(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 August 2006 (17.08.2006)

PCT

(10) International Publication Number
WO 2006/086084 A3

(51) International Patent Classification:
H01J 49/16 (2006.01) *H01L 21/26* (2006.01)

(21) International Application Number:
PCT/US2005/046838

(22) International Filing Date:
22 December 2005 (22.12.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/638,821 22 December 2004 (22.12.2004) US

(71) Applicant *(for all designated States except US)*: **FOX CHASE CANCER CENTER** [US/US]; 7701 Burholme Avenue, Philadelphia, Pennsylvania 19111 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **FOURKAL, Eugene, S.** [CA/US]; 1801 Winchester Avenue, Apartment #d12, Philadelphia, Pennsylvania 19115 (US). **VELTCHEV, Lavor** [BG/US]; 913 Meadowbrook Drive, Huntingdon Valley, Pennsylvania 19006 (US). **MA, Chang, Ming** [US/US]; 1857 Nicholas Drive, Huntingdon Valley, Pennsylvania 19006 (US).

(74) Agents: **REED, Janet, E.** et al.; WOODCOCK WASHBURN LLP, One Liberty Place, Philadelphia, Pennsylvania 19103 (US).

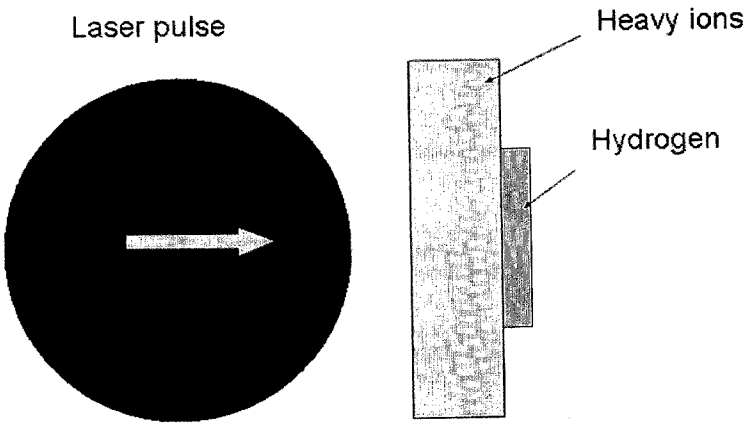
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) **Title:** TARGET DESIGN FOR HIGH-POWER LASER ACCELERATED IONS



(57) **Abstract:** Methods for designing a laser-accelerated ion beam are disclosed. The methods include modeling a system including a heavy ion layer, an electric field, and high energy light positive ions having a maximum light positive ion energy, correlating physical parameters of the heavy ion layer, the electric field, and the maximum light positive ion energy using the model, and varying the parameters of the heavy ion layer to optimize the energy distribution of the high energy light positive ions. One method includes analyzing the acceleration of light positive ions, for example protons, through interaction of a high-power laser pulse with a double-layer target using two-dimensional particle-in-cell (PIC) simulations and a one-dimensional analytical model. The maximum energy acquired by the accelerated light positive ions, *e.g.*, protons, in this model depends on the physical characteristics of the heavy-ion layer-the electron-ion mass ratio and effective charge state of the ions. The hydrodynamic equations for both electron and heavy ion species solved and the test-particle approximation for the protons is applied. It was found that the heavy ion motion modifies the longitudinal electric field distribution, thus changing the acceleration conditions for the light positive ions.

WO 2006/086084 A3

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
7 December 2006

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.