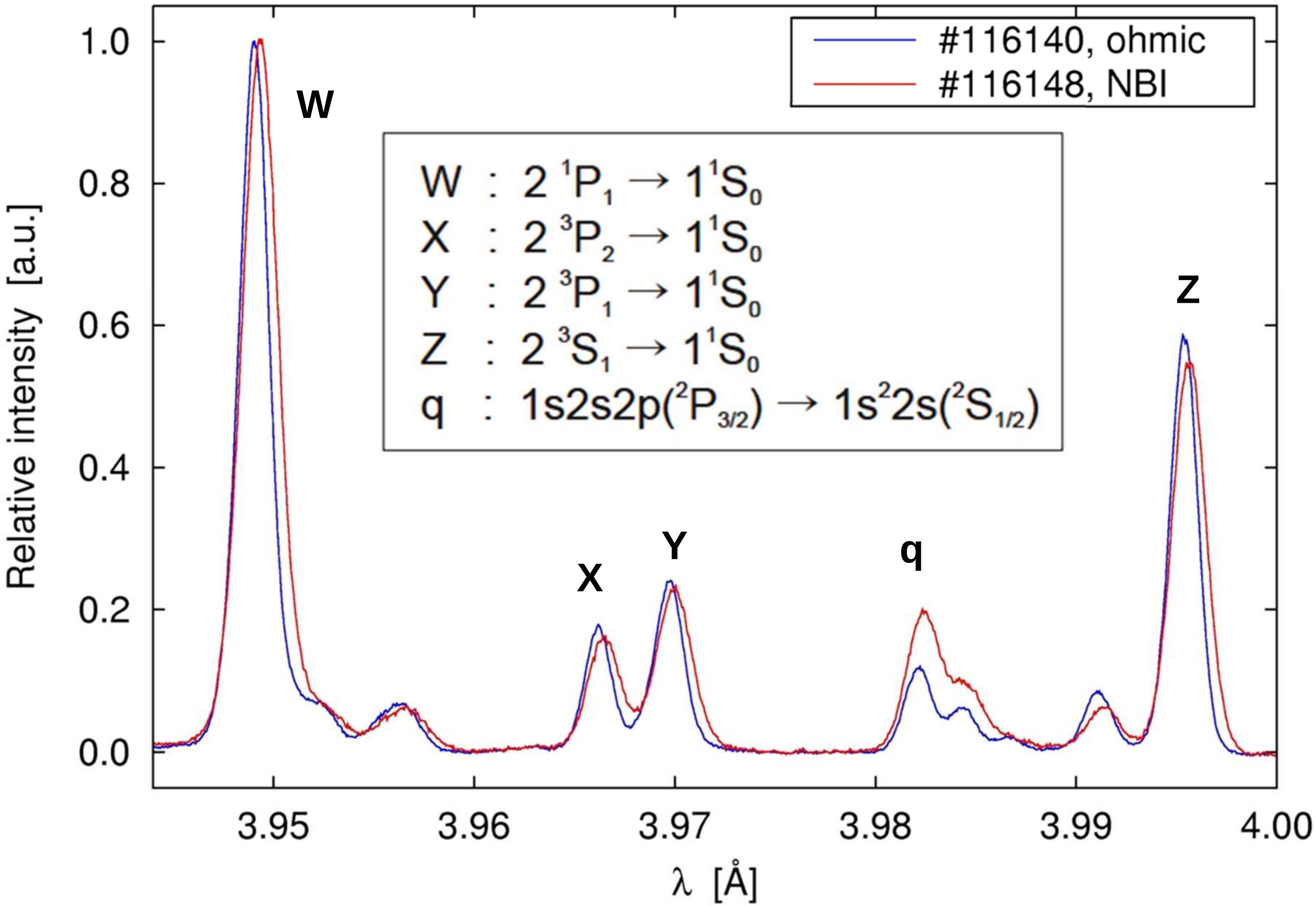


- New 6 channel imaging **Bragg-spectrometer** for future use at W7-X
- Optimized for **K-alpha spectrum of He-like argon**

➢ **Radial profiles** of:

- Ion temperature
- Electron temperature
- **Argon ion ratios**
  - **H-like**
  - **He-like**
  - **Li-like**

Part 2 – Argon ion ratios in TEXTOR



Thank you for your attention !